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U.S. Department of the Interior

Water Resources Division
Natural Resource Program Center

Technical Report NPS/NRWRD/NRTR-2006/350

EFFIGY MOUNDS NATIONAL MONUMENT

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WATER RESOURCES FOUNDATION REPORT

The National Park Service Water Resources Division is responsible for providing water resources management policy and guidelines, planning, technical assistance, training, and operational support to units of the National Park System. Program areas include water rights, water resources planning, regulatory guidance and review, hydrology, water quality, watershed management, watershed studies, marine resource management, and aquatic ecology.

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Effigy Mounds National Monument

Iowa

Water Resources Foundation Report

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United States Department of the Interior
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EXECUTIVE SUMMARY

This Water Resources Foundation Report is one of several planning products offered by the NPS Water Resources Division that assist national park units with achieving or maintaining water resource integrity.

Following the 2004 Park Planning Program Standards, parks are to prepare a *Foundation for Park Planning and Management* document (Foundation Document), which describes its purpose, significance, primary interpretive themes and special mandates, identifying and analyzing those resources and values determined to warrant primary consideration (*Fundamental and Important Resources and Values*) in park planning and management. The Foundation Document may be developed as the first stage of a park's general management planning or independently of a General Management Plan (National Park Service, 2004a).

This Water Resource Foundation Report is designed to support development of the Foundation Document for Effigy Mounds National Monument's (EFMO's) planning process and extend as a reference for the General Management Plan.

The primary objectives of this report are to 1) provide background for water resources and 2) build from the park's purpose and significance statements, identifying and describing the important water resources at EFMO, along with the identification of stakeholders and laws and policies that apply to these important water resources.

Workshops were held to generate a *Purpose Statement*, which describes the specific reason(s) for establishing the park and *Significance Statements*, which define what is most important about the park's resources and values and are based on the park purpose.

The *Purpose Statement* for EFMO is, "Effigy Mounds National Monument preserves outstanding representative examples of prehistoric Indian mound-building cultures in the American Midwest; protects wildlife and natural values within the monument; and provides for scientific study and appreciation of its features – for the benefit of this and future generations."

The EFMO *Significance Statement* that pertains to water resources is, "The natural and cultural resources of the monument are intricately connected – the moundbuilding cultures were the result of the dynamic interface of people and their environment. The native vegetation communities associated with the moundbuilding era was the result of the topography and climate found in the geologically unique Driftless Area of the Upper Midwest. This environment produced microhabitats that support high flora and fauna diversity."

Building from the *Significance Statement*, water can be defined as an important resource at EFMO. The park's important water resources include portions of the Mississippi River, Sny Magill Creek, Dousman Creek and the Yellow River. Ground water from the

local aquifers provide the important cold water characteristics of these steams that feed the Mississippi River. Important wetland habitats at EFMO are supported by these surface water and ground water resources.

The importance of water resources at EFMO includes:

- The Yellow River and Dousman Creek are designated by the state as "high quality resource water" due to their substantial recreational and ecological significance. Special protection is warranted to maintain the unique or outstanding physical, chemical, or biological characteristics for waters under this state designation (Iowa Department of Natural Resources, 2003).

- The Yellow River (34-mile segment that includes EFMO) is placed on the Nationwide Rivers Inventory (NRI). The inventory is a listing of river segments that are believed to possess one or more "outstandingly remarkable" natural or cultural values judged to be of more than local or regional significance (National Park Service, 2006).

- The Yellow River has the potential to be one of the top trout streams, not only in Iowa, but in the entire Upper Midwest (Iowa Watershed Improvement Review Board, 2005).

- Sny Magill Creek is designated by the state as "high quality waters" to be protected against degradation of water quality. This state designation is for waters with exceptionally better water quality than the levels specified in the Water Quality Standards (Iowa Department of Natural Resources, 2003). Sny Magill Creek is also designated as a Class "B" cold water stream (North Carolina State University, 2001).

- Sny Magill Creek is one of the more widely used streams for recreational trout fishing in Iowa (Iowa Department of Natural Resources, 2005a). The creek is managed for "put and take" trout fishing by the Iowa Department of Natural Resources. Sny Magill Creek ranks sixth in the state for angler usage (Tisl and Palas, 1998).

- The rivers and creeks within EFMO's watershed have high proportions (70-80% or more of annual flow) of ground water base flow, which provides the important cold water characteristics of the creeks that support trout habitat (North Carolina State University, 2001).

- Preservation of EFMO's wetland habitats and their related values is a long-term management goal of the NPS managers. These wetland habitats represent endangered landscapes in the upper Midwest. Those that remain play important roles in water quality improvement, erosion control, and flood water abatement (Sanchini, 1999).

The current conditions and trends of water resources at EFMO include:

- A portion of the Yellow River is currently listed on Iowa's impaired waters list for high levels of fecal coliform bacteria (Iowa's 2004 303[d] list). The impaired segment runs through EFMO. The elevated bacteria concentrations are cause for concern due to the recreational value of the stream (Iowa Department of Natural Resources, 2006a).

- Pesticide and nutrient loading have been reduced on 45% of cropland acres in the Sny Magill Creek watershed. The Natural Resources Conservation Service (NRCS) estimates that structures and crop management BMPs have reduced sediment delivery to the stream over 50% compared to pre-project practices. Streambank bioengineering practices established by the project have become a laboratory for study of innovative, lower-cost stream protection measures in Iowa (Iowa State University, 2005).

- Although BMPs have effectively reduced the sediment delivered from the upland to Sny Magill Creek by an estimated 50.7%, these reductions are not reflected in the sediment loads discharged by Sny Magill Creek (North Carolina State University, 2001). Estimates based on the Universal Soil Loss Equation suggested that as a result of implemented BMPs, sediment delivery to Sny Magill Creek has decreased over 33% since 1991 (Iowa Department of Natural Resources, 2005a). A large amount of post-settlement alluvium continues to be a source of erodible sediment within the Sny Magill watersheds and may be masking the upland reductions. Because the impact of post-settlement alluvium on the sediment loads is poorly understood, whether Sny Magill Creek will show significant reductions in sediment load as a result of BMPs implemented is uncertain (North Carolina State University, 2001).

- Improvements in water quality from the implementation of extensive Best Management Practice (BMP) methods have been observed in two recently completed, smaller scale projects in Clayton County: Ensign Hollow and North Cedar Creek (a tributary to Sny Magill Creek). BMPs are designated to reduce the amount of pollutants such as sediment, nitrogen, phosphorus, and animal wastes that enter surface water or groundwater. Increased rates of natural reproduction of brown trout have been documented in Ensign Hollow and are attributed to BMP implementation. Sedimentation and fecal coliform rates have been lowered in North Cedar Creek, increasing the creek's ability to support brook trout reproduction (Iowa Department of Natural Resources, 2005a).

- The state's Nonpoint Source Assessment Report indicates that the present classifications of the Sny Magill Creek as protected for wildlife, fish, and semiaquatic life and secondary aquatic usage are only partially supported. The report cites impairment of water quality primarily by nonpoint agricultural pollutants, particularly sediment, animal wastes, nutrients, and pesticides (North Carolina State University, 2001).

- A major change in local land use was the tremendous rise in the total area of farm ponds, from 1.5 acres (0.6 ha) in the 1940s to nearly 398 acres (161 ha) in the 1990s, indicating changes in agricultural practices over the 60-year timeframe (Narumalani et al., 2004). In 1936, USDA policy focused on decreasing soil erosion losses from agricultural lands in the U.S. Landowners were encouraged to create water impoundments by building earthen berms in the path of precipitation runoff. Consequently, a large number of farm ponds were constructed between the 1960s and 1990s (Narumalani et al., 2004).

- The fish species sampled in Sny Magill Creek have remained relatively constant through the years and are typical of Iowa coldwater streams. Based on survey results, Sny Magill creek is dominated by a single species, the fantail darter (*Etheostoma flabellare*). In 2001, the first occurrence of slimy sculpin (*Cottus cognatus*), a cold water fish that is intolerant of environmental degradation, was noted in Sny Magill Creek (North Carolina State University, 2001).

- Birmingham (2002) has summarized the benthic data through 2001. The benthic macroinvertebrate communities in the Sny Magill watersheds have remained relatively constant. Multiple regressions on means from the control sites and the treatment sites over time indicate trends towards improving water quality in the Sny Magill sites for taxa richness, EPT index, and percent dominant taxa, but not for the Hilsenhoff Biotic Index (North Carolina State University, 2001).

- There are very few unionids in the Yellow River. The lack of unionid fauna in this river is puzzling (Nichols et al., 2002). Considering the connection to the extensive unionid fauna in the Mississippi River, plus the presence of a number of host fish, one would expect this river to have a larger number of unionids than it does. A number of environmental factors could be limiting unionid populations, including water temperature regime (too cold), long-term pollution, pulses of pollutants, or natural metal contamination (Nichols et al., 2002).

- In Johnson's Slough, Mississippi River, 29 native unionid species were identified, of which 21 had live representation (Nichols et al., 2002). All live and dead shells were colonized by zebra mussels to some degree. While the unionid fauna in the park waters of Johnson's Slough is species rich, it is not a discrete population but merely an edge of a larger population existing in adjacent waters presently under the jurisdiction of the U.S. Fish and Wildlife Service. Zebra mussels have colonized this entire section of the Mississippi River for a number of years, and the survival projections for the native mussels were poor just a few years ago, since unionids generally do not survive in zebra mussel-infested waters. On the other hand, zebra mussel densities have drastically declined recently for unknown reasons and befouling rates on unionids are down. Zebra mussels affect native mussels through two mechanisms, biofouling as well as food competition (Baker and Hornback, 1996; Schlosser et al., 1996; Strayer and Smith, 1996).

The current and potential threats to water resources at EFMO include:

- A large meat processing plant in Postville, Iowa that discharges waste into the Yellow River is planning to expand. The town-managed industrial waste treatment lagoon has been the subject of controversy for years, and has been implicated in several fish kills in the Yellow River and in the general degradation of one section of the Yellow River and all of Hecker Creek, the small tributary receiving the waste. Hecker Creek is a "losing stream" with a direct connection to the aquifer. Measurements have shown that local wells are impacted by the discharge (Veysey, 2004). In 2006, a settlement was reached between the meatpacking plant and the Northeast Iowa Citizens for Clean Water in the Yellow River. The agreement calls for a 30 percent reduction in chloride emissions from the city's wastewater system, which treats discharge from the agriprocessors (Waterloo Courier Iowa, 2006).

- In the Sny Magill Creek watershed, there are more than 13 locations where livestock facilities need improved runoff control and manure management systems to control solid and liquid animal wastes. Grazing management is needed to control sediment and animal waste runoff from over 750 acres (304 ha) of pasture and an additional 880 acres (356 ha) of grazed woodland. Streambank erosion has contributed to significant sedimentation in the creeks. In order to mitigate animal waste and nutrient problems and improve bank stability in critical areas, improved stream corridor management designed to repair riparian vegetation and keep cattle out of the stream is necessary (North Carolina State University, 2001).

- A portion of the Yellow River is currently listed on Iowa's impaired waters list for high levels of fecal coliform bacteria (Iowa's 2004 303[d] list). This impaired segment runs through EFMO and is a cause of concern due to the recreational value of the stream (Iowa Department of Natural Resources, 2006a).

- Sny Magill Creek is one of 25 coldwater streams identified by the state of Iowa as a priority concern. Impairment of its water quality is primarily a result of nonpoint agricultural sources, particularly sediment, animal waste, nutrients, and pesticides (Iowa Department of Natural Resources, 2005a; U.S. Environmental Protection Agency, 2005).

- Forested floodplains associated with oxbows and secondary channels of the Yellow River or Mississippi River have had their natural hydrology altered by deposition of sediments in agricultural runoff entering the Yellow River and by control of water levels in the Mississippi (Sanchini, 1999).

- Sedimentation in Founders Pond appears to have increased over the past several years. Overgrazing on steep slopes adjacent to EFMO may be a contributing source to the sedimentation. Sediment has been accumulating where an intermittent drainage empties into the pond. The rate of sedimentation may greatly shorten the life expectancy of the wetland. It is necessary to determine if

the sedimentation flow into the pond is natural and how to mitigate the sedimentation deposition that threatens this wetland's longevity (National Park Service, 2003b).

- Based on flooding frequencies of the Sny Magill unit and field observations of sediment deposited during a 2001 flood, it was estimated that most of the mounds at Sny Magill could be buried within 100-700 years. More extensive sedimentations studies are recommended (Benedetti, no date).

- The unique habitats found along the algific talus slopes in the region remain cool throughout the year and are home to rare species of plants and animals (i.e., Iowa Pleistocene snail (*Discus macclintocki*)). These species' habitat cannot be restored once lost and the primary objective of their recovery plans is providing protection for remaining colonies. Concern over threats to the habitat stemmed from logging, grazing, filling of sinkholes, agricultural runoff, roads and quarries. The invasion of garlic mustard (*Alliaria petiolata*) onto algific talus slopes has emerged as a threat in recent years. And no one knows the potential effects of modern global warming (U.S. Fish and Wildlife Service, 2006).

- Coordination is critical in management of a watershed that extends beyond your jurisdictional boundaries. The National Park Service has been designated as the lead agency for a two-year demonstration project of the Yellow River Initiative Concept to provide project coordination with over thirty interested local partners during the Initiative's development (Upper Mississippi Basin Stakeholder Network, 2005).

Interest of Various Stakeholders for EFMO includes:

- <u>Federal:</u>

  U.S. Department of Agriculture, Farm Services Agency
  U.S. Department of Agriculture, Natural Resources Conservation Service
  U.S. Environmental Protection Agency
  U.S. Fish and Wildlife Service (Upper Mississippi River National Wildlife and Fish Refuge)
  U.S. Forest Service (Marquette)
  U.S. Geological Survey
  U.S. Natural Resources Conservation Service

- <u>State:</u>

  Clayton County Soil and Water Conservation District
  Iowa Department of Agriculture and Land Stewardship, Division of Soil Conservation.
  Iowa Department of Natural Resources – Water Quality Bureau, Fisheries Bureau, Geological Survey Bureau
  Iowa Geological Survey

Iowa State University Extension
St. Mary's University of Minnesota (Winona) office of Geospatial Services

- Regional:

  Allamakee County Conservation Board
  Clayton County Conservation Board
  Northeast Iowa Citizens for Clean Water

It should be noted that the contents of this report are limited to information acquired by the author during the time this report was prepared. As a result, descriptions of the water resources vary in detail.

INTRODUCTION

Effigy Mounds National Monument (EFMO), established in 1949, comprises 2,526 acres (1022 ha) in four sections in northeastern Iowa; the north and south units, Heritage Addition, and Sny Magill units. The monument was established to preserve outstanding examples of prehistoric American Indian mound building cultures; to protect wildlife, scenic, and other natural values of the area; and to provide for scientific study of its features for the benefit of this and future generations (National Park Service, 1999).

Water helped carve the rugged landscape we see today at EFMO. A landscape that attracted prehistoric people to the area more than 8,000 years ago. The first mound builders arrived in the area of the monument over 1,000 years ago. A culture that specialized in ceremonial mounds along the upper Mississippi River called effigies. The fresh water streams and rivers, wetlands and ground water springs in the area helped support these inhabitants with drinking water, fish, mussels and waterfowl to name a few. Today, water continues to play a vital role at EFMO for both the ecology and visitor experience, and is and will continue to be a very important resource at the monument.

The monument represents an important link in a complex of protected areas that preserve many of the values characteristic of this region. Much of the nearby Mississippi River bank and island area is protected by the Upper Mississippi River National Wildlife and Fish Refuge, a 261-mile-long (420 km) preserve that extends from Wabasha, MN to Rock Island, IL. Situated between the currently developed EFMO north and south units and the Sny Magill unit is Pikes Peak State Park, which preserves several effigy mounds, as well as bluff tops much like those of the monument (Narumalani et al., 2004).

In 2005, EFMO began the process to update their 1991 General Management Plan (GMP). A new GMP was needed to address some of the new information and understanding about the park's resources, along with recent development trends in northeast Iowa.

EFMO is following the 2004 Park Planning Program Standards during their planning process. This new National Park Service (NPS) planning format begins with development of a *Foundation for Park Planning and Management* document. As a guide, the Foundation Document (also referred to as the Foundation Statement) ensures that the most important objectives that are critical to achieving the park purpose and maintaining its significance are accomplished.

The first workshops produced the *Purpose Statement* for EFMO and the *Significance Statement* for the monument's natural resources (see below). The park purpose is a clear statement of why Congress established the monument as a unit of the National Park System. The Significance Statement defines what is most important about the park's resources and values and is based on the purpose of why the monument was created.

Purpose Statement

"Effigy Mounds National Monument preserves outstanding representative examples of prehistoric Indian mound-building cultures in the American Midwest; protects wildlife and natural values within the monument; and provides for scientific study and appreciation of its features – for the benefit of this and future generations."

Significance Statement for Natural Resources

"The natural and cultural resources of the monument are intricately connected – the moundbuilding cultures were the result of the dynamic interface of people and their environment. The native vegetation communities associated with the moundbuilding era was the result of the topography and climate found in the geologically unique Driftless Area of the Upper Midwest. This environment produced microhabitats that support high flora and fauna diversity."

Water Resources Planning

This Water Resources Foundation Report is designed to support development of the Foundation Document for Effigy Mounds National Monument's (EFMO's) planning process. This section outlines in detail the individual elements of this new NPS planning framework and better describes how this report fits into the framework.

The NPS Water Resources Division initiated a program in 1991 that assists parks with their water resources planning needs. Recent changes in NPS general planning (2004 *Park Planning Program Standards*) and resources planning (draft *Director's Order 2.1: Resource Stewardship Planning*) required programmatic revision to the existing NPS Water Resources Planning Program to assure that its products support the new NPS planning framework within which planning and decision-making are now accomplished. Within this new planning framework, six discrete elements of planning are in place that is captured in six planning-related documents (Figure 1).

The *Foundation for Planning and Management* (Foundation) document defines the legal and policy requirements that mandate the park's basic management responsibilities, and identifies and analyzes the resources and values that are fundamental to achieving the park's purpose or otherwise important to park planning and management.

The *General Management Plan* (GMP) uses information from the Foundation document to define broad direction for resource preservation and visitor use in a park, and serves as the basic foundation for park decision-making, including long-term direction for *desired conditions* of park resources and visitor experiences.

The *Program Management Plan* tiers off the GMP identifying and recommending the best strategies for achieving the desired resource conditions and visitor experiences presented in the GMP. Program planning serves as a bridge to translate the qualitative statements of *desired conditions* established in the GMP into measurable or objective indicators that can be monitored to assess the degree to which the *desired conditions* are

being achieved. Based on information obtained through this analysis, comprehensive strategies are developed to achieve the *desired conditions*. The Program Management Plan component for natural and cultural resources is the Resource Stewardship Strategy (Figure 1).

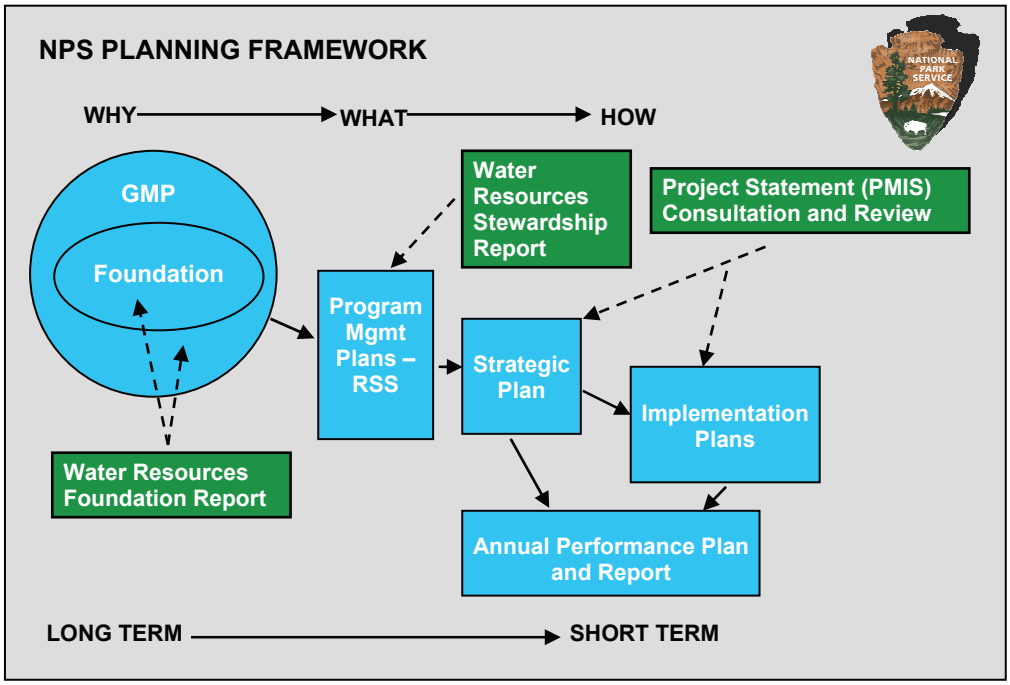


Figure 1. The 'new" NPS framework for planning and decision making (blue boxes). Green boxes represent WRD planning or assistance. RSS = Resource Stewardship Strategy.

The *Strategic Plan* tiers off the Program Management Plan identifying the highest-priority strategies, including measurable goals that work toward maintaining and/or restoring the park's *desired conditions* over the next 3 to 5 years.

Implementation Plans tier off the Strategic Plan describing in detail (including methods, cost estimates, and schedules) the high-priority actions that will be taken over the next several years to help achieve the *desired conditions* for the park.

The *Annual Performance Plan and Report* measures the progress of projects from the Implementation Plan with objectives from the Strategic Plan.

The *Water Resources Foundation Report* and the *Water Resources Stewardship Report* will support this new planning framework. The Water Resources Foundation Report (Figure 1) addresses the needs of either the Foundation Document or phase one of the GMP. The Water Resources Stewardship Report (Figure 1) is designed specifically to address the water resource needs in a park's Resources Stewardship Strategy.

Water Resources Foundation Report Objectives

The primary objectives of this *Water Resources Foundation Report* are to; 1) provide background for water resources and 2) identify and describe the important water resources at EFMO, along with the identification of stakeholders and laws and policies that apply to these important water resources. The water-related information contained in this report is designed to better assist EFMO with development of the Foundation Document, which ultimately supports the preparation of a new park General Management Plan.

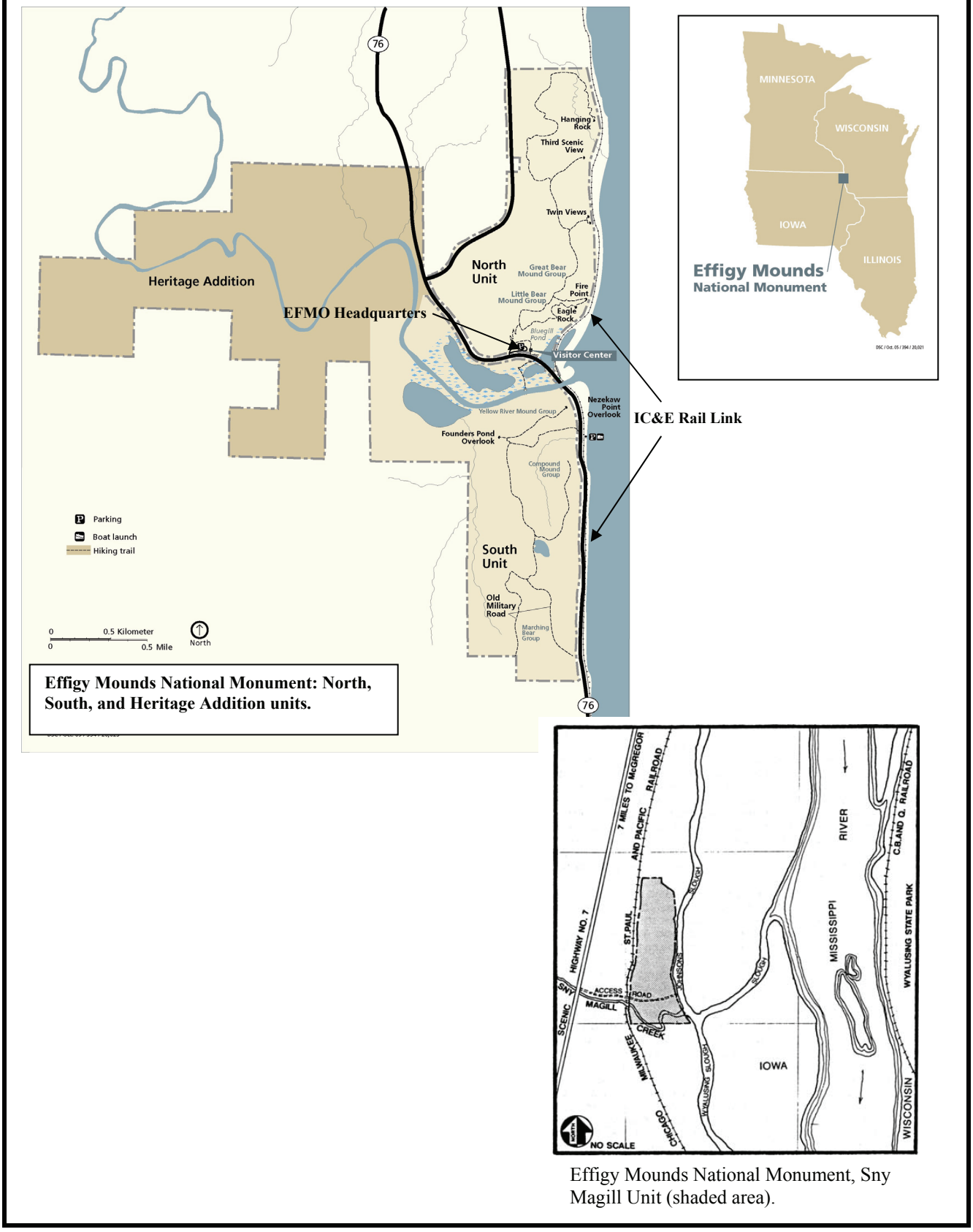
Location and Demography

EFMO is located on the west bank of the Mississippi River, in the northeast corner of Iowa (Allamakee and Clayton counties). Highway 76 runs along the eastern boundary of EFMO's south unit, before bisecting the north unit where park headquarters is located. Highway 76 continues to run north through the northeast portion of the Heritage Addition. Park headquarters is about five miles (8 km) north of Prairie du Chien, Wisconsin and McGregor, Iowa. The IC&E Rail Link parallels the eastern monument boundary of both the north and south units. The IC&E Rail Link forms the western boundary of the Sny Magill unit. The Sny Magill unit is on Johnson's Slough of the Mississippi River; 11 miles (17.7 km) south of monument headquarters (see Figure 2).

The city of Prairie du Chien is located across the Mississippi River, just southeast of EFMO's north and south units. In 2000, Prairie du Chien had a population of approximately 6000, with smaller communities such as Marquette, McGregor, and Harpers Ferry well under one thousand.

Lands adjacent to EFMO's north and south unit boundaries on the north, west, and south are in private ownership. Land use includes farmland, woodland, and low-density residence. Lands on the east boundary are within the legislative boundary but owned by the State of Iowa and IC&E Rail Link railroad. The Sny Magill unit is bounded on three sides by U.S. Fish and Wildlife Service (USFWS) property and on the west side by the railroad. The state of Iowa currently operates a boat landing and parking area in the Sny Magill unit under a special use permit. In 1997, the state enlarged the ramp to provide access for deeper draught boats and expanded the parking area (National Park Service, 1999).

Eastern Iowa is primarily a rural agricultural area. The landscape is dominated by agricultural land use. Suitable bluff tops are used principally as cropland or pastures. Timber is harvested on the steeper woodland slopes and along the Yellow River valley (National Park Service, 1999). Cattle, hogs, corn, and soybeans continue to be the foundation of the local economy. There is a shift in the local agriculture, as the small diversified farms are shifting to larger "factory" farms. Livestock operations are consolidating into "confinement system" farms, with large numbers of animals concentrated into one location (National Park Service, 1999). Outdoor recreation



Effigy Mounds National Monument: North, South, and Heritage Addition units.

Effigy Mounds National Monument, Sny Magill Unit (shaded area).

Figure 2. Location map for Effigy Mounds National Monument (North and South units, Heritage Addition, and Sny Magill unit.

(hunting and fishing) and tourism (Marquette casino operation) are also important to the local economy.

The single most significant land use trend in the region is the urbanization of the countryside. The Upper Mississippi River region has been described as the fourth fastest growing region in the nation. As recreation and tourism have taken hold in the area, the market for second homes and retirement homes has mushroomed. The result of this explosion of land values is a growing incentive to convert agricultural land to residential development. Land adjoining the monument is particularly vulnerable to this phenomenon; the scenic values that the monument preserves are precisely those that appeal to the upscale home buyer (National Park Service, 1999).

DESCRIPTION OF NATURAL RESOURCES

Climate

The climate at EFMO is characterized as a continental climate, where winter temperatures are cold enough to support a fixed period of stable snow each year, and relatively low precipitation. Cold air masses infiltrate during the winter and warm air masses form in summer under conditions of high sun and long days.

Winters are brisk and snowfall common. Spring is the beginning of the severe weather, as well as bringing increased precipitation and warming temperatures. The summers are known for heat and humidity, with daytime temperatures sometimes exceeding 100° F (37.8° C). Figure 3 presents climate data for Prairie du Chien, Wisconsin (5 miles (8 km) southeast of EFMO). The annual average precipitation is 32.9 inches (83.6 cm) (World Climate, 2006). On average, the area receives 39.3 inches of snow annually (Midwest Regional Climate Center, 2006). Typically, June and August are the wettest months (4.4 inches (11.2 cm)) with January and February typically the driest months (1 inch (2.5 cm)). Average monthly air temperatures range from 18.7° F (-7.4ºC) in January to 74.3° F (23.5ºC) in July (World Climate, 2006).

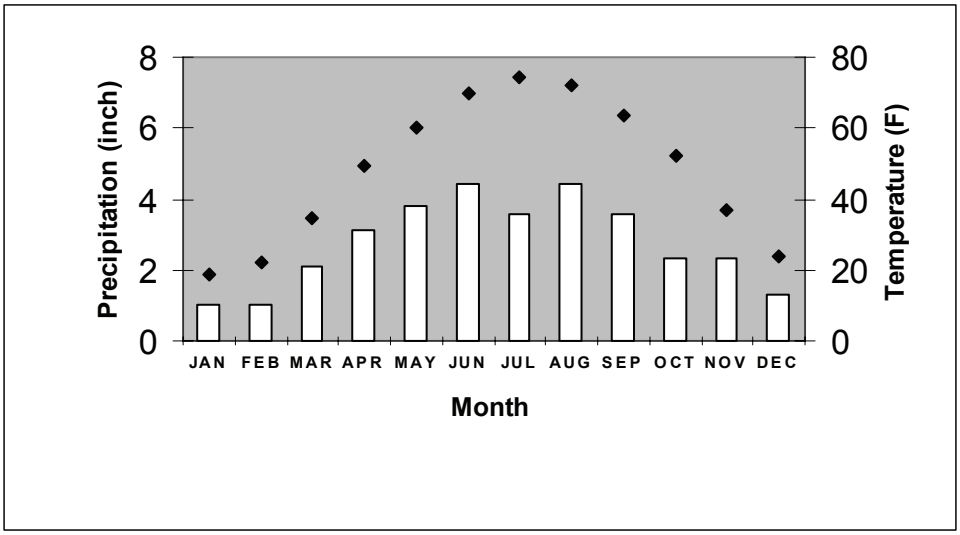


Figure 3. Monthly mean precipitation (bars) (1931-1995) and 24-hr average air temperature (diamonds) (1822-1996), Prairie du Chien, Wisconsin (World Climate, 2006).

Physiography

EFMO is located on the southwestern fringe of the rugged physiographic region called the Paleozoic Plateau, which extends along the steep bluffline of the Mississippi River in Iowa and continues into Wisconsin and Minnesota. Unlike the rest of Iowa, the Paleozoic Plateau was bypassed by the last of the Pleistocene glaciers (the Wisconsin), allowing the region's fast cutting streams to expose and carve out deep channels in the bedrock-

dominated terrain. EFMO is located within this "driftless" (non-glaciated) area of northeastern Iowa. Erosion forces have cut through the plain leaving high divides and bluffs towering up to 500 feet (152.4 m) above adjacent waterways (Narumalani et al., 2004). There is approximately 500 feet (152.4 m) of vertical relief in the monument, from the lowest point at the mouth of the Yellow River (600 feet (182.9 m) above sea level) to the highest point in the south unit (1,084 feet (330.4 m) above sea level) (National Park Service, 1999).

The north and south units and Heritage Addition are predominately uplands with steep bluffs and old open fields on the highest upland flat areas. Uplands above the 900-foot (274.3 m) elevation level comprise about 50 percent of the monument area. The area of steep slopes rising from the floodplain up to the 900-foot (274.3m) level make up about 25 percent, while the remaining 25 percent of monument lands consist of floodplains, water impoundments and waterways (National Park Service, 1999).

The Sny Magill unit is situated atop an isolated fluvial terrace that rises between a side channel of the Mississippi River to the east (Johnson's Slough), a poorly drained floodplain swamp to the west, a floodplain lake to the north and the mouth of Sny Magill Creek to the south. Most of the terrace surface lies at elevations of 188.5 – 189.5 m (618.4 – 621.7 feet) (msl). This elevation is 2 to 3 meters (6.6 – 9.8 feet) above the general elevation of the Mississippi River floodplain and 3 to 4 meters (9.8 – 13.1 feet) above the normal low water elevation in Navigation Pool 10 (Lynott, 1992; Benedetti, (no date)).

Geology

The Quaternary deposits of the Paleozoic Plateau are characterized by loess covered patches of isolated glacial till. Generally this area is a bedrock controlled terrain with deeply entrenched valleys, karst topography, and an integrated drainage network. The Paleozoic Plateau is unique as the only region of Iowa where bedrock dominates the landscape. In all other regions of Iowa the landscape features are dominated by unconsolidated materials and landforms (or dissections of them) including glacial materials, loess, and alluvium (Tassier-Surine, 2000).

Sedimentary limestone and sandstone layers form the bedrock of northeastern Iowa. The oldest layer exposed at the monument is the Jordan sandstone formation. Overlying the Jordan sandstone is the Prairie du Chien formation of dolomitic limestone, which forms the dominant geologic strata exposed along the river bluffs (National Park Service, 1999).

During the ice ages, this area was untouched by the continental glaciers (Driftless Zone). Although glaciers did not directly affect the area, their meltwaters carved out the Mississippi River valley (National Park Service, 1999).

The rugged terrain of the area resulted from the waters eroding and dissolving the limestone bedrock. The more resistant rock types (sandstones, carbonates) form cliffs and escarpments high on the landscape whereas the more easily weathered shales have gentler slopes. This differential weathering creates a landscape reflecting variations in

the local bedrock. Topography is also controlled by extensive karst development in this area forming caves, sinkholes, springs, and subsurface caverns (Tassier-Surine, 2000).

In addition to the karst and other erosion features, the regional landform characteristics are also controlled by river development. The Mississippi River and its tributary valleys contain well preserved terraces and older floodplain deposits. All of these features indicate the complexity of the alluvial history and river development associated with glacial melting and drainage diversions (Tassier-Surine, 2000).

Algific Talus Slopes

Small ice caves are found behind some of the steep slopes of limestone, which are scattered with loose rock (talus) at the base. In the summer, warm air is drawn down through sinkholes into these ice caves, cooled, and then escapes through vents in the slopes. In winter, the air in the caves is warmer than the outside air, which then reverses the air flow. As the warm air rises and exits the sinkholes, cold air is drawn in through the talus vents, freezing the ground water (Figure 4). This unusual geology (*Algific Talus Slopes*) exists along the north to northeast facing slopes in the Driftless Zone, including EFMO (Upper Mississippi Basin Stakeholder Network, 2005).

These cold microhabitats allow northern species and periglacial relicts (species from glacial times) to persist. Of primary importance are the Iowa Pleistocene snail (*Dicus macclintocki*) and northern monkshood (*Aconitum noveboracense*), a plant with blue hood-shaped flowers (Upper Mississippi Basin Stakeholder Network, 2005).

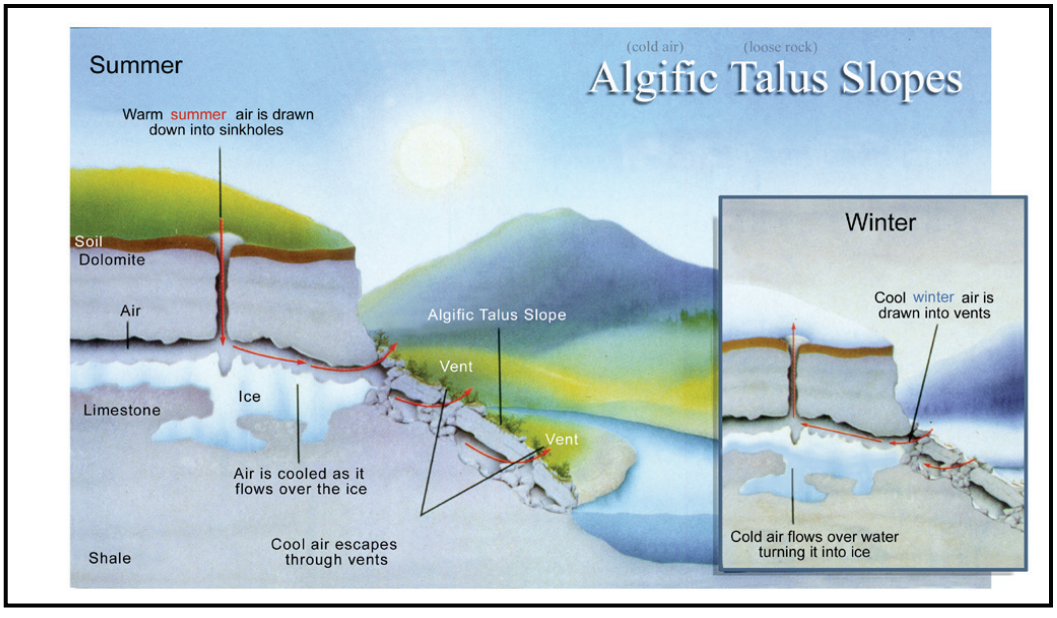


Figure 4. Algific Talus Slopes (U.S. Fish and Wildlife Service, 2006).

Soils

Soils in the north unit (Allamakee County) are well drained soils formed in loess, loess clayey pedisediments, and loess over clayey pedisediments on 5-14 percent upland slopes; loamy colluvium on 14-70 percent upland slopes; well-drained, loamy or silty alluvium on 9-25 percent terrace slopes; and poorly drained, silty alluvium on flooded 0-2 percent bottomlands along the Yellow River (National Park Service, 1999).

Soils in the south unit (Clayton County) are moderately sloping to very steep, well-drained soils formed of loess or loamy sediments derived from limestone on uplands. Specific soils consist of well-drained, moderately permeable soils on uplands, upland ridges, side slopes, and stream benches formed in loess. Slopes range from 2 to 40 percent. Additional site specific soils information on monument lands in Clayton County is available in the 1982 Soil Survey of Clayton County, Iowa (National Park Service, 1999).

In contrast, soils in the Sny Magill unit (Clayton County) are nearly level to gently slopping (0-5 percent), poorly drained to well-drained, loamy or silty alluvium on 9-25 percent terrace slopes; and poorly drained to well-drained soils formed in silty, loamy, and sandy alluvial sediments on bottomland and stream benches. Permeability is moderate with seasonal high water table, while surface runoff is slow to medium (National Park Service, 1999). The Soil Survey of Clayton County, Iowa identifies two major soil series at the Sny Magill site (Kuehl, 1982). The soils on the gravel terrace are mapped as Wapsie Series, well-drained forest soils formed in thin loamy alluvium over gravel (Mollic Hapludalfs). Soils on the adjacent backswamps of the Mississippi River floodplain are mapped as Caneek Series, poorly drained soils that lack subsurface horizons and exhibit stratification.

Hydrology

Watersheds

According to the NPS Management Policies, the NPS will manage watersheds as complete hydrologic systems, and will minimize human disturbance to the natural upland processes that deliver water, sediment, and woody debris to streams (National Park Service 2001a). Watersheds are delineated by the U.S. Geological Survey using a nationwide system based on surface hydrologic features. This system divides the country into 21 regions, 222 subregions, 352 accounting units, and 2,262 cataloguing units. A hierarchical hydrologic unit code (HUC) consisting of 2 digits for each level in the hydrologic unit system is used to identify any hydrologic area. The 6-digit accounting units and the 8-digit cataloguing units are generally referred to as basin and sub-basin, respectively. HUC is defined as the Federal Information Processing Standard (FIPS) and generally serves as the backbone for the country's hydrologic delineation. EFMO is located within the Upper Mississippi Maquoketa-Plum Basin (070600). The 8-digit cataloguing sub-basin unit that includes the monument is the Coon-Yellow (07060001), (see Figure 5).

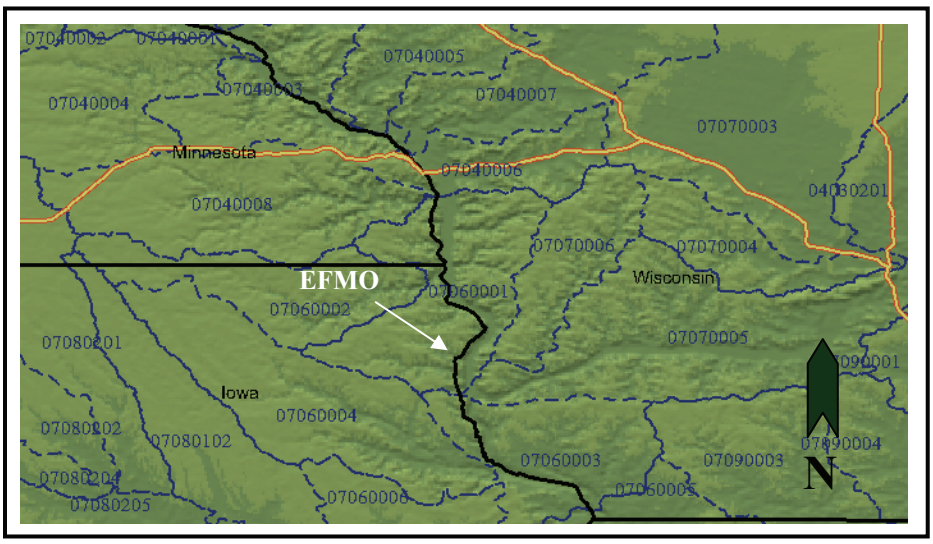


Figure 5. Sub-Basin watersheds identified (modified after U.S. Geological Survey, 2006).

Yellow River Watershed

The Yellow River 154,666-acre (62,590-ha) watershed has diverse topographic and natural resource features, along with a variety of resource-related problems similar to those found throughout the watersheds of most tributary streams feeding into the Upper Mississippi River (National Park Service, 2003b). The Yellow River and its tributaries are 360 miles (579.3 km) in length. The elevation of the watershed ranges from 655 feet (199.6 m) at the mouth to 1250 feet (381.0 km) along the uppermost boundary of the watershed (Upper Mississippi Basin Stakeholder Network, 2005). Situated in a karst region, approximately 90% of the Yellow River's flow comes from groundwater. The watershed is a diverse, mostly agricultural landscape of incised valleys and rolling uplands. Significant natural habitat exists in the watershed, particularly within its lower reaches where EFMO is located. Due to the rugged topography and drainage pattern of this portion of the driftless area, small rural communities are situated almost exclusively along the outer fringe of the Yellow River watershed (National Park Service, 2003b).

Sny Magill Watershed

The 22,780-acre (9,219-ha) watershed of Sny Magill is characterized by narrow, gently sloping uplands that break into steep slopes with abundant rock outcrops. Up to 550 feet (167.6 m) of relief occurs across the watershed. Within the EFMO boundary at Sny Magill, the gradient becomes less steep, and the stream bottom is generally silty, emptying into the backwater wetlands of the Mississippi River (Iowa Department of Natural Resources, 2005a). These backwaters are heavily used for fishing and also serve as an important nursery area for juvenile and young largemouth bass (*Micropterus salmoides*) (North Carolina State University, 2001). The entire watershed is agricultural, with no industrial or urban areas. No significant point sources exist in the watershed (North Carolina State University, 2001). The watershed consists of row crops, pasture,

forest and forested pasture, and farmsteads, with approximately 140 dairy, beef, and swine producers in the watershed (Iowa Department of Natural Resources, 2005b). Land use is variable on the alluvial plain of Sny Magill Creek, ranging from row cropped areas, to pasture and forest, to areas with an improved riparian right-of-way where the Iowa Department of Natural Resources (IDNR) owns and manages the land in the immediate stream corridor. Some of the land within the corridor is used for pasture and cropping through management contracts with the IDNR (North Carolina State University, 2001).

Surface Water

Aggradation of the upper Mississippi River floodplain could be accelerated by changes in climate and land use that may be increasing flood frequencies along the upper Mississippi River. This topic has received much attention in recent years, including studies of precipitation and snowmelt patterns, the influence of lock and dam operations, and changes in stage/discharge relationships that may be related to sedimentation in the navigation pools (Karl et al., 1995; Knox, 2000; Pinter et al., 2001; U.S. Army Corps of Engineers, 2004). The annual flood records for the upper Mississippi River at McGregor and Clinton, Iowa show a trend toward increased flood frequency since about 1950.

The estimated 100-year and 500-year flood levels in and adjacent to the north and south units between river miles 639.0 and 636.0 minimally affect the north and south unit. The 100-year and 500-year flood levels along the north and south units are about 631.0 and 633.0 feet (192.3 and 192.9 m) above mean sea level (msl), respectively. The entire Sny Magill unit is within the 100-year and 500-year floodplains, which are at 627.0 and 630.0 feet (191.1 and 192.0 m) above msl, respectively, in that area. Periodic and seasonal flooding is common, causing complete or partial inundation of the Sny Magill unit for short periods, usually in the spring (National Park Service, 1999).

The Yellow River and Sny Magill drainages are influenced by the Mississippi River during high flows, when the Mississippi River backs into these drainages, reducing flow velocity of the Yellow River and Sny Magill Creek (National Park Service, 1999).

Rivers and Streams

Yellow River

The Yellow River originates in southwestern Winneshiek County, Iowa and flows through southern Allamakee County receiving tributaries from northern Clayton County before joining the Mississippi River at EFMO. The Yellow River ranges from stream order 1 in the upper watershed to stream order 4 at the mouth (confluence with the Mississippi River). The most complex river systems reach an order of 7 (Strahler, 1952). The Yellow River drainage has nine major tributary streams. Four of these tributaries, including Dousman Creek which enters the Yellow River inside EFMO's boundary, are coldwater trout streams. Historically the majority of the main stem of the Yellow River supported a warmwater fishery dominated by smallmouth bass. But over the last two decades over 25 miles (40.2 km) of the Yellow River has become cold enough to support trout populations (Iowa Department of Natural Resources, 2005b).

Sny Magill

For the Sny Magill watershed, the majority of a water year's discharge occurs during intermittent high flow events. For most years, discharge is higher during the spring and summer and declines during the fall and winter (Knox, 1988). Spring floods are about twice as frequent as summer floods on the upper Mississippi River, and account for about twice as much of the suspended sediment load over the period of record at McGregor, Iowa (Benedetti, 2003). Most sediment is discharged from Sny Magill Creek during short periods of time, associated with a spring snowmelt period and a summer storm period. For example, nine days accounted for 90% of the sediment load for Sny Magill in Water Year 1998 (North Carolina State University, 2001).

Sny Magill Creek is one of the more widely used streams for recreational trout fishing in Iowa. The stream bottom of Sny Magill and its tributaries is primarily rock and gravel with frequent riffle areas. Along the lower reach of the creek where the gradient is less steep, the stream bottom is generally silty. The upstream areas have been degraded by sediment deposition (North Carolina State University, 2001).

Wetlands

Wetlands represent transitional environments between terrestrial and aquatic systems where the water table is at or near the surface or the land is covered by shallow water (Cowardin et al., 1979). Flora within these wetland systems exhibit extreme spatial variability, triggered by very slight changes in elevation. Temporal variability is also great because the surface water depth is highly influenced by changes in precipitation, evaporation and/or infiltration. Cowardin and colleagues (1979) developed a wetland classification system that is now the standard in the federal government. In this system, a wetland must have one or more of the following attributes: (1) at least periodically, the land supports predominately hydrophytes; (2) the substrate is predominately undrained hydric soil; and (3) the substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season of each year. There are four federal government agencies responsible for identifying and delineating wetlands: the U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, and Natural Resources Conservation Service.

Common wetland and riparian communities in northeast Iowa include plants of cold, spring-fed streams, floodplain and stream-side woodlands, and associated algific talus-slopes and sandy areas. The algific slopes produce particularly rare and sensitive biological habitat. National Wetlands Inventory data show that the predominant wetlands and riparian areas in the Paleozoic Plateau region are Lacustrine unconsolidated bottom (33,378 acres (13,507.3 ha), 50.6%), Palustrine forested (20,658 acres (8,359.8 ha), 31.3%), Palustrine emergent (3,990 acres (1,614.7 ha), 6.1%), and Riverine unconsolidated bottom (3,923 acres (1,587.6 ha), 6.0%) (Iowa State University, 2006).

The north and south units of EFMO contain four ponded wetlands, totaling approximately 65 acres (26.3 ha), that are associated with active floodplains of the Yellow River and the west bank of the Mississippi River. Three wetlands are located in

the Yellow River floodplain and one wetland is isolated from the Mississippi River by a railroad embankment. These ponds are located within the 100-year floodplain (National Park Service, 1999).

Preservation of these wetland habitats and their related values is a long-term management goal of the Park managers. Wetland habitats like these represent endangered landscapes in the upper Midwest. Many potential wetlands of the upper Mississippi River have been permanently inundated by Lock and Dam construction, leaving floodplains associated with tributary rivers as the only habitats available for wetland dependent species. Those that remain play important roles in water quality improvement, erosion control, and flood water abatement. All relatively undisturbed wetlands remaining in Iowa are valuable for their natural resources, for the wildlife habitat they contain and for their use as natural laboratories. The wetlands within EFMO contribute all of these values. Of the four wetlands sampled at EFMO, Founders Pond had the highest species density (Sanchini, 1999). Founders Pond is the largest wetlands complex in EFMO with approximately 40 acres (16.2 ha) of surface water (National Park Service, 2003b).

Ground Water

Ground water at EFMO is found in the Jordan-Prairie du Chien bedrock interval, typically called the Jordan Aquifer. This widespread, productive aquifer supplies wells as far away as central Iowa, where it lies over 1,500 feet (457.2 m) below the surface. Only here in the northeast corner of the state are these rocks exposed at the surface (Iowa Department of Natural Resources, 2005b). The aquifer is an important source of ground water and also drinking water in the area. The local creeks have high proportions (70-80% or more of annual flow) of ground water base flow, which provides the important cold water characteristics of the creeks (North Carolina State University, 2001).

According to the Upper Mississippi River Stakeholder Network (2005), 2918 sinkholes have been identified primarily in the Galena-Decorah-Platteville formations of the Yellow River watershed, which overly the older Jordan-Prairie du Chien formations. Sinkholes are common in bedrock composed of soluble materials such as dolomite (calcium and magnesium carbonate) or limestone (calcium carbonate). Through time, precipitation and ground water drain through cracks and crevices in the carbonate bedrock, slowly dissolving the rock to form an underground network of conduits that often produce karstic features on the surface (i.e., sinkholes, caves, springs). Surface contamination can easily infiltrate into the ground water via these open conduits. As such, the quality of ground water in these karst (carbonate) landscapes is particularly sensitive to land use practices such as agriculture.

Water Quality

The pollution of surface waters and ground waters by point and non-point sources can impair the natural function of aquatic and terrestrial ecosystems and diminish the utility of park waters for visitor use and enjoyment. According to the NPS Management Policies, the NPS will determine the quality of EFMO water resources and avoid, whenever possible, the pollution of park waters by human activities occurring within and outside park boundaries (National Park Service, 2001a).

Historic surface water quality testing in the monument and on adjacent rivers and streams has been limited. The results of a 1982 *Yellow River Rainfall Runoff and Low-Flow Water Quality Study* indicated that the most notable effects of the runoff were increased total solids and associated organic nitrogen, total phosphate, biological oxygen demand (BOD), metals, and pesticides. The impact of these contaminants on stream biota is unknown. Pesticide levels were low and below acute toxic levels in samples collected during the study. The limited study results demonstrated good water quality throughout the entire Yellow River reach. Based on a *Benthic Macroinvertebrate Survey* (1981), the densities, number of taxa, and types of benthic macroinvertebrates indicated generally good, long-term water quality in the Yellow River (National Park Service, 1999).

Water quality evaluations conducted by the University Hygienic Laboratory (UHL) in 1976 and 1978 during summer low-flow periods in Sny Magill Creek showed elevated water temperatures and fecal coliform levels (from animal wastes). Animal waste decomposition increases biochemical oxygen demand (BOD) to levels that are unsuitable for trout survival at times of high water temperature and low stream flows. The Iowa Department of Natural Resources has identified these as the most important factors contributing to the failure of brook trout (*Salvelinus fontinalis*) to establish a viable population (North Carolina State University, 2001).

In 1978, a water quality survey of Sny Magill Creek showed fecal coliform concentrations of 230,000 to 330,000 counts per 100 ml. Weekly surveys in July, August, and September of 1997 showed levels ranging from 50 to 2,500 counts per 100 ml. with a mean of 417 counts per 100 ml. This is below the 1,200 counts per 100 ml. limit. For the same period, the mean dissolved oxygen level was 11 mg/L. Other parameters of water quality have shown similar improvement for Sny Magill Creek (National Park Service, 1999).

The NPS Water Resources Division completed a comprehensive summary of existing surface water quality data for EFMO, the *Baseline Water Quality Inventory and Analysis, Effigy Mounds National Monument* (National Park Service, 2001b). This document presents the results of surface water quality data retrievals for EFMO from six of the United States Environmental Protection Agency's (EPA) national databases: (1) Storage and Retrieval (STORET) water quality database management system; (2) River Reach File (RF3); (3) Industrial Facilities Discharge (IFD); (4) Drinking Water Supplies (DRINKS); (5) Water Gages (GAGES); and (6) Water Impoundments (DAMS).

The results of the EFMO water quality criteria screen found 12 groups of parameters that exceeded screening criteria at least once within the study area. Dissolved oxygen, pH, chloride, cadmium, copper, and zinc exceeded their respective EPA criteria for the protection of freshwater aquatic life. Chlorine, sulfate, nitrate, nitrite plus nitrate, cadmium, and atrazine exceeded their respective EPA drinking water criteria for the protection of marine aquatic life. Chloride, fluoride, sulfate, nitrate, arsenic, cadmium, chromium, lead, mercury, nickel, and dibromochloropropane (DBCP) exceeded EPA drinking water criteria. Fecal-indicator bacteria concentrations (fecal coliform) and

turbidity exceeded the WRD screening limits for freshwater bathing and aquatic life, respectively (National Park Service, 2001b).

Air Quality

The NPS is responsible to preserve, protect and enhance air quality and air quality related values of the National Park System units under both the Organic Act (16 U.S.C. 1, 1a-1) and the Clean Air Act (National Park Service, 2001a). Air quality is linked to many natural processes (i.e., soil and water nutrients, photosynthesis, acidification of lakes and streams).

EFMO is designated as a Class II clean air area under the prevention of significant deterioration program, as enacted by the Clean Air Act, amended on August 7, 1977 (National Park Service, 1999).

The nearest air quality monitoring station, 65 miles south of the monument at Dubuque, Iowa, is maintained by the state of Iowa. The data indicates that sulfur dioxide levels are below national ambient air quality standards, and carbon dioxide levels are above the 8-hour national standards, probably because of heavier automotive and increased traffic conditions in the city. Particulate levels, although important, are unknown or not being monitored at this time (National Park Service, 1999).

Biological Resources

Water resources are critical to the sustenance of EFMO's populations of flora and fauna. Biological resources are intimately linked to hydrological systems. For example, riparian habitat is closely tied to the health of both wetlands and streams, influencing stream fish assemblages. Characteristics of riparian habitat structure such as the ratio of edge to interior, the degree of canopy complexity within riparian strata (e.g., herb/forbs, shrubs, sub-canopy tree, and overstory tree), and the degree of fragmentation is highly associated with amount and type of wildlife use (National Park Service, 2004b).

This section concentrates on some of the listed species in or in close proximity of the monument, including a discussion on unionids. The purpose of this section is to begin exposing some of the biological concerns where water resources are found to be an important habitat requirement.

Flora

Listed Species

The threatened northern wild monkshood *(Aconitum noveboracense)* is a federally-listed species that has been reported outside but near EFMO, and can be found in Allamakee and Clayton counties, specifically on north-facing slopes (National Park Service, 1999).

State-listed "endangered" species located at EFMO or adjacent areas include:

Swamp loosestrife (*Decodon verticillatus*)
Arrow arum (*Peltandra virginica*)
Waxy meadowrue (*Thalictrum revolutum*)
Large-leaved violet *(Viola incognita*)

State-listed "threatened" species located at EFMO or adjacent areas include:

Leathery grapefern (*Botrychium multifidum*)
Golden corydalis (*Corydalis aurea*)
Jeweled shooting star (*Dodecatheon amethystinum*)
Glandular wood fern (*Dryoperis intermedia*)
Creeping juniper (*Juniperus horizontalis*)
Purple fringed orchid (*Platanthera psycodes*)
Wild lupine (*Lupinus perennis*)

State-listed "special concern" species located at EFMO or adjacent areas include:

Balsam fir (*Abies balsamea*)
Brook lobelia (*Lobelia kalmii)*
Purple angelica (*Angelica atropurpurea*)
Coast blite (*Chenopodium rubrum*)
Purple coneflower (*Echinacea purpurea*)
Dwarf spikerush (*Eleocharis parvula*)
Rough bedstraw (*Galium asprellum*)
Naked miterwort (*Mitella nuda*)
Water milfoil (*Myriophyllum verticillatum*)
Annual ground cherry (*Physalis pubescens*)
Hairy Solomon's-seal (*Polygonatum pubescens*)
Large-leave pondweed *Potamogeton amplifolius*)
Dewberry (*Rubus hispidus*)
Widgeon grass (*Ruppia maritime*)
Burreed (*Sparganium androcladum*)
Summer grape (*Vitis aestivalis*)

Fauna

Unionid mussels (freshwater clams) are the most endangered group of animals in North American waters (Williams et al. 1993). Unionid populations are declining due to a number of factors relating to habitat alteration and human interference. Problems stem from changes in physical habitat such as increased siltation, sedimentation, and channelization; changes in water quality due to increased pollution such as heavy metals, pesticides, human and feed lot wastes, mining wastes, and acid runoff; and harvesting for shell and pearls (Turner and Rabalais, 1994; Schloesser et al., 1996). The increased spread of exotic species present in the Mississippi River (i.e., the zebra mussel), have

placed additional stress on fragile populations, causing major extirpations of all unionid species in many regions (Schloesser and Nalepa 1994, Strayer and Smith, 1996). Unionid fauna are present in the Yellow River and Johnson's Slough. Detailed discussions on unionid species are presented later in this report.

Listed Species

There are two federally-listed endangered species observed seasonally in the monument area. The endangered bald eagle *(Haliaeetus leucocephalus)* migrates through the monument area in the spring and fall and resides in the area for breeding and wintering. Current species populations are unknown. The historic breeding range of the endangered peregrine falcon *(Falco peregrinus)* includes this general area. Peregrine falcons were reintroduced to the monument in 1998. Additional birds were introduced in 1999, and their status will be monitored on a continuing basis (National Park Service, 1999).

Reported outside EFMO's boundary, the federally-listed Iowa Pleistocene snail *(Discus macclintocki)* prefers habitat associated with the algific talus slopes described earlier. A dead shell of the federally-listed Higgin's eye clam *(Lampsilis higginsi)* was found inside EFMO's boundary (Rovang, pers. comm., 2006). The Higgin's eye clam is found in the Mississippi River channel bottoms (National Park Service, 1999).

State-listed "endangered" species located at EFMO or adjacent areas include:

Birds
- Red-shouldered hawk (*Buteo lineatus*)

Fish
- Lake sturgeon (*Acipenser fulvenscens*)
- Weed shiner (*Notropis texanus*)

Freshwater Mussels
- Buckhorn (*Tritogonia verrucosa*)
- Slough sandshell (*Lampsilis teres teres*)
- Yellow sandshell (*Lampsilis teres anodontoides*)

Mammals
- Spotted skunk (*Spilogale putorius*)

State-listed "threatened" species located at EFMO or adjacent areas include:

Fish
- Burbot (*Lota lota*)
- Western sand darter (*Ammocrypta clara*)
- Black redhorse (*Moxostoma duquesnei*)

Freshwater mussels

Ellipse (*Venustaconcha ellipsiformis*)

Mammals

Eastern bobcat (*Felis rufus*)
Southern bog lemming (*Synaptomys cooperi*)
Least shrew (*Cryptotis parva*)

State-listed "special concern" species located at EFMO or adjacent areas include:

Birds

Forester's tern (*Sterna forsteri*)

Fish

Pugnose minnow (*Notropis emiliae)*

Mammals

Southern flying squirrel (*Glaucomys volans*)

IMPORTANT WATER RESOURCES AND VALUES

It is important for NPS units to identify the resources and values critical to achieving the park's purpose and maintaining its significance. The reasons for identifying fundamental and other important resources and values are:

1. To define and understand the most important resources and values that support the park's purpose and significance. If these resources and values are degraded or eliminated, they then jeopardize the park's purpose and significance.
2. To ensure that the planning team and public understand the key elements that sustains the park's purpose and significance.
3. To help planning and management activities focus on larger issues and concerns regarding protection of the resources and values that support the park's purpose and significance.
4. To allow the planning team to test out alternatives and estimate how they will influence the fundamental and important resources and values of the park.
5. To become the building blocks in creating a future vision and management strategy for the park while being responsive to the park's needs.

Identifying the fundamental and important resources and values at EFMO helps ensure that all planning is focused on what is truly most significant about the park. The following sections follow a format provided by the NPS Denver Service Center (DSC) Planning Division. This includes the following six questions that are answered for water resources at the park:

1. Who are the stakeholders who have an interest in EFMO's water resources and values?
2. Which laws and policies apply to EFMO's water resources and values, and what guidance do the laws and policies provide?
3. What is the importance of these water resources and values?
4. What is the adequacy of the existing water resources information at EFMO?
5. What are the current state or conditions and the related trends of these water resources and values?
6. What are the current or potential threats to these water resources and values?

For water resources, these questions are answered from existing technical references provided to the author, forming the justifications as important resources at EFMO:

1. Who are the stakeholders who have an interest in EFMO's water resources and values?

<u>Federal:</u>

U.S. Department of Agriculture, Farm Services Agency
U.S. Department of Agriculture, Natural Resources Conservation Service
U.S. Environmental Protection Agency
U.S. Forest Service (Marquette)

U.S. Fish and Wildlife Service (Upper Mississippi River National Wildlife and Fish Refuge)
U.S. Geological Survey

State:

Clayton County Soil and Water Conservation District
Iowa Department of Agriculture and Land Stewardship, Division of Soil Conservation.
Iowa Department of Natural Resources – Water Quality Bureau, Fisheries Bureau, Geological Survey Bureau
Iowa State University Extension
St. Mary's University of Minnesota (Winona) office of Geospatial Services

Regional:

Allamakee County Conservation Board
Clayton County Conservation Board
Northeast Iowa Citizens for Clean Water

2. *Which laws and policies apply to EFMO's water resources and values, and what guidance do the laws and policies provide?*

The management of EFMO's water resources is guided by many federal and state laws and policies.

Park-specific

Presidential Proclamation 2860 (1949) established EFMO and directed preservation of the earthen mounds within.

Public Law 87-44 (1961) added land to the monument and mandated preservation of the mounds, wildlife, and other natural values.

Federal

Management of EFMO's water resources is also guided by many additional federal laws and NPS policies.

- The *National Park Service Organic Act* of 1916 created the NPS and includes a significant management provision stating that the NPS *shall promote and regulate the use of the federal areas known as national parks, monuments, and reservations by such means and measures as conform to the fundamental purpose of the said parks, monuments, and reservations, which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for future generations*. The Organic Act also authorizes

the NPS to *regulate the use* of national parks and develop rules, regulations and detailed policies to implement the broad policies provided by Congress. Rules and regulations for the national park system are described in the *Code of Federal Regulations* (Title 36).

- The *General Authorities Act* of 1970 strengthened the 1916 *Organic Act*, stating that lands in all NPS units, regardless of title or designation, shall have a common purpose of preservation. All water resources in the national park system, therefore, are equally protected by federal law. It is the primary duty of the NPS to protect those resources unless otherwise indicated by Congress.

- The *Redwood National Park Act* of 1978 amended the *General Authorities Act* of 1970, identifying the *high public value and integrity of the national park system* as reason to manage and protect all park system units. The act further stated that no activities should be allowed that will compromise the *values and purposes for which these various areas have been established*, except where specifically authorized by law or provided for by Congress.

- The *National Parks Omnibus Management Act* of 1998 outlined a strategy to improve the ability of the NPS to provide high-quality resource management, protection, interpretation and research in the national park system by:

    - Fostering the collection and application of the highest quality science and information to enhance management of units of the national park system;
    - Authorizing and initiating cooperative agreements with colleges and universities, including but not limited to land grant schools, along with creating partnerships with other Federal and State agencies, to construct cooperative study units that will coordinate multi-disciplinary research and develop integrated information products on the resources in national park system units and/or the larger region surrounding and including parks;
    - Designing and implementing an inventory and monitoring program of national park system resources to collect baseline information and to evaluate long-term trends on resource condition of the national park system, and;
    - Executing the necessary actions to fully and properly apply the results of scientific study to park management decisions. Additionally, all NPS actions that may cause a significant adverse effect on a park resource must conduct unit resource studies and administratively record how study results were considered in decision making. The trend in resource condition in the national park system shall be a critical element in evaluating the annual performance of the NPS.

- The 1972 *Federal Water Pollution Control Act*, also known as the *Clean Water Act*, strives to restore and maintain the integrity of U.S. waters. The Clean Water Act grants authority to the states to implement water quality protection through best management practices and water quality standards. Section 404 of the act requires that any dredged or fill materials discharged into U.S. waters, including

wetlands, must be authorized through a permit issued by the U.S. Army Corps of Engineers, which administers the Section 404 permit program. Additionally, Section 402 of the act requires that pollutants from any point source discharged into U.S. waters must be authorized by a permit obtained from the National Pollutant Discharge Elimination System (NPDES). All discharges and storm water runoff from major industrial and transportation activities, municipalities, and certain construction activities generally must be authorized by permit through the NPDES program. NPDES permitting authority typically is delegated to the state by the U.S. Environmental Protection Agency.

- *Safe Drinking Water Act* (42 USC 3001 et seq.) applies to developed public drinking water supplies. It sets national minimum water quality standards and requires testing of drinking water.

  2001 NPS Management Policies: The NPS will determine the quality of park surface and ground water resources and avoid, whenever possible, the pollution of park waters by human activities occurring within and outside of parks.

  - ❖ Work with appropriate governmental bodies to obtain the highest possible standards available under the Clean Water Act for the protection of park waters.
  - ❖ Take all necessary actions to maintain or restore the quality of surface waters and ground waters within the parks consistent with the Clean Water Act and all other applicable federal, state, and local laws an regulations; and
  - ❖ Enter into agreements with other agencies and governing bodies, as appropriate, to secure their cooperation in maintaining or restoring the quality of park water resources.

  2001 NPS Management Policies: The NPS will manage watersheds as complete hydrologic systems, and will minimize human disturbance to the natural upland processes that deliver water, sediment, and woody debris to streams. The NPS will achieve the protection of watershed and stream features primarily by avoiding impacts to watershed processes to proceed unimpeded.

- *Executive Order* 11990: *Wetlands Protection* requires the NPS to 1) exhibit leadership and act to minimize the destruction, loss, or degradation of wetlands; 2) protect and improve wetlands and their natural and beneficial values; and 3) to refrain from direct or indirect assistance of new construction projects in wetlands unless there are no feasible alternative to such construction and the proposed action includes all feasible measures to minimize damage to wetlands.

  NPS 2001 Management Policies: The NPS will manage wetlands in compliance with NPS mandates and the requirements of Executive Order

11990 (Wetland Protection), the Clean Water Act, and the Rivers and Harbors Appropriation Act of 1899, and the procedures described in D.O. 77-1. The service will 1) provide leadership and take action to prevent the destruction, loss, and degradation of wetlands; 2) preserve and enhance the natural and beneficial values of wetlands; and 3) avoid direct and indirect support of new construction in wetlands unless there are not practicable alternatives and the proposed action includes all practicable measures to minimize harm to wetlands. The NPS will implement a "no net loss of wetlands" policy.

- *Executive Order* 11988: *Floodplain Management* has a primary objective *...to avoid to the extent possible the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is an practicable alternative*. For non-recurring actions, the order requires that all proposed facilities must be located outside the boundary of the 100-year floodplain. Barring any feasible alternatives to construction within the floodplain, adverse impacts are to be minimized during the design phase of project planning. NPS guidance for this executive order can be found in D.O. 77-2.

  2001 NPS Management Policies: In managing floodplains on park lands, the NPS will 1) manage for the preservation of floodplain values; 2) minimize potentially hazardous conditions associated with flooding; and 3) comply with the NPS Organic Act and all other federal laws and executive orders related to the management of activities in flood-prone areas, including Executive Order 11988 (Floodplain Management), NEPA, applicable provisions of the Clean Water Act, and the Rivers and Harbors Appropriation Act of 1899. Specifically the NPS will:

  - ❖ Protect, preserve, and restore the natural resources and functions of floodplains;
  - ❖ Avoid the long-and short-term environmental effects associated with the occupancy and modifications of floodplains; and
  - ❖ Avoid direct and indirect support of floodplain development and actions that could adversely affect the natural resources and functions of floodplains or increase flood risks.

  2001 NPS Management Policies: Natural shoreline processes (such as erosion, deposition, dune formation, shoreline migration) will be allowed to continue without interference. Where human activities have altered the nature or rate of natural shoreline processes, the NPS will, in consultation with appropriate state and federal agencies, investigate alternatives for mitigating the effects of such activities or structures and for restoring natural conditions. New developments will not be placed in areas subject to wave erosion or active shoreline processes unless 1) the development is required by law; or 2) the development is essential to meet the parks' purposes, as defined by its establishing act of proclamation, and

- ❖ No practicable alternative locations are available,
- ❖ The development will be reasonably assured by surviving during its planned life span, without the need for shoreline control measures, and
- ❖ Steps will be taken to minimize safety hazards and harm to property and natural resources.

- *2001 NPS Management Policies*: The NPS will manage karst terrain to maintain the inherent integrity of its water quality, spring flow, drainage patterns, and caves. Local and regional hydrological systems resulting from karst processes can be directly influenced by surface land use practices. If existing or proposed developments do or will significantly alter or adversely impact karst processes, these impacts will be mitigated. Where practicable, these developments will be placed where they will not have an effect on the karst system.

- The *Clean Air Act* of 1970 (as amended in 1990) regulates airborne emissions of a variety of pollutants from area, stationary, and mobile sources. The amendments to the act were added primarily to fill gaps in earlier regulations pertaining to acid rain, ground level ozone, stratospheric ozone depletion and air toxics, and also to identify 189 hazardous air pollutants. The act directs the U.S. Environmental Protection Agency to study these pollutants, identify their sources, determine the need for emissions standards and develop and enforce appropriate regulations.

- The *National Environmental Policy Act* (NEPA) of 1969 requires that any action proposed by a federal agency that may have significant environmental impacts shall *utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decision making which may have an impact on man's environment*.

- The *Endangered Species Act* of 1973 requires the NPS to identify all federally listed endangered, threatened and candidate species that occur within each park unit and promote their conservation and recovery. The act requires that any activity funded by federal monies that has the potential to impact endangered biota must be consulted through the Secretary of Interior. It requires agencies to protect designated critical habitats upon which endangered and threatened species depend. Although not required by law, it also is NPS policy to identify, preserve and restore state and locally listed species of concern and their habitats.

- *Invasive Species* (Executive Order 13112): enhances and furthers the existing authority of the federal government to assist in preventing and controlling the spread of invasive species.

State of Iowa

Iowa's antidegradation policy and accompanying provisions include:

> *High Quality Resource Water*: In general, chemical integrity of these water bodies has been affected. Discharges are allowed as long as water quality standards are not violated. Only physical and biological integrity will be maintained and protected. The Yellow River has this designation.
>
> *High Quality Water*: No new or increased discharges are to be allowed in these designated waters. The chemical, physical, and biological integrity of the water quality shall be protected, except when it is determined by the State Environmental Protection Commission (after public hearing and intergovernmental coordination and public participation provisions noted in a planning process) that there is need to allow lower chemical quality because of necessary and justifiable economic and social development in the area. Sny Magill Creek has this designation.

Surface waters in Iowa can be designated for one or a combination of the following uses:

> *Recreational (Class A)* uses: protected for various contact recreational uses
> *Aquatic Life (Class B)* uses: protected for wildlife, fish, and aquatic and semi-aquatic life uses. Sny Magill Creek has this designation.
> *Drinking water (Class C)* uses: protected as raw water source for potable drinking water.

Restoration plans called *Total Maximum Daily Loads* (TMDLs) are prepared for impaired waters in Iowa. The objective of the TMDLs is to restore impacted waters to where they meet their respective state designated uses. A TMDL is scheduled for the Yellow River (upper reach) in 2007.

In Iowa, local boards of health have primary responsibility for regulation of sewer systems serving less than 15 people, while Iowa Department of Natural Resources (DNR) has primary responsibility for larger (public) systems. The DNR standards specify siting and construction requirements relative to the primary and secondary treatment portions of the sewage disposal systems as well as minimum depth to groundwater, minimum separation distances to potable water sources, and maximum percolation rates for soils. Any onsite wastewater treatment system that discharges treated wastewater to the ground surface must be monitored to ensure it meets secondary treatment standards.

Iowa has two types of animal feeding operations regulated under the DNR: confinements and open feedlots.

> *Confinement feeding operations*: confine animals to areas that are totally roofed. Confinement feeding operations are not allowed to discharge manure to a water of the State.

Open feedlot operations: unroofed or partially roofed with no vegetation or residue ground cover. Large open feedlots are allowed to discharge to a water of the state under certain conditions, such as a storm event.

Environmentally sensitive areas such as wells, sinkholes, and water resources are protected by setbacks from animal feedlot construction and manure application.

Additional water quality information can be found at the Iowa DNR website: http://www.iowadnr.com/water/index.html

Water Rights (McGlothlin, pers. comm., 2006)

Water rights, whether federal or state law-based, are needed by the park to meet the water needs of park personnel and visitors, and to protect natural, water-dependent resources. Legislative authorities for NPS water rights in Iowa include state statute (Iowa Administrative Code), NPS Organic Act, and park-specific enabling acts. The NPS will obtain and use water in accordance with these legal authorities. The NPS will consider authorities under Iowa and federal law on a case-by-case basis and will pursue those that are most appropriate to accomplish the purposes and protect water-related resources at EFMO. While preserving its legal remedies, the NPS will work with state water administrators to protect park resources and, if conflicts amongst multiple water users arise, will seek their resolution through good faith negotiations.

The Iowa water rights system retains basic common-law riparian concepts for non-regulated water uses and sets out principles of water use allocation and regulation. Thus, the water right system is classified as regulated riparianism. Iowa law (IOWA CODE § 455A.) vests the control of the allocation and use of ground and surface water resources in the Department of Natural Resources (DNR). A permit (§ 455B.265) is required for all beneficial uses greater than 25,000 gallons per day for diverting, storing, or withdrawing water from any surface or groundwater source. Exceptions to this requirement include collecting diffuse water not a part of any watercourse and ponds having a capacity of less than 18 acre-feet. The DNR Water Allocation Program contains many of the tenets of a prior-appropriation system. It provides: a means to resolve competing uses through a permit system; public involvement in water allocation permit decisions, and a conflict resolution process. The DNR reviews each permit application for beneficial use and effect of the use upon existing water resources, landowners, and prior users of the source. A permit may be granted if established minimum flow is preserved, the authorized use does not impede water quality, stream navigability, or the long-term availability of water. A permit is granted for a ten-year period, requires annual reports of water use, and may be renewed through re-application to DNR. Streams are protected for minimum instream flows for domestic, fish and wildlife, recreational, wasteload assimilation and pollution control, water use needs, preservation of aesthetic values, and other public interests through designation of protected low flows.

Important Water Resources

Finally, in looking at the specific important water resources (streams, rivers, wetlands, groundwater), we answer the remaining four questions posed by the GMP Planning Team that provide the justifications for why these resources are important to EFMO, along with the issues that threaten these important park resources.

3. What is the importance of these water resources and values?

Surface Water

The Yellow River and Dousman Creek are designated by the state as "high quality resource water" due to their substantial recreational and ecological significance. Special protection is warranted to maintain the unique or outstanding physical, chemical, or biological characteristics for waters under this state designation (Iowa Department of Natural Resources, 2003).

The Yellow River (34-mile segment that includes EFMO) is placed on the Nationwide Rivers Inventory (NRI). The inventory is a listing of river segments that are believed to possess one or more "outstandingly remarkable" natural or cultural values judged to be of more than local or regional significance (National Park Service, 2006).

The Yellow River has the potential to be one of the top trout streams, not only in Iowa, but in the entire Upper Midwest (Iowa Watershed Improvement Review Board, 2005). Dousman Creek empties into the Yellow River and has been reported to contain trout in the lower reaches of the three-mile drainage (National Park Service, 1999).

Sny Magill Creek is designated by the state as "high quality waters" to be protected against degradation of water quality. This state designation is for waters with exceptionally better water quality than the levels specified in the Water Quality Standards (Iowa Department of Natural Resources, 2003). Sny Magill Creek is also designated as a Class "B" cold water stream (North Carolina State University, 2001).

Sny Magill Creek is one of the more widely used streams for recreational trout fishing in Iowa (Iowa Department of Natural Resources, 2005a). The creek is managed for "put and take" trout fishing by the Iowa Department of Natural Resources. Sny Magill Creek ranks sixth in the state for angler usage (North Carolina State University, 2001).

Ground Water

The rivers and streams within EFMO's watershed have high proportions (70-80% or more of annual flow) of ground water base flow, which provides the important cold water characteristics of the creeks that support trout habitat (North Carolina State University, 2001). The NPS is required to manage EFMO's karst terrain to maintain the inherent integrity of its water quality, spring flow, drainage patterns and caves (National Park Service, 2001a).

Over 80% of Iowans use ground water for their drinking water. This resource is available through wells drilled into river valley sands and gravels, into other sand and gravel bodies buried within glacial deposits, and into the deeper limestone and sandstone strata beneath the state (Iowa Department of Natural Resources, 2006b).

Wetlands

Preservation of EFMO's wetland habitats and their related values is a long-term management goal of the NPS managers. These wetland habitats represent endangered landscapes in the upper Midwest. Those that remain play important roles in water quality improvement, erosion control, and flood water abatement. All relatively undisturbed wetlands remaining in Iowa are valuable for their natural resources, for the wildlife habitat they contain and for their use as natural laboratories. The wetlands within EFMO contribute to all of these values (Sanchini, 1999).

4. *What is the adequacy of the existing water resources information at EFMO?*

Active water quality monitoring programs, including some physical and biological monitoring, are in place for both the Yellow River and Sny Magill watersheds. Most of the sampling occurs outside EFMO's boundary. The National Park Service (2001b) completed a comprehensive summary of existing surface water quality data for EFMO. Some of the historic and current sampling efforts are listed below:

- Early independent "one-time" water quality sampling occurred in 1976 and 1978 for Sny Magill Creek and in 1982 for the Yellow River.

- Benthic macroinvertebrate survey (1981) for the Yellow River.

- The Yellow River is currently monitored monthly at select locations, supported by the Iowa Watershed Improvement Grant (Iowa Department of Natural Resources, 2006a). Monitoring includes bacteria, chloride, nutrient, and sediment analyses.

- The Sny Magill Watershed is part of the U.S. EPA's Section 319 National Monitoring Program to address nonpoint source pollution. Select sites are sampled for chemical and physical water quality parameters on a weekly to monthly basis. Annual habitat assessments are being conducted along stretches of the stream corridor. Biomonitoring of macroinvetebrates occurs on a bimonthly basis, and an annual fisheries survey is conducted (North Carolina State University, 2001).

- Brimingham (2002) summarized the benthic data collected from Sny Magill watershed through 2001.

- Nichols et al. (2002) inventoried unionids in the Yellow River, Dousman Creek and Johnson's Slough.

Discharge has been recorded on the Yellow River (9.7 miles upstream from the mouth of the Mississippi River, Station # 05389000) since 1934 by the U.S. Geological Survey (U.S. Geological Survey, 2005).

Since 1991, discharge has been recorded on Sny Magill Creek (approximately 1.5 miles upstream from the mouth of the Mississippi River, Station # SN-1) as part of the Sny Magill Watershed, Section 319, National Monitoring Program Project.

The wetlands in the region have been identified through the U.S. Fish and Wildlife National Wetland Inventory (NWI). It should be noted that some wetlands may have been missed in this inventory since the aerial surveys typically miss small wetlands (<0.5 acre) without field confirmation. Spring and seeps are common in karst landscapes like EFMO, and small wetlands can be associated with these wet areas.

5. *What are the current state or conditions and the related trends of these water resources and values?*

Water Quality

Yellow River

The Yellow River watershed encompasses 154,666 acres (62,590 ha) in Winneshiek, Clayton, and Allamakee counties, and a portion of the Yellow River is currently listed on Iowa's impaired waters list for high levels of fecal coliform bacteria (Iowa's 2004 303[d] list http://www.iowadnr.com/water/tmdlwqa/wqa/303d.html#2004). The impaired segment runs through EFMO. The elevated bacteria concentrations are cause for concern due to the recreational value of the stream (Iowa Department of Natural Resources, 2006a). For the past two years, a coalition of state, federal, and local officials have been working together to collect baseline data in the Yellow River watershed in northeast Iowa. This unique coalition was forged from a mutual concern for regional water quality and the desire to share resources effectively.

The Yellow River is surveyed monthly for water quality with continual improvements shown in overall water quality since 1991. Improvements are most noticeable with decreases in mean turbidity and triazine herbicide levels. Dissolved oxygen levels have shown a sustained improvement since 1993 (National Park Service, 1999).

In order to understand the potential sources of bacteria and other contaminants, intensive sampling was conducted on a weekly basis at twelve sites within the Yellow River watershed during 2004 and 2005. Samples were analyzed for bacteria, chloride, nutrients, and sediment. In addition, one site was equipped with a real-time sensor to monitor dissolved oxygen, water temperature, pH, specific conductance, and turbidity. The resulting data provided a roadmap for local officials to begin developing plans for Best Management Practices throughout the watershed. In January of 2006, the Yellow River watershed was identified to receive a State of Iowa Watershed Improvement Grant. Continued monitoring over the next few years will provide valuable feedback as to the

success of the initial targeting of the management practices (Iowa Department of Natural Resources, 2006a).

Funding will be utilized to improve stream quality to the level of fully supporting game fish such as brown (*Salmo trutta*), rainbow (*Oncorhychus mykiss*) and brook trout (*Salvelinus fontinalis*), walleye (*Sander vitreus vitreus*), northern pike (*Esox lucius*) and smallmouth bass (*Micropterus dolomieu*). This will greatly enhance recreational activities such as fishing, canoeing and inner tubing. The management objectives concentrate on two sources of impairment: stream bank erosion and coliform bacteria from both livestock and inadequate human septic systems (Iowa Watershed Improvement Review Board, 2005).

Sny Magill Creek

A USDA Hydrologic Unit Area (HUA) project was initiated in the Sny Magill Creek watershed in 1991. Over $3.1 million has been allocated for watershed protection and monitoring from state and federal programs. Eighty-one percent of the watershed's 98 landowners have participated in the project. Pesticide and nutrient loading have been reduced on 45% of cropland acres in the watershed through the delivery of nutrient and pest management assistance and education programs by ISU Extension. The Natural Resources Conservation Service (NRCS) estimates that structures and crop management BMPs have reduced sediment delivery to the stream over 50% compared to pre-project practices. Streambank bioengineering practices established by the project have become a laboratory for study of innovative, lower-cost stream protection measures in Iowa (Iowa State University, 2005).

Sny Magill Creek is one of 25 coldwater streams identified by the state of Iowa as a priority concern. Impairment of its water quality is primarily a result of nonpoint agricultural sources, particularly sediment, animal waste, nutrients, and pesticides. Improvements in water quality from the implementation of extensive Best Management Practice (BMP) methods have been observed in two recently completed, smaller scale projects in Clayton County: Ensign Hollow and North Cedar Creek (a tributary to Sny Magill Creek). BMPs are designated to reduce the amount of pollutants such as sediment, nitrogen, phosphorus, and animal wastes that enter surface water or groundwater. Increased rates of natural reproduction of brown trout have been documented in Ensign Hollow and are attributed to BMP implementation. Sedimentation and fecal coliform rates have been lowered in North Cedar Creek, increasing the creek's ability to support brook trout reproduction (Iowa Department of Natural Resources, 2005a). It should be noted that overall, multiple linear regression analyses produced no evidence of trends toward an improving water quality in the Sny Magill watershed (North Carolina State University, 2001).

Recent studies indicate that up to 60% of the sediment in streams like Sny Magill comes from streambank erosion. Significant progress has been made in demonstrating alternative bioengineering approaches to streambank stabilization that may be practical and cost-effective for landowners in the watershed (Iowa State University, 2005). The BMPs preferred by landowners are contour terraces, water and sediment control basins,

contour stripcropping and conservation tillage. Demonstrations that utilize multiple bank-stabilization techniques, ranging from willow posts to rock rip-rap, have been initiated (Iowa Department of Natural Resources, 2005a). The monitoring program has found improved water quality trends in pesticide detections and benthic macroinvertebrates (Iowa State University, 2005).

The state's Nonpoint Source Assessment Report indicates that the present classifications of Sny Magill Creek as protected for wildlife, fish, and semiaquatic life and secondary aquatic usage are only partially supported. The report cites impairment of water quality primarily by nonpoint agricultural pollutants, particularly sediment, animal wastes, nutrients, and pesticides. No significant point sources of pollution exist within the Sny Magill watershed. Sediment delivered to Sny Magill Creek includes contributions from excessive sheet and rill erosion on approximately 4,700 acres (1,902 ha) of cropland and 1,600 acres (647.5 ha) of pasture and forest land in the watershed. Gully erosion problems were identified at nearly 50 locations (North Carolina State University, 2001).

Although BMPs have effectively reduced the sediment delivered from the upland to Sny Magill Creek by an estimated 50.7% (Palas and Tisl, 1998), these reductions are not reflected in the sediment loads discharged by Sny Magill Creek (North Carolina State University, 2001). Estimates based on the Universal Soil Loss Equation suggested that as a result of implemented BMPs, sediment delivery to Sny Magill Creek has decreased over 33% since 1991 (Iowa Department of Natural Resources, 2005a). A large amount of post-settlement alluvium continues to be a source of erodible sediment within the Sny Magill watersheds and may be masking the upland reductions. Because the impact of post-settlement alluvium on the sediment loads is poorly understood, whether Sny Magill Creek will show significant reductions in sediment load as a result of BMPs implemented is uncertain (North Carolina State University, 2001).

Integrated Crop Management (ICM) methods are being used to assist producers with the adoption of refined crop-management practices. This activity resulted in 39,450 pounds less nitrogen, 33,625 pounds (15,252.3 kg) less phosphate, 128 pounds (58.0 kg) less alachlor (herbicide) and 1,450 pounds (657.7 kg) less corn rootwarm insecticide being applied annually in the watershed (Iowa Department of Natural Resources, 2005a). The Sny Magill Watershed is part of the U.S. EPA's Section 319 National Monitoring Program to address nonpoint source pollution. Changes in water quality are being measured using a paired watershed approach. Sny Magill is being compared with the adjacent Blood Run watershed to the north (Iowa Department of Natural Resources, 2005a). Primary monitoring sites, equipped with U.S. Geological Survey (USGS) stream gauges to measure discharge and suspended sediment, have been established on both Sny Magill and Bloody Run creeks. The primary sites and several other sites on both creeks are being sampled for chemical and physical water quality parameters on a weekly to monthly basis. Annual habitat assessments are being conducted along stretches of both stream corridors. Biomonitoring of macroinvertebrates occurs on a bimonthly basis, and an annual fisheries survey is conducted (North Carolina State University, 2001).

Hydrology

EFMO experienced major changes between 1940s-1960s, especially with reference to surface runoff and natural vegetation that included: (a) net gain in bottomland woodland and marsh land, (b) increases in the number of farm ponds, and (c) a general gain of bottomland shrub resulting from a reduction in canopy cover, which was likely the result of timber harvest (Narumalani et al., 2004).

A major change in local land use was the tremendous rise in the total area of farm ponds, from 1.5 acre (0.6 ha) in the 1940s to nearly 398 acres (161 ha) in the 1990s, indicating changes in agricultural practices over the 60-year timeframe (Narumalani et al., 2004). In 1936, USDA policy focused on decreasing soil erosion losses from agricultural lands in the U.S. Practices such as field reshaping for terrace formation combined with contour seedbed tillage and planting were some of the land management strategies implemented to slow the rate of water runoff and decrease topsoil losses. Another facet of soil erosion policy encouraged landowners to create water impoundments by building earthen berms in the path of precipitation runoff. Cash assistance payments were made when land operators cooperated with the USDA for these projects. Consequently, a large number of farm ponds were constructed between the 1960s and 1990s (Narumalani et al., 2004).

Sedimentation in Founders Pond has been heavy. Overgrazing on steep slopes adjacent to EFMO may be a source of the sedimentation. Sediment has been accumulating where an intermittent drainage has been emptying into the pond. The rate of sedimentation is such that the life expectancy of the wetland will be greatly shortened (National Park Service, 2003).

The National Park Service is collaborating with The Center for Advanced Land Management Information Technologies, University of Nebraska-Lincoln (UNL-CALMIT) to document land use/land cover changes at EFMO during the last 60 years to facilitate management decisions (Narumalani et al., 2005).

Biology

The fish species sampled in Sny Magill Creek have remained relatively constant through the years and are typical of Iowa coldwater streams. Based on survey results, Sny Magill creek is dominated by a single species, the fantail darter (*Etheostoma flabellare*). In 2001, the first occurrence of slimy sculpin (*Cottus cognatus*), a cold water fish that is intolerant of environmental degradation, was noted in Sny Magill Creek (North Carolina State University, 2001).

Birmingham (2002) has summarized the benthic data through 2001. The benthic macroinvertebrate communities in the Sny Magill watersheds have remained relatively constant. Multiple regressions on means from the control sites and the treatment sites over time indicate trends towards improving water quality in the Sny Magill sites for taxa richness, EPT index, and percent dominant taxa, but not for the Hilsenhoff Biotic Index (North Carolina State University, 2001).

There are very few unionids in the Yellow River. The lack of unionid fauna in this river is puzzling (Nichols et al., 2002). Considering the connection to the extensive unionid fauna in the Mississippi River, plus the presence of a number of host fish, we would expect this river to have a larger number of unionids than it does. A number of environmental factors could be limiting unionid populations, including water temperature regime (too cold), long-term pollution, pulses of pollutants, or natural metal contamination. There is no indication that unionids were ever commonly found in this river. Either unionids were never common at this site or this river underwent substantial bed modification that covered or destroyed the historical shells as has been hypothesized for some other Iowa rivers. Nichols et al. (2002) identified seven live individuals representing five species and 13 dead shell representing the five species plus two additional species. Live individuals of two Iowa-listed species, the strange floater (*Strophitus undulates*) and flutedshell (*Lasmigona costata*) were found. Most of the live unionids were found above the mouth of Dousman Creek. The two unionids found below Dousman Creek, giant floater (*Pyganodon grandis*), are very pollution and disturbance tolerant. Further environmental monitoring of water quality is recommended in the Yellow River and Dousman Creek in order to determine stressors limiting unionid recruitment and survival (Nichols et al., 2002).

In Johnson's Slough, Mississippi River, 29 native unionid species were identified, of which 21 had live representation (Nichols et al., 2002). All live and dead shells were colonized by zebra mussels to some degree. While the unionid fauna in the park waters of Johnson's Slough is species rich, it is not a discrete population but merely an edge of a larger population existing in adjacent waters presently under the jurisdiction of the U.S. Fish and Wildlife Service. A gravel bar (Station JS-36) located within 1-3 meters of shore, is important unionid habitat. Any shoreline development, armoring, vegetation removal, or other shoreline disturbance could have substantial negative impact on the mussel bed. The second potential area of impact is around the current boat launch site. Fluctuations in water levels or alterations around the boat launch area could potentially alter this situation. The collection of a recently dead shell of the federally endangered species, Higgins eye mussel (*Lampsilis higginsii*), may indicate that this mussel still survives in these waters under NPS jurisdiction (Nichols et al., 2002). Zebra mussels have colonized this entire section of the Mississippi River for a number of years, and the survival projections for the native mussels were poor just a few years ago, since unionids generally do not survive in zebra mussel-infested waters. On the other hand, zebra mussel densities have drastically declined recently for unknown reasons and befouling rates on unionids are down. Zebra mussels affect native mussels through two mechanisms, biofouling as well as food competition (Baker and Hornback, 1996; Schlosser et al., 1996; Strayer and Smith, 1996).

6. *What are the current or potential threats to these water resources and values?*

Watershed

Yellow River

A large meat processing plant in Postville, Iowa that discharges waste into the Yellow River is planning to expand. The town-managed industrial waste treatment lagoon has been the subject of controversy for years, and has been implicated in several fish kills in the Yellow River and in the general degradation of one section of the Yellow River and all of Hecker Creek, the small tributary actually receiving the waste. Hecker Creek is a "losing stream" with a direct connection to the aquifer. Measurements have shown that local wells are impacted by the discharge (Veysey, 2004)

In 2003, the wastewater division of DNR issued a "final" discharge permit to the industry, associated with the proposed construction of a new waste treatment facility. Unfortunately, the proposed treatment facility was not designed to remove chloride. The facility was going to use approximately 800,000 gallons (3,636,880 liters) of fresh water pumped from the aquifer daily to dilute the effluent to levels that still exceed levels protective of aquatic life (Veysey, 2004).

In 2006, a settlement was reached between the meatpacking plant and the Northeast Iowa Citizens for Clean Water in the Yellow River. The agreement calls for a 30 percent reduction in chloride emissions from the city's wastewater system, which treats discharge from the agriprocessors (Waterloo Courier Iowa, 2006).

The city is now able to open the $11 million wastewater treatment plant. The treatment plant will be an improvement over the existing lagoon treatment system, reducing a number of other pollutants discharged into the creek. Those include nitrogen, ammonia and bacteria. As part of the settlement, Agriprocessors agreed to extend the period the company will monitor groundwater for contamination from 3 years to 7.5 years. The company will also pay $25,000 annually for five years to the Allamakee County Soil and Water Conservation District for watershed improvements and water quality monitoring (Waterloo Courier Iowa, 2006).

Coordination is critical in management of a watershed that extends beyond your jurisdictional boundaries. The National Park Service has been designated as the lead agency for a two-year demonstration project of the Yellow River Initiative Concept to provide project coordination with over thirty interested local partners during the Initiative's development. This team was voluntarily joined by a watershed biologist with the US Fish and Wildlife Service's Upper Mississippi River National Wildlife and Fish Refuge. The interagency group then partnered with St. Mary's University of Minnesota (Winona) Office of Geospatial Services, which had already been contributing support for this project through its website, for further website development (Upper Mississippi Basin Stakeholder Network, 2005).

Sny Magill Creek

There are more than 13 locations where livestock facilities need improved runoff control and manure management systems to control solid and liquid animal wastes. Grazing management is needed to control sediment and animal waste runoff from over 750 acres (303.5 ha) of pasture and an additional 880 acres (356.1 ha) of grazed woodland. Streambank erosion has contributed to significant sedimentation in the creeks. In order to mitigate animal waste and nutrient problems and improve bank stability in critical areas, improved stream corridor management designed to repair riparian vegetation and keep cattle out of the stream is necessary (North Carolina State University, 2001).

Water Quality

Yellow River

A portion of the Yellow River is currently listed on Iowa's impaired waters list for high levels of fecal coliform bacteria (Iowa's 2004 303[d] list). This impaired segment runs through EFMO and is a cause of concern due to the recreational value of the stream (Iowa Department of Natural Resources, 2006a).

Sny Magill Creek

Sny Magill Creek is one of 25 coldwater streams identified by the state of Iowa as a priority concern. Impairment of its water quality is primarily a result of nonpoint agricultural sources, particularly sediment, animal waste, nutrients, and pesticides (Iowa Department of Natural Resources, 2005a; U.S. Environmental Protection Agency, 2005).

Ground Water

Ground water flow paths within the karst along the Yellow River were studied in June 2005, with three dye injections using fluorescein, eosin, and sulforhodamine B. This dye trace is the beginning of many more along the Yellow River to better understand the local hydrogeology (Boyle et. al., 2005). This information will be useful for identifying contaminate sources and recommending appropriate land use activities within the EFMO watershed.

Wetlands

Forested floodplains associated with oxbows and secondary channels of the Yellow River or Mississippi River have had their natural hydrology altered by deposition of sediments in agricultural runoff entering the Yellow River and by control of water levels in the Mississippi (Sanchini, 1999).

Sedimentation in Founders Pond appears to have increased over the past several years. Overgrazing on steep slopes adjacent to EFMO may be a contributing source to the sedimentation. Sediment has been accumulating where an intermittent drainage empties into the pond. The rate of sedimentation may greatly shorten the life expectancy of the

wetland. It is necessary to determine if the sedimentation flow into the pond is natural and how to mitigate the sedimentation deposition that threatens this wetland's longevity (National Park Service, 2003b).

Dr. Jim Christainsen (Drake University) conducted a herpetological study in 1999 and suggested that the drainage of the wetland at Founders Pond had been altered in the past to lower water levels (National Park Service, 2003b).

EFMO needs technical assistance to develop mitigation plans to reduce wetland impacts from unnatural sedimentation and altered water levels at Founders Pond. Analysis of wetland conditions would determine condition and threats requiring mitigation. Development of a wetland mitigation plan would follow with compliance for restoration and protection of wetlands (National Park Service, 2003b).

Other

In a preliminary study by the NPS Geologic Resources Division (2002) of flooding and sedimentation at the Sny Magill unit, it was determined that the terrace surface is inundated by floods with a discharge of 4,200 $m^3 s^{-1}$ (148,327 $ft^3 s^{-1}$) or more at McGregor (Mississippi River gaging station 6.1 miles (9.8 km) upstream from Sny Magill), having an average recurrence interval of about 5 years or more. Based on this frequency estimate and field observations of sediment deposited during a 2001 flood, it was estimated that most of the mounds at Sny Magill could be buried within 100-700 years (Benedetti, no date).

More extensive sedimentations studies at the Sny Magill unit have been recommended. In order to refine the estimates of mound burial, continued monitoring of overbank deposition during flood events of the Sny Magill site is recommended. Estimates of longevity for the mound group might also be refined by monitoring the trends in flood frequency and sediment load of the upper Mississippi River (Benedetti, (no date)).

The unique habitats found along the algific talus slopes in the region remain cool throughout the year and are home to rare species of plants and animals (i.e., Iowa Pleistocene snail (*Discus macclintocki*)). These species' habitat cannot be restored once lost and the primary objective of their recovery plans is providing protection for remaining colonies. Concern over threats to the habitat stemmed from logging, grazing, filling of sinkholes, agricultural runoff, roads and quarries. The invasion of garlic mustard (Alliaria petiolata) onto algific talus slopes has emerged as a threat in recent years. And no one knows the potential effects of modern global warming (U.S. Fish and Wildlife Service, 2006).

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As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

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