

# Chapter 3 – The Affected Environment

## 3.1 Introduction

The proposed Addition area is located in west-central Missouri in Bates County, approximately 10 miles west of Butler, Missouri. The area contains 11,145 acres between the Missouri state line and County Highway V. Marais des Cygnes NWR (9,300-acre acquisition area) and Marais des Cygnes Wildlife Area (7,500 acres) are located immediately west of the Addition area.



*Mussels collected on Marais des Cygnes NWR*

The Addition area is located within the Osage Cuestas subdivision of the Osage Plains Physiographic region. The Osage Cuestas are characterized by forested southwest-northeast trending limestone ridges with valleys (Bare 1979) containing high quality tracts of prairie scattered amid expanses of fescue pasture. River and stream valleys in the region are dominated by cropland and pasture with scattered tracts of floodplain hardwood forest.

The Marais des Cygnes River, which meanders through the study area, is a major tributary of the Osage River which in turn is a tributary of the Missouri River. Floodplains

within the mid reach of the River are generally 1.5 miles in width. Numerous oxbow wetlands of various depth were historically found throughout much of the floodplain. Many of the wetlands in the Addition area have been either fully or partially drained. Original wetlands still exist throughout portions of the floodplain, however. The largest wetlands in the area are 20-30 acres in size.

Prior to 1911, the Missouri portion of the Marais des Cygnes River was 52 miles in length. In 1911 the Bates County Drainage Ditch was constructed. The ditch traverses the Marais des Cygnes River valley from just downstream of the Addition area to its confluence with the Osage River, a distance of 23 miles. The reach of river along the drainage ditch was previously 43 miles long. The drainage ditch shortened the River by 17 miles (Dent et al. 1998). This shortening, along with significant channel downcutting and construction of levees, has significantly reduced flooding of the floodplain along this reach of the River and has facilitated the presence of a number of corporate farming operations. Today, the Missouri portion of the Marais des Cygnes River is comprised of 15 miles of the original river and 20 miles of drainage ditch (the first 3 miles of the drainage ditch do not carry water except during high flows).

Historically, much of the uplands of the study area were dominated by tallgrass prairie with savannah groves in areas less prone to fire. The floodplains of the

Marais des Cygnes River and larger tributaries were dominated by floodplain hardwood forest with wet prairie on more moist and fire prone sites.

The Osage Cuestas region once supported large populations of free-roaming bison, elk, waterfowl and prairie chickens. Forests of pin oak, pecan, Shumard oak, and shellbark hickory provided winter cover and protection from prairie fires for large ungulates as well as habitat for wolves and black bear.

Today, bison and elk herds, wolves and black bear are gone and little remains of this vast prairie/forest complex. Remnant tallgrass prairies found on portions of the study area are now grazed by cattle or hayed. Osage orange, persimmon, and plum have established themselves along fencelines throughout the area. Post oak and blackjack oak savannahs, located on some of the drier hilltops, have largely become woodlands.

Despite these changes, many prairie and forest species still exist in the Addition area. Large expanses of native tallgrass prairie in the Kansas Flint Hills, to the west of the study area, and large expanses of oak-hickory forest in the Missouri Ozarks, to the east of the study area, offer significant opportunities for natural recolonization by prairie and forest species not currently found in the area.

## **3.2 Climatic/Geologic Features**

### **3.2.1 Temperature**

Bates County has a continental climate typical of the interior of a large land mass in the middle latitudes. Such a climate is characterized by large daily and annual variations in temperature. Winters are cold because of the frequent southerly flows of air from the polar regions. Winter lasts only from December through February. Warm summer temperatures last for about 6 months every year, and the transition seasons, spring and fall, are fairly long. Temperature data recorded at Mound City, Kansas, is characterized by a winter (January) average daily temperature of 34.4 degrees Fahrenheit (F) and a summer (July) average daily temperature of 77.4 degrees F (U.S. Department of Agriculture 1981).

### **3.2.2 Precipitation**

Bates County is in the path of a fairly dependable current of moisture-laden air from the Gulf of Mexico. Precipitation is heaviest late in spring and early in summer. Much of it occurs as late-evening or nighttime thunderstorms. Although the total precipitation is generally adequate for any crop, its distribution may cause problems in some years. Prolonged dry periods of several weeks duration are common during the growing season. A surplus of precipitation often produces muddy fields and a delay in planting and harvesting. Precipitation averages 38.53 inches per year, with the highest monthly amounts occurring in spring and fall (U.S. Department of Agriculture 1981).

### **3.2.3 Growing Season**

Elevations in the study area are approximately 800 feet above sea level. The combination of elevation and latitude gives the area a fairly long growing season that will exceed 200 days in most years (U.S. Department of Agriculture 1981).

### **3.2.4 Geology**

The topography of the region is characterized by southwest-northeast trending limestone ridges with gently rolling valleys. The limestone ridges are largely comprised of Pennsylvanian and Permian limestone and shale (Bare 1979). The region has not been glaciated. Soils in the region were produced from the weathering of limestone and shale.

### **3.2.5 Soils**

Predominant upland soil types in the study area are the Kenoma-Hartwell-Deepwater Association. This soil association is generally suited for row crops with appropriate conservation measures such as terraces and grassed waterways on sloping fields. Predominant floodplain soil types are the Osage-Verdigris Association. This association is suited for row crops though flooding is generally a problem without significant landscape alterations including levees and ditches (U.S. Department of Agriculture 1995).

### **3.2.6 Minerals**

Mineral resources are present in the proposal area. Limestone is quarried in Bates County and is used as concrete aggregate and building stone, or is crushed for use as agricultural lime, riprap, and road surfacing. No operating pits are present in the proposal area.

Mineral production in Bates County has been primarily centered around coal production. Coal deposits exist throughout the western portion of the county and retrievable deposits are present throughout the proposal area. The coal seam is within 30 to 40 feet of the surface and ranges from 24 to 38 inches thick.

Pittsburg and Midway Coal Mining Company had a large active open pit mining operation on their ownership adjacent to, and within the northwest corner, of the proposal area. The company discontinued operation in 1989 when the LaCygne Power Plant, the company's main customer, terminated its purchase agreement. The company no longer owns land within the Addition area. A small open pit coal mine was recently in operation 1.5 miles south of the proposal area but is no longer in operation. It is currently conducting reclamation activities. Marketability of coal in the region is limited due to a number of factors, including coal quality, overburden depth-coal seam width ratio, and availability of local markets.

In 1977, the 95th Congress passed legislation regulating the coal industry in its operation of surface mines. Public Law 95-87, known as the "Surface Mining Control and Reclamation Act of 1977" (Act), further regulates the industry by designating certain areas as unsuitable for coal mining operations. Title V, Section 522(e)(1) of the Act states in part: "...no surface mining operations...shall

be permitted -- on any lands within the boundaries of units of...the National Wildlife Refuge System...". The exclusion of Refuge System lands is subject to valid existing rights (VER) (U.S. Fish and Wildlife Service 1992).

### 3.2.7 River Hydrology

The Marais des Cygnes River is a sub-basin of the Osage River, which flows into the Missouri River near Jefferson City, Missouri. The mainstem of the Marais des Cygnes River is approximately 177 river miles in length from the Kansas-Missouri state line to its headwaters west and south of Topeka, Kansas. An additional 35 miles of the River occur in Missouri for a total length of 221 miles. Upstream from the state line, it drains an area of approximately 3,300 square miles with an average discharge of 2,033 cfs or 1,473,000 acre-feet per year. Major tributaries of the River are Big Sugar Creek, Big Bull Creek, Pottawatomie Creek, Dragoon Creek, Hundred and Ten Mile Creek, Mine Creek, and Mulberry Creek.



*Marais des Cygnes River*

The natural flow of the River has been significantly affected by construction of several major impoundments by the U.S. Army Corps of Engineers that include Pomona Lake, Melvern Lake, and Hillsdale Lake as well as La Cygne Lake, which was constructed by Kansas City Power and Light. These dams control 23 percent of the watershed (Dent et al. 1998). Another factor affecting flows is retention of overbank flows in wildlife refuge ponds at Marais des Cygnes Wildlife Management Area, operated by the State of Kansas. Retention in these ponds amounts to 5,500 acre-feet annually. In addition, the flows are affected by power developments and numerous small diversions for stock ponds and irrigation (U.S. Fish and Wildlife Service 1992)).

The effects the dams have had on river flows are difficult to determine. While upstream dams have reduced flows, construction of upstream levees, drainage of wetlands, and increased runoff from towns have increased flows. In general, it is believed that flood events are more frequent, attain greater heights, and are of shorter duration compared to events that occurred prior to settlement of the area by Europeans.

A U.S. Geological Survey river gauge near Trading Post, Kansas, and approximately 7.5 miles upstream from the Addition area, has been recording river flow information since 1929. Review of this information indicates that the dams have had a much greater impact to river flows during drought events than during flood events. While the River frequently ceased to flow for weeks at a time prior to dam construction, no-flow events (< 5 cubic feet/second) now rarely occur and are of much shorter duration (Gleason 2001).

Flood events generally occur every 8 out of 10 years for the years 1960-2000. Average flood frequency at the gauge for this period is two to three times per year. The greatest number of flood events per year was eight. The average

depth of water above the riverbank was 4 feet with a high of 10 feet (Gleason 2001). Flooding is also caused by numerous highway and railroad causeways that constrict the floodplain of the rivers and streams in the Marais des Cygnes River basin.

Features of the major upstream reservoirs are as follows:

**1. Pomona Reservoir** – The 3,885-acre reservoir was completed in October 1963 for the purposes of flood control and recreation. The Reservoir is approximately 20 miles south of Topeka, near the towns of Vassar and Michigan Valley. The Reservoir is formed by a compacted earthfill dam and has a total capacity of 498,500 acre-feet at elevation 1,025 feet msl. Normal spill elevation is 974 feet msl. The Reservoir is supplied by the 322-square-mile watershed of Hundred and Ten Mile Creek, a tributary of the Marais des Cygnes River.

**2. Melvern Reservoir** – The 6,877-acre reservoir was completed in July 1972 for the purposes of flood control, irrigation and recreation. The Reservoir extends approximately 12 miles westerly from the Town of Melvern to the Town of Reading. The Reservoir is formed by a compacted earthfill dam and has a total capacity of 920,600 acre-feet at elevation 1,073 feet msl. Normal spill elevation is 1,036 feet msl. The Reservoir is supplied by the 349-square-mile watershed of the upper Marais des Cygnes River.

**3. Hillsdale Reservoir** – The 4,566-acre reservoir was completed in September 1981 for the purposes of flood control, water supply, water quality control, fish and wildlife, and recreation. The Reservoir is 3 miles north and west of Hillsdale near Highway I-35. The Reservoir is formed by a compacted earthfill dam and has a total capacity of 315,600 acre-feet. Normal spill elevation is 917 feet msl. The Reservoir is supplied by the 144-square-mile watershed of Big Bull Creek, a tributary of the Marais des Cygnes River.

**4. La Cygne Reservoir** – La Cygne Reservoir is the first large Kansas reservoir designed as a cooling pond for power generation. Kansas City Power and Light Company and Kansas Gas and Electric constructed the fossil-fuel generating facility and reservoir to supply electricity for eastern Kansas and western Missouri. The Reservoir covers an area of 2,420 acres and has a storage capacity of 40,000 acre-feet. Its maximum depth is 40 feet and average depth is 15.4 feet. Normal spill elevation is 840 feet msl. Through cooperative agreements, Kansas Department of Wildlife and Parks and Linn County manage 2,000 acres of wildlife land and a 1,000-acre county park surrounding the reservoir area. The Reservoir is supplied by waters of Elm Creek and Sugar Creek, a tributary of the Marais des Cygnes River.

The Bates County drainage ditch was completed in 1911. The ditch traverses the Marais des Cygnes River valley from the east edge of the Addition area to its confluence with the Osage River. Although the ditch is 23 miles in length, the first 3 miles do not carry water except during high flows. This reach of the River was 43 miles in length prior to construction of the 23-mile-long drainage ditch that shortened the River by 17 miles (Dent et al. 1998).

The drainage ditch likely had an immediate and dramatic impact on local and downstream hydrology. The removal of 17 miles of river greatly increased the transport of water from the area and likely made nearby cropland much easier to farm, while downstream farmland likely flooded much more frequently.

Channel downcutting also occurred until bedrock was reached. One result of this downcutting is significant bank erosion and downstream deposition of silt. Bank erosion will continue until the 17 miles of river that were removed are once again reclaimed (Dent et al. 1998).

The impacts of the drainage ditch on the Addition area are much less extreme. The first 3 miles of the drainage ditch do not carry water except during high flows because the presence of bedrock prevented excavation to the required depth. Upstream headcutting likely occurred shortly after drainage ditch construction but not to the same degree as the downcutting within the drainage ditch. Current levels of bank erosion and changes in hydrology are probably influenced much more by upstream factors than lingering effects of the drainage ditch.

### **3.2.8 River Water Quality**

Erosion and sedimentation from agricultural lands do cause water quality problems in the Marais des Cygnes River, especially during periods of moderate to high flows. During low flow periods in the summer and winter River clarity increases dramatically. The quality of water in the River may perhaps best be determined by a close study of the River's mussel population. Currently, 23 species have been found living in the River at Marais des Cygnes NWR.

Acid mine drainage and high iron and sulphate levels occur in portions of Mulberry Creek, a tributary located within the Addition area. However, the stream is not considered acidified. Mining ceased within the watershed in 1989 and, as a result of this, water quality is expected to improve with time (Dent et al. 1997).

## **3.3 Description of Habitat**

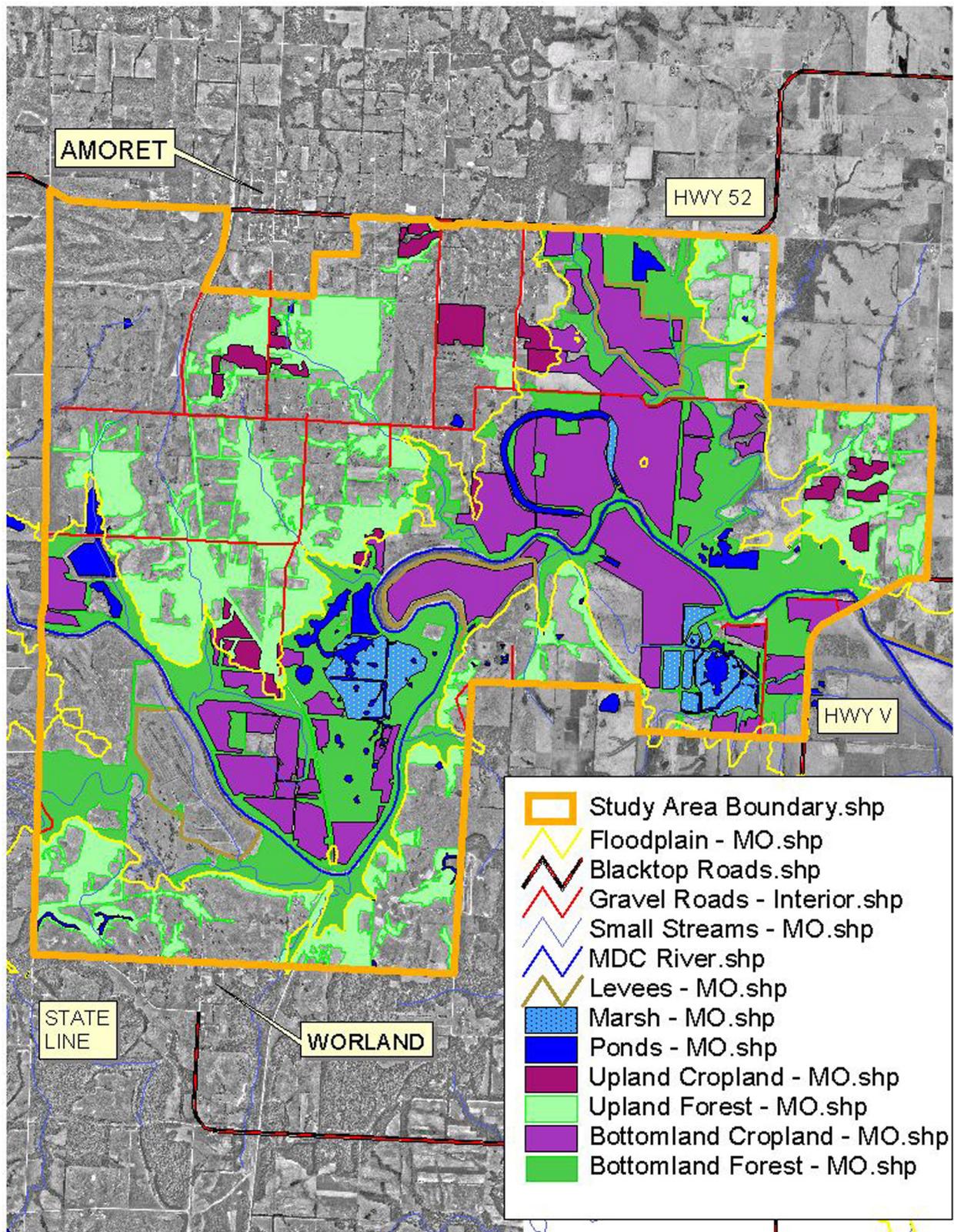
### **3.3.1 Wetlands**

Wetlands are largely confined to the floodplain of the Marais des Cygnes River and two of its larger tributaries, Mine Creek and Mulberry Creek. Shallow wetlands are found throughout floodplain hardwood forest tracts. These wetlands are quickly recharged by local rain events. Oxbow wetlands are much deeper and rarely go dry. Large open wetlands are generally created by man-made dikes for waterfowl hunting.

Wetlands within floodplain cropland can often be restored by plugging ditches or the construction of a series of shallow dikes along the end of a field which has been W-ditched. W-ditches occur where a field's flat topography is made to appear in cross-section as a W to provide high spots for crops and low spots for water.

Approximately 370 acres of oxbow wetlands and wetlands managed for waterfowl hunting occur in the Addition area. (Figure 5 illustrates all cover types found within the area of the proposed addition.)

**Figure 5: Cover Types of Proposed Area Superimposed Upon an Aerial Photograph**



### 3.3.2 Floodplain and Upland Forests

Young floodplain forests are generally composed of sycamore, green ash, cottonwood, and silver maple while more mature stands include pecan, Shumard oak, pin oak, shellbark hickory, and American elm.

Young upland forests are frequently composed of osage orange, honey locust, and persimmon while more mature forests are often comprised of red oak, bur oak, chinquapin oak, post oak, hackberry, and shagbark hickory.

Some of the upland forests are very open and have a grass understory. A number of these open forests may be restorable to oak savannah.

Pecan orchards are found throughout the region. A number of local harvesters purchase nuts from private landowners, process the nuts, and sell them in the national marketplace.

Abandoned cropland in the bottoms rapidly reverts to forest. While floodplain forest tracts are generally small throughout the area, they are also frequent.

Seed sources abound and flood events bring in seed from upstream forests. Rapidity of reforestation and species composition varies greatly depending on distance to seed sources and kinds of trees closest to the site. Most abandoned sites will appear as a young forest within 4 to 5 years.

Approximately 35 percent of the original floodplain hardwood forest acreage still occurs within the floodplain of the Addition area. The area contains approximately 1,675 acres of upland forest and 1,840 acres floodplain forest. Forests cover approximately 32 percent of the Addition area.

### 3.3.3 Tallgrass Prairie and Other Grasslands

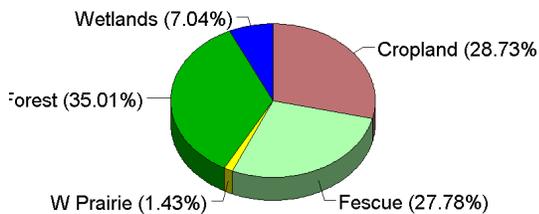
Much of the tallgrass prairie in the Addition area has been replaced by forest, cropland, and fescue pasture. Remaining tracts are generally less than 40 acres in size, are grazed or hayed, and vary in quality from poor to high. High quality tracts contain 100 to 200 species of plants. Common prairie species are Indian grass, big bluestem grass, gama grass, compass plant, pale purple coneflower, and prairie blazing star. Examples of dry rock prairie, mesic prairie, and wet prairie can all be found in the area.

Fescue pasture is the predominant cover type on the uplands. This non-native grass is able to withstand tremendous grazing pressure and therefore was widely planted to replace native grasslands that had become dominated by annual weeds due to season-long grazing. Some fescue grasslands harbor a great diversity of native prairie plants and can be returned to native prairie with careful management. Other fescue stands must be farmed or sprayed if fescue is not desired. The largest fescue stands occur in the northwestern portion of the Addition area where they were planted after the area was mined and reclaimed.



*Natural forest regeneration in abandoned floodplain crop field.*

**Figure 6: Floodplain Cover Types**



The area contains 430 acres of tallgrass prairie (estimate) and 5,020 acres of fescue and other grasses. Grasslands cover 49 percent of the Addition area.

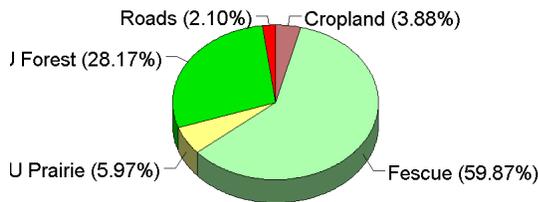
### 3.3.4 Cropland

Crops commonly grown in the area include corn, milo, soybeans, and winter wheat. Crops provide food and cover for many species of wildlife but only during certain times of the year.

Most cropland within the floodplain is not protected by levees and is thus subject to river flooding. A number of corporate farming operations are located immediately downstream of the Addition area where the Bates County Drainage Ditch and levees have reduced the likelihood of flooding.

Approximately 1,740 acres of cropland occur in the addition area, of which 230 acres occur on the uplands and 1,510 occur in the bottoms. The percentage of croplands is 2 percent of the uplands, 29 percent of the floodplain, and 16 percent of the Addition Area (see Figure 6 and Figure 7).

**Figure 7: Upland Cover Types**



### 3.3.5 Prairie River

An 8.8-mile reach of the Marais des Cygnes River and the last 3.7 miles of Mine Creek and 3.5 miles of Mulberry Creek travel through the Addition area. The River contains three rock riffles with associated gravel bars, which are believed to be important for paddlefish and walleye spawning (Dent et al. 1997) as well as mussel habitat. Approximately 1.5 miles (20 percent) of the 8.8-mile reach of the River contains exposed rock substrate in and along the River. The area provides excellent spawning and nursery habitat for a number of sport fish (walleye, white bass, perhaps paddlefish) that migrate out of Truman Lake and into the river to spawn. The young of these fish are recruited to the Truman Lake fishery to maintain a quality fishery for sport anglers.

One levee, 2.1 miles long, occurs along a portion of the south bank of the Marais des Cygnes River within the Addition area. The bank opposite of this levee exhibits significant erosion, probably in part due to the presence of the levee but also because all streamside forest has been removed. Another levee is located along the lower reach of Mine Creek and is 1.9 miles in length. This levee does not prevent flooding from the Marais des Cygnes River, however. The land behind the levee is in fescue pasture. Mulberry Creek also has one levee along it that is 2.2 miles in length. The total area of floodplain behind levees is 444 acres, 8 percent of the floodplain.

Two dams, Bagnell (1931) and Truman (1979), are located downstream of the Addition area. These reservoirs do not impact flooding of the area but nevertheless have significant impacts on aquatic species, especially mussels. A severe drought, even if it occurs only once or twice a century, could easily reduce or

eliminate some populations in the upper watershed as there is no longer a means for downstream populations, whose young disperse by attaching to fish, to recolonize above the dams. However, upstream reservoirs have greatly lessened the intensity, frequency, and duration of low water events (< 5 cfs) (Gleason 2001) and therefore have to some degree mitigated the negative effects of downstream dams.

## **3.4 The Current Ecological Condition**

### **3.4.1 Fish and Wildlife**

#### 3.4.1.1 Mammals

The proposed Addition area supports a variety of resident mammals including white-tailed deer, opossum, raccoon, wood and cotton rat, gray, fox, and flying squirrel, red and gray fox, coyote, otter, bobcat, and nine-banded armadillo. A total of 41 mammal species are likely to occur in the addition area (U.S. Fish and Wildlife Service 1998).

Reports of wild hogs and mountain lions occur occasionally. No populations are believed established in the area. However, the Schell-Osage Wildlife Area, 30 miles southeast of the Addition area, enacted an eradication program in 2000 to prevent a small population of wild hogs from becoming established in the area.

At the time of European settlement in the early 1800s the area was home to herds of elk and bison. Bison skulls and bones are still commonly found along river bars. See Appendix D for area mammals species list.

#### 3.4.1.2 Birds

A Comprehensive Conservation Plan for Marais des Cygnes NWR lists the presence of 317 species of birds including 31 waterfowl and 36 warbler species. A total of 109 species of birds nest on the Refuge.

Wetlands are important stopover sites in the spring and fall for many migratory birds. Puddle ducks, including Mallards, Wood Ducks, Gadwall and Blue-winged Teal, and Canada Geese are frequently observed where wetlands are available. Resident Canada Geese (giant) use open water wetlands for nesting. Canada Geese and Mallards concentrate in large numbers on river riffles that remain open throughout the winter. These sites provide hunting opportunities for people and Bald Eagles.

In general, fall waterfowl populations at Marais des Cygnes Wildlife Area average 30,000 with peaks of 60,000 (Karl Karrow, personal communication). Waterfowl populations at August A. Busch Four Rivers Wildlife Area generally average 75,000 with peaks of 100,000 (Josh Cussimano, Personal communication). Most waterfowl use is by ducks, particularly mallards. Waterfowl migrate back and forth between these two areas and can be expected to readily utilize any wetlands that are restored in the Addition area. Marais des Cygnes Wildlife Area is located 4 miles west of the Addition area and Four Rivers Wildlife Area is located 20 miles southeast of the Addition area.

A number of Great Blue Heron rookeries are located along the mid reach of the Marais des Cygnes River. Nests are generally located in large sycamores. The number of nests in a rookery are generally less than 100.

Greater Prairie Chickens are occasionally seen in the area. The nearest active dancing grounds, or leks, occur 25 miles to the southwest of the Addition area near Blue Mound, Kansas, and 30 miles to the southeast of the Addition area near Nevada, Missouri. The leks are gathering sites where male Prairie Chickens display to attract females during the breeding season.

The following migratory bird species are listed as Resource Conservation Priorities by Region 3 of the U.S. Fish and Wildlife Service, and would benefit from the proposed project: Bald Eagle, Wood Thrush, Piping Plover, Interior Least Tern, Loggerhead Shrike, Grasshopper Sparrow, and Dickcissel.

The following additional bird species listed as Endangered by the State of Missouri would also benefit from the project: Barn Owl, Northern Harrier, King Rail, American Bittern, Snowy Egret, and possibly the Greater Prairie Chicken (Missouri Department of Conservation websites).

Other birds also likely to benefit include Cerulean Warbler, Bell's Vireo, Red-shouldered Hawk, Henslow's Sparrow, Scissor-tailed Flycatcher, Short-eared Owl, and Painted Bunting. See Appendix D for area bird species list.



*Spectacle Case  
Mussel*

Limited surveys conducted since 1998 at Marais des Cygnes NWR have documented a total of 30 species of mussels living within the Marais des Cygnes River and adjacent floodplain wetlands. Based on recent discoveries of non-relict shells and upstream discoveries, additional species will likely occur.

Non-relict shells of spectacle case mussel (*Cumberlandia monodonta*) indicate a recently (estimates range from 25 years to 75 years) extirpated population on a rocky reach of river within Marais des Cygnes NWR (Brian Obermeyer and Ed Miller, personal communication). The possibility of undiscovered specimens or populations within the River still exists. The species has been proposed for federal listing and is on a “Watch List” in Missouri.

Flat floater mussels (*Anodonta suborbiculata*) are uncommon in both Kansas and Missouri but are relatively common within the mid reach of the Marais des Cygnes River. These mussels are largely confined to floodplain wetlands that are periodically flooded by a nearby river. The species is listed as “endangered” in Kansas.

#### 3.4.1.3 Fish and Mussels

A total of 48 species of fish have been collected from the Marais des Cygnes River and tributaries in Missouri since 1986 (Dent et al. 1998). Walleye, white bass, and paddlefish migrate to river gravel bars located within the Addition area to spawn. The spawning sites for paddlefish that occur within Marais des Cygnes NWR and the Addition area may be among the most important within the West Osage River Basin (Dent et al. 1998). The paddlefish is listed on a “Watch List” in Missouri.

Rock pocketbook mussels (*Arcidens confragosus*) are also uncommon in Kansas and Missouri. A population was discovered in 2000 in Pottawatomie Creek, an upstream tributary of the Marais des Cygnes River in Kansas, by Dr. Robert Angelo, Kansas Department of Health and Environment. The species is listed as “threatened” in Kansas and “rare” in Missouri.

Black sandshell (*Ligumia recta*) mussels have not been observed live in Kansas since 1912. In August 2002, a live Black sandshell mussel was found in the Marais des Cygnes River on the Refuge (Angelo 2003).

Winged mapleleaf (*Quadrula fragosa*) is another federally listed endangered species that may occur on the Refuge. A shell discovered on the Refuge in 2001 was confirmed by Dr. David Stansbery, Ohio State University, to be *Quadrula fragosa*. Dr. Stansbery urged further exploration for this rare mussel.

Pink mucket (*Lampsilis abrupta*) is a federally listed endangered species that was discovered live in the Sac River in Missouri in 2001 by Dr. Chris Barnhart, Southwest Missouri State University. The Sac River is a tributary of the Osage River. No dams obstruct movement of fish and mussels between the Marais des Cygnes River and the Sac River.

Scaleshell mussel (*Leptodea leptodon*) was federally listed as an endangered species in 2001. An extant population of this species was discovered downstream of Bagnall Dam in 2001 in the Osage River. Historic records within the West Osage River Basin indicate the possibility that the species may occur within Marais des Cygnes NWR and the Addition area (Brian Obermeyer, personal communication).

See Appendix D for a list of area fish and mussel species.

#### 3.4.1.4 Reptiles and Amphibians

Approximately 58 species of snakes, lizards, frogs, salamanders, and turtles are likely to occur in the Addition area (Marais des Cygnes NWR CCP) of which 16 are amphibians and 42 are reptiles. The northern crawfish frog and great plains skink are two species that are likely in the Addition area and are uncommon in Missouri. See Appendix D for area reptile and amphibian species list.

#### 3.4.1.5 Threatened and Endangered Species

Ten federally listed threatened or endangered species may occur in the Addition Area, four of which – Bald Eagle, Interior Least Tern, Piping Plover, and Mead’s milkweed – have been observed within or near the Addition area. Pink mucket mussel, winged mapleleaf mussel, scaleshell mussel, American burying beetle, western prairie fringed orchid, and running buffalo clover historically occurred in the area and may still occur or be restored to the area.

A population of Mead’s milkweed occurs at Marais des Cygnes NWR within a short distance of the Addition area and likely occurs within existing prairie areas in the Addition area.



*Mussel bed on the Marais des Cygnes River (above) and mussels (below).*





*Mead's Milkweed*

Bald Eagles are common winter visitors along the Marais des Cygnes River, especially where rock riffles keep water open and attract large concentrations of geese and Mallards. Active Bald Eagle nests occur 40 miles upstream (northwest) of the Addition area at Hillsdale Reservoir, Kansas, and 30 miles downstream (southeast) at Schell-Osage Wildlife Area, Missouri.

Thirteen species listed as endangered in Missouri may occur within the Addition area, 10 of which have been observed within or near the Addition area. Bald Eagle, Barn Owl, Northern Harrier, King Rail, American Bittern, Snowy Egret, Interior Least Tern, Greater Prairie Chicken, black tailed jackrabbit, and Mead's milkweed have been observed within or near the Addition area. American burying beetle, western prairie fringed orchid, and running buffalo clover may occur in the area but have not been recently observed (Missouri Department of Conservation websites). See Appendix D for a listing of area federal and state-listed endangered species.

### 3.4.2 Biological Diversity

Biological diversity is the variety of life and its processes. This variety may occur at the species, community, and ecosystem level. Bio-diversity supports the stability and resilience of ecological systems that provide the “ecosystem services” upon which we depend, such as soil building, erosion control, and hydrologic cycles. The loss of this diversity threatens the function of ecosystems everywhere (U.S. Fish and Wildlife Service 2001), including the State of Missouri.

The Addition area contains a tremendous variety of plants and animals for an area of its size. Located within the transition zone of two biomes, tallgrass prairie and the eastern deciduous forest, and between two high quality representatives of these biomes, the tallgrass prairie of the Flint Hills of Kansas and the oak-hickory forest of the Ozarks of Missouri, the region has tremendous potential, with management, to increase in diversity. The presence of the Marais des Cygnes River and its associated floodplain further adds to the diversity of the area.

A total of 317 species of birds, 41 mammals, 58 reptiles and amphibians (Marais des Cygnes NWR CCP), 48 fish (Dent et al. 1998), and 30 mussels (Marais des Cygnes NWR staff) occur in the area for a total of 494 different animal species. This number includes a tremendous variety of aquatic, forest, and prairie species all within a short distance of each other, such as Cerulean Warbler and Red-shouldered Hawk in forests, Loggerhead Shrike and Scissor-tailed Flycatcher in shrubland/savannah, Henslow's Sparrow and Short-eared Owl in grasslands, flat floater mussels and Green Herons in wetlands, and paddlefish and Hooded Merganser along the River.

Plant community diversity is equally great with examples of prairie and woodland sites containing dry, mesic, and wet species associations. Some representative prairie species of each community association include prickly pear cacti on dry sites, big bluestem on mesic sites, and cordgrass on wet sites. Some repre-

sentative woodland species of each community association include black jack oak on dry sites, shagbark hickory on mesic sites, and pin oak on wet sites. American lotus, an emergent, and Potamogeton spp., a submergent, are some representative aquatic species.

Many typically southern species occur at their northern limits in the region including pecan, persimmon, and paw paw. Other species that are commonly found farther north, such as bur oak, occur as a southern subspecies. The southern subspecies of bur oak is readily recognized from the northern subspecies by its location in wet rather than dry sites and by the much larger nut size. See Appendix D for area Missouri rare species list.

### 3.5 Archaeological and Cultural Resources

The Addition area is located within a region identified to contain archaeological sites dating to the Archaic Period, circa 3500 B.C. Settlement patterns for both Archaic and Ceramic periods were in sheltered lowlands along major and minor drainages. However, seasonal upland camps have been identified dating to the Archaic and Early Ceramic periods.



*Artifacts found on Refuge land.*

A prehistoric campsite assigned to the Early Ceramic Temporal Period (A.D. 1 to A.D. 1000) is located 1 mile west of the Addition area. The site covers approximately 7 acres and is located within the floodplain of the Marais des Cygnes River. The potential for similar sites along the River is high (Marais des Cygnes NWR CCP). Evidence of old homesteads and small family coal mines are also present in the area.

An archaeological review, conducted for Pittsburgh and Midway Coal Mining Company prior to excavation within the northwest portion of the Addition area, identified two prehistoric archaeological sites. Both sites were believed to be of temporary use as no middens (prehistoric dumps) were identified. Both sites contained chipped stone fragments and tools such as scrapers (Schmits 1986).

Plant and mollusc fossils, mammoth teeth, and bison, elk, and camel bones are occasionally discovered along the Marais des Cygnes River.

