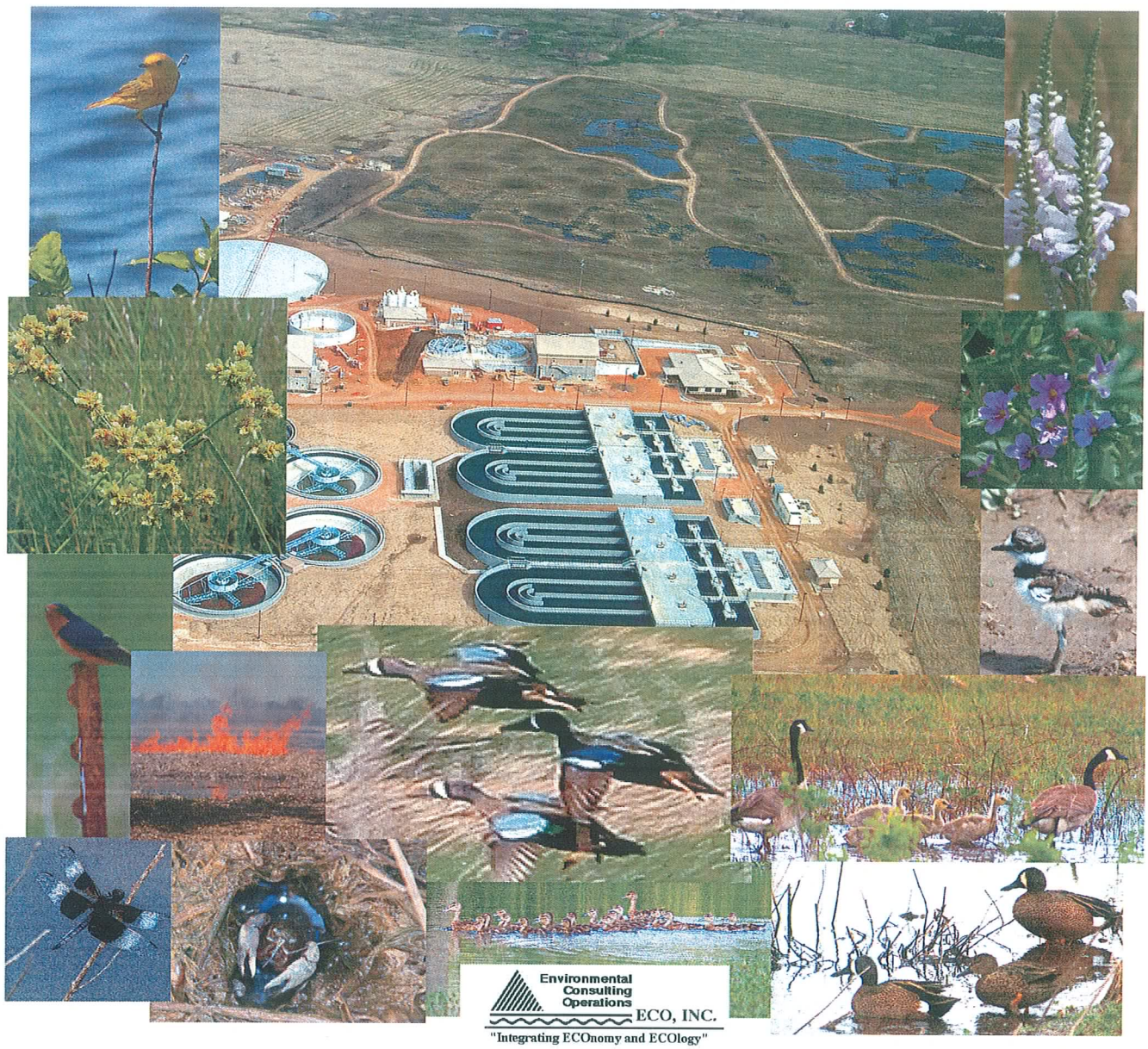
City Of Fayetteville, Arkansas
Wastewater Systems Improvements Project
Compensatory Wetland Mitigation Monitoring
Report No. 2

Fayetteville
ARKANSAS

404 PERMIT FILE NO. 14207

December 31, 2008



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1.0 - INTRODUCTION AND PROJECT OVERVIEW

The City of Fayetteville, Arkansas' Wastewater System Improvement Project (WSIP) was designed to improve the existing sewer collection system, upgrade the existing Paul Noland Wastewater Treatment Plant (WWTP), and construct a new (Westside) WWTP. The project's primary purpose was to implement corrective actions to eliminate/reduce odor and overflow problems associated with the existing treatment plant and collection system, and to provide wastewater treatment to areas currently outside the treatment area while reducing the total loading to the existing Noland WWTP. The linear portions of the project involved installation and replacement of approximately 38.02 miles of gravity flow sewer lines and force mains, and resulted in approximately 459.38 acres of surface disturbance. Construction activities commenced during the mid part of 2005 and will be completed near the end of the year 2009.

Roughly half of the Fayetteville sewer service is located within the Illinois River Watershed (within the Arkansas River Basin) and the other half is within the Beaver Reservoir Watershed (within the White River Basin). The WSIP involved discharges of fill into "waters of the U.S." therefore permitting under Section 404 of the Clean Water Act was required. This was done under one individual and two nationwide Section 404 permit actions, as described below.

On March 10, 2005, the City of Fayetteville received Section 404 Individual Permit No. 14207 from the U.S. Army Corps of Engineers, Little Rock District (Corps) for the portion of the WSIP in the Illinois River Watershed (west side) that involved 36 stream crossings and 15 wetland crossings during construction of sewer lines and road improvements. The permit required wetland compensatory mitigation due to the permanent alteration of 9.88 acres of wetlands.

As part of the terms and conditions included in the Corps Section 404 permit, five annual reports on the status of the mitigation site must be submitted to the Corps. The first annual wetland monitoring report is due December 31st after the first growing year and each year thereafter for a total of five years. The Section 404 Individual Permit No. 14207 was modified on December 19, 2007 as Permit No. 14207-3 to allow the use of vegetation management tools including herbicide application, mowing, and prescribed burning. The permit modification required two additional years of monitoring, and the submittal of monitoring reports for seven years instead of five years.

Within the Illinois Watershed, another Nationwide Section 404 permit (No.14207-1) was issued to the City of Fayetteville WSIP on October 30, 2007 due to

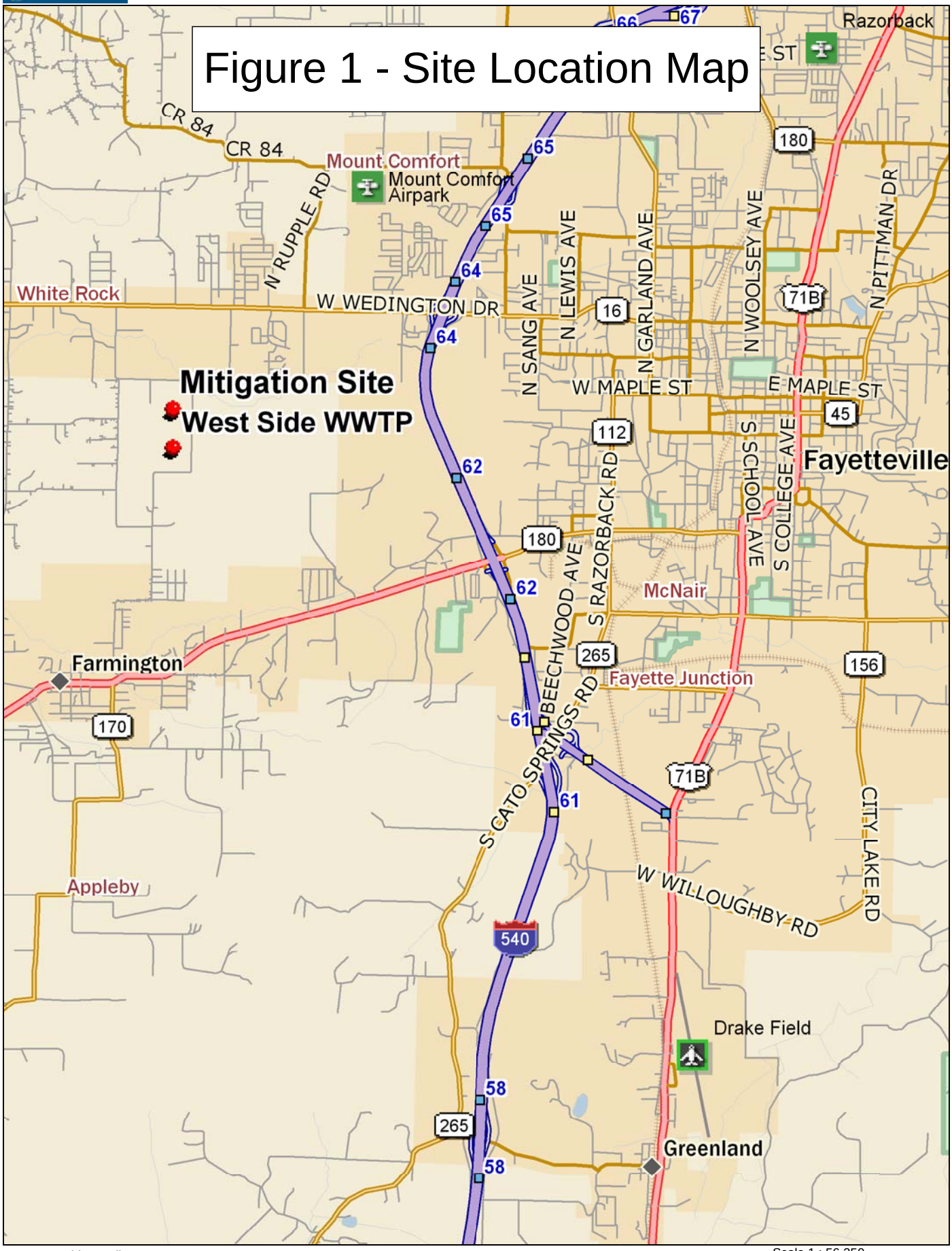
unavoidable impacts to Goose Creek as a result of construction of an outfall structure. This permit required the creation of approximately 0.084 acres of riparian buffer zone along the channel of Goose Creek, as mitigation. Planting of trees was required within the riparian buffer zone and monitoring is required for a period of three years. Two annual monitoring reports are required for years 1 and 3, and the reports are to be submitted to the Little Rock District within the monitoring reports required for Permit No. 14207.

On March 29, 2006, the City of Fayetteville received Section 404 Nationwide Permit No. 19371 from the U.S. Army Corps of Engineers, Little Rock District (Corps) for the portion of the WSIP in the White River Watershed (east side) that involved 27 stream crossings and 4 wetland crossings during construction of sewer lines. The permit required wetland compensatory mitigation due to the permanent alteration of 0.16 acres of wetlands. The compensatory mitigation has been achieved at the west side mitigation site.

The 26.62-acre wetland mitigation site lies within a 43.65-acre parcel of real property, which is located immediately to the north of the new Westside Wastewater Treatment Plant (WWTP) that became operational on June 1, 2008. A site location map is shown in Figure 1. The wetland mitigation site has been divided into two parcels due to the presence of a high-pressure natural gas line that extends diagonally through the property. Consequently, the West Mitigation Site is comprised of 12.04 acres and the East Mitigation Site is comprised of 14.58 acres.

Modifications to the existing hydrology at the mitigation site have been achieved via the construction of low elevation perimeter earthen berms designed to provide a mechanism for water retention at the site. Spillways with stop logs or risers have been constructed within the terrace berms in order to provide the ability to both hold and release water, as needed. Construction of the earthen berms resulted in two cells (W-1 and W-2) within the West Mitigation Site, and five cells (E-1 through E-5) within the East Mitigation Site. The mitigation site has been named "Woolsey Wet Prairie Sanctuary" in honor of Samuel Gilbert Woolsey, whose family settled the property in 1830.

Figure 1 - Site Location Map



TN
MN (2.5°E)

Scale 1 : 56,250
1" = 4,687.5 ft
Data Zoom 11-0

2.0 - SITE MANAGEMENT ACTIVITIES

The "adaptive management" (AM) approach, also known as adaptive resource management (ARM) has been utilized to manage site vegetation and hydrology. AM is a structured, iterative process of optimal decision-making in the face of uncertainty, with the objective to reduce uncertainty over time via system monitoring. Consequently, decision making simultaneously maximizes one or more resource objectives and, either passively or actively, generates information needed to improve future management. AM is often characterized as "learning by doing."

With regard to ecological restoration projects, each site has its own unique characteristics such as soil chemistry, hydrology, and dormant seeds within the seedbed. This creates a scenario whereby the observed results from the implementation of site management tools can be somewhat unpredictable. The timing of implementation of each management tool can also be a very critical factor in the results that are produced. For Woolsey Wet Prairie Sanctuary, the use of each site management tool was based upon the observed results from the previously used management tool, and was done in the following sequence:

- **May 2006 - Discontinuation of decades of cattle grazing and haying operations;**
- **May-July 2006 - Construction on of earthen berms for hydrological modification;**
- **October 2006 - Spot spray Bermuda, Johnson grass, honey locust, sericea lespedeza, elm with trichlopyr;**
- **March 2007 - Installation of water level control structures;**
- **April 27, 2007 - Mow fescue to prevent seed head development;**
- **February 29, 2008 - Prescribed burn;**
- **March 27, 2008 - Plant tree saplings in forested wetland cells and at outfall structure;**
- **March 27-April 5, 2008 - Boom spray fescue with sulfosulfuron;**
- **June 25, 2008 - Plant approximately 50 *Rhynchospora macrostachya;***
- **November 14, 2008 - Boom spray fescue with sulfosulfuron.**

2.1 - Prescribed Burning

The City of Fayetteville received a modification to Section 404 permit No. 14207 to conduct a prescribed burn at the mitigation site. A prescribed burn was conducted on February 29, 2008. This is a widely accepted vegetation management tool for ecological restoration projects. Studies have shown that the anthropogenic suppression of fire has been responsible for the eradication of many native plant communities nationwide.

Fire removes much of the surface layer of decaying vegetation "thatch" that covers the ground. Many native plant species require sunlight to germinate, while others actually require fire to germinate. Prescribed burning is commonly used to increase native plant species richness. It has been obvious that many native plant species (some of them rare) are within the seedbed at the mitigation site, and have been either dormant or suppressed until conditions became favorable for them to complete their life cycle.

The full extent of what species lie dormant within the existing seedbed is currently unknown, as new species continue to be added during each monitoring event. A second prescribed burn will be conducted in late winter/early spring of 2009.

2.2 - Herbicide Applications

The City of Fayetteville has received a modification to Section 404 permit No. 14207 to apply herbicides for control of tall fescue and other non-native invasive species. ECO, Inc. has conferred with Dr. Tom Barnes of the University of Kentucky Agricultural Extension Service, a nationally renowned expert in native wetland grass restoration, and control of non-native invasive species. He has conducted several studies showing the effectiveness of several herbicides for native grassland restoration. The herbicide sulfosulfuron was selected as the herbicide to be used at Woolsey Wet Prairie Sanctuary.

The primary objective of spraying sulfosulfuron was for control of tall fescue *(Schedonorus arundinaceus)*. This species was originally introduced from Europe to the United States during the late 1800s. The University of Kentucky began developing tall fescue varieties in the early 1900s and released the KY 31 variety for distribution in 1943. Tall fescue is extremely competitive and capable of forming monocultures in former native grasslands. It is estimated that approximately 4 million of the 5.4 million acres of pasturelands in Arkansas are dominated by tall fescue. It contains a toxic alkaloid that is detrimental to bobwhite quail, white-tailed deer, songbirds, wild turkey, and other wildlife. Tall fescue has a wetland indicator status of FAC- and is capable of dominating wet meadow areas, significantly reducing native plant species richness.

Tall fescue is a cool season grass and actively begins photosynthesis very early in the growing season. It goes dormant during hot dry weather and actively grows in the fall even after several killing frosts. This provides an advantage in vegetation management since the fescue can be sprayed at a time when native plant species are still dormant. Due to its life cycle, it was anticipated to be the first plant species to become active after completion of the prescribed burn. It was apparent

that three to four weeks after the burn would be a critical time to apply herbicides on the fescue. Sulfosulfuron is a grass-specific herbicide that causes minimal harm to many native plant species, has a very short half-life, and has been proven to be very effective for control of tall fescue.

The March 27-April 5, 2008 herbicide application event was not done satisfactorily. Unfortunately, the low bid contractor had inferior equipment and was not prompt in completion of the work. It was apparent that a uniform application of herbicide was not done as indicated by observations made two months later. Roughly 30 percent of the spray area indicated reduced tall fescue density; however, 70 percent of the spray zone appeared to have not been sprayed at all.

To address this matter, specifications were written in a more stringent manner to require a higher standard of qualifications and experience in ecological restoration projects. In November 2008, another contractor was hired to spray areas where tall fescue had not been reduced. This contractor had computerized equipment to assure a uniform application rate. Small stands of cool season sedges and rushes that exist in marsh areas were flagged in the field, and designated as "no spray" areas.

2.3 - Mowing

The City of Fayetteville has received a modification to Section 404 permit No. 14207 to conduct periodic mowing. The mowing is aimed toward invasive species such as tall fescue, Johnson grass, ragweed, and sericea lespedeza. If necessary, stands of these species will be mowed to a height of 10-12 inches as they begin to mature, but before they form seed heads. This is intended to prevent the dispersal of additional seeds from invasive species. Currently, most areas at the mitigation site remain too wet to mow. However, periodic mowing will be continued in a 50-foot perimeter around the mitigation site and on the earthen berms, as necessary.

2.4 - Hydrological Controls

Field observations have indicated that the hydrological model was extremely accurate in delineating wetland habitat type hydrology size and location. The model used 100 years of rainfall data, soil properties, evaporation, and detailed drawings with 6-inch contour lines.

Although the earthen berms were completed in July 2006, stormwater was only retained for 8 months. In March 2007, narrow excavations were made through the berms in order to install the water level control structures. The majority of the

retained water was discharged at that time. Due to this water loss, and the fact that 2007 was a dry year, the full benefit of hydrological modifications to allow for a full year of uninterrupted rainfall storage was not experienced until March 2007 through March 2008. Year 2008 was an extremely wet year that had significant impacts upon the site hydrology.

The annual average precipitation at Fayetteville is 46.02 Inches. Rainfall distribution is fairly even throughout the year. The wettest month of the year is June with an average rainfall of 5.26 inches. As shown in Figure 2, rainfall amounts were 45.1 inches in 2006 (2.0% below average), 34.8 inches in 2007 (24.3% below average), and 57.7 inches in 2008 (25.3% above average). Given that the site was allowed to collect a full year of rainfall in 2008 (a very wet year) an increase in monitoring stations exhibiting wetland vegetation, soils, and hydrology was observed.

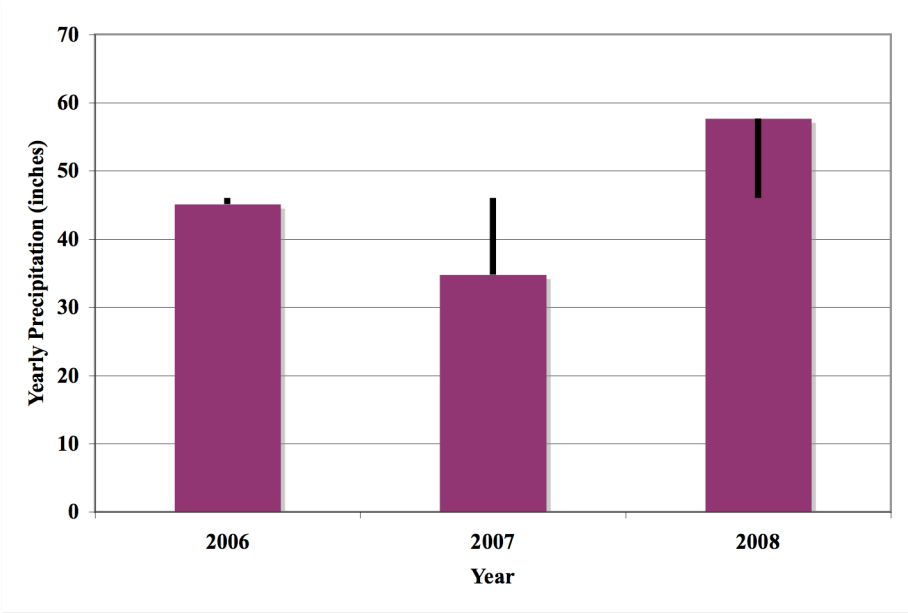


Figure 2. Annual Rainfall for Fayetteville, Arkansas. The deviation (±) from mean annual rainfall is displayed as black bars.

2.5 - Forested Wetland Planting Zones

The majority of the seven rare plant species have been observed at wet meadow areas within the West Mitigation Site that have been targeted for planting of wetland trees and shrubs. Planting of trees and shrubs within these areas would be detrimental to the survival of the rare sedge species that grow in full sunlight. Consequently, forested planting zones were relocated to be predominately on the north end of the mitigation site where rare sedges have not been observed. On

March 27, 2008, saplings of each of the following tree species were planted at designated forested wetland zones.

Table 1 – Trees Planted In Designated Forested Wetland Zones

Cell	Acres Planted	Species	# Planted	# Surviving
E-1	0.46	Green Ash	16	15
		Shumards Oak	16	12
E-2	1.08	Pecan	20	14
		Green Ash	26	24
		Shumards Oak	26	22
E-3	0.53	Shumards Oak	15	15
		Pecan	15	12
		N. Red Oak	6	4
		Black Walnut	6	6
W-1	0.79	Green Ash	15	13
		Shumards Oak	10	10
		Pecan	10	8
		N. Red Oak	10	10
		Black Walnut	10	9
	TOTAL = 2.86		Total = 201	174

During the fall of 2008, a field survey was conducted to evaluate survival rate. Survey results indicated an overall survival rate of 87 percent. Many volunteers of persimmon, green ash, and winged elm were also observed. Native prairie grass and forb volunteers have provided good ground cover. More efforts will likely be required to control the density of tree and shrub growth in order to maintain the wet prairie character of the mitigation site.

3.0 - MITIGATION SITE MONITORING

As specified within the City's 404 permit, ***"monitoring reports shall include inventories of all plant species, along with their relative frequency and percent cover, and photographs showing all representative areas of the mitigation site".*** Since the issuance of the City's 404 permit, the Director of Civil Works, Headquarters, U.S. Army Corps of Engineers issued Regulatory Guidance Letter (RGL) No. 06-03 on August 3, 2006, to provide guidance for minimum monitoring requirements for compensatory mitigation projects. Specifically, the RGL expressed that monitoring reports must be concise and effectively provide the information needed to determine the status of compensatory mitigation efforts. It also outlined the use of the three parameters defined in the 1987 Corps Wetland

Delineation Manual (soils, hydrology, vegetation) and the use of functional assessment methods as performance standards for wetland mitigation monitoring. Consequently, the following performance standards were evaluated to determine success in achieving mitigation goals and objectives:

- **Inventories of all plant species**
- **Estimated relative frequency and species dominance**
- **1987 Corps Delineation Manual parameters –soils, hydrology, vegetation**
- **Functional Assessment – "Pre" & "Post" Charleston Method**

Monitoring activities completed to date include:

- **2002-2005 Pre-Mitigation Baseline Site Characterization**
- **October 2006**
- **May 2007**
- **November 2007**
- **June 2008**
- **October 2008**

Forty-seven permanent monitoring stations (plots) were established, based upon the original percent acreage of each plant community zone within each wetland cell, as shown in Table 2 below:

TABLE 2 - Plant Community Zone Acreage and # Plots Per Zone/Cell

Zone	Cell W1	Cell W2	Cell E1	Cell E2	Cell E3	Cell E4	Cell E5	TOTALS
Wet Meadow	0	4.45 ac. 7 plots	0	0.78 ac. 1 plot	0	1.80 ac. 3 plots	1.25 ac. 2 plots	8.28 ac. 13 plots
Forested	2.34 ac. 4 plots	0	0.46 ac. 1 plot	0	0.35 ac. 1 plot	0	0	3.15 ac. 6 plots
Marsh	0.12 ac. 1 plot	0.67 ac. 1 plot	0.36 ac. 1 plot	0.77 ac. 1 plot	0.19 ac. 1 plot	0.43 ac. 1 plot	0	2.54 ac. 6 plots
Open Water	0	0.05 ac. 1 plot	0.03 ac. 1 plot	0.04 ac. 1 plot	0.0	0.31 ac. 1 plot	0	0.43 ac. 4 plots
Upland Buffer	2.8 ac. 4 plots	1.61 ac. 2 plots	1.15 ac. 2 plots	1.41 ac. 2 plots	0.91 ac. 1 plot	2.67 ac. 4 plots	1.67 ac. 3 plots	12.22 ac. 18 plots
Acreage Totals	5.26 ac.	6.78 ac.	2.0 ac.	3.0 ac.	1.45 ac.	5.21 ac.	2.92 ac.	26.62 ac.
Total # Plots	9 plots	11 plots	5 plots	5 plots	3 plots	9 plots	5 plots	47 plots

3.1 - Plant Species Inventory/ Species Richness

A spring season plant species inventory was conducted in 2001 and 2003 prior to mitigation activities. Only 47 and 53 plant species were observed, respectively, due to decades of haying and cattle grazing activities. After removal of cattle and construction of the earthen berms, 181 taxa were observed during a plant species inventory in the fall of 2006. The term "taxa" includes specimens observed that cannot be identified to species level due to lack of flowering parts, or an immature stage, while the terms "species" refers to specimens identified to the species level. The species list continued to increase, as an additional 99 taxa, not previously observed, were present during the spring 2007 inventory. Thirteen new species

were observed during the fall 2007 inventory. The master plant species list increased to 292 taxa during the June 2008 inventory, and 334 taxa during the October 2008 inventory. The plant species inventory is indicative of total number of species observed and does not reflect relative frequency or percent density of any given species.

A total of 334 taxa have been documented from the site, though nine have not been observed since wetland cells were created and may have been lost to hydrologic changes. However, many more wetland species have colonized the site as a result of wetland mitigation. There are 73 species on the site (21.9% of the total) that are considered to be not native to northwest Arkansas. Seven species (2.1% of the total) are identified as species of conservation concern by the Arkansas Natural Heritage Commission. Initial increases in species richness in 2006 and 2007 were likely the result of cessation of grazing on the site, though the addition of a few wetland species were linked to wetland mitigation activities. Overall plant species richness at Woolsey Prairie increased steadily from 2006 to 2008, as shown in Figure 3.

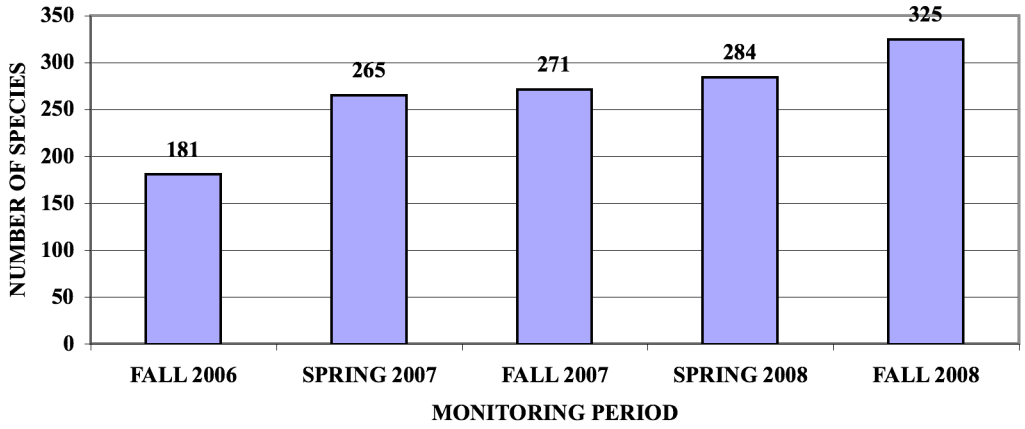


Figure 3. Overall vegetative species richness at Woolsey Wet Prairie 2006-2008.

Increases in species richness in 2008 are likely the result of two factors: 1) maturation of the mitigated wetlands in 2006 and 2007 (and associated arrival of new species via waterfowl using these new wetlands), and 2) decrease in tall fescue cover following prescribed fire in February 2008 and herbicide application in March and April 2008. This fescue reduction released warm season forbs and grasses formerly suppressed by fescue competition.

With regard to trend analysis of species richness, the fall monitoring periods were compared to each other, as were the spring monitoring periods, since plant

communities are temporal in nature. Consequently, it would be invalid to compare any given spring plant community data to any fall plant community data.

Changes in species richness in monitoring plots between fall 2006 and fall 2008 varies by plot type. The following graphs illustrate the changes in the mean number of species by plot type (Figure 4). These data include only species found in the four 1 m by 1 m herbaceous subplots and not species found outside the subplots but within the larger 5 m radius plots. The number of species in the plots between the fall 2006 and fall 2008 monitoring periods decreased at least slightly across all plot types. However, species richness increased in upland, wet meadow, and forested plots between the fall 2007 and fall 2008 monitoring periods.

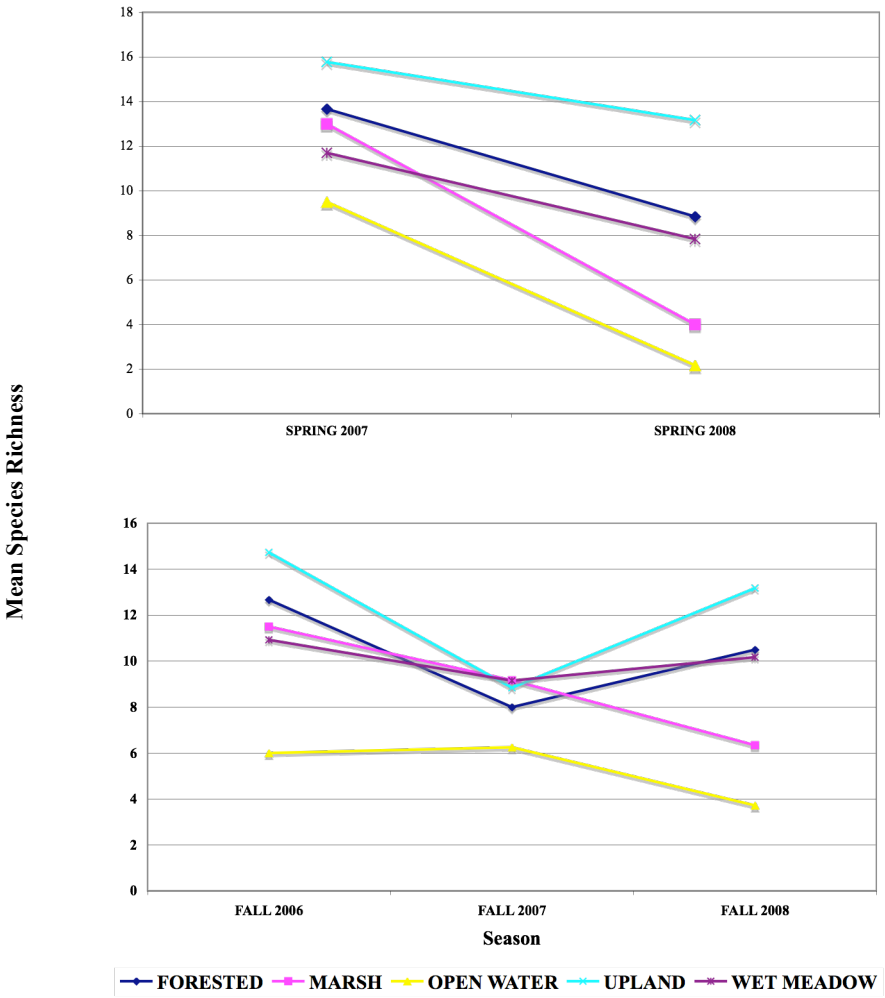


Figure 4. Mean spring (2007 and 2008) and fall (2006, 2007, and 2008) species richness per plot type (forested, marsh, open water, upland, and wet meadow).

A number of factors explain seasonal and long-term changes in species richness. With the exception of upland plots, all plot types became wetter with time, especially in 2008, in which the annual rainfall reported at 57.69 inches. Decreases in the number of species in forested, marsh, wet meadow, and upland plots during the period from fall 2006 to fall 2007 can likely be attributed to competitive exclusion by tall fescue (*Schedonorus arundinaceus*), which increased during this same period. However, variation in climate and management between 2006 and 2007 also contributed. The decrease in species richness in the marsh and open water plots from 2007 to 2008 are the result of wetter conditions in 2008 than 2007.

A transition period was observed in the vegetation community composition and density, whereby areas that became inundated exhibited a reduced community diversity and density in 2007. This was due to standing water that killed tall fescue and other species that were not adapted to such wet conditions. During 2008, the replacement of the species with obligate wetlands plants was observed.

The nine species listed below were observed on Woolsey Prairie prior to site hydrological modifications but could not be relocated in 2008. It is most likely that these species were lost from the site due to changes in hydrology associated with mitigation activities.

Asclepias amplexicaulis (curly milkweed)
Baptisia bracteata var. *leucophaea* (cream false indigo)
Corydalis crystallina (mealy fumewort)
Festuca rubra (red fescue)
Helianthus grosseserratus (sawtooth sunflower)
Helianthus mollis (ashy sunflower)
Hieracium gronovii (hawkweed)
Penstemon tubaeflorus (whitewand beard-tongue)
Schizachyrium scoparium (little bluestem)

The changes in hydrology were also responsible for adding new species at the site. The 54 species listed below were not observed prior to 2008 (species preceded by an * are non-native). It is likely that these appeared either from recruitment from the seed bank following the reduction in tall fescue and/or arrived at the site via waterfowl and shorebirds, which began actively using the site once the wetland cells began to hold water, and colonized newly created/enhanced wetland habitat. None of these new species were intentionally planted on the site.

Acer saccharinum (silver maple)
Aristida dichotoma (churchmouse three-awn)
Aristida oligantha (three-awn)
Bidens aristosa (tickseed sunflower)
Boltonia diffusa (doll's daisy)
Carex flaccosperma (a sedge)
Carex meadii (Mead's sedge)
Celtis occidentalis (hackberry)
Chamaesyce nutans (spurge)
* *Cirsium vulgare* (common thistle)
* *Conium maculatum* (poison hemlock)
Crataegus mollis (hairy hawthorn)
Croton monanthogyus (prairie tea)
Desmodium nuttallii (tick-trefoil)
Desmodium obtusum (tick-trefoil)
Dichanthelium clandestinum (deer-tongue rosettegrass)
Eleocharis quadrangulata (squarestem spikerush)
Eragrostis intermedia (lovegrass)
Erechtites hieraciifolia (fireweed)
Fimbristylis annua (annual fimbry)
Galium obtusum (bluntleaf bedstraw)
Gaura longiflora (gaura)
Gratiola neglecta (hedge-hyssop)
Helenium autumnale (fall sneezeweed)
Hypericum drummondii (nits-and-lice)
Hypericum mutilum (dwarf St. John's wort)
Hypericum punctatum (dotted St. John's wort)
Juncus brachycarpus (a rush)
Juncus marginatus (a rush)
Juniperus virginiana (eastern redcedar)
Krigia dandelion (potato dandelion)
Leersia virginica (Virginia cutgrass)
Lobelia siphilitica (big blue lobelia)
Ludwigia alternifolia (seedbox)
Lycopus americanus (American water horehound)
Morus rubra (red mulberry)
Muhlenbergia schreberi (nimblewill)
Myriophyllum sp. (water mifoil)
Nothoscordum bivalve (crow poison)
Oenother biennis (evening-primrose)
Panicum capillare (witchgrass)
* *Persicaria longiseta* (pink smartweed)
Physalis angulata (smooth groundcherry)
Pycnanthemum pilosum (hairy mountain mint)
Sabatia campestris (prairie rosepink)
Schoenoplectus tabernaemontani (softstem bulrush)
Silphium laciniatum (compass plant)
Sisyrinchium angustifolium (blue-eyed grass)
Sporobolus vaginiflorus (dropseed)
Strophostyles leiosperma (wild bean)
Stylosanthes biflora (pencil flower)
Tripsacum dactyloides (eastern gamagrass)
* *Typha angustifolia* (narrowleaf cattail)
Vernonia baldwinii (Baldwin's ironweed)

3.2 - 1987 Corps Delineation Manual Parameters

Wetland parameters that included soils, hydrology, and vegetation (based on wetland plant community dominance) were sampled within each plot type (upland, forested and wet meadow, marsh, and open water). The size and location of each of these zones was based upon a hydrological model that predicted areas of soil saturation and/or inundation. The percent of wetland characteristics present are shown graphically in Figure 5.

Upland Plots

As expected, upland plots exhibited a low percentage of wetland characteristics in the soil, hydrology, and vegetation parameters during the 2006-2008 sampling periods. A transition of soil characteristics from upland to wetland was observed at some of the plots from the fall of 2006 to the fall of 2008. As planned, some of the upland areas that are not on top of mounds will be converted from upland to wetland to generate wetland creation credits, due to hydrological modifications. Therefore, this trend indicates success in generating wetland creation credits.

In terms of vegetation, the fall 2006 period exhibited minimal wetland vegetation at some of the upland plots where the hydrology had been enhanced. However, the preceding sampling periods did not exhibit dominant wetland vegetation, due to tall fescue dominance, lower 2007 rainfall, and water loss during installation of water level control structures.

Forested and Wet Meadow Plots

Forested wetland plots are areas that exhibit the same hydrology as wet meadows, but have been selected for planting of trees to offset the loss of forested wetlands from the WSIP. The forested and wet meadow plots exhibited a high percentage of wetland soil and hydrology parameters during all five sampling periods. Dominant wetland vegetation was not observed in the forested and wet meadow plots until the spring of 2008. This is believed to be due to tall fescue dominance, lower 2007 rainfall, and water loss during installation of water level control structures.

Marsh Plots

Marsh plots initially exhibited a high percentage of wetland characteristics in the vegetation, soil, and hydrology parameters during the first two sampling periods, but subsequently declined during the fall 2007 sampling period. The decline in vegetation and hydrology characteristics was likely due to lower 2007 rainfall and water loss during installation of water level control structures. The 2008 spring and fall sampling periods indicate an increase in vegetation, soil, and hydrology wetland characteristics, which is due to an increase in rainfall and retention of water by earthen berms. An increase in dominance by wetland vegetation was observed over the three sampling periods, but declined during the spring of 2008 from inundation, as the fescue was being killed by the standing water, and replaced by emergent aquatic plants.

Open Water Plots

Open water plots exhibited a trend as the marsh plots, as a decline in vegetation and hydrology characteristics was observed in the 2007 transition when a more stable hydrology was established. In 2008, an increase in vegetation, soil, and hydrology wetland characteristics was observed after tall fescue was replaced by emergent aquatic plant species.

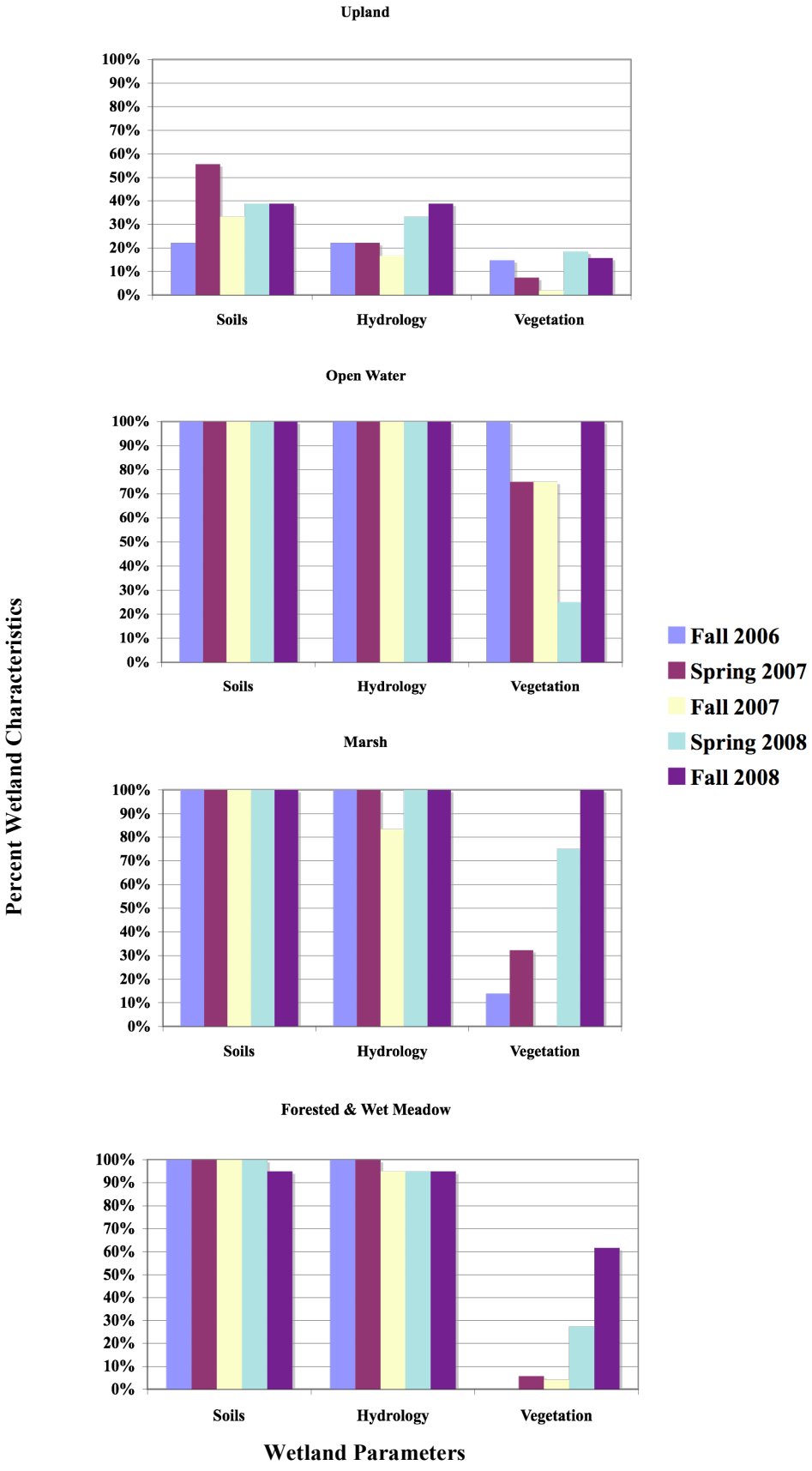


Figure 5 – Percent of wetland characteristics for soil, hydrology, and vegetation wetland parameters for five sampling periods (Fall 2006, Spring 2007, Fall 2007, Spring 2008, and Fall 2008).

The success of establishment of wetland vegetation was analyzed by calculating the type of dominant vegetative species present. Plots in which more than 50% of the dominant species are OBL, FACW, or FAC are considered to exhibit wetland vegetation. Therefore, wetland vegetation has been present in the open water plots for the five sampling periods (fall 2006,spring 2007, fall 2007, spring 2008 and fall 2008), the last three samplings periods (fall 2007, spring 2008, and fall 2008) for the marsh plots have exhibited wetland vegetation, and the wet meadow and the forested plots also exhibited wetland vegetation during the fall 2008 sampling period (Figure 6).

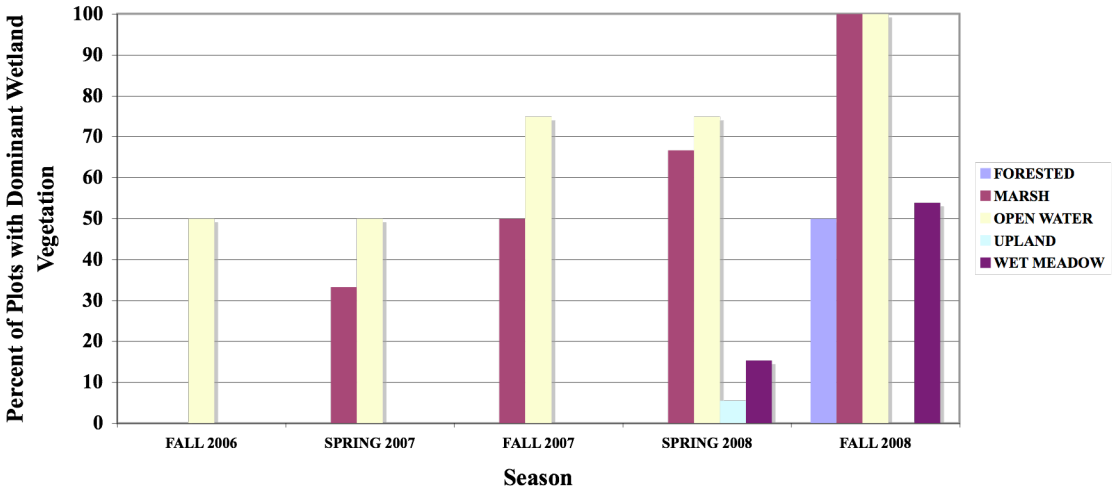


Figure 6. Percentage of plots dominated by wetland vegetation (OBL, FACW, or FAC), based on the 50/20 rule for calculating dominance, for Fall 2006, Spring 2007, Fall 2007, Spring 2008, and Fall 2008 monitoring periods.

The increase in wetland dominant vegetation in the forested, marsh, open water, and wet meadow plots is due to an increase in rainfall, successful retention of water by the earthen berms, recruitment of wetland species seeds, management of fescue by herbicide application and implementation of fire management.

3.3 - Tall Fescue Percent Cover

A decrease in tall fescue percent cover for all plot types is displayed in Figure 7. The decline is a result of adaptive management activities that produced conditions that enabled an increase in native wetland vegetation as the community dominants.

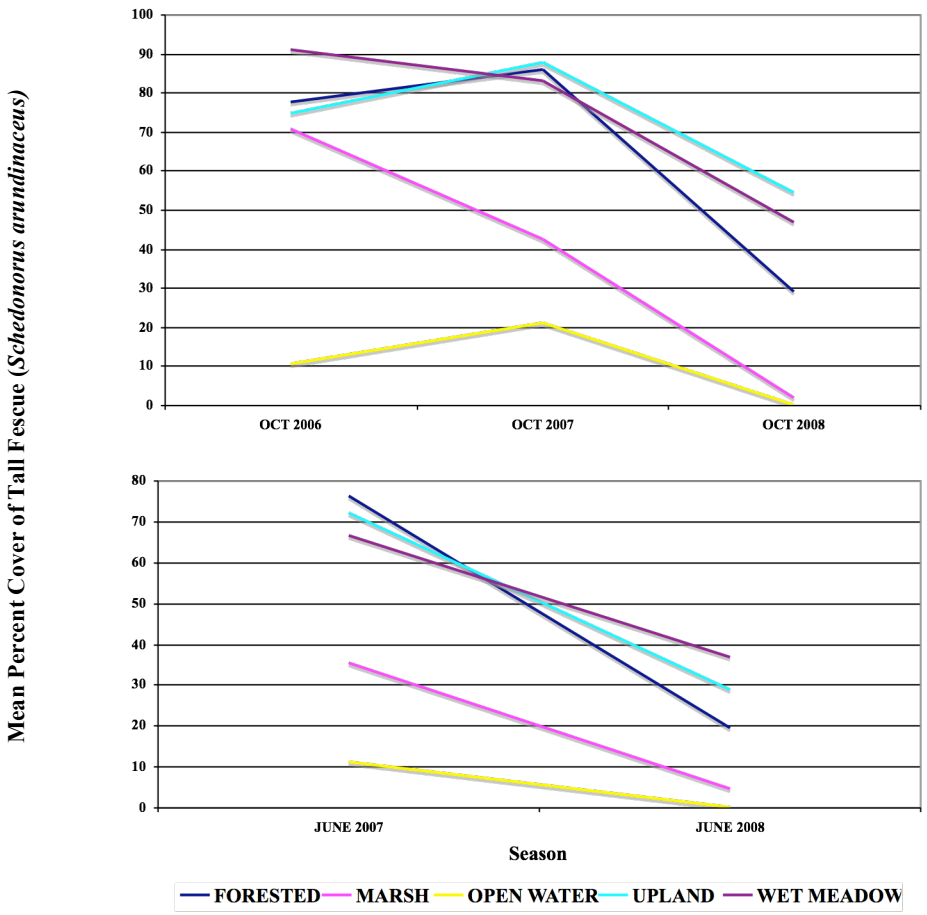


Figure 7. Mean percent cover of Tall Fescue (*Schedonorus arundinaceus*) by plot types forested, marsh, open water, upland, and wet meadow grouped by season for October 2006, October 2007, October 2008, June 2007, and June 2008.

3.4 - Rare plant species at Woolsey Wet Prairie Sanctuary

Seven plant species tracked as elements of conservation concern (rare species) by the Arkansas Natural Heritage Commission, were found to naturally occur at the mitigation site. All are sedges (family Cyperaceae) and are characteristic of wet prairie remnants. These include:

***Carex arkansana* (Arkansas sedge) – G4S1 –** This uncommon sedge is known in Arkansas from wet prairie remnants, hydric oak flatwoods, and similar open wetland habitats (ANHC, 2007). While it has no wetland indicator status code in the USDA Plants Database, it is listed by Yatskievych (1999) as occurring primarily in bottomland prairies and moist depressions of upland prairies. At Woolsey Wet Prairie it is scattered in wetter areas of the prairie.

***Carex opaca* (opaque prairie sedge) – G4S2S3 –** This rare sedge is primarily associated with unplowed, wet tallgrass prairie remnants in Arkansas (ANHC,

2007). While it has no wetland indicator status code in the USDA Plants Database, it is listed by Yatskievych (1999) as primarily occurring in "bottomland prairies, moist depressions of upland prairies, and margins of fens." At Woolsey Wet Prairie it is scattered in wetter areas of the prairie.

***Carex fissa* var. *fissa* (a sedge) – G3G4S1 –** Prior to its discovery at Woolsey Wet Prairie, this rare sedge was known in Arkansas from only two sites in Saline and Lonoke Counties where is occurs in disturbed prairie-associated wetlands and wet hardwood flatwoods (ANHC, 2007). At Woolsey Wet Prairie, it occurs in small numbers in two naturally occurring prairie swales in cells W-1 and W-2.

***Carex pellita* (a sedge) – G5S1 –** Prior to its collection at Woolsey Wet Prairie, this species was known to be extant at a single Arkansas locality, in a fen in Marion County. At Woolsey Wet Prairie it is uncommon in one open water plot and locally common in one marsh plot. It is apparently increasing at the site based on observations in 2007.

***Eleocharis wolfii* (Wolf's spikerush) – G3G4S2 –** This wetland sedge occurs in Arkansas primarily in wet areas in unplowed tallgrass prairie remnants but can persist in wet, open areas in landscapes that were formerly dominated by prairie vegetation (ANHC, 2007). At Woolsey Wet Prairie it is locally common in several naturally occurring swales and is now expanding around at least two of the marsh plots.

***Rhynchospora macrostachya* (tall horned beaksedge) – G4S1 -** Prior to its collection at Woolsey Wet Prairie, this species was known from Arkansas only from historical collections. At Woolsey Wet Prairie it was known from two natural prairie swales prior to construction of the berms, but is now also increasing in at least one marsh plot. In the fall of 2006, ECO, Inc. gathered seeds and successfully propagated over 50 specimens during the 2007 growing season that were transplanted into marsh areas at the mitigation site during 2008. A 90 percent survival rate was observed, and all transplanted specimens produced large seed heads by the end of the 2008 growing season.

***Scleria pauciflora* (fewflower nutrush) – G5S3 –** This sedge is known in Arkansas from unplowed tallgrass prairies, saline barrens, and open pine flatwoods (ANHC, 2007). At Woolsey Wet Prairie it occurs in areas that support other characteristic prairie vegetation.

SOURCES:

ANHC (Arkansas Natural Heritage Commission). 2007. Database of Elements of Conservation Concern. Arkansas Natural Heritage Commission. Little Rock, AR.

Yatskievych, G. 1999. Steyermark's Flora of Missouri. Vol. 1. Revised Edition. Missouri Dept. of Conservation & Missouri Botanical Garden Press. St. Louis, MO. 991 pp.

3.5 - Wetland Functional Assessment

The Charleston Method was initially utilized to determine that a total of 80.8 mitigation credits were needed to offset the permanent alteration of 9.88 acres of wetlands by the WSIP, as follows:

Table 3 – Permanently Altered Wetland Acreage and Credits Needed for Mitigation	
North Broyles Road PEM Wetlands Permanently Altered	1.27 acres/9.13 debits
Westside WWTP PEM Wetlands Permanently Altered	5.64 acres/40.6 debits
Broyles Road/Goose Creek PFO Wetlands Permanently Altered	1.39 acres/16.0 debits
Westside Collection System PFO Wetlands Permanently Altered	1.42 acres/13.5 debits
Eastside Collection System PFO Wetlands Permanently Altered	0.16 acres/1.52 debits
Total Permanently Altered Wetlands	9.88 acres/80.8 debits

*PFO – palustrine forested wetlands "seasonally inundated forest"
*PEM – palustrine emergent wetlands "wet meadow"

During construction of the eastside collection system, a sewer line realignment was designed that resulted in a diversion around the 0.16 acres of PFO wetlands on the eastside collection system. Therefore, 1.52 of the needed credits can be deducted, leaving a need for 79.2 mitigation credits were needed to offset the permanent alteration of 9.56 acres of wetlands by the WSIP.

The City of Fayetteville WSIP Wetland Compensatory Mitigation Plan, developed and submitted to the Little Rock District in January 2005, and the City's Section 404 permit outlined the creation of 4.05 acres of wet meadow wetlands and 3.06 acres of forested wetlands (total creation acreage = 7.11 acres), restoration and enhancement of 7.29 acres of existing emergent wetlands, and enhancement of 12.22 acres of existing upland prairie as buffering. This resulted in a total of 110 credits to be generated on 28.2 acres to offset wetland losses. This produced an excess of 29.2 credits over the 80.8 credits needed, as shown below.

Table 4 - Project Acreage and Credits Originally Generated in 2007	
Existing Mitigation Site PEM Wetlands Restored/enhanced	7.29 acres/37.9 credits
Upland Prairie Buffer Restored/enhanced	12.22 acres/55.0 credits
Eastside Collection System PFO Wetlands partially restored	0.16 acres 0.2 credits
Westside Collection System PFO Wetlands partially restored	1.42 acres 2.3 credits
Total Wetlands Restored/Enhanced	21.09 acres/95.4 credits
PEM Wetlands Created	4.05 acres/8.5 credits
PFO Wetlands Created	3.06 acres/6.1 credits
Total Wetlands Created	7.11 acres/14.6 credits
Total Mitigation Acreage/Credits Generated	28.2 acres/110 credits

*PFO – palustrine forested wetlands "seasonally inundated forest"
*PEM – palustrine emergent wetlands "wet meadow"

The 110 credits were based upon field surveys and quantifications of wetland/upland acreage during the calendar year 2007. As previously stated, water

losses were experienced from installation of water level control structures and excessively low rainfall amounts in 2007. Therefore, a full year of uninterrupted rainfall storage was not experienced until March 2007 through March 2008. Regardless, the site demonstrated a high capability of water storage. Stop logs at water level control structures were set to optimize water storage and prevent berm overflows that may cause erosional damage to the berms.

Due to optimized hydrological controls in 2008, an increase in wetland acreage was observed that was well beyond what designers anticipated. The increase in created wetland acreage resulted in a corresponding reduction in upland buffer enhancement acreage. Table 5 shows the revised 2008 wetland acreage and credits, as compared to the 2007 assessment.

A portion of the increase in wetland acreage and credits was generated from improved hydrology and site management, and a portion was generated from including acreages of wetland creation, wetland enhancement, and upland buffer enhancement in areas outside of the wetland cells. Observations of these areas have shown improved habitat function and value as compared the preconstruction conditions. Additionally, the earthen berms themselves serve as upland buffers and were included in the 2008 revised values. These areas outside of the cells qualify for the generation of wetland mitigation credits since they meet the following criteria:

1) They are located within the 43.65-acre parcel that was deed restricted in perpetuity as a mitigation site;

2) They contain native species not observed within the wetland cells;

3) They contribute to wetland habitat at Woolsey Wet Prairie;

4) They are managed in the same manner as Woolsey Wet Prairie. Management activities including removal of cattle, discontinuation of haying, application of herbicides, and mowing to provide a protective buffer around the perimeter of the cells that preclude the introduction of non-native invasive species.

5) Construction of the berms has also resulted in wetland enhancement and creation outside of the wetland cells in these areas.

A total of 160.13 credits have been generated from mitigation activities. This equates to an excess of 80.93 credits over the 79.2 credits needed.

Table 5 – Revised Project Acreage and Credit Comparison for 2007-2008		
Mitigation Type	**2007**	**2008**
Existing Mitigation Site PEM Wetlands Restored/Enhanced	7.29 acres/37.9 credits	7.29 acres/37.9 credits
Existing PEM Wetlands Outside Cells Restored/Enhanced	0	1.49 acres/7.75 credits
Eastside Collection System PFO Wetlands partially restored	0.16 acres/0.2 credits	0
Westside Collection System PFO Wetlands partially restored	1.42 acres/2.3 credits	1.42 acres/7.1 credits
Total Non-Buffer Wetlands Restored/Enhanced	8.87 acres/40.4 credits	10.2 acres/52.75 credits
Upland Prairie Buffer in Cells Restored/Enhanced	12.22 acres/55.0 credits	6.52 acres/31.95 credits
Upland Prairie Berms Restored/Enhanced	0	4.39 acres/21.51 credits
Upland Prairie Outside Cells Restored/Enhanced	0	5.14 acres/25.19 credits
Total Upland Buffer Restored/Enhanced	12.22 acres/55.0 credits	16.05 acres/78.65 credits
PEM Wetlands Created in Cells	4.05 acres/8.5 credits	9.95 acres/20.89 credits
PEM Wetlands Created Outside Cells	0	1.01 acres/2.12 credits
PFO Wetlands Created in Cells	3.06 acres/6.1 credits	2.86 acres/5.72
Total Wetlands Created	7.11 acres/14.6 credits	13.82 acres/28.73 credits
Total Mitigation Acreage/Credits Generated	28.2 acres/110 credits	40.07 acres/160.13 credits

4.0 – RIPARIAN MITIGATION AT OUTFALL STRUCTURE

As required by NWP No. 19371, riparian mitigation must be completed to offset unavoidable impacts to 0.02 acres of waters of the US caused by redirection of Goose Creek during the construction of the wastewater plant outfall structure. The permit requires riparian restoration activities on 0.084 acres of riparian buffer zone near the outfall structure.

On March 27, 2008, 24 saplings of each of the following tree species were planted at the designated riparian zone. During the fall of 2008, a field survey was conducted to evaluate percent survival.

Table 6 – Trees Planted at Outfall Structure Riparian Zone

Common Name	Botanical Name	Indicator Status	# Surviving
Black walnut	*Juglans nigra*	FACU	22
Pecan	*Carya illinoensis*	FAC	7
N. Red Oak	*Quercus rubra*	FACU	24
Shumards oak	*Quercus shumardii*	FACW	22

Survey results indicate an overall survival rate of 78 percent. Volunteers of honeysuckle and greenbrier were also observed. Native grass and forb volunteers have provided good ground cover.

5.0 - CONCLUSIONS

The success of Woolsey Wet Prairie Sanctuary has been well noted in local media newspapers and television. Not only has it achieved above and beyond the required wetland compensatory mitigation requirements, it has provided passive recreation for the public and academia. "Bird.org" a website co-sponsored by Audubon and Cornell University lists Woolsey Wet Prairie as one of the countries birding hotspots. To date, 14 species of shorebirds have been observed at the site, and migratory waterfowl seasonally make their visits, some of them staying to raise their young. During 2008, three pairs of Canada geese raised their goslings at the site. Two broods of blue-winged teal also grew to maturity at Woolsey, and event only documented on four other events in Northwest Arkansas. Amphibian and reptiles have thrived at this newly created habitat, and many visitors go to the site at dusk simply to hear the frogs singing.

Systematic monitoring and assessment of wetland condition will be continued to generate additional data that will be used in the "adaptive management" strategy to maintain and restore the site. It was originally a tall grass wet prairie, still has intact upland prairie mounds that appear to have never been subjected to plowing, and depressional areas between mounds where water seasonally ponds forming wetlands. Such prairie mounds and wet prairie depressions were common in the area prior to the western expansion by settlers in the early to mid 1800's. Recognizing that this is a very rare and endangered natural resource in northwest Arkansas, the designers developed a wetland mitigation strategy with the objective of restoring the natural prairie ecosystem that once existed on the site.

Plant ecologists universally agree that today, prairie is the rarest and most fragmented of North American ecosystems, and the one most in danger of being lost completely. Tall grass prairies once extended from Manitoba to the Texas Coast and eastward into Indiana. Today, only 2,000 acres (only one percent) of the original two million acres of tall grass prairie in this region of the country are as yet unplowed. Decades of crop farming, cattle grazing, mowing for hay, fire suppression, introduction of non-native plant species, and drainage ditches have contributed to the pre-restoration degraded condition of the Woolsey Wet Prairie Sanctuary.

The Woolsey Wet Prairie Sanctuary is part of the original prairie of Prairie Township, Fayetteville, Arkansas that extended all the way to the Prairie Grove and Lincoln areas in Washington County. Conversion of an estimated 100,000 acres of prairie habitat to production of wheat in northwest Arkansas in the late 1800's and early 1900's was the beginning of the decimation of prairie habitat.

With more than twice the credits needed for compensatory mitigation, plans are under way to seek approval from the Little Rock District to create a mitigation bank to use the surplus credits for future infrastructure improvement projects. A draft Mitigation Bank Prospectus has been prepared that includes expanding the mitigation to include the adjacent 70 acres.

The current economy and regulatory requirements may provide the optimum opportunity to create this mitigation bank. The Arkansas Highway and Transportation Department has tried for years to establish a mitigation bank in Northwest Arkansas. Federal Guidance on the Use of the Transportation Equity Act (TEA-21) established a "Preference for Mitigation Banking to fulfill Mitigation Requirements under Section 404 of the Clean Water Act – July 11, 2003". As the upcoming federal administration develops the Federal Stimulus Bill to provide funding for highway infrastructure improvements, there will be a greater potential need for a mitigation bank in Northwest Arkansas.

Furthermore, as published in the Federal Register on April 10, 2008, the 40 CFR 230 Compensatory Mitigation For Losses of Aquatic Resources: Final Rule established a preference for mitigation bank credits over permittee-sponsored mitigation due to findings that banks involves less risk of failure because they must undergo a multi-resource agency review process. They also provide lower costs for the consumer of wetland permits and are more stable, support more diversity, and contribute more to larger ecosystem relationships than small onsite mitigation projects.

Additional information and periodic updates will be posted at the Woolsey Wet Prairie Sanctuary Website at:

http://ecoarkansas.com/WoolseyMain.html

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