City Of Fayetteville, Arkansas
Woolsey Wet Prairie Adaptive Management Strategy & Monitoring Report No. 8
December 2014

CITY OF Fayetteville ARKANSAS

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Field Work and Report Preparation Conducted by Bruce Shackleford, Seth Pickens, and Theo Witsell Environmental Consulting Operations, Inc., Benton Arkansas

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1.0 – Introduction & Project Overview

The City of Fayetteville, Arkansas' Wastewater System Improvement Project (WSIP) was designed to improve the City's sewer collection system, upgrade the 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 Noland Plant and collection system, and to provide wastewater treatment to areas currently outside the treatment area while reducing the total hydraulic loading to the system. The WSIP involved discharges of fill into "Waters of the U.S." within the Illinois River Watershed (within the Arkansas River Basin) and the Beaver Reservoir Watershed (within the White River Basin); therefore, permitting under Section 404 of the Clean Water Act (CWA) was required.

1.1 – Individual Section 404 Permit No. 14207

On March 10, 2005, the City of Fayetteville received Individual Section 404 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 the new Westside WWTP, sewer lines, and road improvements. The permit required wetland compensatory mitigation due to the permanent alteration of 8.87 acres of wetlands. As part of the terms and conditions included in the 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 was due December 31st after the first growing year, and each year thereafter, for a total of five years. The first Monitoring Year was 2007 and the fifth annual monitoring report was completed in December 2011.

Upon completion of the intensive monitoring activities required by the Corps, ECO, Inc. commenced with abbreviated monitoring activities in 2012. The Corps monitoring requirements included an evaluation concerning the achievement of performance standards at 47 monitoring stations. It is well documented that Woolsey Wet Prairie has more than met the required performance standards. Consequently, the abbreviated monitoring strategy focuses more on where adaptive management activities are needed on a cell-by-cell basis in lieu of the 47 monitoring stations.

1.2 – Mitigation Site Concept & Team

The 43.65-acre wetland mitigation site is located immediately to the north of the Westside WWTP that became operational on June 1, 2008. A site aerial photograph is shown in Figure 1. McGoodwin, Williams, and Yates Consulting Engineers, Inc. (MWY) of Fayetteville designed hydrological features and Environmental Consulting Operations, Inc. (ECO, Inc.) of Benton provided ecological feature design, site management, and monitoring. Brasfield and Gorrie General Contractors completed construction of earthen berms and water level control structures. Operation of hydrological controls, mowing, staff gauge and monitoring well data, and herbicide applications are managed through CH2M Hill Companies, Ltd. that also manages and maintains the City's wastewater utility system. CH2M Hill subcontracts herbicide applications to Isaac Ogle Landscaping (IOL). Prescribed burns are contracted by the City of Fayetteville through an informal bidding process. ECO, Inc. oversees environmental regulatory compliance and conducts annual monitoring and site adaptive management strategy development at Woolsey Wet Prairie.

Modifications to the existing hydrology at the mitigation site were achieved via the construction of low elevation perimeter earthen berms designed to provide a mechanism for water retention. Water

level control structures with stop logs were constructed within the berms in order to provide the ability to 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 west and east mitigation sites are separated by a gas pipeline easement that is 80 feet in width. The easement has undergone the same adaptive management as the remaining acreage on the deed restricted property. The mitigation site has been named "Woolsey Wet Prairie Sanctuary" in honor of Samuel Gilbert Woolsey, whose family settled the property in 1830.

2.0 – Mitigation Site Monitoring Activities & Results

Monitoring activities completed to date include:

- **2002-2005 Pre-Mitigation Baseline Site Characterization**
- **October 2006**
- **May 2007**
- **November 2007**
- **June 2008**
- **October 2008**
- **July 2009**
- **November 2009**
- **July 2010**
- **October/November 2010**
- **June 2011**
- **November 2011**
- **June 2012**
- **November 2012**
- **June 2013**
- **November 2013**
- **July 2014**
- **November 2014**

The following sections describe observations for each wetland cell during the 2014 growing season. An aerial photograph of the wetland cells is shown in Figure 1, and 2014 field observations are indicated on a cell-by-cell basis in Figures 2-8. A summary of non-native invasive species, rare species, and species richness is contained in Table 1.

Figure 1. Woolsey Wet Prairie Site Aerial Photograph

2.1 – Wetland Cell E-1

Rare Species

Three rare plant species, opaque prairie sedge (*Carex opaca*), Arkansas sedge (*Carex arkansana*), and cluster sedge (*Carex aggregata*) occur in Cell E-1. All three are uncommon in this cell and are scattered in low areas that are not inundated for long durations.

Invasive Species

Four invasive species were observed in this cell in 2014 that need management. Tall fescue (*Schedonorus arundinaceus*) was observed to be persisting in scattered areas and is especially thick near the northwest corner of the cell. Callery pear (*Pyrus calleryana*) was observed at two locations and sericea lespedeza (*Lespedeza cuneata*) was found thinly scattered around the margins of the cell. White sweet clover (*Melilotus albus*) is becoming established around the margins of the cell. The locations of the non-native/invasive plant species are marked on the cell map shown in Figure 2.

Species Richness

A total of 107 plant species were observed in 2014 in Cell E-1, of which 103 are native species and four are non-native or invasive species.

2.2 – Wetland Cell E-2

Rare Species

Four rare plant species, cluster sedge, Arkansas sedge, opaque prairie sedge, and Wolf's spikerush (*Eleocharis wolfii*) occur in Cell E-2. The *Carex* species are uncommon in this cell and are scattered in low areas that are not inundated for long durations. The Wolf's spikerush is rare at the edge of a marsh near the south end and also in a swale near the center of the cell.

Invasive Species

Seven invasive species were observed in this cell in 2014 that need management. Bush honeysuckle (*Lonicera maackii*) is still persisting, growing among several elm trees just inside the berm immediately north of the pond (in Cell E-4). Sericea lespedeza occurs at scattered sites on the berms. Tall fescue is thinly scattered throughout and Johnson grass (*Sorghum halepense*) was observed at two sites near the east and south edges of the cell. Six locations for callery pear were found near the perimeters of the cell. One sizeable patch of Himalayan blackberry (*Rubus serissimus*) was found near the southeast corner. White sweet clover is becoming established around the margins of the cell. The locations of the non-native/invasive plant species are marked on the cell map shown in Figure 3.

Species Richness

A total of 136 plant species were observed in 2014 in Cell E-2, of which 129 are native species and seven are non-native or invasive species.

Figure 2. Wetland Cell E-1 2014 Monitoring Map

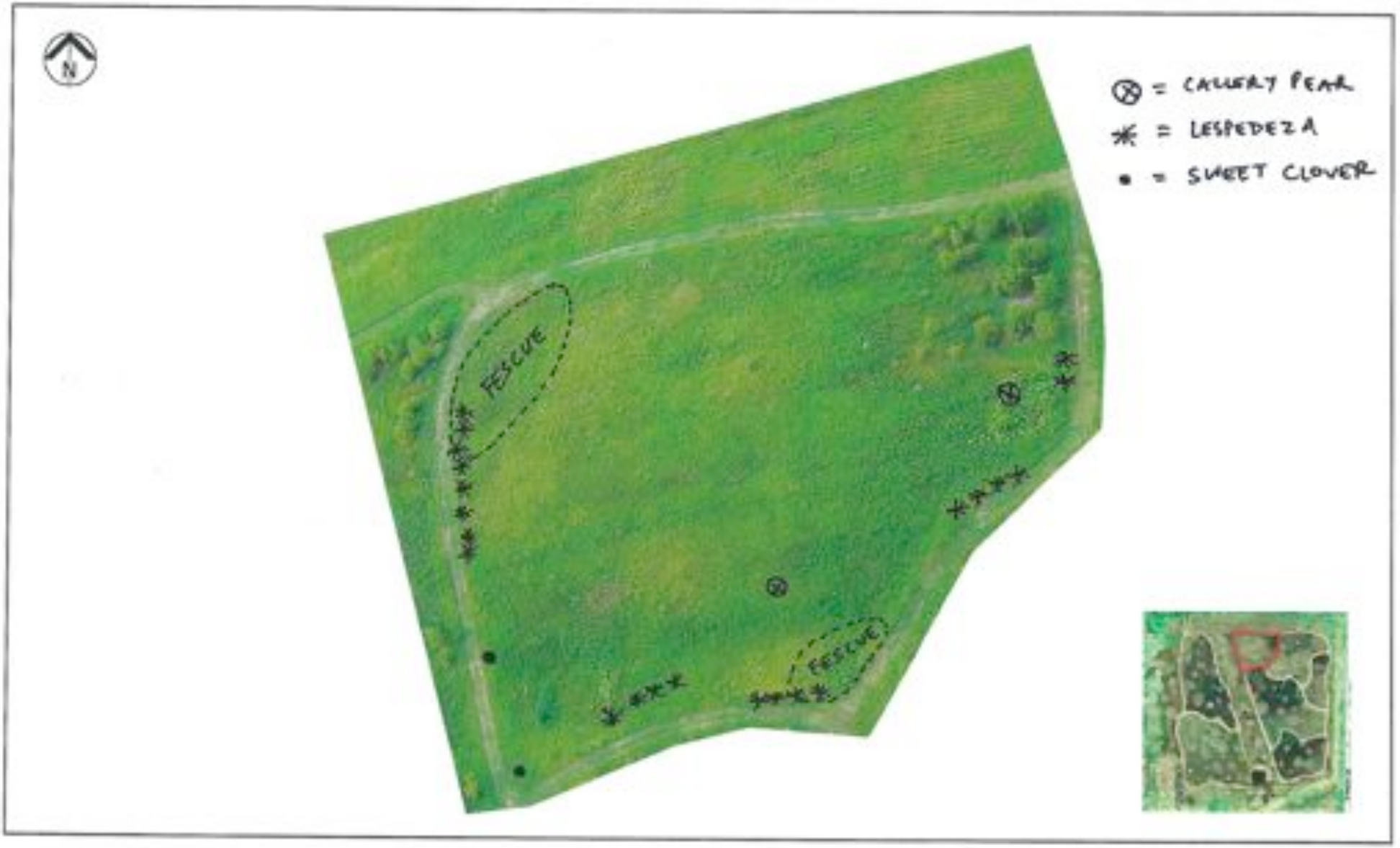
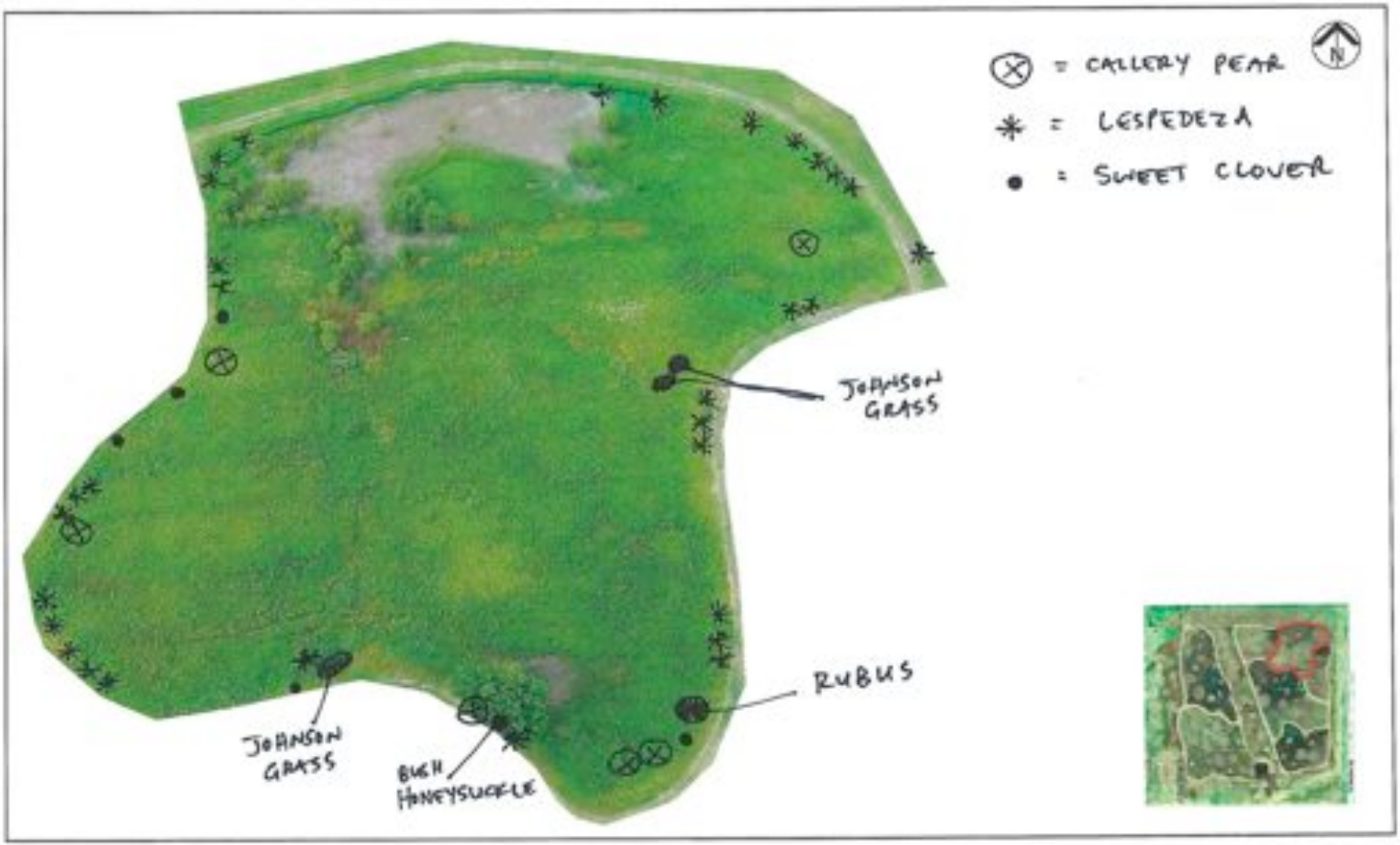


Figure 3. Wetland Cell E-2 2014 Monitoring Map



2.3 – Wetland Cell E-3

Rare Species
Three rare plant species, opaque prairie sedge, Arkansas sedge, and cluster sedge occur, but are uncommon or rare in this cell and are scattered in low areas that are not inundated for long durations.

Invasive Species
Four invasive species were observed in 2014 that need management. Callery pear occurs at three sites; tall fescue is scattered throughout the cell; sericea lespedeza occurs at scattered sites on the berms; and white sweet clover is becoming established around the margins of the cell. The locations of the non-native/invasive plant species are marked on the cell map shown in Figure 4.

Species Richness
A total of 113 plant species were observed in 2014 in Cell E-3, of which 109 are native species and four are non-native or invasive species.

2.4 – Wetland Cell E-4

Rare Species
Eight rare plant species occur in Cell E-4. Cluster sedge, Arkansas sedge, opaque prairie sedge are uncommon and are scattered in low areas that are not inundated for long durations. A single colony of woolly sedge (*Carex pellita*) observed in 2013 has persisted and expanded. Tall horned beaksedge (*Rhynchospora macrostachya*) and Wolf's spikerush occur scattered at the edge of open marshes. Pink milkwort (*Polygala incarnata*) returned to the site in 2014 where it was observed in 2012 (but not observed in 2013). Six plants of this species were observed in 2014 (up from one in 2012). Dr. George Yatskievych, director of the Flora of Missouri Project, identified Reverchon's hawthorn (*Crataegus reverchonii*) not previously recognized as occurring in Arkansas. This species is known from a handful of prairie or formerly prairie habitats in Benton and Washington counties and has been added to the official list of plants of state conservation concern. It had previously been identified as cockspur hawthorn (*Crataegus crus-galli*), its closest relative recognized as being in Arkansas prior to 2014. It occurs at several sites on City of Fayetteville property on and adjacent to Woolsey Prairie, with one large, easy-to-see specimen just west of the parking area and trailhead near the entrance to the water treatment plant. A single plant of Reverchon's hawthorn was found near the west side of the Cell E-4 in 2014.

Invasive Species
Eight invasive species was observed in 2014 that need management. Himalayan blackberry occurs in several large patches and callery pear occurs as several scattered individuals, particularly on the west side of the cell outside of the berm. Patches of Japanese honeysuckle (*Lonicera japonica*) occur in clumps of woody vegetation in two areas. Bush honeysuckle was observed in a patch of woody vegetation east of the pond. Tall fescue and sericea lespedeza are scattered throughout the cell. A stand of Johnson grass was found on the west side of the pond. White sweet clover is becoming established around the margins of the cell. The locations of the non-native/invasive plant species are marked on the cell map shown in Figure 5.

Species Richness
A total of 163 plant species were observed in 2014 in Cell E-4, of which 155 are native species and eight are non-native or invasive species.

Figure 4. Wetland Cell E-3 2014 Monitoring Map

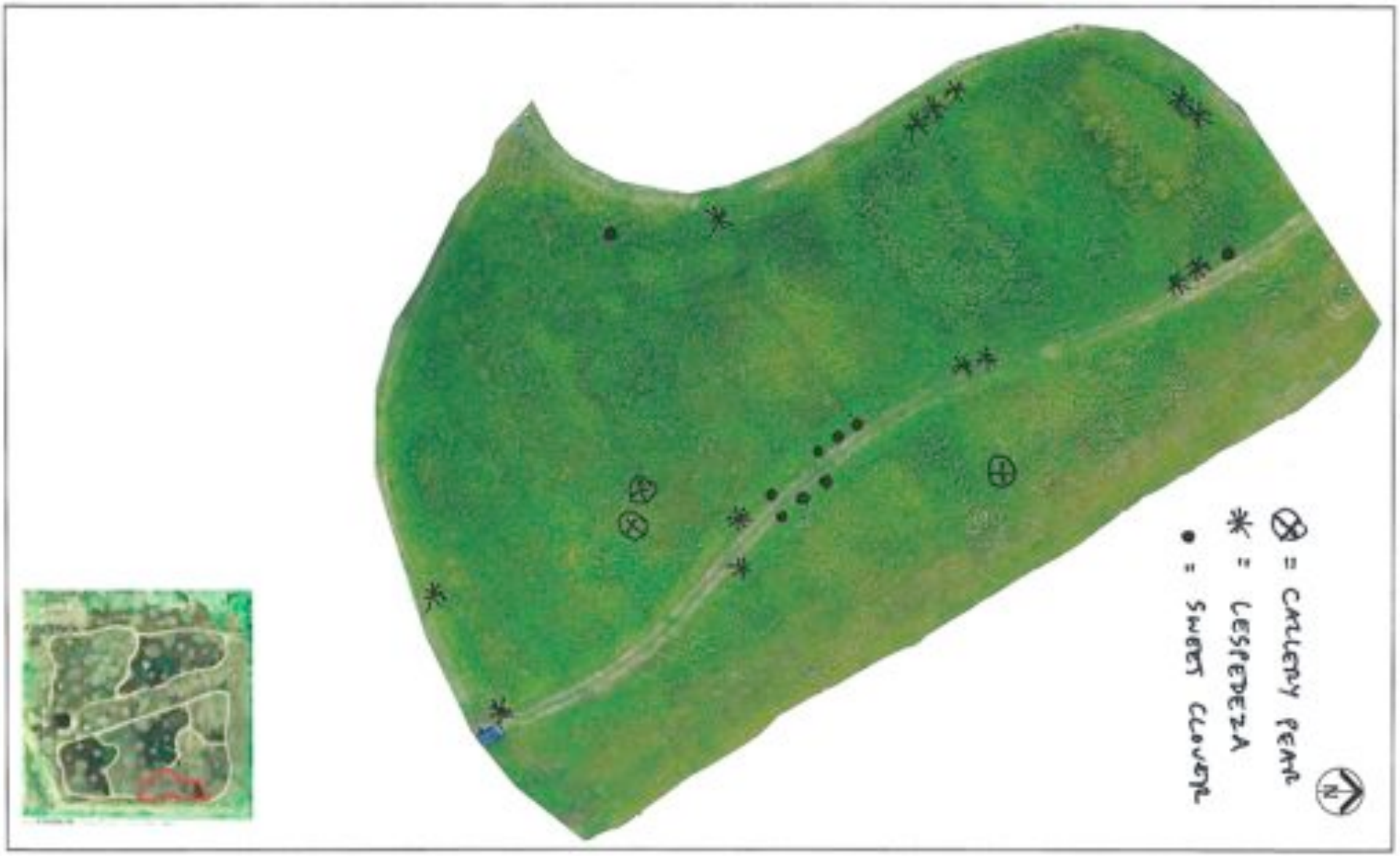
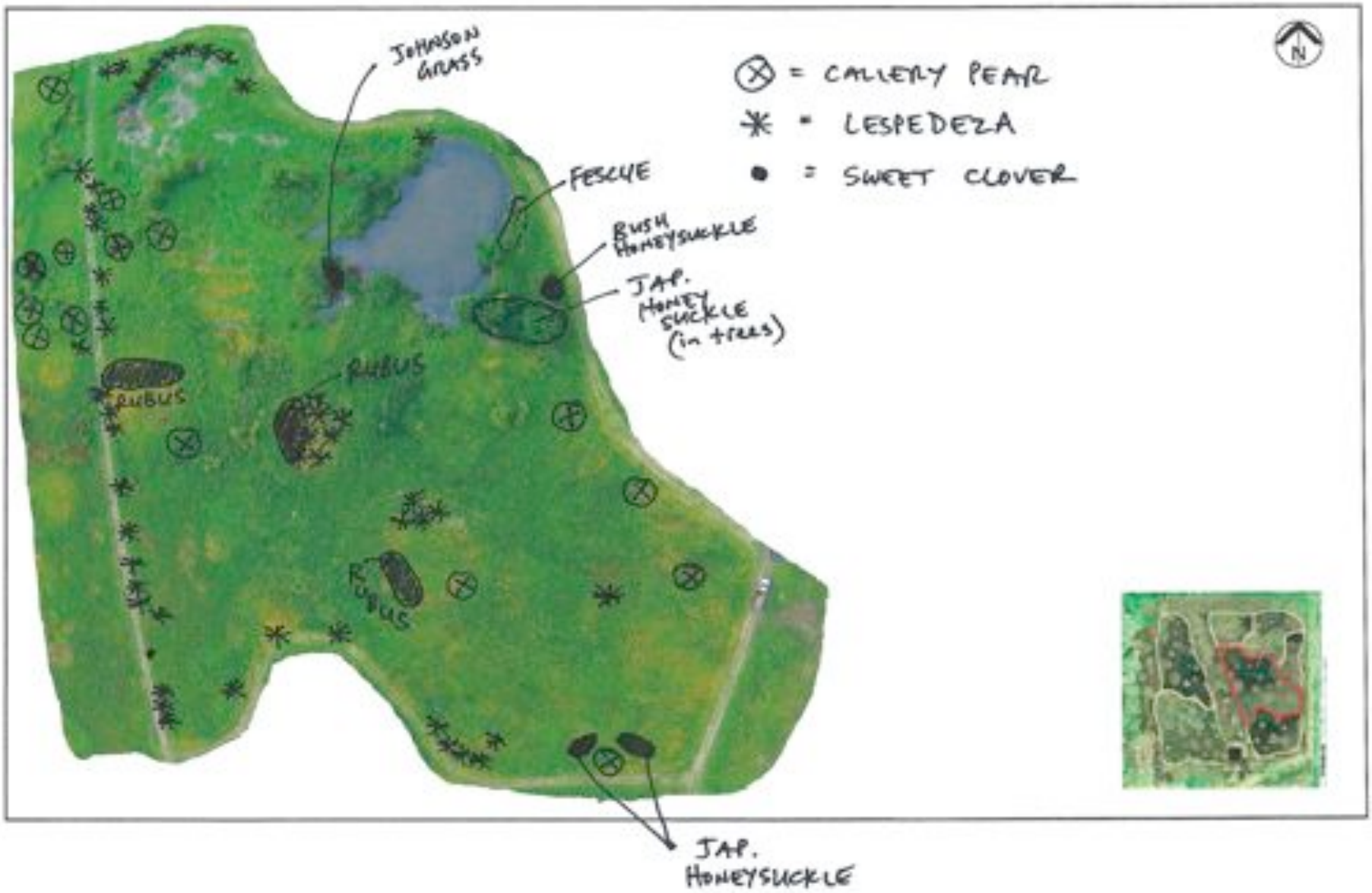


Figure 5. Wetland Cell E-4 2014 Monitoring Map



2.5 – Wetland Cell E-5

Rare Species

Six rare plant species occur in Cell E-5. Cluster sedge is rare and scattered on the east side of the cell. Arkansas sedge and opaque prairie sedge are uncommon and are scattered in low areas that are not inundated for long durations. A single colony of woolly sedge observed in 2013 has persisted and expanded. Tall horned beaksedge and Wolf's spikerush occur scattered at the edge of open marshes on the south end of the cell.

Invasive Species

Four invasive species were observed in 2014 that need management. Sericea lespedeza is thinly scattered around the edges of the cell and callery pear occurs as scattered individuals at several sites. Tall fescue remains scattered in the cell. A patch of Himalayan blackberry has persisted outside the berm on the south side of the path leading to Cell W-2. The locations of the non-native/invasive plant species are marked on the cell map shown in Figure 6.

Species Richness

A total of 135 plant species were observed in 2014 in Cell E-5, of which 131 are native species and of four are non-native or invasive species.

2.6 – Wetland Cell W-1

Rare Species

Eight rare plants occur in Cell W-1. The single clump of pointed sedge (*Carex scoparia*) observed in 2012 is persisting, but no additional plants were found. Arkansas sedge and opaque prairie sedge are uncommon in this cell and are scattered in low areas that are not flooded for long durations. A few individuals of hammock sedge (*Carex fissa*) occur in a single swale. A single colony of woolly sedge was found outside the berm. Tall horned beaksedge and Wolf's spikerush occur scattered at the edge of open marshes. Two small plants of Reverchon's hawthorn were found outside the berm on the west side of this cell.

Invasive Species

Seven invasive species were observed in this cell in 2014 that need management. Himalayan blackberry occurs at the south end of this cell and callery pear occurs as scattered individuals. Tall fescue occurs as a few scattered individuals throughout and sericea lespedeza is scattered around the perimeter of the cell. Johnson grass occurs just inside the berm near the northwest corner of the cell. A concentrated patch of Queen Anne's lace (*Daucus carota*) was found near the south end of the cell. White sweet clover is becoming established around the margins of the cell. The locations of the non-native/invasive plant species are marked on the cell map shown in Figure 7.

Species Richness

A total of 157 plant species were observed in 2014 in Cell W-1, of which 150 are native species and seven are non-native or invasive species.

Figure 6. Wetland Cell E-5 2014 Monitoring Map

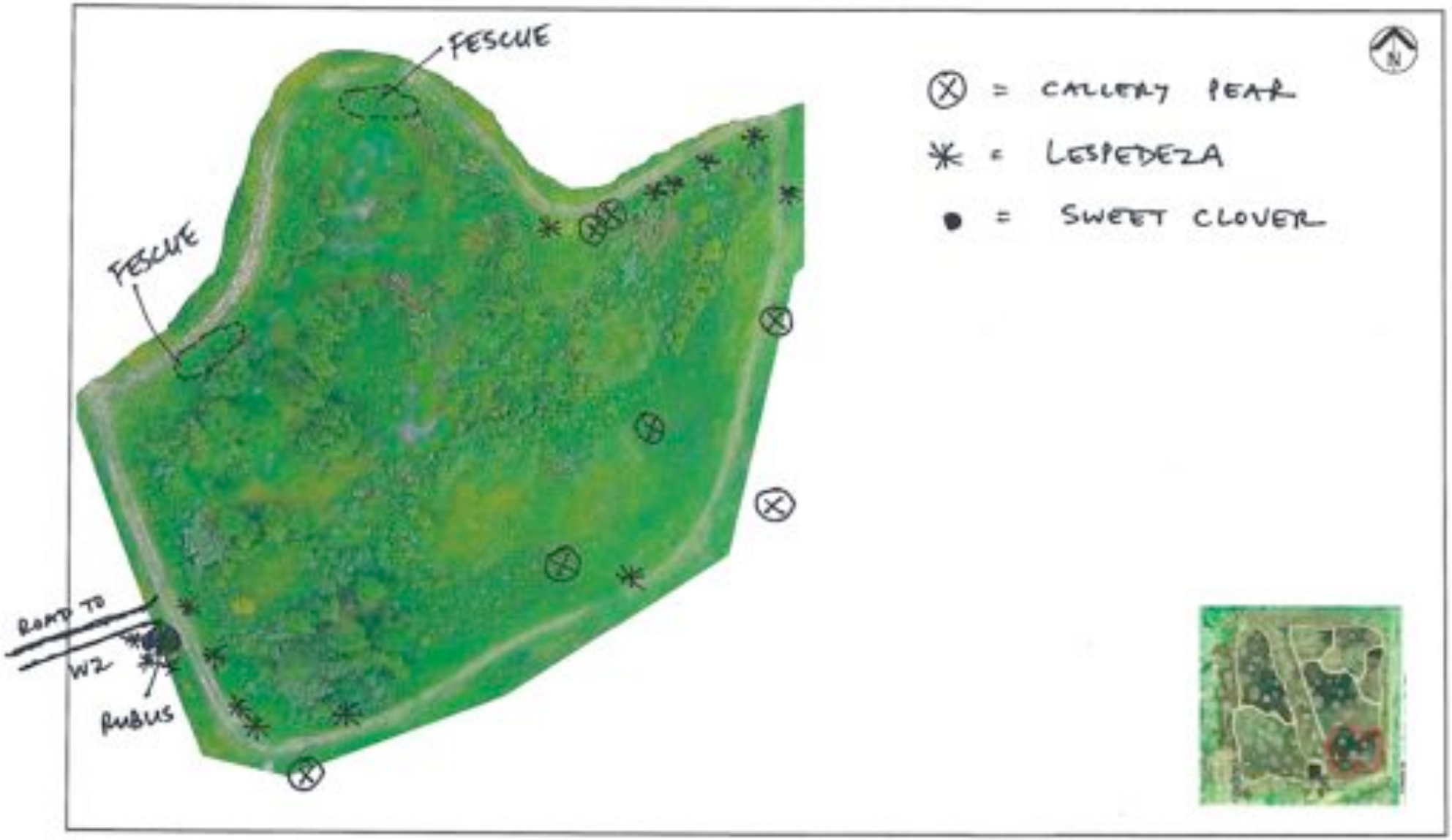
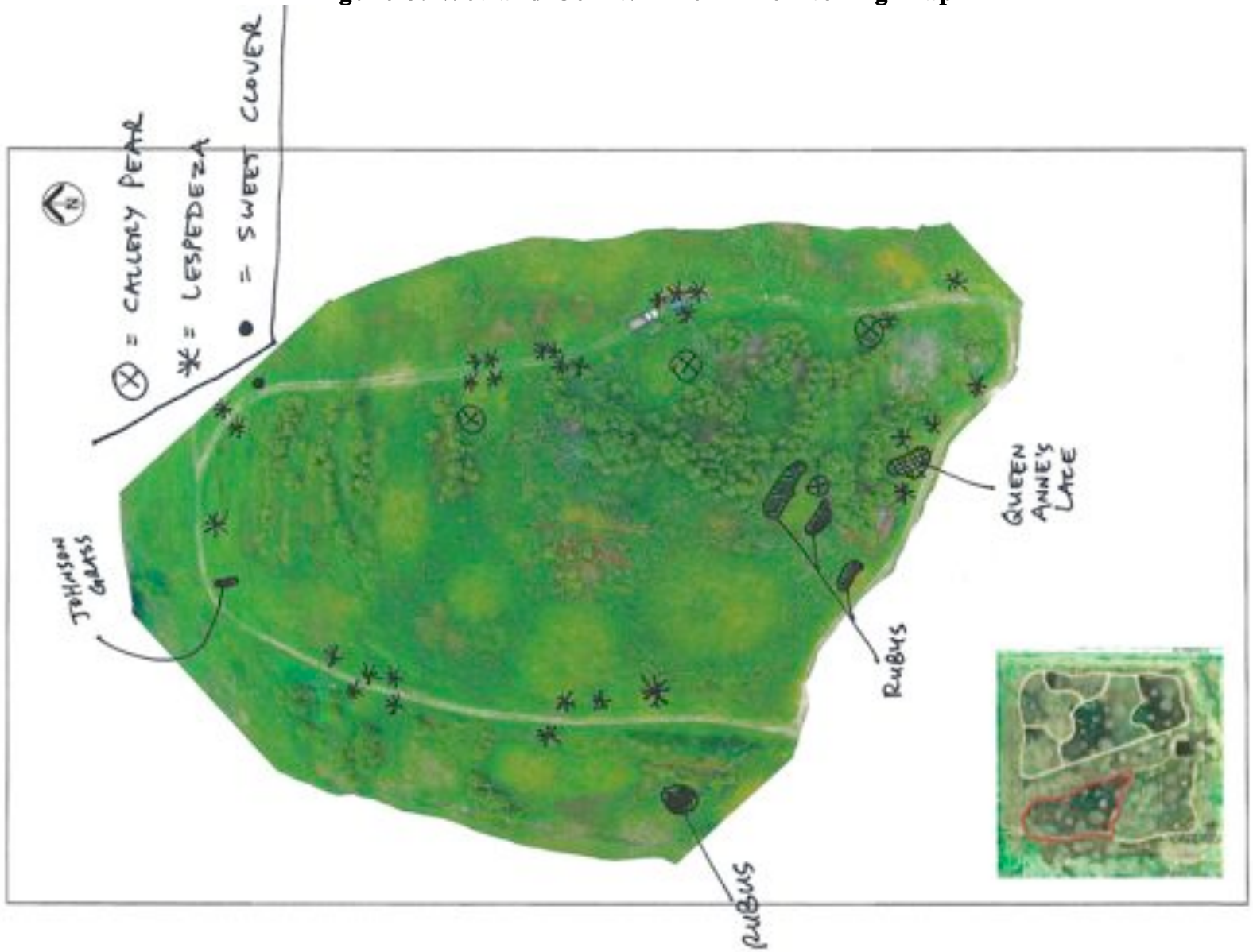


Figure 7. Wetland Cell W-1 2014 Monitoring Map



2.7 – Wetland Cell W-2

Rare Species

Eight rare plants occur in Cell W-2. Ten clumps of cluster sedge were found in the wooded area outside the berm on the western edge, along with a few scattered plants elsewhere. Arkansas sedge and opaque prairie sedge are fairly common and are scattered in low areas that are not inundated for long durations, especially in the southern half of the cell. A large population of hammock sedge occurs in the southern half of this cell and several colonies of woolly sedge occur in the eastern half of this cell. Tall horned beaksedge and Wolf's spikerush occur scattered at the edge of open marshes. A single large, fruiting tree of Reverchon's hawthorn was found on the west side of the wooded area outside the berm on the west edge of this cell.

Invasive Species

Ten invasive species were observed in 2014 that need management. Tall fescue has persisted as small, but dense patches in several areas, especially in the southern half. Himalayan blackberry occurs in scattered patches, especially on the edges of mounds in the northern half. Sericea lespedeza occurs as scattered individuals, particularly along the berm on the east side. Johnson grass is scattered along the edge of the berm around this cell, concentrated along the southern edge. The wooded area outside the berm on the west edge of this cell is especially thick with invasive plants including multiflora rose (*Rosa multiflora*), Chinese privet (*Ligustrum sinense*), bush honeysuckle, Himalayan blackberry, Japanese honeysuckle, and winter-creeper (*Euonymus fortunei*). Callery pear is scattered in the cell. The locations of the non-native/invasive plant species are marked on the cell map shown in Figure 8.

Species Richness

A total of 186 plant species were observed in 2014 in Cell W-2, of which 176 are native species and ten are non-native or invasive species.

A summary of non-native invasive species, rare species, and species richness is contained in Table 1.

Figure 8. Wetland Cell W-2 2014 Monitoring Map

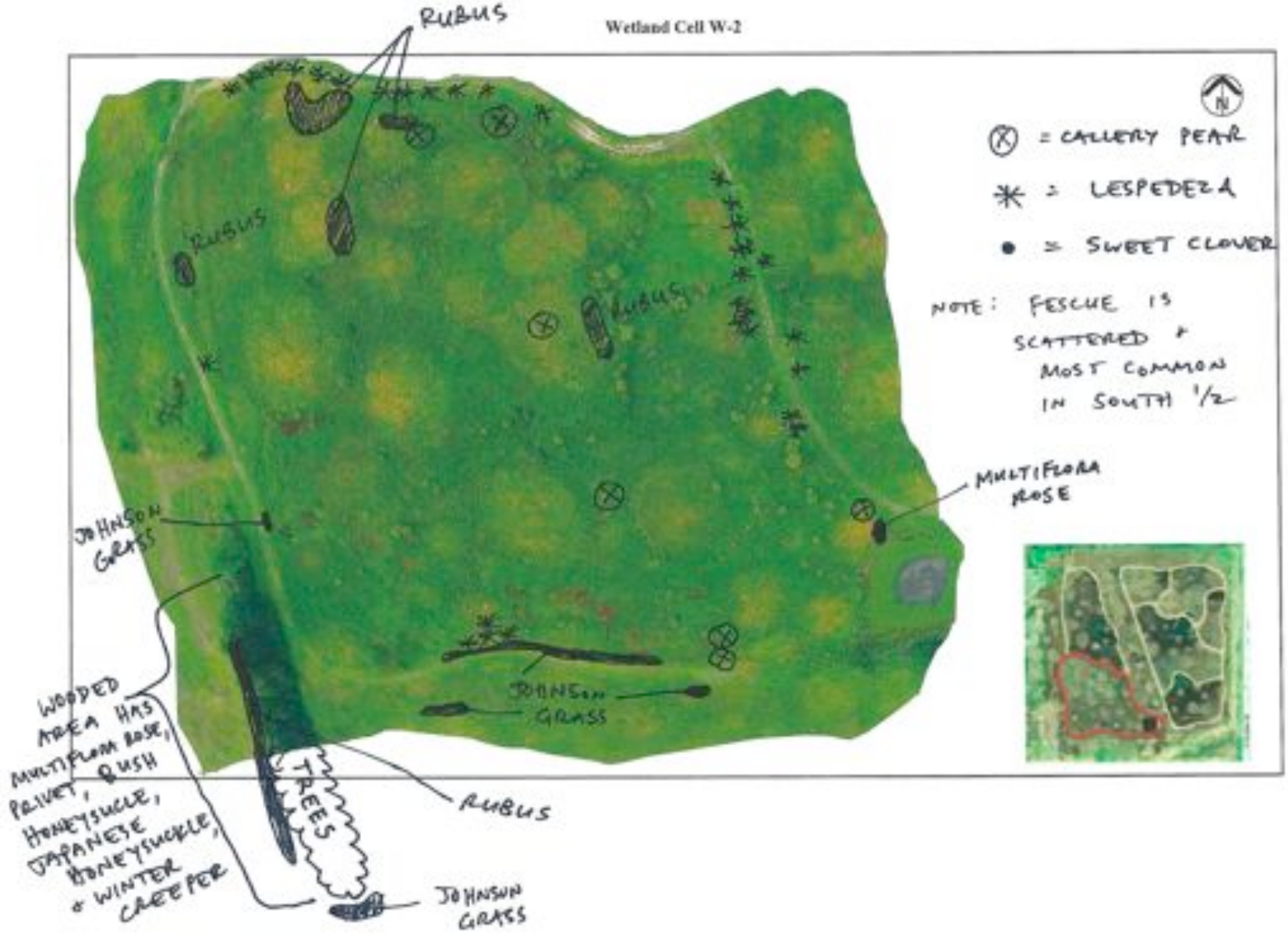


Table 1 – 2014 Wetland Cell Observations Summary

Cells	Non-Native/Invasives	Rare Plant Species	Species Richness
E-1	Tall Fescue Callery Pear Sericea Lespedeza	Cluster Sedge Opaque Prairie Sedge Arkansas Sedge	107
E-2	Bush Honeysuckle Sericea Lespedeza Callery Pear Tall Fescue Himalayan Blackberry Johnson Grass White Sweet Clover	Opaque Prairie Sedge Arkansas Sedge Cluster Sedge Wolf's Spikerush	136
E-3	Tall Fescue Callery Pear Sericea Lespedeza White Sweet Clover	Cluster Sedge Opaque Prairie Sedge Arkansas Sedge	119
E-4	Himalayan Blackberry Callery Pear Japanese Honeysuckle Bush Honeysuckle Tall Fescue Johnson Grass Sericea Lespedeza White Sweet Clover	Opaque Prairie Sedge Arkansas Sedge Cluster Sedge Woolly Sedge Tall Horned Beaksedge Wolf's Spikerush Pink Milkwort Reverchon's Hawthorn	163
E-5	Tall Fescue Himalayan Blackberry Callery Pear Sericea Lespedeza	Cluster Sedge Arkansas Sedge Opaque Prairie Sedge Woolly Sedge Tall Horned Beaksedge Wolf's Spikerush	135
W-1	Tall Fescue Callery Pear Sericea Lespedeza Queen Anne's Lace White Sweet Clover Himalayan Blackberry Johnson Grass	Pointed Sedge Arkansas Sedge Opaque Prairie Sedge Hammock Sedge Woolly Sedge Tall Horned Beaksedge Wolf's Spikerush Reverchon's Hawthorn	157
W-2	Multiflora Rose Chinese Privet Bush Honeysuckle Japanese Honeysuckle Winter-Creeper Callery Pear Johnson Grass Tall Fescue Sericea Lespedeza Himalayan Blackberry	Cluster Sedge Arkansas Sedge Opaque Prairie Sedge Hammock Sedge Woolly Sedge Tall Horned Beaksedge Wolf's Spikerush Reverchon's Hawthorn	186

2.8 – Rare Species at Woolsey Wet Prairie Sanctuary

Ten plant species tracked as elements of conservation concern (rare species) by the Arkansas Natural Heritage Commission (ANHC), were found to naturally occur at the wetland mitigation site. The rare plants include sedges (family *Cyperaceae*), milkwort (family *Polygalacea*), and Hawthorn (family *Crataegus*) and are characteristic of unplowed tall grass wet prairie remnants.

***Carex aggregata* (cluster sedge) – G5S1 –** This sedge is known in Arkansas only from a few sites in Benton, Fulton, Newton, Sharp, and Washington counties. It typically grows in low open woodlands or seasonally wet grasslands. At Woolsey Wet Prairie it is scattered in seasonally wet areas that are not inundated for long periods.

***Polygala incarnata* (pink milkwort) – G5S1S2 –** This rare species of wildflower is known in Arkansas from remnant prairies and other historically open grassland habitat like glades and savannas. A single plant was found on a pimple mound in Cell E-4 in 2012 and was not observed at all in 2013. In 2014, this population increased to 6 plants. It is known from scattered counties in Arkansas, but most of the records are historical and many of the sites where it was historically found have since been destroyed.

***Carex scoparia* var. *scoparia* (pointed sedge) – G5S1S2 –** This species is very rare in Arkansas and is known only from prairie-associated wetlands in Washington and Benton counties and from a wet depression on top of Rich Mountain in Polk County. It is known from just a single clump in Cell W-1 at Woolsey Wet Prairie.

***Carex arkansana* (Arkansas sedge) – G4S2 –** This uncommon sedge is known in Arkansas from wet prairie remnants, open hydric oak flatwoods, and similar open wetland habitats (ANHC, 2014). 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 seasonally wet areas that are not inundated for long periods.

***Carex opaca* (opaque prairie sedge) – G4S2S3 –** This rare sedge is primarily associated with unplowed, wet tall grass prairie remnants in Arkansas (ANHC, 2014). 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 seasonally wet areas that are not inundated for long periods.

***Carex fissa* var. *fissa* (hammock sedge) – G4S1 –** Prior to its discovery at Woolsey Wet Prairie, this rare sedge was known in Arkansas from only two sites in Franklin and Lonoke Counties where it occurs in prairie-associated wetlands (ANHC, 2014). At Woolsey Wet Prairie it occurs in two naturally occurring prairie swales in Cells W-1 and W-2.

***Carex pellita* (woolly sedge) – G5S1S2 –** 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. It has since been found at three other sites in Benton, Washington, and Marion counties. At Woolsey Wet Prairie it is now found in several cells where it grows in seasonally wet areas. It has increased at the site based on observations from 2007 to 2014.

***Eleocharis wolfii* (Wolf's spikerush) – G3G4S3 –** This wetland sedge occurs in Arkansas primarily in wet areas in unplowed tall grass prairie remnants, but can persist in wet, open areas in landscapes that were formerly dominated by prairie vegetation (ANHC, 2014). At Woolsey Wet Prairie it is locally common in several naturally occurring swales and has been found at the margins of two of the constructed marshes.

Rhynchospora macrostachya **(tall horned beaksedge) – G4S2 –** Prior to its collection at Woolsey Wet Prairie, this species was known in Arkansas only from a few scattered historical collections from remnant prairies. It has since also been found in several prairie-associated wetlands in Franklin County. At Woolsey Wet Prairie it was known from two natural prairie swales prior to construction of the berms. 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 transplanted specimens produced large seed heads by the end of the 2008 growing. The species has now increased in density in several of the wetland cells.

Crataegus reverchonii **(Reverchon's hawthorn) – G4S1 –** This small tree has been confirmed to occur in Arkansas only in Benton and Washington counties. All sites where it grows are low prairies or woodlands. It is primarily a western species. Specimens at Woolsey Wet Prairie appear to be *Crataegus reverchonii* subsp. *palmeri*, but both that subspecies and subspecies *reverchonii* have been reported for northwestern Arkansas. Additional study is needed to determine if both subspecies are present in the state.

In addition to these ten species, which occur within the boundary marked by wetland mitigation signs, an 11th species of state concern was located on City of Fayetteville property just north of Woolsey Wet Prairie:

Artemisia ludoviciana **var. *mexicana* (Mexican white sage) – G5T5S1S2 –** Two distinct patches of this species were found in a fencerow and field margin along the south side of Persimmon Street, just west of Owl Creek. This species is known to occur in Arkansas in dry grasslands and glades in a few counties in the northwestern part of the state. It was last documented from the Fayetteville area in 1954, when it was collected from "West Mountain" (a site believed to be about two miles east of Woolsey Wet Prairie).

Key to ANHC Species Category Rankings:

G3 – Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (ex. A single physiographic region) or because of other factors making it vulnerable to extension throughout its range (21 to 100 known extant populations)

G4 – Apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery (100 to 1000 known extant populations)

G5 – Demonstrably secure globally, although it may be quite rare in parts of its range, especially at the periphery (1000 + known extant populations)

T – Subspecies or variety rank (ex. G5T4 applies to a subspecies with a global species rank of G5, but with a subspecies rank of G4)

S1 – Critically imperiled because of extreme rarity (5 or fewer known extant populations) or because of some factor(s) making it especially vulnerable to extirpation

S2 – Imperiled because of rarity (6 to 20 known extant populations) or because of some factor(s) making it especially vulnerable to extirpation

S3 – Rare and local throughout the state or found locally (even abundantly at some of its locations) in a restricted region of the state, or because of other factors making it vulnerable to extirpation (21 to 100 known extant populations)

SOURCES:

ANHC (Arkansas Natural Heritage Commission). 2014. 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.

Yatskievych, G. 2013. Steyermark's Flora of Missouri. Vol. 3. Revised Edition. Missouri Dept. of Conservation & Missouri Botanical Garden Press. St. Louis, MO. 1382 pp.

2.9 Total Plant Species Richness

Overall plant species richness at Woolsey Wet Prairie has increased significantly from 2005 to 2014. A total of 450 plant taxa have been documented at the site since the initiation of monitoring. Ninety-three species on the site (20.6% of the total) are considered not native to northwestern Arkansas. Five species were intentionally planted at the site and ten species are identified as species of concern (rare species) by the ANHC. Plant species richness is the total number of species observed and does not indicate the density or relative abundance of each species.

Among the 2014 additions were several native prairie species, presumably recruited from a dormant seed bank following prescribed burns. These include hoary vervain (*Verbena stricta*), Texas goldentop (*Euthamia gymnospermoides*), and creeping dropseed (*Sporobolus compositus* var. *macer*). The appearance of these species is a testament to the ongoing restoration work at the site. Several difficult-to-identify species of blackberries on the site were identified to species with the assistance of Dr. Johnnie Gentry at the University of Arkansas. These had previously been identified only to Subgenus (a broad category sometimes used when dealing with difficult taxonomic groups of organisms).

Other signs of restoration progress include increases in native plant populations, including rare or uncommon species. Of particular note is the expansion of the only known colony of wild good plum (*Prunus munsoniana*) at Woolsey Wet Prairie, which increased from two stems in 2013 to at least 10 stems in 2014. This increase followed the removal of several invasive callery pears growing in the same spot, which were competing with the native plums. Similarly, two small individuals of Reverchon's hawthorn on the west side of cell W-1 were released from competition by pears.

The 2014 Master Plant Species List for Woolsey Wet Prairie is contained in Appendix I. Appendix II shows the dramatic increase in plant species richness from 47 taxa in 2005 to 450 taxa in 2014.

3.0 Site Adaptive Management Activities To Date

The "adaptive management" approach has been utilized to manage site vegetation and hydrology. Adaptive management 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. Adaptive management is often characterized as "learning by doing" in a decision-making process whereby any given selection of a vegetation management tools is done after observing the results of the previous vegetation management tool.

Adaptive management tools used for vegetation management at Woolsey Wet Prairie include the following:

- **Hand cutting/cut stump herbicide application of woody plants**
- **Mowing to prevent undesirable plant species from forming seed heads**
- **Hand pulling of undesirable plant species**
- **Herbicide applications**
- **Prescribed burning**
- **Water level control**

Use of mowing, prescribed burning, and herbicide applications for control of non-native and invasive plant species have become commonly accepted practices among ecological restoration professionals. Implementation of "adaptive management" techniques that were previously prohibited at wetland mitigation sites are now not only condoned, but actually encouraged, by both the Corps and EPA. With regard to ecological restoration projects, each site has its own unique characteristics such as soil chemistry, hydrology, and dormant seeds within the relict seed bank. 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. A historical list of adaptive management activities at Woolsey Wet Prairie is shown in Table 2.

Table 2 – Woolsey Wet Prairie Adaptive Management Activities

Date	Activity
May 2006	Discontinuation of decades of cattle grazing and haying operations
May - July 2006	Construction on of earthen berms for hydrological modification
Oct. 4-11, 2006	Spot spray Bermuda, Johnson grass with Glyphosate (Roundup) - PWC, Inc.
Oct. 11-20, 2006	Basal bark spot spray honey locust, sericea lespedeza, elm with Triclopyr (Remedy) - PWC, Inc.
Mar. 2007	Installation of water level control structures/ Wetland cells drained
Apr. 27, 2007	Mow to height of 10-12 " to prevent tall fescue seed head development (OMI)
Feb. 29, 2008	Prescribed burn (Wildland, Inc.)
Mar. 27, 2008	Plant tree saplings in forested wetland cells and at outfall structure
Mar. 27-Apr. 5, 2008	60 ft. Boom spray fescue with Sulfosulfuron (Outrider) - OERI
June 13, 2008	Plant approx. 10 Rattlesnake Master (*Eryngium yuccifolium)* plants from Saline County – ECO, Inc.
June 25, 2008	Plant approx. 50 tallhorned beaksedge (*Rhynchospora macrostachya*) from WWP seeds/cultured in Saline Co. – ECO, Inc.
Nov. 14, 2008	60 ft. Boom spray fescue with Sulfosulfuron (Outrider) - OERI
Feb. 19, 2009	Prescribed burn – Wildland, Inc.
Mar. 25, 2009	60 ft. Boom spray fescue with Glyphosate (Roundup) - OERI
Mar. 29, 2009	Spot spray Johnson grass with Sethoxydim (Poast) - ECO, Inc. found that Poast is not effective for Johnson grass
June – Oct. 2009	Weekly spot spraying of invasive woody vegetation (callery pear, persimmon, honey locust, elm, honeysuckle, and sericea lespedeza) with Triclopyr (Remedy); and weekly spot spraying of Bermuda and Johnson grass with Sulfosulfuron (Maverick) - OERI
Nov. 19-24, 2009	Wetland cell drawdown in preparation for prescribed burn.
Dec. 16, 2009	Prescribed burn – Wildland, Inc.
Dec. 17, 2009	Reset stop logs in water level control structures to restore water levels in wetland cells
Mar. 23, 2010	Wetland cell drawdown in preparation for herbicide application.

Table 2 (Continued)

Apr. 9-12, 2010	**60 ft. Boom spray with Clethodim (CropSmart) and spot spray with ATV - OERI**
June 15-18, 2011	**Mow tall fescue and Queen Anne's Lace around perimeter of mitigation site prior to formation of seed heads - OMI**
June 16-17, 2011	**Hand pull Queen Anne's Lace and curly dock on entire mitigation site - OERI**
June-Sept. 2011	**Monthly spot spraying of selected woody vegetation with Triclopyr (Remedy) - OERI**
June-Nov. 2011	**Hand cut selected black willow, honey locust, persimmon and green ash/spray cut stems with Triclopyr (Remedy) - OERI**
Dec. 2011	**Spot spray tall fescue with Clethodim (CropSmart) OERI**
Mar. 13, 2012	**Prescribed burn – Chloeta Fire, LLC**
June-Sept. 2012	**Monthly spot spraying of selected woody vegetation with Triclopyr (Remedy) - OERI**
June-Nov. 2012	**Hand cut selected black willow, honey locust, persimmon and green ash/sprayed cut stems with Triclopyr (Remedy) - OERI**
Dec. 2012	**Spot spray tall fescue with Clethodim (CropSmart) OERI**
Feb. 13-14, 2013	**Hand cut selected black willow/sprayed cut stems with Triclopyr (Remedy) - OERI**
Mar. 3, 2013	**Prescribed burn – Chloeta Fire, LLC**
Mar. 12, 2013	**Native plant seeding in all West Wetland Cells - ECO, Inc.**
Apr. 4, 2013	**Native plant seeding in all East Wetland Cells - ECO, Inc.**
Apr. 4-5, 2013	**Spray tall fescue with Clethodim (Section2EC) - ECO, Inc.**
Apr. 30, 2013	**Plant sprigs of Eastern gamagrass (*Tripsacum dactyloides*) within all wetland cells. – ECO, Inc.**
June 14, 16-18, 2013	**Spot spray curly dock, nodding thistle, and Himalayan blackberry using Triclopyr and Glyphosate and hand pulling of Queen Anne's lace – IOL**
June 18, 2013	**Mow tall fescue and Queen Anne's Lace around perimeter of mitigation site prior to formation of seed heads - IOL**
June 28, 2013	**Mow northern boundary of WWP to remove seed heads of Queen Anne's lace, nodding thistle, dallis grass, curly dock, and fescue – IOL**
July 3, 2013	**Hand pulling of Queen Anne's lace and thistle – IOL**
July 11, 2013	**Spot spray Himalayan blackberry and Johnson grass using Glyphosate and mow northern boundary of WWP to remove seed heads of Queen Anne's lace, nodding thistle, dallis grass, curly dock, and fescue – IOL**
July 22, 2013	**Spot spray Himalayan blackberry and Johnson grass using Glyphosate and hand pulling of Queen Anne's lace and thistle – IOL**
July 25-26, 2013	**Hand pulling of sericea lespedeza, and spot treatment of Himalayan blackberry using Glyphosate and Triclopyr – IOL**
Aug. 8-9, 2013	**Hand pulling of sericea lespedeza, and spot treatment of Himalayan blackberry using Glyphosate and Triclopyr – IOL**
Aug. 14-15, 2013	**Hand pulling of sericea lespedeza – IOL**
Aug. 21, 2013	**Spot treatment of Himalayan blackberry using Triclopyr – IOL**
Sept. 5, 2013	**Spot treatment of sericea lespedeza and Himalayan blackberry using Glyphosate and Triclopyr – IOL**
Sept. 13, 2013	**Spot treatment of sericea lespedeza and Himalayan blackberry using Glyphosate and Triclopyr – IOL**
Sept. 21, 2013	**Spot treatment of sericea lespedeza and Himalayan blackberry using Glyphosate and Triclopyr – IOL**
Oct. 5, 2013	**Spot treatment of Himalayan blackberry using Triclopyr and hand pulling of Queen Anne's lace – IOL**
Oct. 23, 2013	**Hand pulling of sericea lespedeza and top mowing of cocklebur to remove seed heads – IOL**
Mar. 13, 2014	**Prescribed burn – Wildland, LLC**

Table 2 (Continued)

March 30, 2014	**Post burn treatment of fescue with Clethodim**
April 9, 2014	**Spot treatment of curly dock with Glyphosate**
April 17, 2014	**Hand cutting and spot treatment of curly dock with Glyphosate**
May 7, 14, & 21, 2014	**Hand cutting and spot treatment of curly dock, Himalayan blackberry, Queen Anne's lace, nodding thistle, and callery pear with Glyphosate**
June 3, 13, & 21, 2014	**Hand cutting and spot treatment of Himalayan blackberry, Queen Anne's lace, nodding thistle, sericea lespedeza, and fescue with Glyphosate. Flail mowing of the northern and southwest buffer to control Queen Anne's lace, nodding thistle, and fescue.**
July 1, 18, & 25, 2014	**Hand cutting and spot treatment of Himalayan blackberry, Johnson grass, and sericea lespedeza with Glyphosate. Flail mowing of the northern and southwest buffer to control sericea lespedeza, fescue, and Johnson grass.**
August 8, 9, 20, & 28, 2014	**Spot treatment and hand pulling of sericea lespedeza and Himalayan blackberry with Glyphosate.**
September 4, 12, & 19, 2014	**Hand cutting/pulling and spot treatment of Queen Anne's lace, sericea lespedeza, and Himalayan blackberry with Glyphosate.**

3.1 – Prescribed Burning

Prescribed burning is a widely accepted vegetation management tool for ecological restoration projects and is routinely conducted in Arkansas by the U.S. Forest Service (USFS), Arkansas Game and Fish Commission (AGFC), Arkansas Forestry Commission (AFC), the Nature Conservancy, and the Arkansas Natural Heritage Commission (ANHC) at natural areas. To date, prescribed burns have been conducted at Woolsey Wet Prairie on February 29, 2008, February 19, 2009, December 16, 2009, March 18, 2011, March 13, 2012, March 3, 2013, and March 13, 2014.

A multitude of studies have shown that the anthropogenic suppression of fire has been responsible for the eradication of many native plant communities nationwide. Historically, Native Americans intentionally set fires for various reasons, one of which was for habitat enhancement for attraction of large migrating mammals such as bison and elk. For ecological restoration, fire has become recognized as a valuable vegetation management tool that can be used to enhance community diversity. It has also been documented that prescribed burning should be done at a variety of seasons throughout the year instead of the same time each year. 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.

Burning at Woolsey Wet Prairie has been avoided during May through August each year when the majority of songbirds are nesting and waterfowl are rearing their young. Prescribed burns aide in preventing woody encroachment and maintains the wet prairie habitat, depending upon the time of year of the burn, and the site hydrology at the time of the burn. The volunteer woody plant growth has primarily occurred in the wetter areas where inundation protects woody plants from fire.

3.2 – Herbicide Applications

Herbicides have been applied for control of tall fescue and other non-native invasive species. 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 dormant. As observed soon after all of the previous prescribed burns, tall fescue was the first plant species to become active after completion of the prescribed burn. It was apparent that three to four weeks after these burns would be a critical time to apply herbicides on the fescue. In 2006 through 2008, tall fescue was the most dominant plant species on the site, with densities of 70 to 90%. The Adaptive Management Team has tried various herbicides for tall fescue control. The graminicide Clethodim has proven to be the most effective herbicide and tall fescue densities on the site have been reduced to less than 10%.

The most common woody plants at the site that are targeted for control include honey locust (*Gleditsia triacanthos*), Callery pear, Himalayan blackberry, sericea lespedeza, and bush honeysuckle. Triclopyr and Glyphosate have proven to be the most effective herbicide for controlling woody vegetation.

3.3 – Mowing and Hand Cutting/Pulling

The mowing at the site is aimed toward invasive species such as tall fescue, Johnson grass, dallis grass, Queen Anne's lace, ragweed, and sericea lespedeza. When necessary, stands of these species are 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.

During April of 2014, an unusual event occurred that had not previously been observed. A large flowering stand of yellow rocket (*Barbarea vulgaris*) appeared, primarily along the north perimeter of the mitigation site with a few scattered plants along the eastern and southern perimeter. A portion of the yellow rocket stands was sprayed with herbicide, but the majority was addressed by hand cutting/pulling and mowing.

Management activities targeted woody vegetation in some areas with both mechanical and chemical control, which contributed to the decline in several species. One non-native invasive woody species, callery pear is encountered frequently, and requires continued control measures such as cut stem herbicide applications.

Hand pulling of Queen Anne's lace, sericea lespedeza, and curly dock is also an effective alternative in June before the plants form seed heads.

3.4 – Hydrological Controls

Two drawdown events have taken place since the 2008-2009 period when all wetland cells were inundated during the majority of the year. The first such event occurred during November 19-24, 2009 in preparation for a prescribed burn. The second drawdown occurred on March 23, 2010 in preparation for herbicide boom spraying. The drawdowns coupled with a very dry 2010, 2011, and 2012 are believed to have been the cause for the emergence of dense stands of pale smartweed (*Persicaria lapathifolia*) during the 2010 – 2011 growing seasons. However, Wetland Cell W-2, which cannot be drained since it has no water level control structure, became very dry like the other

cells. Therefore, it is speculated that the lack of previously observed variations in water depth and degree of soil saturation would have occurred anyway due to drought conditions.

Although pale smartweed is a native species that provides value to wildlife, both as food and as cover, it did appear to reduce the diversity of sedges, rushes, and emergent aquatic plants in certain areas. The management of Woolsey Wet Prairie is aimed at promoting biodiversity, and avoidance of near monoculture conditions, even with native species.

Management of hydrology was selected as the primary tool to control the pale smartweed since it prefers moist soil in poorly drained areas with abundant organic matter. It is somewhat weedy, and can be aggressive when favorable conditions exist. It tolerates occasional flooding, but typically grows at the edge of flooded areas. It does not grow as well in standing water with depths of one foot or more. Therefore, restoring water retention to previous levels of inundation and soil saturation was anticipated to reduce the density of smartweed and allow other species to grow. This is to be achieved via discontinuation of drawdowns, which has been implemented since 2011.

The water level control structures have stop logs consisting of two dimensions; five-inch and seven-inch heights. This allows for control of water levels within the wetland cells within two-inch increments, depending upon the configuration of the stop logs. For instance, two five-inch stop logs retain ten inches of water; a five-inch with a seven-inch stop log retains 12 inches of water; two seven-inch stop logs retain fourteen inches of water and so forth.

CH2M Hill maintains records of surface water observations, stop log overflows, and stop log configurations for each wetland cell. Maintenance of hydrological records is vital, as hydrology is very critical in determining the plant species composition that appears on the site. The 2014 observations are shown in Figure 9. Wetland cells E-4, E-2, W-1, and W-2 all had observable surface water present at least once each month for all months but August and September and appear to be the cells with most frequent inundation. Wetland Cell E-3 had no observable surface water from July through November. It was observed that Wetland Cells E-1, E-2, W-1 and W-2 reached maximum water retention at least once in the month during March, April and May; while Wetland Cells E-4 and E-3 only overflowed in March. Wetland Cell E-5 was never observed reaching maximum water retention.

Figure 9 – Woolsey Wet Prairie 2014 Surface Water and Stop Log Records

	Year		2014											
	Month		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wetland Cells	E5	Surface H_2O	x	x	x	x	x	x	x	o	o	x	o	x
		Max Ret.	-	-	-	-	-	-	-	-	-	-	-	-
		Log Combo	7:7:5	7:7:5	-	-	-	-	-	7:7:7	-	-	-	-
		Height (in.)	19	19	19	19	19	19	19	21	21	21	21	21
	E4	Pond Ret.	x	x	x	x	x	x	x	x	x	x	x	x
		S. H2O	x	x	x	x	x	x	x	o	o	x	x	x
		Max Ret.	-	-	X	-	-	-	-	-	-	-	-	-
		L.C.	7:5	7:5	7:5:5	-	-	-	-	7:5:7	-	-	-	-
		H. (in.)	12	12	17	17	17	17	17	19	19	19	19	19
	E3	S. H_2O	x	x	x	x	x	x	o	o	o	o	o	x
		Max Ret.	-	-	X	-	-	-	-	-	-	-	-	-
		L.C.	7:7:5	7:7:5	7:7:7	-	-	-	-	7:5:5:7	-	-	-	-
		H. (in.)	19	19	21	21	21	21	21	24	24	24	24	24
	E1	S. H_2O	x	x	x	x	x	x	o	o	o	x	o	x
		Max Ret.	-	-	X	X	X	-	-	-	-	-	-	-
		L.C.	5:5:7	5:5:7	7:7:5	-	-	-	-	7:7:7	-	-	-	-
		H. (in.)	17	17	19	19	19	19	19	21	21	21	21	21
	E2	S. H2O	x	x	x	x	x	x	x	o	o	x	x	x
		Max Ret.	-	-	X	X	X	-	-	-	-	-	-	-
		L.C.	7:7:5	7:7:5	7:7:5	-	-	-	-	7:7:7	-	-	-	-
		H. (in.)	19	19	19	19	19	19	19	21	21	21	21	21
	W1	S. H_2O	x	x	x	x	x	x	x	o	o	x	x	x
		Max Ret.	-	-	X	X	X	-	-	-	-	-	-	-
		L.C.	7:5:5	7:5:5	7:5:5	-	-	-	-	-	-	-	-	-
		H. (in.)	17	17	17	17	17	17	17	17	17	17	17	17
	W2	Pond Ret.	x	x	x	x	x	x	x	x	x	x	x	x
		S. H2O	x	x	x	x	x	x	x	o	o	x	x	x
		Max Ret.	-	-	X	X	X	-	-	-	-	-	-	-
		L.C.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		H. (in.)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Legend: x = observable surface water; o = no observable surface water; X = stop log overflow observed; - = no overflow or no change to stop logs

3.5 – Native Plant Introductions

In an effort to increase plant species diversity at Woolsey Wet Prairie, native plant seeds were collected by ECO, Inc. from Cherokee Prairie and Presson-Oglesby Prairie in the Arkansas River Valley and at locations in Saline County, Arkansas during the fall of 2012. The seeds were air-dried at room temperature for approximately 60 days, and then cleaned of stems, bracts, and other miscellaneous plant matter. The cleaned seeds were mixed with moist potting soil and vermiculite and placed into 2-gallon Zip-Lok plastic bags, then cold moist stratified at approximately 35 degrees Fahrenheit for approximately 90 days. During the growing season of 2013, ECO, Inc. germinated and propagated the seeds. The propagated plants were grown outdoors and allowed to go dormant during the winter of 2013. These plants were planted at Woolsey Wet Prairie after the spring 2014 prescribed burn.

The 2014 plant inventory showed the following propagated species to have been successfully established at the site:

- Indigo Bush (*Amorpha fruticosa*)
- Rattlesnake Master (*Eryngium yuccifolium*)

- Eastern Gamagrass *Tripsacum dactyloides*,
- Swamp Agrimony (*Agrimonia parviflora*)

4.0 – Planned Adaptive Management Activities for 2015

4.1 – 2015 Hydrology Management

Currently, all stop logs at water level control structures are set for maximum water retention in the wetland cells. They will be maintained at these settings in order to restore and maintain optimal inundation. This will allow for standing water in areas of dense smartweed growth as an effort to continue the reduction in smartweed density observed in 2013. Drawdowns are not planned in the near future. Management of hydrology is an important tool in vegetation community diversity optimization because plant zonation occurs along water depth and soil saturation gradients. Consequently, variations in water depth and degree of soil saturation lead to variations in species composition. The timing and frequency of flooding and drawdowns are also among the most important filters in species assemblages. Inundation causes physical disturbances, removal of litter, transport of sediments and nutrient availability and an increased dispersal of seeds.

In summary, for management of hydrology, the major emphasis will be to recreate natural hydrological regimes in a manner to limit productivity of any single species from becoming excessively high, while at the same time, enriching biodiversity. The strategy for management of hydrology has not only included considerations for the volume of water retained, but also the time of the year water is retained. It is vital to retain water during the growing season in order to maintain areas of soil saturation and/or inundation to support desirable wetland vegetation.

4.2 – 2015 Prescribed Burning

The season of the year at which a prescribed burn is conducted has a great influence over the vegetation community. This knowledge can be used as a management tool to achieve desired effects. With the objective of increasing encouraging native warm season grasses (NWSG) and suppressing hardwood sprouts, the most effective burn period at Woolsey Wet Prairie has been found to be during the month of March. Ideally, this will occur during the transition from the Late Dormant to Dormancy Break periods. At that time, most of the warm season species will still be dormant and there will be adequate fuel from the vegetation killed by winter cold weather. A burn during this time should:

- **Reduce the density of woody seedlings**
- **Set back cool season invasives such as tall fescue**
- **Favor NWSGs**
- **Be outside the bird breeding season**

Prairie burning reduces mulch cover, increases the number of reproductive grass shoots, and results in a more rapid phenological development of young plants and an increase in flower production. Removal of the litter allows soil temperatures to warm more rapidly, giving the NWSG an earlier emergence thereby providing a competitive edge against cool season invasives. The cumulative effects of fire seem to be important in controlling invasion by non-native species due to the increased productivity of dominant native C4 grasses under a regime of frequent fire rather than to direct negative impacts of fire on nonnative species.

4.3 – 2015 Herbicide Applications

It is anticipated that future herbicide applications can be accomplished with backpack sprayers and/or ATV mounted spray equipment. Soon after the March 2015 prescribed burn, Clethodim will be applied to the remaining tall fescue via backpack sprayers and/or ATV mounted spray equipment. Excellent results on eradication of fescue with very minimal harm to non-target plant species, including sedges and rushes, have been observed when herbicides are applied while native warm season species are dormant. During the growing season, Glyphosate and Triclopyr will be applied for control of warm season invasive plant species.

Invasive plant management is ongoing at Woolsey Prairie and saw some great successes in 2014. Himalayan blackberry, curly dock, Dallis grass, and multiflora rose both saw noticeable declines from 2013 levels. Individuals of callery pear that were marked in the spring and treated were mostly dead by November. However, white sweet clover, which was first detected on the site in 2006 was noticed to be spreading along the berms of cells on the northern end of the site in 2014. This species can be very invasive in grasslands and needs to be controlled in 2015. The locations of other invasive species are noted on the wetland cell maps (Figure 2-8), these species are still present on the site and will need continued management and monitoring in 2015.

4.4 – Control of Invasive Plant Species on Adjacent City Property

Observations have been made of dense growth of the invasive multiflora rose, Himalayan blackberry, callery pear, and bush honeysuckle on City-owned property surrounding the deed-restricted Woolsey Wet Prairie, particularly in parcel of land to the west. This poses a threat that needs to be a high priority adaptive management task. Herbicide applications should be made to these non-native and invasive plants in the 2015-growing season when they come out of winter dormancy. Caution should be exercised, as some of the callery pear is growing in close proximity to desirable species that looks similar such as Reverchon's hawthorn and wild goose plum. Multiflora rose is growing in close proximity to prairie rose (*Rosa setigera*) a desirable prairie plant species. The fencerows are abundant with these invasive species and they bear a tremendous amount of fruit that is eaten by birds and subsequently transferred to the wetland cells at Woolsey Wet Prairie. Similarly, the stand of timber on the southwest side of Wetland Cell W-2 has an abundance of invasive species that need to be thoroughly controlled. This area also supports a good stand of the desirable cluster sedge (*Carex aggregata*), as shown on the 2014 wetland cell maps in Figure 8.

4.5 – 2015 Adaptive Management Scheduling

A general schedule for 2015 is shown in Table 3. Site conditions will be observed and changes will be made to scheduling, as necessary.

Table 3 – 2015 Woolsey Wet Prairie Adaptive Management Tentative Schedule

General Timeframe	Activity
January	Prescribed burn informal bid process; establishment of fire line
March	Prescribed burn
Late-March to Early-April	Spray tall fescue before native plants come out of dormancy
Early June	Mow berms (IOL)
Mid June	Adjacent (west and north) fescue fields to be hayed before tall fescue goes to seed
Mid to Late June	Mow berm sides and site perimeter to primarily keep Queen Anne's Lace from going to seed (CH2M Hill)
June - August	Hand Pull curly dock, nodding thistle, and Queen Anne's lace
May – October	Weekly spot spraying of invasive woody vegetation and hand cutting of selected vegetation (IOL)
November – December	Spray stands of tall fescue

5.0 – The Distinctions and the Future of Woolsey Wet Prairie Sanctuary

The success of Woolsey Wet Prairie Sanctuary has been well noted in local media coverage via newspapers, periodicals, and television programs. In addition to achieving above and beyond the required wetland compensatory mitigation requirements, it has provided passive recreation and educational value for the public and academia.

Woolsey Wet Prairie has won awards and special recognitions for the City of Fayetteville, including:

April 2009 - Arkansas Environmental Stewardship Award (ENVY Award) Finalist presented by Arkansas Department of Environmental Quality

August 2009 - Governor's Conservation Awards - Corporate Conservationist of the Year presented by Arkansas Wildlife Federation in (the first time this award has been presented to a City since the inception of the AWF in 1936)

November 2009 - Golden Paddle Award presented by Illinois River Watershed Partnership

February 2011 - designation as a Certified Wildlife Habitat by the National Wildlife Federation

October 2011 – Special recognition in the America in Bloom National Turf and Groundcover Award

July 2013 – Woolsey Wet Prairie successfully nominated as The Arkansas Audubon Society's 32nd Important Bird Area in the State of Arkansas

January 2014 – "Woolsey Wet Prairie – After the Burn" The City of Fayetteville Government Channel Television Documentary produced by Neal Bilbe and narrated by Bruce Shackleford

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.

6.0 – Expanding Woolsey Wet Prairie Sanctuary As A Wetland Mitigation Bank

On November 19, 2013, a resolution to expand Woolsey Wet Prairie by an additional 80 acres as a wetland mitigation bank was unanimously passed by the Fayetteville City Council. ECO, Inc. recommends to the City of Fayetteville to implement the expansion of Woolsey Wet Prairie as a mitigation bank, as defined by the April 10, 2008 Final Mitigation Rule that was jointly issued by the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency.

As the expansion comes to fruition, Woolsey Wet Prairie Sanctuary will almost triple in size, becoming a unique 124-acre city-owned property of endangered tall grass wetland prairie to provide enhanced recreational, educational, and ecological benefits while generating revenue for the City of Fayetteville, Arkansas. Unlike the existing surplus wetland credits discussed in Section 7.0, credits generated from the expansion of Woolsey Wet Prairie can be sold to other parties.

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." 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

For questions or comments, contact:

Bruce Shackleford, President
Environmental Consulting Operations, Inc.
17724 I-30, Suite 5A
Benton, AR 72019
(501) 315-9009
bruceshackleford@sbcglobal.net

7.0 – Woolsey Wet Prairie Mitigation Bank Existing Surplus Wetland Credit Guidance

7.1 – Background and Overview

The City of Fayetteville, Arkansas' Wastewater System Improvement Project (WSIP) was designed to improve the City's sewer collection system, upgrade the Paul Noland Wastewater Treatment Plant (WWTP), and construct a new Westside WWTP. The WSIP involved discharges of fill into "Waters of the U.S." within the Illinois River Watershed (within the Arkansas River Basin) and the Beaver Reservoir Watershed (within the White River Basin); therefore, permitting under Section 404 of the Clean Water Act was required.

On March 10, 2005, the U.S. Army Corps of Engineers, Little Rock District (Corps) issued Individual Section 404 Permit No. 14207 to the City of Fayetteville 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 the new Westside WWTP, sewer lines, and road improvements. The permit required wetland compensatory mitigation due to the permanent alteration of 8.87 acres of wetlands as a result of construction of the new Westside WWTP and improvements to Broyles Road (now avenue). Consequently, the city was required to develop a wetland mitigation strategy to generate 73.57 wetland mitigation credits to offset permanent impacts to wetlands from construction of the City of Fayetteville's WSIP.

The 43.65-acre wetland mitigation site (commonly known as Woolsey Wet Prairie Sanctuary) is located immediately to the north of the Westside WWTP. McGoodwin, Williams, and Yates Consulting Engineers, Inc. of Fayetteville designed hydrological features and Environmental Consulting Operations, Inc. (ECO, Inc.) of Benton provided ecological feature design, site management, and monitoring.

After five years of monitoring, ECO, Inc. determined that 94.47 mitigation credits had been generated, producing a surplus of 20.90 credits above the required 73.57 credits. ECO, Inc. and the City of Fayetteville met with the Corps in mid-2013 to discuss the use of surplus wetland credits for city infrastructure projects that required wetland compensatory mitigation. On September 30, 2013, the City of Fayetteville received approval from the Corps to use the 20.90 surplus wetland credits for impacts to wetlands caused by municipal projects within the Illinois River Watershed 8-digit Hydrologic Unit Code (HUC) watershed (11110103), but the City would not be allowed to sell the surplus credits (Attachment # 1).

Consequently, the City of Fayetteville's surplus wetland credits in essence serve as a mitigation bank where improvements to wetland ecological function and value provide an ecological gain, and are available to be used to meet compensatory mitigation requirements for city projects that permanently alter wetlands. More specifically, these surplus credits serve as what is known as a Single-Client Mitigation Bank, or a bank for which the sponsor is also the principal credit user or client.

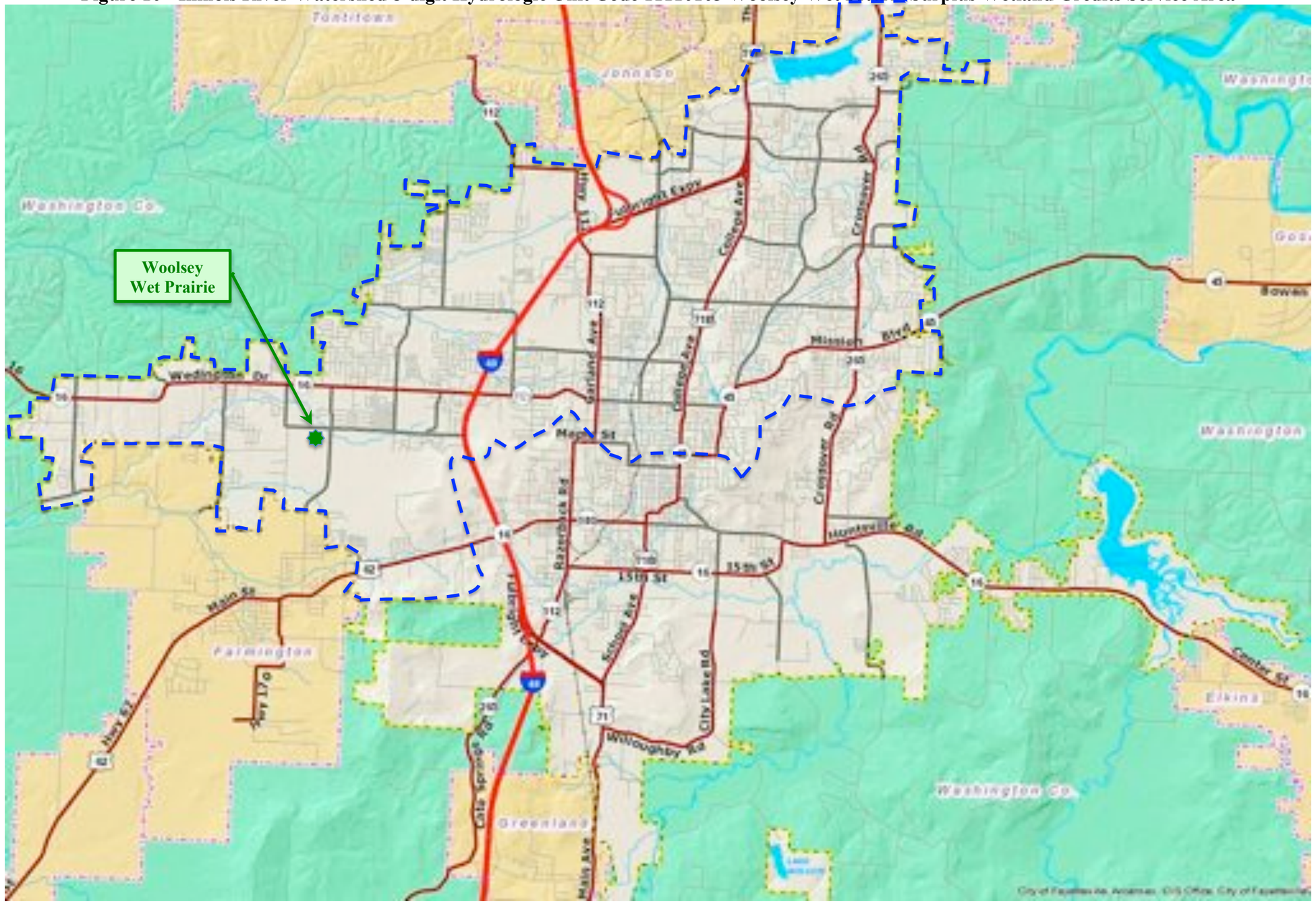
7.2 – Service Area

A wetland mitigation bank service area is the designated geographic area within which the Woolsey Wet Prairie Bank can reasonably be expected to provide, and is authorized to provide, appropriate compensatory mitigation for unavoidable permanent impacts to wetlands.

Impact projects located within a bank's service area are eligible to apply to use credits from that bank to compensate for impacts requiring authorization under Section 404 of the Clean Water Act. However, location within the service area does not provide a guarantee that the impacting project will receive authorization to use bank credits. To use the bank as a source of compensatory mitigation, City of Fayetteville wetland impact projects must obtain the approval of the Little Rock District Corps that has jurisdiction over the impacting project on a case-by-case basis.

The Woolsey Wet Prairie Bank service area primarily includes impact projects within the watersheds of Clear Creek, Goose Creek, and headwaters of the Illinois River within HUC 11110103 that are under the authority and control of the City of Fayetteville. Figure 10 shows a general depiction of the service area. This service area may change as the city's area expands into other portions of HUC 11110103.

Figure 10 - Illinois River Watershed 8-digit Hydrologic Unit Code 11110103 Woolsey Wet Prairie Surplus Wetland Credits Service Area



7.3 – Credit Release Process

ECO, Inc. developed this credit guidance for the purpose of clarifying the terms, uses, and measures of credits as they apply to wetland mitigation banking. This guide is intended for use by the City of Fayetteville as the bank sponsor of the surplus wetland credits to satisfy mitigation requirements, for regulated impacts to aquatic resources. This process may change, as wetland mitigation regulations and policies are modified. The WSIP was funded by and through the City of Fayetteville Utilities Department. Therefore, the Utilities Department is considered to be the bank sponsor for releasing credits to other City of Fayetteville entities.

7.4 – Defining Credits

Credits are the trading medium, or unit of measure that is used to represent the ecological gains at a mitigation bank site. The gains are typically considered in terms of improvement in ecological functions for wetlands or other aquatic resources that are expected to result from the types of activities implemented at the bank site. The number of credits earned by a bank is therefore based on the quantity and quality of the resources that are **restored, created (established), or enhanced**. Credits may also be measured in terms of acreage, functional units, or some other assessment method.

Once an available or surplus credit is withdrawn from the bank to meet regulatory requirements for compensatory mitigation it is considered a debited credit, or a debit. For the Woolsey Wet Prairie surplus credits, the service area includes city projects where restoration of herbaceous wetlands of similar functional values within the Illinois River Watershed 8-digit Hydrologic Unit Code (HUC) watershed (11110103) are required by the Corps (Figure 1).

The Little Rock District Corps uses the Charleston Method for determining the replacement of lost functions and values (credits) for impact project sites where wetlands will be permanently altered. Likewise, the Charleston Method was used to determine the wetland credits generated by mitigation at Woolsey Wet Prairie.

7.5 – Accounting Procedures For Tracking Credits

The number of available credits and all credit releases must be tracked throughout the life of a mitigation bank and credit use must be monitored to ensure that bank credits aren't overdrawn. Tracking credits on a ledger ensures that the same credit is not used to meet compensatory mitigation requirements for multiple projects. The **ledger** documents the credit releases and withdrawals for a mitigation bank, similar to keeping track of money in a checking account.

The Sponsor shall be responsible for keeping an up-to-date ledger of all transactions within the Bank. The bank sponsor must compile an annual ledger report showing the beginning and ending balances of available credits and permitted impacts (i.e., debits) for each resource type, all credit additions and subtractions, and other changes in credit availability, such as the release of additional credits or the suspension of credit sales. The ledger report is to be submitted to the Corps as part of the administrative record for the mitigation bank and will be made available to the public by the Corps upon request.

The current ledger report for 2014 is contained in Attachment #2. During 2014, the Corps authorized the use of a portion of the Woolsey Wet Prairie surplus wetland credits to offset 0.31 acres of permanent alterations to wetlands from the construction of an extension to Van Ashe Drive (COE Project No. 2012-00525). Consequently, the City of Fayetteville Transportation Division Van Asche Drive project deducted 3.09 credits or 0.562 acres from the Woolsey Wet Prairie 20.90 surplus wetland credits, leaving a balance of 17.81 surplus credits.

Attachment # 1
September 30, 2013 Corps Correspondence Approving Use of Woolsey Wet Prairie 20.90 surplus wetland credits for impacts to wetlands caused by municipal projects within the Illinois River Watershed 8-digit Hydrologic Unit Code (HUC) watershed (11110103)

DEPARTMENT OF THE ARMY
LITTLE ROCK DISTRICT, CORPS OF ENGINEERS
POST OFFICE BOX 867
LITTLE ROCK, ARKANSAS 72203-0867
www.swl.usace.army.mil/

REPLY TO
ATTENTION OF

Regulatory Division

STANDARD PERMIT MODIFICATION NO. **1997-14207-3**

The Honorable Lioneld Jordan
Mayor of Fayetteville
113 West Mountain Street
Fayetteville, Arkansas 72701

Dear Mayor Jordan:

This letter is in response to the request by Environmental Consulting Operations, Inc. (ECO) to recalculate impacts incurred and mitigation required for Department of the Army (DA) Permit No. **1997-14207**. The project site is located in the E ½ of section 14, T. 16 N., R. 31 W., in Fayetteville, Washington County, Arkansas.

Regulatory personnel have evaluated the original authorizations, existing site conditions, and current proposal. The impacts and mitigation credits were reviewed and recalculated based off of the original 2005 mitigation proposal, with these changes/additions:

1. On the Adverse Impacts calculation, corrected Duration value for Wastewater Treatment Plant and North Broyles Road from 0.2 to 2.0.
2. On the Adverse Impacts calculation, adjusted impact acreages based on information from ECO in June 2013.
3. On the Adverse Impacts calculation, adjusted Cumulative Impact value to account for lesser impact acreage.
4. On the Restoration and Enhancement calculation, removed Eastside Line Work as there were no impacts to restore.
5. On the Restoration and Enhancement calculation, changed the Net Improvement value for the buffer areas to 0.1, per ECO.
6. On the Restoration, Enhancement, and Creation calculations, separated herbaceous and forested as well as inside berm and outside berm to maintain consistency with original proposal.
7. On the Restoration, Enhancement, and Creation calculations, adjusted the Control value to "Covenant POA," except for Westside Line Work, which cannot be deed restricted.
8. On the Creation calculation, adjusted wetland created acreage to account for additional wetlands created.
9. On the Creation calculation, adjusted Vegetation values within the berms to 0.25, and used a value of 0.1 for areas outside the berms, per ECO.

As identified on the attached 2002 Charleston Method calculation sheets, 73.57 credits are

required to mitigate for impacts to aquatic resources for the City of Fayetteville's Wastewater Treatment Plant. We have calculated that the mitigation areas have generated 94.47 wetland credits. Therefore, the city will be able to use the excess 20.90 wetland credits to mitigate for wetland impacts generated by the City of Fayetteville within the Illinois River watershed, HUC 11110103.

The additional areas (referred to as South, West, and North Buffer) cannot generate buffer credit for this project. If you are interested in expanding the mitigation area into these areas, please submit a mitigation bank prospectus and we will evaluate these areas at that time.

This project and the Woolsey mitigation area present a unique situation in which we are considering new assessments of wetland impacts for a finalized project and recalculation of credits generated from a completed mitigation area. Please note that the Corps Regulatory Division does not intend to use this approach with other permit actions. It would not be feasible to make this a standard practice with the numerous issued permits, mitigation sites, and wetland banks finalized within the Little Rock District. The mitigation assessment credits for this 43-acre site will not be reconsidered in the future.

This letter becomes a part of and should be attached to your original permit.

If you have any questions, please contact Lisa Boyle, Project Manager, at (501) 324-5295 and refer to DA Permit No. **1997-14207-3**.

Sincerely,

M. Elaine Edwards

M. Elaine Edwards
Chief, Regulatory Division

Enclosures

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

Copy Furnished:
Environmental Consulting Operations, Inc.
Mr. Bruce Shackleford, w/cy permit
Arkansas Department of Environmental Quality, w/cy dwgs
Proj Mgr, Beaver Lake PO, w/cy permit
Ch, Regulatory Enf, w/cy permit
Mr. Rocky Presley, w/cy permit

1997-14207-3 Fayetteville, City of - West Side Sewer
Recalculation of impacts

14. Tables and Worksheets.

14.1. *Adverse Impacts Table.*

ADVERSE IMPACT FACTORS FOR WETLANDS AND OTHER WATERS OF THE U.S. EXCLUDING STREAMS

FACTORS	OPTIONS					
Loss Type	Type C 0.2		Type B 2.0		Type A 3.0	
Priority Category	Tertiary 0.5		Secondary 1.5		Primary 2.0	
Existing Conditions	Very Impaired 0.1		Impaired 1.0	Slightly Impaired 2.0	Fully Functional 2.5	
Duration	Seasonal 0.1	0 to 1 0.2	1 to 3 0.5	3 to 5 1.0	5 to 10 1.5	Over 10 2.0
Dominant Impact	Shade 0.2	Clear 1.0	Dredge 1.5	Drain 2.0	Impound 2.5	Fill 3.0
Cumulative Impact	$0.05 \times \sum AA_i$					

Note: For the **Cumulative Impact** factor, $\sum AA_i$ stands for the sum of the acres of adverse impacts to aquatic acres for the overall project. When computing this factor, round to the nearest tenth decimal place using even number rounding. Thus 0.01 and 0.050 are rounded down to give a value of zero while 0.051 and 0.09 are rounded up to give 0.1 as the value for the cumulative impact factor. **The cumulative impact factor for the overall project must be used in each area column on the Required Mitigation Credits Worksheet below.**

Required Mitigation Credits Sample Worksheet

Factor	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6
Loss Type	2.0	3.0	2.0	3.0		
Priority Category	0.5	0.5	0.5	0.5		
Existing Conditions	1.0	2.5	1.0	2.5		
Duration	2.0	2.0	2.0	2.0		
Dominant Impact	3.0	3.0	3.0	1.0		
Cumulative Impact	0.4	0.4	0.4	0.4		
Sum of r Factors	$R_1 = 8.9$	$R_2 = 11.4$	$R_3 = 8.9$	$R_4 = 9.4$	$R_5 =$	$R_6 =$
Impacted Area	$AA_1 = 4.68$	$AA_2 = 1.1$	$AA_3 = 1.27$	$AA_4 = 0.86$	$AA_5 =$	$AA_6 =$
R x AA=	41.65	12.54	11.3	8.08		

Total Required Credits = $\sum (R \times AA)$ = 73.57

9/10/13

1997-14207-3 Fayetteville, City of - West Side Sewer
Recalculation of mitigation

Mitigation for Wetlands

13.3 *Restoration and Enhancement Table*

RESTORATION AND ENHANCEMENT MITIGATION FACTORS FOR WETLANDS AND OTHER WATERS OF THE U.S. EXCLUDING STREAMS

Factors	Options				
Net Improvement	Minimal Enhancement 0.1	to			Excellent Restoration 1.0
Control	N. A. 0	Covenant Private 0.1	Covenant HOA 0.2	Conservation Easement 0.3	Transfer Fee Title Conservancy 0.6
Temporal Lag	N.A.* 0	Over 20 -0.3	10 to 20 -0.2	5 to 10 -0.1	0 to 5 0
Credit Schedule	Schedule 5* 0	Schedule 4 0.1	Schedule 3 0.2	Schedule 2 0.3	Schedule 1 0.4
Kind	Category 5 -0.1	Category 4 0	Category 3 0.2	Category 2 0.3	Category 1 0.4
Location	Zone 5 -0.1	Zone 4 0	Zone 3 0.2	Zone 2 0.3	Zone 1 0.4

N. A. - Not Applicable

*Use this option to calculate credits for enhancement by buffering

Proposed Restoration or Enhancement Mitigation Sample Worksheet

Factor	Wetland (existing) Area 1 within buffer	Wetland (existing) Area 2 offset buffer	Buffer Area 3 within buffer	Buffer Area 4 offset buffer	WS Line Area 5
Net Improvement	4.0	4.0	0.1	0.1	1.0
Control	0.2	0.2	0.2	0.2	0
Temporal Lag	0	0	0	0	0
Credit Schedule	0.3	0.3	0	0	0.2
Kind	0.4	0.4	0	0	0
Locations	0.4	0.4	0.4	0.4	0.4
Sum of m Factors	M_1 = 5.3	M_2 = 5.3	M_3 = 0.7	M_4 = 0.7	M_5 = 1.6
Mitigation Area	A_1 = 7.29	A_2 = 2.27	A_3 = 5.56	A_4 = 7.04	A_5 = 0.86
M · A	38.64	12.03	3.89	4.93	1.38

Total Restoration/Enhancement Credits = Σ (M x A) = 60.87

9/10/13

1992-14207-3 Fayetteville, City of - West Side Sewer
Recalculation of mitigation

14.5. *Creation Table.*

CREATION MITIGATION FACTORS FOR WETLANDS AND OTHER WATERS OF THE U.S. EXCLUDING STREAMS

Factors	Options				
Vegetation	N.A. 0		Natural 0.1		Planted 0.4
Soil	N.A. 0	U.S.S. 0		T.S.S. 0.1	E.S.S. 0.4
Control	N.A. 0	Covenant Private 0	Covenant POA 0.1	Conservation Easement 0.2	Transfer Fee Title Conservancy 0.3
Temporal Lag	Over 20 -0.5	10 to 20 -0.2		5 to 10 -0.1	0 to 5 0
Credit Schedule	Schedule 5 0	Schedule 4 0.1	Schedule 3 0.2	Schedule 2 0.3	Schedule 1 0.4
Kind	Category 5 0.1	Category 4 0.2	Category 3 0.3	Category 2 0.4	Category 1 0.5
Locations	Zone 5 0.1	Zone 4 0.2	Zone 3 0.3	Zone 2 0.4	Zone 1 0.5

N.A. = Not Applicable

Proposed Creation Mitigation Sample Worksheet

Factor	Area 1	Area 2	Area 3	Area 4	Area 5
Vegetation	0.1	0.1	0.25	0.25	
Soil	0.4	0.4	0.4	0.4	
Control	0.1	0.1	0.1	0.1	
Temporal Lag	-0.1	0	-0.1	0	
Credit Schedule	0.3	0.3	0.3	0.3	
Kind	0.5	0.5	0.5	0.5	
Locations	0.5	0.5	0.5	0.5	
Sum of m Factors	M_1 = 1.8	M_2 = 1.9	M_3 = 1.95	M_4 = 2.05	M_5
Mitigation Area	A_1 = 0.39	A_2 = 2.54	A_3 = 1.87	A_4 = 11.91	A_5 =
M x A =	0.70	4.83	3.65	24.42	

Total Creation Credits = Σ (M x A) = 33.60

9/10/02

Attachment #2
December 31, 2014 Woolsey Wet Prairie Mitigation Bank Annual Ledger Report

CITY OF FAYETTEVILLE WOOLSEY WET PRAIRIE SURPLUS WETLAND CREDITS LEDGER
SERVICE AREA: City Jurisdictional Property Within Illinois River Watershed 8-digit Hydrologic Unit Code (HUC) watershed (11110103)

Contact: Don Marr, Chief of Staff City of Fayetteville
113 West Mountain Street
Fayetteville, Arkansas 72701
479-575-8330

Ledger Entry Date	Available Credits	Withdrawn Credits/Acres for Impact Site	Debit Site	Date of Credit Withdrawal	Debit Site Impacts	Debit Site COE Project/Permit No.	New Credit Balance
06/30/14	20.90*	3.09/0.562	Van Asche Drive Extension Terry Gulley, City of Fayetteville Transportation Services Director 479-444-3491	June 2013	0.31 acres Palustrine Emergent Wetland	2012-00525	17.81

*As per September 30, 2013 Corps Correspondence Approving Use of Woolsey Wet Prairie 20.90 surplus wetland credits for impacts to wetlands caused by municipal projects within the Illinois River Watershed 8-digit Hydrologic Unit Code (HUC) watershed 11110103 (Standard Permit Modification No. 1997-14207-3)

Date Submitted to Little Rock District Corps of Engineers: December 31, 2014

8.0 – Appendices

Appendix I
Woolsey Wet Prairie
2014 Master Plant Species List

MASTER PLANT LIST FOR WOOLSEY WET PRAIRIE - updated November 2014 - 450 taxa

SCIENTIFIC NAME	WETLAND INDICATOR STATUS	CODE	COMMON NAME	FAMILY	STRATA	SOURCE CODE
Abutilon theophrastii *	FACU-	ABUT THEO	pie-maker	MALVACEAE	herb	5
Acalypha gracilens	no data	ACAL GRAC	copperleaf	EUPHORBIACEAE	herb	5
Acalypha virginica	FACU-	ACAL VIRG	Virginia copperleaf	EUPHORBIACEAE	herb	3
Acer negundo	FACW	ACER NEGU	boxelder	ACERACEAE	tree/sapling	5
Acer saccharinum	FACW	ACER SACC	silver maple	ACERACEAE	tree/sapling	9
Achillea millefolium	FACU	ACHI MILL	yarrow	ASTERACEAE	herb	12
Agalinis fasciculata	FAC	AGAL FASC	gerardia	SCROPHULARIACEAE	herb	6
Agrimonia parviflora +	FACW	AGRI PARV	swamp agrimony	ROSACEAE	herb	21
Agrostis gigantea *	FACW	AGRO GIGA	redtop	POACEAE	herb	3
Agrostis hyemalis	FAC	AGRO HYEM	ticklegrass	POACEAE	herb	5
Ailanthus altissima *	NI	AILA ALTI	tree-of-heaven	SIMAROUBACEAE	tree/sapling	10
Allium canadense var. canadense	FACU	ALLI CANA CANA	wild onion	ALLIACEAE	herb	19
Allium vineale *	FACU-	ALLI VINE	field garlic	ALLIACEAE	herb	3
Amaranthus cf. viridis *	NO	AMAR VIRI	pigweed	AMARANTHACEAE	herb	4
Amaranthus spinosus	FACU	AMAR SPIN	spiny pigweed	AMARANTHACEAE	herb	3
Ambrosia artemisiifolia	FACU	AMBR ARTE	common ragweed	ASTERACEAE	herb	3
Ambrosia bidentata	no data	AMBR BIDE	lanceleaf ragweed	ASTERACEAE	herb	3
Ambrosia trifida	FAC	AMBR TRIF	giant ragweed	ASTERACEAE	herb	3
Ammannia X coccinea	FACW+	AMMA COCC	toothcup	LYTHRACEAE	herb	3
Amorpha fruticosa +	FACW	AMOR FRUT	false indigo bush	FABACEAE	shrub	21
Ampelopsis cordata	FAC+	AMPE CORD	heartleaf ampelopsis	VITACEAE	woody vine	10
Andropogon gerardii	FAC	ANDR GERA	big bluestem	POACEAE	herb	3
Andropogon glomeratus	FACW+	ANDR GLOM	bushy bluestem	POACEAE	herb	11
Andropogon virginicus	FAC-	ANDR VIRG	broomsedge bluestem	POACEAE	herb	3
Apios americana	FACW	APIO AMER	groundnut	FABACEAE	herb	3
Apocynum cannabinum	FAC-	APOC CANN	Indian hemp	APOCYNACEAE	herb	3
Arctium minus *	FACU	ARCT MINU	burdock	ASTERACEAE	herb	19
Arenaria serpyllifolia var. tenuior *	FAC	AREN SERP TENU	thyme-leaved sandwort	CARYOPHYLLACEAE	herb	19
Aristida dichotoma	FACU	ARIS DICH	churchmouse three-awn	POACEAE	herb	8
Aristida longespica var. longespica	UPL	ARIS LONG	slimspike three-awn	POACEAE	herb	22
Aristida oligantha	no data	ARIS OLIG	three-awn	POACEAE	herb	8
Asclepias amplexicaulis	no data	ASCL AMPL	curly milkweed	ASCLEPIADACEAE	herb	3
Asclepias longifolia ssp. hirtella	UPL	ASCL HIRT	longleaf milkweed	ASCLEPIADACEAE	herb	3
Asclepias viridis	no data	ASCL VIRI	spider milkweed	ASCLEPIADACEAE	herb	3
Baptisia alba var. macrophylla	no data	BAPT ALBA	white false indigo	FABACEAE	herb	3
Baptisia bracteata var. leucophaea	no data	BAPT BRAC	cream false indigo	FABACEAE	herb	1
Barbarea vulgaris *	FAC	BARB VULG	yellow rocket	BRASSICACEAE	herb	5
Bidens aristosa	FACW	BIDE ARIS	tickseed sunflower	ASTERACEAE	herb	8
Bidens frondosa	FACW	BIDE FRON	tickseed sunflower	ASTERACEAE	herb	13
Boltonia asteroides	FACW	BOLT ASTE	false aster	ASTERACEAE	herb	3
Boltonia diffusa	FAC	BOLT DIFF	doll's daisy	ASTERACEAE	herb	8
Brassica rapa *	no data	BRAS RAPA	turnip	BRASSICACEAE	herb	5
Bromus catharticus *	no data	BROM CATH	rescue grass	POACEAE	herb	5
Bromus hordeaceus *	no data	BROM HORD	soft chess	POACEAE	herb	5
Bromus inermis *	no data	BROM INER	smooth broome	POACEAE	herb	5
Bromus racemosus *	no data	BROM RACE	bald brome	POACEAE	herb	5

*Bromus sterilis **	*no data*	BROM STER	poverty brome	POACEAE	herb	19
*Bromus tectorum **	*no data*	BROM TECT	cheatgrass	POACEAE	herb	5
Callitriche heterophylla	*OBL*	CALL HETE	water starwort	CALLITRICHACEAE	herb	5
Callitriche terrestris	*FACW*	CALL TERR	terrestrial water starwort	CALLITRICHACEAE	herb	19
Campsis radicans	*FAC*	CAMP RADI	trumpet creeper	BIGNONIACEAE	herb	10
*Capsella bursa-pastoris **	*FACU+*	CAPS BURS	shepherd's purse	BRASSICACEAE	herb	5
Cardamine parviflora var. arenicola	*FACU*	CARD PARV AREN	small-flowered bittercress	BRASSICACEAE	herb	5
*Carduus nutans **	*no data*	CARD NUTA	nodding thistle	ASTERACEAE	herb	4
Carex aggregata	*no data*	CARX AGGR	cluster sedge	CYPERACEAE	herb	19
Carex amphibola	*FAC*	CARX AMPH	a sedge	CYPERACEAE	herb	19
Carex annectens	*FACW*	CARX ANNE	a sedge	CYPERACEAE	herb	5
Carex arkansana	*no data*	CARX ARKA	Arkansas sedge	CYPERACEAE	herb	5
Carex aureolensis	*no data*	CARX AURE	a sedge	CYPERACEAE	herb	19
Carex austrina	*no data*	CARX AUST	a sedge	CYPERACEAE	herb	5
Carex blanda	*FAC*	CARX BLAN	a sedge	CYPERACEAE	herb	19
Carex brevior	*OBL*	CARX BREV	a sedge	CYPERACEAE	herb	5
Carex bushii	*FACW*	CARX BUSH	Bush's sedge	CYPERACEAE	herb	5
Carex complanata	*FAC+*	CARX COMP	a sedge	CYPERACEAE	herb	5
Carex festucacea	*FACW*	CARX FEST	a sedge	CYPERACEAE	herb	5
Carex fissa	*FACW+*	CARX FISS	hammock sedge	CYPERACEAE	herb	5
Carex flaccosperma	*FAC+*	CARX FLAC	a sedge	CYPERACEAE	herb	9
Carex frankii	*OBL*	CARX FRAN	Frank's sedge	CYPERACEAE	herb	5
Carex glaucodea	*no data*	CARX GLAU	blue sedge	CYPERACEAE	herb	15
Carex granularis	*FACW*	CARX GRAN	granular sedge	CYPERACEAE	herb	5
Carex hirsutella	*no data*	CARX HIRS	a sedge	CYPERACEAE	herb	5
Carex leavenworthii	*no data*	CARX LEAV	Leavenworth's sedge	CYPERACEAE	herb	5
Carex meadii	*FAC*	CARX MEAD	Mead's sedge	CYPERACEAE	herb	7
Carex oklahomensis	*OBL*	CARX OKLA	Oklahoma sedge	CYPERACEAE	herb	3
Carex opaca	*no data*	CARX OPAC	opaque prairie sedge	CYPERACEAE	herb	5
Carex pellita	*OBL*	CARX PELL	woolly sedge	CYPERACEAE	herb	5
Carex retroflexa	*no data*	CARX RETR	a sedge	CYPERACEAE	herb	5
Carex scoparia	*FACW*	CARX SCOP	pointed sedge	CYPERACEAE	herb	16
Carex shortiana	*FACW*	CARX SHOR	Short's sedge	CYPERACEAE	herb	14
Carex vulpinoidea	*OBL*	CARX VULP	foxtail sedge	CYPERACEAE	herb	3
Carya illinoinensis	*FACU*	CARY ILLI	pecan	JUGLANDACEAE	tree/sapling	20
Catalpa bignonioides	*FAC-*	CATA BIGN	catalpa	BIGNONIACEAE	tree/sapling	3
Celtis laevigata	*FACW*	CELT LAEV	sugarberry	CELTIDACEAE	tree/sapling	20
Celtis occidentalis	*FACU*	CELT OCCI	hackberry	CELTIDACEAE	tree/sapling	8
Cephalanthus occidentalis	*OBL*	CEPH OCCI	buttonbush	RUBIACEAE	shrub	3
*Cerastium fontanum ssp. vulgare **	*no data*	CERA FONT VULG	chickweed	CARYOPHYLLACEAE	herb	19
*Cerastium pumilum **	*no data*	CERA PUMI	chickweed	CARYOPHYLLACEAE	herb	4
Ceratophyllum demersum	*OBL*	CERA DEME	coontail	CERATOPHYLLACEAE	herb	10
Chamaesyce maculata	*no data*	CHAM MACU	spotted spurge	EUPHORBIACEAE	herb	3
Chamaesyce nutans	*FACU*	CHAM NUTA	spurge	EUPHORBIACEAE	herb	8
Chenopodium album	*FAC-*	CHEN ALBU	lamb's quarters	CHENOPODIACEAE	herb	3
Cicuta maculata	*OBL*	CICU MACU	water hemlock	APIACEAE	herb	5
Cirsium altissimum	*no data*	CIRS ALTI	tall thistle	ASTERACEAE	herb	19
*Cirsium vulgare **	*FAC*	CIRS VULG	common thistle	ASTERACEAE	herb	8
Claytonia virginica	*FAC*	CLAY VIRG	spring beauty	PORTULACACEAE	herb	18
Cocculus carolinus	*FAC*	COCC CARO	Carolina snailseed	MENISPERMACEAE	herb	20
*Conium maculatum **	*FACW*	CONI MACU	poison hemlock	APIACEAE	herb	7
Conyza canadensis	*FACU*	CONY CANA	horseweed	ASTERACEAE	herb	3

Coreopsis grandiflora	*no data*	CORE GRAN	tickseed	ASTERACEAE	herb	5
Cornus drummondii	*FAC*	CORN DRUM	rough-leaved dogwood	CORNACEAE	shrub	3
Corydalis crystallina	*no data*	CORY CRYS	mealy fumewort	FUMARIACEAE	herb	5
Crataegus mollis	*FAC*	CRAT MOLL	hairy hawthorn	ROSACEAE	herb	8
Crataegus reverchonii	*no data*	CRAT CRUS	Reverchon's hawthorn	ROSACEAE	shrub	21
Crotalaria sagittalis	*no data*	CROT SAGI	rattlebox	FABACEAE	herb	12
Croton capitatus	*no data*	CROT CAPI	goatweed	EUPHORBIACEAE	herb	3
Croton glandulosus var. septentrionalis	*no data*	CROT GLAN SEPT	tropic croton	EUPHORBIACEAE	herb	3
Croton monanthogynus	*no data*	CROT MONA	prairie tea	EUPHORBIACEAE	herb	8
Croton willdenowii	*no data*	CROT WILD	rushfoil	EUPHORBIACEAE	herb	3
Cruciata pedemontana *	*no data*	CRUC PEDE	yellow-flowered bedstraw	RUBIACEAE	herb	5
Cuscuta campestris	*no data*	CUSC CAMP	field dodder	CONVOLVULACEAE	herb	12
Cynodon dactylon *	*FACU*	CYNO DACT	Bermuda grass	POACEAE	herb	3
Cyperus acuminatus	*OBL*	CYPE ACUM	tapertip flatsedge	CYPERACEAE	herb	6
Cyperus echinatus	*FAC*	CYPE ECHI	globe flatsedge	CYPERACEAE	herb	3
Cyperus erythrorhizos	*OBL*	CYPE ERYT	redroot flatsedge	CYPERACEAE	herb	11
Cyperus esculentus	*FAC*	CYPE ESCU	yellow nutsedge	CYPERACEAE	herb	3
Cyperus flavescens	*OBL*	CYPE FLAV	yellow flatsedge	CYPERACEAE	herb	3
Cyperus lancastriensis	*FAC*	CYPE LANC	manyflower flatsedge	CYPERACEAE	herb	21
Cyperus lupulinus	*no data*	CYPE LUPU	flatsedge	CYPERACEAE	herb	4
Cyperus odoratus	*FACW*	CYPE ODOR	rusty flatsedge	CYPERACEAE	herb	6
Cyperus pseudovegetus	*FACW*	CYPE PSEU	marsh flatsedge	CYPERACEAE	herb	3
Cyperus strigosus	*FACW*	CYPE STRI	false nutsedge	CYPERACEAE	herb	1
Dactylis glomerata *	*FACU*	DACT GLOM	orchard grass	POACEAE	herb	3
Datura stramonium *	*no data*	DATU STRA	Jimson weed	SOLANACEAE	herb	5
Daucus carota *	*no data*	DAUC CARO	Queen Anne's lace	APIACEAE	herb	3
Desmanthus illinoensis	*FAC*	DESM ILLI	Illinois bundleflower	FABACEAE	herb	21
Desmodium canescens	*no data*	DESM CANE	tick-trefoil	FABACEAE	herb	19
Desmodium nuttallii	*no data*	DESM NUTT	tick-trefoil	FABACEAE	herb	8
Desmodium obtusum	*no data*	DESM OBTU	tick-trefoil	FABACEAE	herb	8
Desmodium paniculatum	*FACU*	DESM PANI	tick-trefoil	FABACEAE	herb	3
Desmodium sessilifolium	*no data*	DESM SESS	sessile-leaf tick-trefoil	FABACEAE	herb	16
Dichanthelium aciculare	*FACU*	DICH ACIC	slimleaf rosettegrass	POACEAE	herb	3
Dichanthelium acuminatum	*FAC*	DICH ACUM	pointed rosettegrass	POACEAE	herb	3
Dichanthelium clandestinum	*FACW*	DICH CLAN	deer-tongue rosettegrass	POACEAE	herb	8
Dichanthelium commutatum	*FAC*	DICH COMM	variable rosettegrass	POACEAE	herb	11
Dichanthelium dichotomum	*FAC*	DICH DICH	rosettegrass	POACEAE	herb	3
Dichanthelium malacophyllum	*no data*	DICH MALA	soft-leaved rosettegrass	POACEAE	herb	19
Dichanthelium oligosanthes var. scribnerianum	*FACU*	DICH OLIG SCRI	Scribner's rosettegrass	POACEAE	herb	5
Dichanthelium scoparium	*FACW*	DICH SCOP	velvet rosettegrass	POACEAE	herb	3
Dichanthelium sphaerocarpon	*FACU*	DICH SPHA	rosettegrass	POACEAE	herb	5
Digitaria ciliaris *	*FAC*	DIGI CILI	southern crabgrass	POACEAE	herb	4
Digitaria ischaemum *	*UPL*	DIGI ISHA	smooth crabgrass	POACEAE	herb	3
Diodia teres	*FACU-*	DIOD TERE	poorjoe	RUBIACEAE	herb	3
Diodia virginiana	*FACW*	DIOD VIRG	Virginia buttonweed	RUBIACEAE	herb	3
Diospyros virginiana	*FAC*	DIOS VIRG	persimmon	EBENACEAE	tree/sapling	3
Dysphania ambrosioides *	*FACU*	DYSP AMBR	wormseed	CHENOPODIACEAE	herb	3
Echinochloa colona *	*FACW*	ECHI COLO	jungle rice	POACEAE	herb	3
Echinochloa crus-galli *	*FACW-*	ECHI CRUS	barnyard grass	POACEAE	herb	1
Echinochloa muricata	*FAC*	ECHI MURI	barnyard grass	POACEAE	herb	3
Eclipta prostrata	*FACW-*	ECLI PROS	yerba de tajo	ASTERACEAE	herb	1

Eleocharis acicularis	*OBL*	ELEO ACIC	least spikerush	CYPERACEAE	herb	5
Eleocharis lanceolata	*FACW*	ELEO LANC	spikerush	CYPERACEAE	herb	3
Eleocharis macrostachya	*OBL*	ELEO MACR	pale spikerush	CYPERACEAE	herb	16
Eleocharis obtusa	*OBL*	ELEO OBTU	blunt spikerush	CYPERACEAE	herb	3
Eleocharis palustris	*OBL*	ELEO PALU	common spikerush	CYPERACEAE	herb	3
Eleocharis quadrangulata	*OBL*	ELEO QUAD	squarestem spikerush	CYPERACEAE	herb	9
Eleocharis tenuis var. verrucosa	*FACW*	ELEO TENU VERR	slender spikerush	CYPERACEAE	herb	5
Eleocharis wolfii	*OBL*	ELEO WOLF	Wolf's spikerush	CYPERACEAE	herb	5
*Eleusine indica **	*FACU*	ELEU INDI	India goosegrass	POACEAE	herb	3
Elymus glabrifloris	*no data*	ELYM GLAB	wild rye	POACEAE	herb	3
Eragrostis hirsuta	*UPL*	ERAG HIRS	bigtop lovegrass	POACEAE	herb	22
Eragrostis spectabilis	*FACU*	ERAG SPEC	purple lovegrass	POACEAE	herb	3
Eragrostis intermedia	*no data*	ERAG INTE	lovegrass	POACEAE	herb	8
Erechtites hieraciifolia	*FAC-*	EREC HIER	fireweed	ASTERACEAE	herb	8
Erigeron annuus	*FACU*	ERIG ANNU	fleabane	ASTERACEAE	herb	3
Erigeron strigosus	*FAC*	ERIG STRI	daisy fleabane	ASTERACEAE	herb	5
Eryngium yuccifolium +	*FAC*	ERYN YUCC	rattlensnake master	APIACEAE	herb	10
*Euonymus fortunei **	*no data*	EUON FORT	winter-creeper	CELASTRACEAE	woody vine	19
Eupatorium perfoliatum	*FACW+*	EUPA PERF	clasping boneset	ASTERACEAE	herb	3
Eupatorium serotinum	*FAC*	EUPA SERO	late boneset	ASTERACEAE	herb	1
Euphorbia spathulata	*FACU*	EUPH SPAT	warty spurge	EUPHORBIACEAE	herb	21
Euthamia gymnospermoides	*FAC*	EUTH GYMN	Texas goldentop	ASTERACEAE	herb	21
Festuca rubra	*FACU+*	FEST RUBR	red fescue	POACEAE	herb	2
Fimbristylis annua	*FACW*	FIMB ANNU	annual fimbry	CYPERACEAE	herb	9
Fimbristylis puberula	*OBL*	FIMB PUBE	hairy fimbry	CYPERACEAE	herb	5
Fraxinus pennsylvanica	*FACW*	FRAX PENN	green ash	OLEACEAE	tree/sapling	3
Galactia regularis	*no data*	GALA REGU	milk pea	FABACEAE	herb	3
Galium aparine	*FACU*	GALI APAR	cleavers	RUBIACEAE	herb	19
Galium obtusum	*FACW-*	GALI OBTU	bluntleaf bedstraw	RUBIACEAE	herb	7
Galium pilosum	*no data*	GALI PILO	hairy bedstraw	RUBIACEAE	herb	4
Gamochaeta antillana	*no data*	GAMO ANTI	cudweed	ASTERACEAE	herb	19
Gamochaeta purpurea	*UPL*	GAMO PURP	purple cudweed	ASTERACEAE	herb	5
Gaura longiflora	*no data*	GAUR LONG	gaura	ONAGRACEAE	herb	8
Geranium carolinianum	*no data*	GERA CARO	Carolina cranesbill	GERANIACEAE	herb	5
*Geranium dissectum **	*no data*	GERA DISS	cutleaf cranesbill	GERANIACEAE	herb	5
*Geranium molle **	*no data*	GERA MOLL	dovesfoot cranesbill	GERANIACEAE	herb	4
Geum canadense	*FACU*	GEUM CANA	white avens	ROSACEAE	herb	19
Glandularia canadensis	*no data*	GLAN CANA	rose vervain	VERBENACEAE	herb	3
Gleditsia triacanthos	*FAC-*	GLED TRIA	honey locust	FABACEAE	tree/sapling	3
Glyceria septentrionalis	*OBL*	GLYC SEPT	mannagrass	POACEAE	herb	3
Gratiola neglecta	*OBL*	GRAT NEGL	hedge-hyssop	SCROPHULARIACEAE	herb	9
Gratiola virginiana	*OBL*	GRAT VIRG	hedge-hyssop	SCROPHULARIACEAE	herb	3
Helenium amarum	*FACU-*	HELE AMAR	bitterweed	ASTERACEAE	herb	3
Helenium flexuosum	*FACW*	HELE FLEX	purple-headed sneezeweed	ASTERACEAE	herb	1
Helenium autumnale	*FACW*	HELE AUTU	fall sneezeweed	ASTERACEAE	herb	8
Helianthus grosseserratus	*FAC+*	HELI GROS	sawtooth sunflower	ASTERACEAE	herb	3
Helianthus mollis	*no data*	HELI MOLL	ashy sunflower	ASTERACEAE	herb	3
*Heliotropium indicum **	*FAC*	HELI INDI	Indian heliotrope	BORAGINACEAE	herb	21
Hibiscus moscheutos ssp. lasiocarpos	*OBL*	HIBI MOSC LASI	rose mallow	MALVACEAE	herb	3
Hieracium gronovii	*UPL*	HIER GRON	hawkweed	ASTERACEAE	herb	2
*Hordeum pusillum **	*FACU*	HORD PUSI	little barley	POACEAE	herb	5
Hypericum drummondii	*FACU*	HYPE DRUM	nits-and-lice	CLUSIACEAE	herb	8

Hypericum gymnanthum	*FACW*	HYPE GYMN	clasping St. John's wort	CLUSIACEAE	herb	10
Hypericum hypericoides var. multicaule	*FAC*	HYPE HYPE MULT	creeping St. Andrew's cross	CLUSIACEAE	shrub	3
Hypericum mutilum	*FACW*	HYPE MUTI	dwarf St. John's wort	CLUSIACEAE	herb	9
Hypericum punctatum	*FAC*	HYPE PUNC	dotted St. John's wort	CLUSIACEAE	herb	8
Ilex decidua	*FACW*	ILEX DECI	deciduous holly	AQUIFOLIACEAE	shrub	22
Ipomoea lacunosa	*FAC+*	IPOM LACU	whitestar morning glory	CONVOLVULACEAE	herb	10
Ipomoea pandurata	*FACU*	IPOM PAND	wild potato vine	CONVOLVULACEAE	herb	5
Isoetes melanopoda	*OBL*	ISOE MELA	black-footed quillwort	ISOETACEAE	herb	19
Isolepis carinata	*FACW+*	ISOL CARI	bulrush	CYPERACEAE	herb	5
Juncus anthelatus	*no data*	JUNC ANTH	rush	JUNCACEAE	herb	3
Juncus biflorus	*FACW*	JUNC BIFL	rush	JUNCACEAE	herb	3
Juncus brachycarpus	*FACW*	JUNC BRAC	rush	JUNCACEAE	herb	9
Juncus diffusissimus	*FACW*	JUNC DIFF	spreading rush	JUNCACEAE	herb	10
Juncus effusus	*FACW+*	JUNC EFFU	soft rush	JUNCACEAE	herb	3
Juncus interior	*FACU*	JUNC INTE	inland rush	JUNCACEAE	herb	5
Juncus marginatus	*FACW*	JUNC MARG	rush	JUNCACEAE	herb	8
Juncus secundus	*FAC*	JUNC SECU	rush	JUNCACEAE	herb	4
Juncus validus	*FACW+*	JUNC VALI	rush	JUNCACEAE	herb	5
Juniperus virginiana	*FACU-*	JUNI VIRG	eastern redcedar	CUPRESSACEAE	tree/sapling	8
Krigia dandelion	*FACU*	KRIG DAND	potato dandelion	ASTERACEAE	herb	7
Kummerowia stipulacea *	*FACU-*	KUMM STIP	Korean bushclover	FABACEAE	herb	3
Kummerowia striata *	*FACU*	KUMM STRI	Japanese bushclover	FABACEAE	herb	3
Lactuca canadensis	*FACU-*	LACT CANA	Canada wild lettuce	ASTERACEAE	herb	16
Lactuca saligna *	*UPL*	LACT SALI	willowleaf lettuce	ASTERACEAE	herb	21
Lactuca serriola *	*FAC*	LACT SERR	prickly wild lettuce	ASTERACEAE	herb	3
Leersia oryzoides	*OBL*	LEER ORYZ	rice cutgrass	POACEAE	herb	2
Leersia virginica	*FACW*	LEER VIRG	Virginia cutgrass	POACEAE	herb	8
Lemna minuta	*OBL*	LEMN MINU	duckweed	LEMNACEAE	herb	5
Lepidium virginicum	*FACU*	LEPI VIRG	Virginia peppergrass	BRASSICACEAE	herb	3
Lespedeza cuneata *	*NI*	LESP CUNE	sericea lespedeza	FABACEAE	herb	3
Lespedeza repens	*no data*	LESP REPE	creeping lespedeza	FABACEAE	herb	21
Leucospora multifida	*OBL*	LEUC MULT	leucospora	SCROPHULARIACEAE	herb	5
Ligustrum sinense *	*FAC*	LIGU SINE	Chinese privet	OLEACEAE	shrub	17
Lindernia anagallidea	*OBL*	LIND ANAG	false pimpernel	SCROPHULARIACEAE	herb	10
Lobelia siphilitica	*OBL*	LOBE SIPH	big blue lobelia	CAMPANULACEAE	herb	8
Lobelia spicata	*FAC*	LOBE SPIC	spike lobelia	CAMPANULACEAE	herb	5
Lolium perenne *	*FACU*	LOLI PERE	ryegrass	POACEAE	herb	5
Lonicera japonica *	*FAC-*	LONI JAPO	Japanese honeysuckle	CAPRIFOLIACEAE	woody vine	3
Lonicera maackii *	*no data*	LONI MAAC	bush honeysuckle	CAPRIFOLIACEAE	shrub	17
Lonicera sempervirens	*FAC*	LONI SEMP	trumpet honeysuckle	CAPRIFOLIACEAE	woody vine	5
Ludwigia alternifolia	*OBL*	LUDW ALTE	seedbox	ONAGRACEAE	herb	8
Ludwigia palustris	*OBL*	LUDW PALU	creeping seedbox	ONAGRACEAE	herb	3
Ludwigia peploides ssp. glabrescens	*OBL*	LUDW PEPL GLAB	floating primrose-willow	ONAGRACEAE	herb	3
Luzula echinata	*FAC*	LUZU ECHI	wood rush	JUNCACEAE	herb	10
Lycopus americanus	*OBL*	LYCO AMER	American water horehound	LAMIACEAE	herb	8
Lythrum alatum	*FACW+*	LYTH ALAT	winged loosestrife	LYTHRACEAE	herb	5
Maclura pomifera *	*FACU*	MACL POMI	bois d'arc	MORACEAE	tree/sapling	3
Mecardonia acuminata	*FACW*	MECA ACUM	purple axilflower	SCROPHULARIACEAE	herb	3
Medicago sp. *	*no data*	MEDI SP.	medic	FABACEAE	herb	16
Melilotus albus *	*FACU-*	MELI ALBU	white sweetclover	FABACEAE	herb	3
Melilotus officinalis *	*FACU-*	MELI OFFI	yellow sweetclover	FABACEAE	herb	16
Melothria pendula	*FACW-*	MELO PEND	dwarf cucumber vine	CUCURBITACEAE	herb	10

Mimosa quadrivalvis var. nuttallii	*no data*	MIMO QUAD NUTT	sensitive brier	FABACEAE	herb	3
Mollugo verticillata	*FAC*	MOLL VERT	green carpetweed	MOLLUGINACEAE	herb	10
Morus alba *	*UPL*	MORU ALBA	white mulberry	MORACEAE	tree/sapling	20
Morus rubra	*FAC*	MORU RUBR	red mulberry	MORACEAE	tree/sapling	8
Muhlenbergia schreberi	*FAC*	MUHL SCHR	nimblewill	POACEAE	herb	8
Muhlenbergia sp.	*no data*	MUHL SP.	muhly grass	POACEAE	herb	19
Myosotis macrosperma	*FAC*	MYOS MACR	large-seeded forget-me-not	BORAGINACEAE	herb	19
Myriophyllum sp.	*OBL*	MYRI SP	water milfoil	HALORAGACEAE	herb	9
Nothoscordum bivalve	*FAC*	NOTH BIVA	crow poison	ALLIACEAE	herb	7
Nuttallanthus texanus	*no data*	NUTT TEXA	blue toadflax	SCROPHULARIACEAE	herb	5
Oenothera biennis	*FACU*	OENO BIEN	evening-primrose	ONAGRACEAE	herb	7
Oenothera laciniata	*FACU*	OENO LACI	cutleaf evening-primrose	ONAGRACEAE	herb	5
Orbexilum pedunculatum var. pedunculatum	*FACU*	ORBE PEDU	Sampson's snakeroot	FABACEAE	herb	5
Oxalis dillenii	*no data*	OXAL DILL	yellow wood sorrel	OXALIDACEAE	herb	3
Oxalis violacea	*no data*	OXAL VIOL	violet woodsorrel	OXALIDACEAE	herb	5
Panicum anceps	*FAC-*	PANI ANCE	beaked panicgrass	POACEAE	herb	3
Panicum capillare	*FAC*	PANI CAPI	witchgrass	POACEAE	herb	8
Panicum dichotomiflorum	*FACW*	PANI DICH	fall panicgrass	POACEAE	herb	3
Panicum rigidulum	*FACW*	PANI RIGI	rigid panicgrass	POACEAE	herb	5
Panicum virgatum	*FAC+*	PANI VIRG	switchgrass	POACEAE	herb	3
Parthenocissus quinquefolia	*FACU*	PART QUIN	Virginia creeper	VITACEAE	woody vine	19
Paspalum dilatatum *	*FAC+*	PASP DILA	Dallisgrass	POACEAE	herb	3
Paspalum floridanum	*FACW-*	PASP FLOR	Florida crowngrass	POACEAE	herb	3
Paspalum laeve	*FACW-*	PASP LAEV	field paspalum	POACEAE	herb	3
Paspalum notatum *	*FACU+*	PASP NOTA	Bahia grass	POACEAE	herb	10
Paspalum pubiflorum	*FACW*	PASP PUBI	hairyseed crowngrass	POACEAE	herb	10
Paspalum setaceum	*FAC*	PASP SETA	thin crowngrass	POACEAE	herb	4
Passiflora incarnata	*no data*	PASS INCA	passion flower	PASSIFLORACEAE	herb	3
Passiflora lutea	*no data*	PASS LUTE	yellow passion flower	PASSIFLORACEAE	herb	19
Penstemon digitalis	*FAC*	PENS DIGI	foxglove beard-tongue	SCROPHULARIACEAE	herb	5
Penstemon tubaeflorus	*no data*	PENS TUBA	whitewand beard-tongue	SCROPHULARIACEAE	herb	3
Persicaria hydropiper *	*OBL*	PERS HYDROPIPER	water pepper	POLYGONACEAE	herb	6
Persicaria hydropiperoides	*OBL*	RS HYDROPIPEROID	wild water pepper	POLYGONACEAE	herb	3
Persicaria lapathifolia	*FACW*	PERS LAPA	pale smartweed	POLYGONACEAE	herb	3
Persicaria longiseta *	*no data*	PERS LONG	pink smartweed	POLYGONACEAE	herb	8
Persicaria maculosa *	*FACW*	PERS MACU	lady's-thumb	POLYGONACEAE	herb	6
Persicaria pensylvanica	*FACW*	PERS PENS	Pennsylvania smartweed	POLYGONACEAE	herb	3
Persicaria punctata	*FACW+*	PERS PUNC	dotted smartweed	POLYGONACEAE	herb	2
Phleum pratense *	*FACU*	PHLE PRAT	timothy	POACEAE	herb	21
Physalis angulata	*FAC*	PHYS ANGU	smooth groundcherry	SOLANACEAE	herb	8
Physalis heterophylla	*no data*	PHYS HETE	clammy groundcherry	SOLANACEAE	herb	10
Physalis longifolia	*no data*	PHYS LONG	longleaf groundcherry	SOLANACEAE	herb	10
Physalis pumila	*no data*	PHYS PUMI	prairie groundcherry	SOLANACEAE	herb	3
Physostegia angustifolia	*FACW*	PHYS ANGU	false dragonhead	LAMIACEAE	herb	3
Phytolacca americana	*FACU+*	PHYT AMER	pokeweed	PHYTOLACACEAE	herb	3
Plantago aristata	*no data*	PLAN ARIS	bracted plantain	PLANTAGINACEAE	herb	3
Plantago lanceolata *	*FAC*	PLAN LANC	English plantain	PLANTAGINACEAE	herb	3
Plantago rugelii *	*FAC*	PLAN RUGE	blackseed plantain	PLANTAGINACEAE	herb	2
Plantago virginica	*FACU-*	PLAN VIRG	Virginia plantain	PLANTAGINACEAE	herb	5
Platanus occidentalis	*FACW-*	PLAT OCCI	American sycamore	PLATANACEAE	tree/sapling	12
Poa annua *	*FAC*	POA ANNU	annual bluegrass	POACEAE	herb	5

Poa compressa *	*FACU-*	POA COMP	Canada bluegrass	POACEAE	herb	3
Poa pratensis *	*FACU+*	POA PRAT	Kentucky bluegrass	POACEAE	herb	5
Polygala incarnata	*FAC-*	POLY INCA	pink milkwort	POLYGALACEAE	herb	16
Polygala sanguinea	*FAC-*	POLY SANG	purple milkwort	POLYGALACEAE	herb	10
Polygonum aviculare *	*FAC-*	POLY AVIC	knotweed	POLYGONACEAE	herb	3
Polygonum erectum	*FACU*	POLY EREC	erect knotweed	POLYGONACEAE	herb	10
Populus deltoides	*FAC+*	POPU DELT	eastern cottonwood	SALICACEAE	tree/sapling	10
Potamogeton diversifolius	*OBL*	POTA DIVE	pondweed	POTAMOGETONACEAE	herb	5
Potamogeton nodosus	*OBL*	POTA NODO	pondweed	POTAMOGETONACEAE	herb	1
Potamogeton pusillus	*OBL*	POTA PUSI	narrowleaf pondweed	POTAMOGETONACEAE	herb	11
Potentilla recta *	*no data*	POTE RECT	rough-fruited cinquefoil	ROSACEAE	herb	5
Potentilla simplex	*FACU*	POTE SIMP	cinquefoil	ROSACEAE	herb	5
Proserpinaca palustris	*OBL*	PROS PALU	mermaid weed	HALORAGACEAE	herb	1
Prunella vulgaris ssp. lanceolata	*FAC-*	PRUN VULG	heal-all	LAMIACEAE	herb	4
Prunus munsoniana	*no data*	PRUN MUNS	wild goose plum	ROSACEAE	shrub	19
Prunus serotina	*FACU*	PRUN SERO	black cherry	ROSACEAE	tree/sapling	3
Pseudognaphalium obtusifolium	*no data*	PSEU OBTU	rabbit-tobacco	ASTERACEAE	herb	22
Pycnanthemum pilosum	*UPL*	PYCN PILO	hairy mountain mint	LAMIACEAE	herb	7
Pycnanthemum tenuifolium	*FAC-*	PYCN TENU	slender mountain mint	LAMIACEAE	herb	3
Pycnanthemum pilosum X P. tenuifolium	*no data*	PYCN PILO X TENU	hybrid mountain mint	LAMIACEAE	herb	13
Pyrrhopappus carolinianus	*no data*	PYRR CARO	false dandelion	ASTERACEAE	herb	12
Pyrus calleryana *	*no data*	PYRU CALL	callery pear	ROSACEAE	tree/sapling	3
Quercus +	-	QUER SP.	oak	FAGACEAE	tree/sapling	10
*Ranunculus bulbosus**	*FAC+*	RANU BULB	bulbous buttercup	RANUNCULACEAE	herb	1
Ranunculus laxicaulis	*OBL*	RANU LAXI	water plantain spearwort	RANUNCULACEAE	herb	5
Ranunculus micranthus	*FACU*	RANU MICR	rock buttercup	RANUNCULACEAE	herb	19
Ranunculus parviflorus *	*FAC*	RANU PARV	smallflower crowfoot	RANUNCULACEAE	herb	5
Ranunculus sardous *	*FAC+*	RANU SARD	hairy buttercup	RANUNCULACEAE	herb	3
Rhexia mariana	*FACW+*	RHEX MARI	meadow beauty	MELASTOMATACEAE	herb	10
Rhus copallinum	*NI*	RHUS COPA	winged sumac	ANACARDIACEAE	shrub	10
Rhus glabra	*no data*	RHUS GLAB	smooth sumac	ANACARDIACEAE	shrub	10
Rhynchospora harveyi	*OBL*	RHYN HARV	Harvey's beaksedge	CYPERACEAE	herb	5
Rhynchospora macrostachya	*OBL*	RHYN MACR	tall horned beaksedge	CYPERACEAE	herb	1
Rhynchospora recognita	*FACW*	RHYN RECO	beaksedge	CYPERACEAE	herb	14
Rorippa palustris ssp. fernaldiana	*OBL*	RORI PALU FERN	Fernald's yellowcress	BRASSICACEAE	herb	12
Rosa carolina	*FACU*	ROSA CARO	Carolina rose	ROSACEAE	shrub	3
Rosa multiflora *	*UPL*	ROSA MULT	multiflora rose	ROSACEAE	shrub	3
Rosa setigera	*FACU*	ROSA SETI	prairie rose	ROSACEAE	shrub	3
Rotala ramosior	*OBL*	ROTA RAMO	toothcup	LYTHRACEAE	herb	3
Rubus aboriginum	*no data*	RUBU ABOR	dewberry	ROSACEAE	shrub	21
Rubus laudatus	*no data*	RUBU LAUD	plains blackberry	ROSACEAE	shrub	21
Rubus satis	*no data*	RUBU SATI	dewberry	ROSACEAE	shrub	21
Rubus serissimus *	*UPL*	RUBU PASC	Himalayan blackberry	ROSACEAE	shrub	5
Rubus flagellaris	*UPL*	RUBU FLAG	northern dewberry	ROSACEAE	herb	3
Rudbeckia hirta	*FACU*	RUDB HIRT	black-eyed Susan	ASTERACEAE	herb	3
Rudbeckia subtomentosa	*FAC+*	RUDB SUBT	sweet coneflower	ASTERACEAE	herb	3
Ruellia humilis var. humilis	*FACU*	RUEL HUMI	hairy wild petunia	ACANTHACEAE	herb	3
Rumex acetosella *	*FACU+*	RUME ACET	red sorrel	POLYGONACEAE	herb	5
Rumex altissimus	*FACW*	RUME ALTI	pale dock	POLYGONACEAE	herb	4
Rumex crispus *	*FAC*	RUME CRIS	curly dock	POLYGONACEAE	herb	3
Sabatia angularis	*FAC*	SABA ANGU	winged rosepink	GENTIANACEAE	herb	5
Sabatia campestris	*FACU*	SABA CAMP	prairie rosepink	GENTIANACEAE	herb	7

Sagittaria montevidensis	*OBL*	SAGI MONT	duck potato	ALISMATACEAE	herb	3
Salix nigra	*OBL*	SALI NIGR	black willow	SALICACEAE	tree/sapling	3
Salsola tragus *	*FACU*	SALS TRAG	Russian thistle	CHENOPODIACEAE	herb	11
Salvia lyrata	*FAC-*	SALV LYRA	cancerweed	LAMIACEAE	herb	3
Sanicula canadensis	*UPL*	SANI CANA	Canada black snakeroot	APIACEAE	herb	19
Sassafras albidum	*FACU*	SASS ALBI	sassafras	LAURACEAE	tree/sapling	3
Schedonorus arundinaceus *	*FAC-*	SCHE ARUN	tall fescue	POACEAE	herb	3
Schizachyrium scoparium	*FACU*	SCHI SCOP	little bluestem	POACEAE	herb	3
Schoenoplectus tabernaemontani	*OBL*	SCHO TABE	softstem bulrush	CYPERACEAE	herb	9
Scirpus cyperinus	*FACW*	SCIR CYPE	woolgrass bulbrush	CYPERACEAE	herb	20
Scirpus georgianus	*OBL*	SCIR GEOR	Georgia bulrush	CYPERACEAE	herb	3
Scirpus pendulus	*OBL*	SCIR PEND	drooping bulrush	CYPERACEAE	herb	5
Scleria ciliata	*FAC*	SCLE CILI	fringed nutrush	CYPERACEAE	herb	12
Scleria pauciflora var. caroliniana	*FAC+*	SCLE PAUC	fewflower nutrush	CYPERACEAE	herb	5
Setaria faberi *	*UPL*	SETA FABE	Chinese foxtail	POACEAE	herb	3
Setaria italica *	*FACU*	SETA ITAL	Italian foxtail	POACEAE	herb	14
Setaria parviflora	*FAC*	SETA PARV	knotroot bristlegrass	POACEAE	herb	3
Setaria pumila ssp. pumila *	*FAC*	SETA PUMI	yellow foxtail	POACEAE	herb	3
Sherardia arvensis *	*no data*	SHER ARVE	field madder	RUBIACEAE	herb	5
Sida spinosa *	*FACU*	SIDA SPIN	prickly sida	MALVACEAE	herb	3
Sideroxylon lanuginosum	*FACU*	SIDE LANU	chittum wood	SAPOTACEAE	tree/sapling	3
Silene antirrhina	*no data*	SILE ANTI	sleepy catchfly	CARYOPHYLLACEAE	herb	19
Silphium laciniatum	*no data*	SILP LACI	compass plant	ASTERACEAE	herb	7
Sisymbrium officinale *	*no data*	SISY OFFI	hedge mustard	BRASSICACEAE	herb	5
Sisyrinchium angustifolium	*FAC*	SISY ANGU	blue-eyed grass	IRIDACEAE	herb	7
Sisyrinchium atlanticum	*FACW-*	SISY ATLA	blue-eyed grass	IRIDACEAE	herb	5
Smilax bona-nox	*FAC*	SMIL BONA	bull greenbrier	SMILACACEAE	woody vine	3
Smilax rotundifolia	*FAC*	SMIL ROTU	common greenbrier	SMILACACEAE	woody vine	19
Solanum carolinense	*FACU*	SOLA CARO	Carolina horsenettle	SOLANACEAE	herb	3
Solanum sarrachoides *	*no data*	SOLA PHYS	hairy nightshade	SOLANACEAE	herb	6
Solidago altissima	*FACU*	SOLI CANA	tall goldenrod	ASTERACEAE	herb	3
Solidago gigantea	*FACW*	SOLI GIGA	giant goldenrod	ASTERACEAE	herb	16
Solidago rugosa	*FAC*	SOLI RUGO	wrinkleleaf goldenrod	ASTERACEAE	herb	13
Sonchus asper *	*FAC+*	SONC ASPE	spiny sowthistle	ASTERACEAE	herb	10
Sorghastrum nutans	*FACU*	SORG NUTA	Indiangrass	POACEAE	herb	3
Sorghum bicolor *	*FACU*	SORG BICO	sorghum	POACEAE	herb	15
Sorghum halepense *	*FACU*	SORG HALE	Johnson grass	POACEAE	herb	3
Sphenopholis obtusata	*FAC+*	SPHE OBTU	prairie wedgescale	POACEAE	herb	3
Spiranthes cernua	*FACW*	SPIR CERN	nodding ladies'-tresses	ORCHIDACEAE	herb	4
Spiranthes vernalis	*FACW-*	SPIR VERN	spring ladies'-tresses	ORCHIDACEAE	herb	10
Spirodella polyrhiza	*OBL*	SPIR POLY	giant duckweed	LEMNACEAE	herb	5
Sporobolus compositus var. compositus	*UPL*	SPOR COMP COMP	rough dropseed	POACEAE	herb	4
Sporobolus compositus var. macer	*no data*	SPOR COMP MACE	creeping dropseed	POACEAE	herb	22
Sporobolus vaginiflorus var. vaginiflorus	*UPL*	SPOR VAGI	dropseed	POACEAE	herb	8
Steinchisma hians	*OBL*	STEI HIAN	gaping panicgrass	POACEAE	herb	1
Stellaria media *	*FACU*	STEL MEDI	common chickweed	CARYOPHYLLACEAE	herb	5
Strophostyles leiosperma	*no data*	STRO LEIO	wild bean	FABACEAE	herb	8
Strophostyles helvola	*FAC*	STRO HELV	amberique-bean	FABACEAE	herb	3
Stylosanthes biflora	*no data*	STYL BIFL	pencil flower	FABACEAE	herb	7
Symphoricarpos orbiculatus	*FAC-*	SYMP ORBI	coralberry	CAPRIFOLIACEAE	shrub	3
Symphyotrichum dumosum	*FAC*	SYMP DUMO	aster	ASTERACEAE	herb	1
Symphyotrichum ericoides	*UPL*	SYMP ERIC	heath aster	ASTERACEAE	herb	3

Symphyotrichum lanceolatum	*NI*	SYMP LANC	tall white ater	ASTERACEAE	herb	5
Symphyotrichum patens	*no data*	SYMP PATE	spreading aster	ASTERACEAE	herb	4
Symphyotrichum pilosum	*FAC-*	SYMP PILO	white heath aster	ASTERACEAE	herb	3
Taraxacum officinale	*FACU*	TARA OFFI	common dandelion	ASTERACEAE	herb	3
Teucrium canadense	*FACW-*	TEUC CANA	germander	LAMIACEAE	herb	10
Torilis arvensis *	*no data*	TORI ARVE	hedge parsley	APIACEAE	herb	3
Toxicodendron radicans	*FAC*	TOXI RADI	poison ivy	ANACARDIACEAE	woody vine	3
Trachelospermum difforme	*FACW*	TRAC DIFF	climbing dogbane	APOCYNACEAE	woody vine	5
Tragia ramosa	*no data*	TRAG RAMO	noseburn	EUPHORBIACEAE	herb	5
Tridens flavus var. flavus	*FACU*	TRID FLAV	purpletop tridens	POACEAE	herb	1
Tridens strictus	*FACW*	TRID STRI	longspike tridens	POACEAE	herb	1
Tridens X oklahomensis	*no data*	TRID OKLA	Oklahoma purpletop	POACEAE	herb	11
Trifolium campestre *	*no data*	TRIF CAMP	hop clover	FABACEAE	herb	5
Trifolium dubium *	*FACU-*	TRIF DUBI	low hop clover	FABACEAE	herb	5
Trifolium pratense *	*FACU-*	TRIF PRAT	red clover	FABACEAE	herb	3
Trifolium repens *	*FACU*	TRIF REPE	white clover	FABACEAE	herb	2
Triodanis perfoliata var. biflora	*no data*	TRIO PERF BIFL	round-leaved Venus' looking gla	CAMPANULACEAE	herb	19
Triodanis perfoliata var. perfoliata	*FAC*	TRIO PERF PERF	twinflower Venus' looking glass	CAMPANULACEAE	herb	5
Tripsacum dactyloides +	*FACW*	TRIP DACT	eastern gamagrass	POACEAE	herb	19
Typha angustifolia *	*OBL*	TYPH ANGU	narrowleaf cattail	TYPHACEAE	herb	7
Typha domingiensis	*OBL*	TYPH DOMI	southern cattail	TYPHACEAE	herb	3
Typha latifolia	*OBL*	TYPH LATI	broadleaf cattail	TYPHACEAE	herb	14
Ulmus alata	*FACU+*	ULMU ALAT	winged elm	ULMACEAE	tree/sapling	3
Ulmus americana	*FACW*	ULMU AMER	American elm	ULMACEAE	tree/sapling	3
Valerianella radiata	*FAC*	VALE RADI	cornsalad	VALERIANACEAE	herb	5
Verbascum thapsus *	*no data*	VERB THAP	woolly mullein	SCROPHULARIACEAE	herb	11
Verbena bracteata	*FACU-*	VERB BRAC	bigbract vervain	VERBENACEAE	herb	16
Verbena hastata	*FAC*	VERB HAST	blue vervain	VERBENACEAE	herb	3
Verbena simplex	*OBL*	VERB SIMP	vervain	VERBENACEAE	herb	5
Verbena stricta	*no data*	VERB STRI	hoary vervain	VERBENACEAE	herb	21
Verbena urticifolia	*FAC+*	VERB URTI	white vervain	VERBENACEAE	herb	5
Vernonia arkansana	*FAC*	VERN ARKA	Arkansas ironweed	ASTERACEAE	herb	10
Vernonia baldwinii	*UPL*	VERN BALD	Baldwin's ironweed	ASTERACEAE	herb	8
Vernonia missurica	*FAC+*	VERN MISS	Missouri ironweed	ASTERACEAE	herb	3
Veronica arvensis *	*NI*	VERO ARVE	corn speedwell	SCROPHULARIACEAE	herb	5
Veronica peregrina	*FAC+*	VERO PERS	necklace weed	SCROPHULARIACEAE	herb	5
Vicia sativa *	*FACU*	VICI SATI	common vetch	FABACEAE	herb	5
Vicia villosa *	*no data*	VICI VILL	vetch	FABACEAE	herb	19
Vitis vulpina	*FAC+*	VITI VULP	fox grape	VITACEAE	woody vine	3
Vulpia octoflora	*FACU*	VULP OCTO	sixweeks fescue	POACEAE	herb	21
Wolffia brasiliensis	*OBL*	WOLF BRAS	wolffia	LEMNACEAE	herb	11
Xanthium strumarium	*FAC*	XANT STRU	cocklebur	ASTERACEAE	herb	6

Species in bold type are tracked by the Arkansas Natural Heritage Commission (n = 10)

Species in red type are new additions for 2014 (n = 19)

*** = nonnative species (93/450 = 20.7% of total)**

+ = native species intentionally introduced to site (n = 5)

STRATA:

tree = ≥ 5 in dbh and ≥ 20 ft tall

sapling = 0.4 to < 5 in dbh and ≥ 20 ft. tall

shrub = usually 3 to 20 ft tall; multi-stemmed brushy shrubs, small trees, and saplings

woody vine = vines that are woody

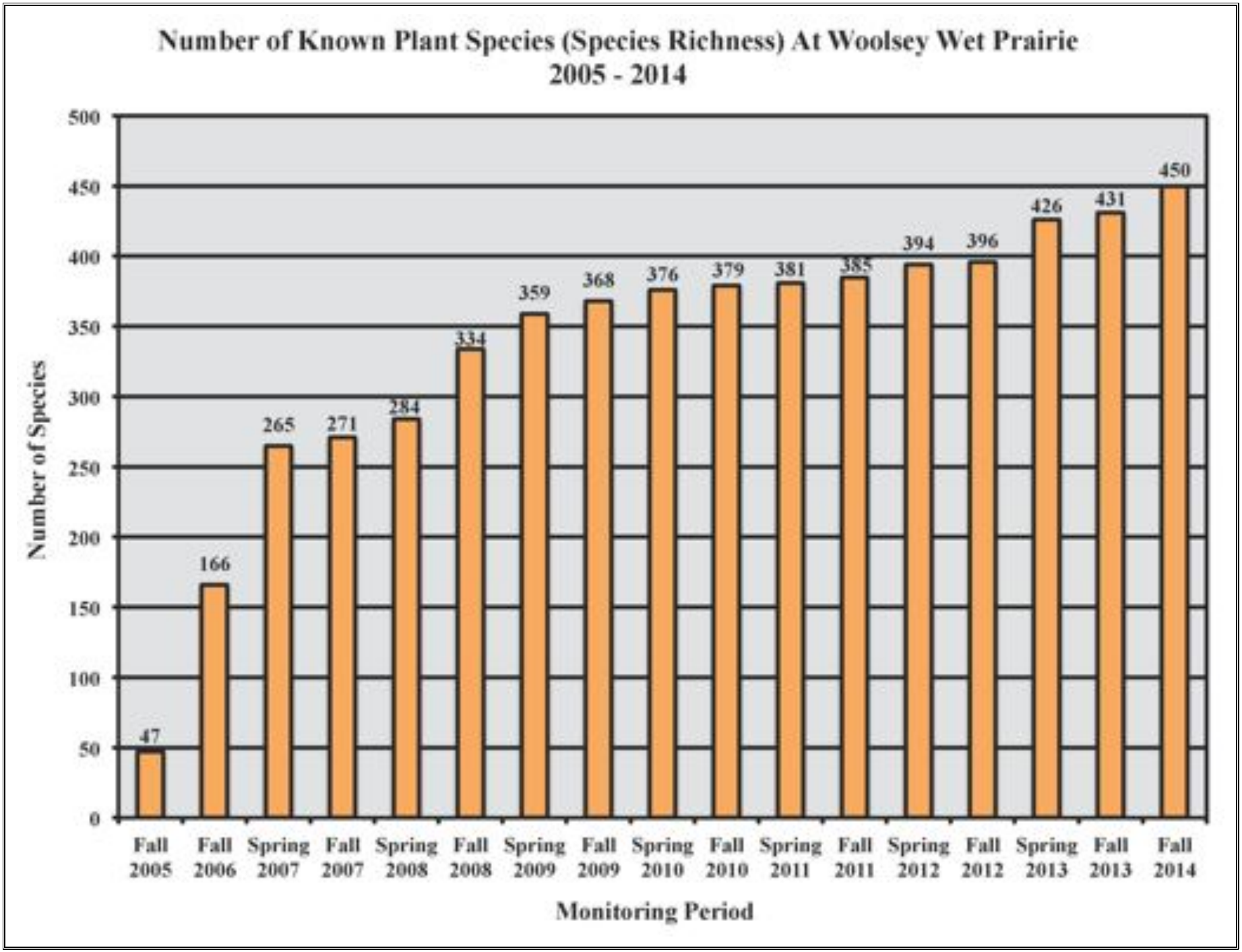
herb = graminoids, forbs, ferns, fern allies, herbaceous vines, tree seedlings

SOURCE CODES:

1 = Chris Reid, site inventory, 17 August 2001 (west side)
2 = Bruce Shackleford, plot data
3 = Theo Witsell, site inventory, 1 August 2006
4 = Theo Witsell, Fall 2006 monitoring & inventory
5 = Theo Witsell, June 2007 monitoring & inventory
6 = Theo Witsell, October 2007 monitoring & inventory
7 = Theo Witsell, May/June 2008 monitoring & inventory
8 = Theo Witsell, September 2008 inventory
9 = Theo Witsell, November 2008 monitoring & inventory
10 = Theo Witsell, July 2009 monitoring & inventory
11 = Theo Witsell, October/November 2009 monitoring & inventory
12 = Theo Witsell, July 2010 monitoring & inventory
13 = Theo Witsell, October/November 2010 monitoring & inventory
14 = Theo Witsell, July 2011 monitoring & inventory
15 = Theo Witsell, November 2011 monitoring & inventory
16 = Theo Witsell, June 2012 monitoring & inventory
17 = Theo Witsell, November 2012 monitoring & inventory
18 = Bruce Shackleford & Seth Pickens, Spring 2013 inventory
19 = Theo Witsell, June 10 & 11 2013 monitoring & inventory
20 = Theo Witsell, November 2013 monitoring & inventory
21 = Theo Witsell, July 2014 monitoring & inventory (with Rubus identified by Dr. Johnnie Gentry, U of A)
22 = Theo Witsell, November 2014 monitoring & inventory

Scientific Nomenclature according to Checklist of the Vascular Plants of Arkansas
Arkansas Vascular Flora Committee. 2006.

Appendix II
Bar Graph Showing Total Plant Species Richness at Woolsey Wet Prairie Sanctuary 2005 – 2014


Number of Known Plant Species (Species Richness) At Woolsey Wet Prairie
2005 - 2014
Number of Species
500
450
400
350
300
250
200
150
100
50
0
47
166
265
271
284
334
359
368
376
379
381
385
394
396
426
431
450
Fall 2005
Fall 2006
Spring 2007
Fall 2007
Spring 2008
Fall 2008
Spring 2009
Fall 2009
Spring 2010
Fall 2010
Spring 2011
Fall 2011
Spring 2012
Fall 2012
Spring 2013
Fall 2013
Fall 2014
Monitoring Period