# Bailey Point
# Natural Resource Management Plan

***Prepared for:***

***The City of Elk River, MN***

*Prepared by:*

Alex Roth
Friends of the Mississippi River
360 North Robert Street, Suite 400
St. Paul, MN 55101
Ph: 651-222-2193 x33
January 2016

## This Natural Area Management Plan and Work Plan has been reviewed and approved by:

**Landowner**

_____ Date: _____
Name, Title, Entity

**Minnesota Land Trust or County**

_____ Date: _____
Name, Title, Entity

## Table of Contents

# LIST OF FIGURES AND TABLES

### *Figures*



### *Tables*

# EXECUTIVE SUMMARY

## Background

This document was assembled by Friends of the Mississippi River (FMR) to guide the restoration and management of Bailey Point Nature Preserve. The property encompasses 24 acres in Elk River, MN and is located at the confluence of the Elk and Mississippi Rivers. Once owner by the Babcock family, the property was purchased by the city in 2012 with the help of the Minnesota Land Trust and a Natural and Scenic Area grant from the Minnesota DNR.

Prior to European settlement, the area including the Bailey Point property was primarily prairie and oak savanna, with some floodplain forest along the rivers. There has been a long history of agriculture in this area of the County and agriculture continues to dominate the overall landscape. However, the area directly around the property is now mostly residential development, highlighting the conversion of agriculture and pasture lands as the City of Elk River expands.

Since European settlement, the property has had a diverse land-use history, including serving as a fairgrounds, golf course, and recreation area, and has experienced continual woody encroachment in recent decades. Historically, conversion of prairie and savanna habitat on the property led to the loss of many native plant and animal species. Existing conditions show evidence of much disturbance to the site, especially a proliferation and dominance of non-native vegetation.

Driven by a lack of natural ecosystems in this matrix of residential and agricultural lands, and by degradation from invasive species and other land use practices, this plan recommends restoring native plant communities on the site. This plan focuses on restoration of prairie and savanna communities, which are targeted by the MN DNR as being among the most in need of restoration in this ecological subsection (Anoka Sandplain/Big Woods subsections). Vegetation and breeding bird surveys are recommended by this plan to monitor the site for plant and bird diversity, the measure of which would show trends that would indicate whether the site's habitat is improving for wildlife.

## Natural Resource Inventory and Assessment

A natural resource inventory and assessment was conducted by staff from Friends of the Mississippi River in the summer and fall of 2015. The Bailey Point property consists of three primary areas: floodplain forest, savanna, and an old hayfield. The narrow belt of floodplain forest rings the entire property and is a mix of silver maple and ash dominated areas, as well as areas of less traditional floodplain species – box elder, hackberry etc. The rest of the property is composed of a hayfield at the north

end and a degraded non-native dominated grassland/savanna in the central and southern portions of the property.

There have been significant restoration efforts on the property, most notably invasive removal in the floodplain forest. The City of Elk River has conducted woody invasive species removal efforts along the northwestern and southern edges of the property. The rest of the property is highly degraded, both in terms of species composition and in the presence of non-native, invasive species. A lack of fire has allowed woody species – both native and non-native – to become overabundant, and has allowed herbaceous invaders to proliferate in the grassland. The hayfield and grassland habitats are dominated by non-native species such as smooth brome and Kentucky bluegrass. Common buckthorn dominates many areas of the woodland understory, while prickly ash is overabundant in some areas and creeping Charlie is present throughout the property. Other non-native herbaceous species are present in both the hayfield and savanna. Another potential issue is erosion of the bank along the Elk River. While this is a lower priority in terms of restoration of the property, it should be given consideration if time and budget allows. Finally, future issues should be considered as well. For example, the large contingent of ash trees on the property is at risk from the emerald ash borer. Understanding these risks and their likelihoods can help design and prepare future management strategies.

## Natural Resource Management Recommendations

Based on the natural resource inventory and assessment, the landowner's past management activities, the city's current goals, as well as general goals by the Minnesota Department of Natural Resources for this landscape, this plan recommends removing invasive species and restoring native prairie and savanna plant communities on the site. Restoration is divided into two phases. The first phase focuses on the removal of non-native woody brush from the entire property, concentrating first on the floodplain forest ring around the property. As time and budget allows, overabundant native woody species should be thinned on these same units, including but not limited to prickly ash. Removal should be conducted in the fall and winter, and may be done through a combination of cutting and treating and brush mowing in certain areas. Follow-up treatment in subsequent years will focus on treating re-sprouts and newly emerged seedlings.

The second phase focuses on prairie and savanna restoration and enhancement. Specific restoration activities include conducting controlled burns throughout the site and prudently targeting invasive species with systemic herbicides. Seeding the savanna with native species after the burn and interseeding to increase diversity will be important tasks. Planting the units with appropriate native shrubs will also help to add species and structural diversity to the site. Continued maintenance of these areas will involve follow-up herbicide treatments, rotating prescribed burns and supplemental seeding. In addition, vegetation and breeding bird surveys are recommended to monitor the site for plant and bird diversity, the measure of which

would indicate whether the management activities are successful and wildlife habitat is improving.

The estimated cost for removing non-native species is $37,600. Prairie and savanna restorations and enhancement will cost an estimated $42,700. These are the biggest priorities and should be undertaken as soon as possible. A comprehensive restoration process would take approximately five years at an estimated cost of $94,100 if all activities are undertaken and contracted. FMR will continue to assist with obtaining grant funding for restoration and enhancement, as well as with the coordination and management of restoration activities.

# INTRODUCTION

This Natural Resource Management Plan presents the site analysis and recommended management and land use activities for the 24-acre Bailey Point property in Elk River, Minnesota (Figure 1). This document can be changed only by written agreement by both the City of Elk River, MN and Friends of the Mississippi River.

Bailey Point is owned by the City of Elk River, Minnesota. The property, one of Elk River's many parks, is located at the confluence of the Elk and Mississippi Rivers and is bounded by the Elk River to the west, the Mississippi to the south and southeast, and residential development to the north. The property itself is essentially a peninsula. The Mississippi river flows freely to the south and east of this area and contains a number of islands on the east side of the property. These islands are part of a State Scientific and Natural Area, the Mississippi River Islands SNA.

The property is approximately 1,663 feet long and 798 feet wide at its maxima. The is within the city of Elk River, with the old downtown lying just to the north of the property and the intersection of US-10 and MN-101/US-169 lying to the east. Private residences flank the property's boundaries on the north and northeast edges.

The property can be divided into three areas: the floodplain forest along the property boundaries, the hayfield on the north end, and the grassland/savanna in between. The site's topography is flat, with the only real grades occurring on the banks of each river. Soils are mainly sandy loam, and range from poorly to excessively well drained.

No rare species occur on the property, though a rare mussel species was recorded just east of the site and two remnants of native plant communities – Dry Sand Gravel Oak Savanna (UPs14b), a state-threatened plant community, and Dry Barrens Oak Savanna (Ups14a2) – occur to the east and southeast.

Bailey Point is located at the edge of the *Anoka Sandplain* ecological subsection, just north of its boundary with the *Big Woods* subsection, as designated by the Minnesota DNR (Figure 2). This subsection lies within the *Minnesota and Northeast Iowa Morainal* section in the *Eastern Broadleaf Forest* province of the state. The property is also situated directly within the Metro Conservation Corridors system (Figure 3), identified as an important habitat network for both sedentary and migratory plant and animal life in and around the Twin Cities. The property is surrounded by a variety of land units identified by the Minnesota County Biological Survey (MCBS) as areas of biological significance (Figure 3), putting it within a network of ecologically important sites.

Due to its more urban nature and disturbed history, there may not be many Species of Greatest Conservation Need (SGCN) that currently utilize the site. However, restoring wildlife habitat is still a priority for this plan, and has the potential to attract SGCNs back to the site. Habitat loss and degradation have been the primary causes of problems for SGCN species in the Anoka Sandplain subsection, with prairie, oak savanna, and grassland currently containing the most species affected. The property's location at the confluence of two water bodies also makes it an important potential habitat for myriad plant and animal species.

Bailey Point presents a unique opportunity to restore land to pre-European conditions, improving habitat for a variety of wildlife species. Given its unique position on the landscape – at the confluence of two rivers and located within the Metro Conservation Corridors – restoration of this property would have a large impact by providing habitat for migrating species. While the majority of the property is in a natural state, the communities are relatively degraded. Improving the health of these ecosystems will benefit many species, some of which are currently experience population declines due to habitat loss and other factors.

The DNR recommends stabilizing and increasing SGCN populations in oak savanna and prairie areas by managing invasive species, using prescribed fire and other practices to maintain savanna and prairie, to encourage restoration efforts, to manage grasslands adjacent to native prairie to enhance habitat, and to provide technical assistance and protection opportunities to interested individuals and organizations. The pre-settlement vegetation for this site was largely "oak openings and barrens" or oak savanna grading into prairie just to the west of the site, and river bottom or floodplain forest along the periphery of the site where it currently occurs today. In its current state the site has been greatly altered throughout its history. Restoring and enhancing savanna and other native plant communities will be one of the top priorities of this management plan. Also improving and expanding the buffer on the Elk and Mississippi Rivers, as well as stabilizing certain badly degraded riverbanks, are priorities, and will be explored in depth herein.

The purpose of this management plan is to:

- Identify the existing ecological conditions on the property
- Identify best management practices to maximize wildlife values, and retain and improve water quality and increase community diversity
- Document allowable uses and activities of the property

Specific ecological and cultural goals for this property are to:

- Increase coverage and diversity of native plant species and reduce non-native species
- Provide connectivity with other natural areas in the landscape and along the river corridor

- Maintain and manage the property for water quality by recommending erosion control and stabilization of riverbanks, and controlling runoff and nutrient loading
- Create a model for responsible public land stewardship
- Utilize this property to guide surface water management activities on adjacent land in a manner that protects and fosters natural community establishment
- Utilize this property to enhance and expand the ecological functions of the area

## SITE INFORMATION

**Owner name, address, city/township, county and phone:**
City of Elk River, Minnesota
1 Morton Ave.
Elk River, MN 55330
Sherburne County
Contact Person: Michael Hecker, Parks and Recreation Director
763-365-1161

**Township, range, section:**
T32N, R26W, Section 4
T33N, R26W, Section 33

**Watershed:**
Clearwater-Elk Watershed

**Parcel Identification Numbers:**
75-402-0020
75-402-0021
75-004-1100

**Rare Features:**
No occurrences on the property.

## FIGURE 1. PROPERTY PARCELS

## LANDSCAPE CONTEXT

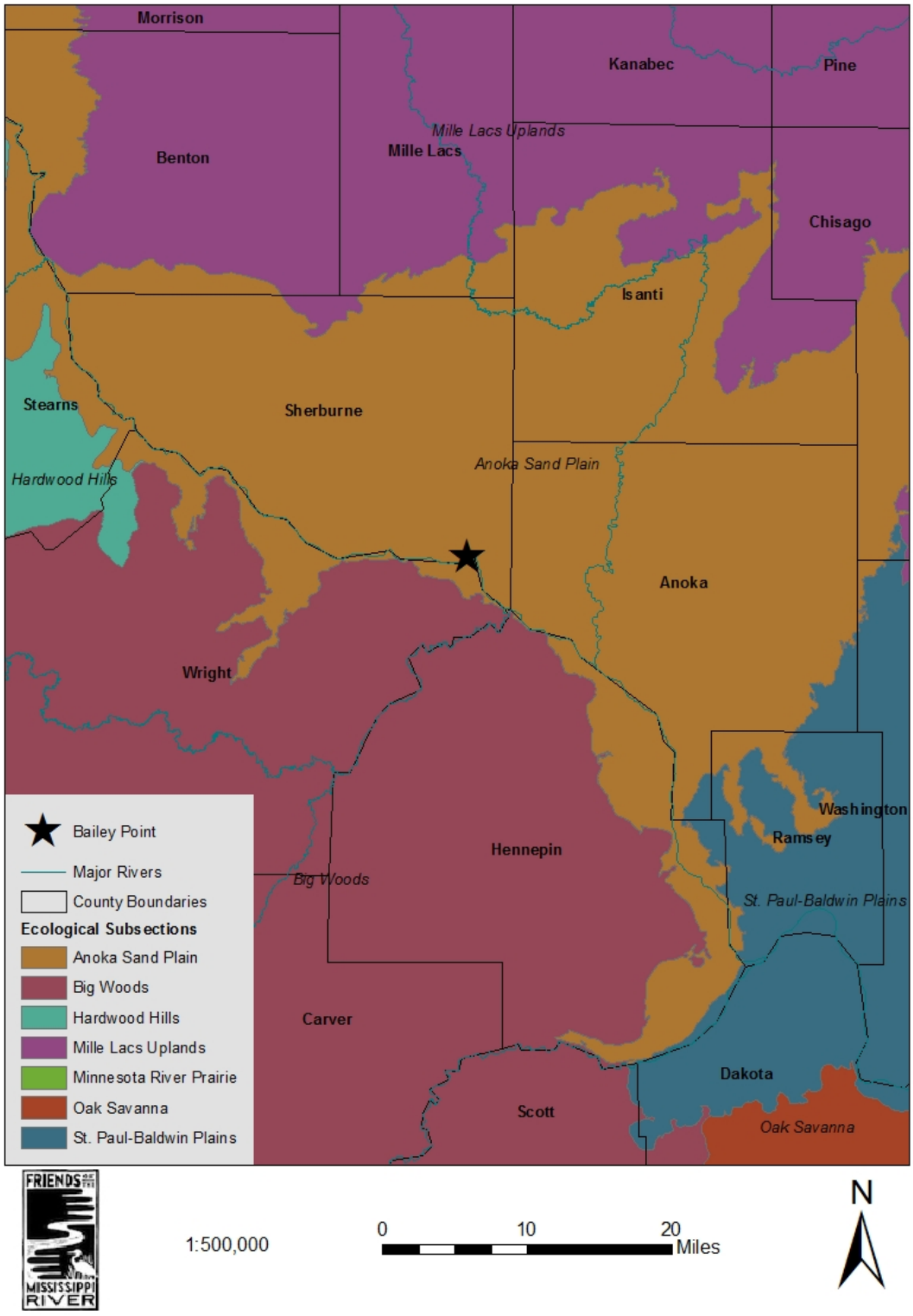
### Proximity to established greenways

This property is located within the Metro Conservation Corridors (Figure 3), a regional land protection plan of the DNR. Bailey Point is also adjacent to the 335-acre William H. Houlton Conservation Area (WHHCA), an Elk River conservation are that is located just across the Elk River and at the confluence of the Elk and Mississippi rivers. Finally, the property is located adjacent to the Mississippi Islands SNA, a chain of seven islands formed by outwash deposited by the Mississippi river designated as a Scientific and Natural Area by the MN DNR.

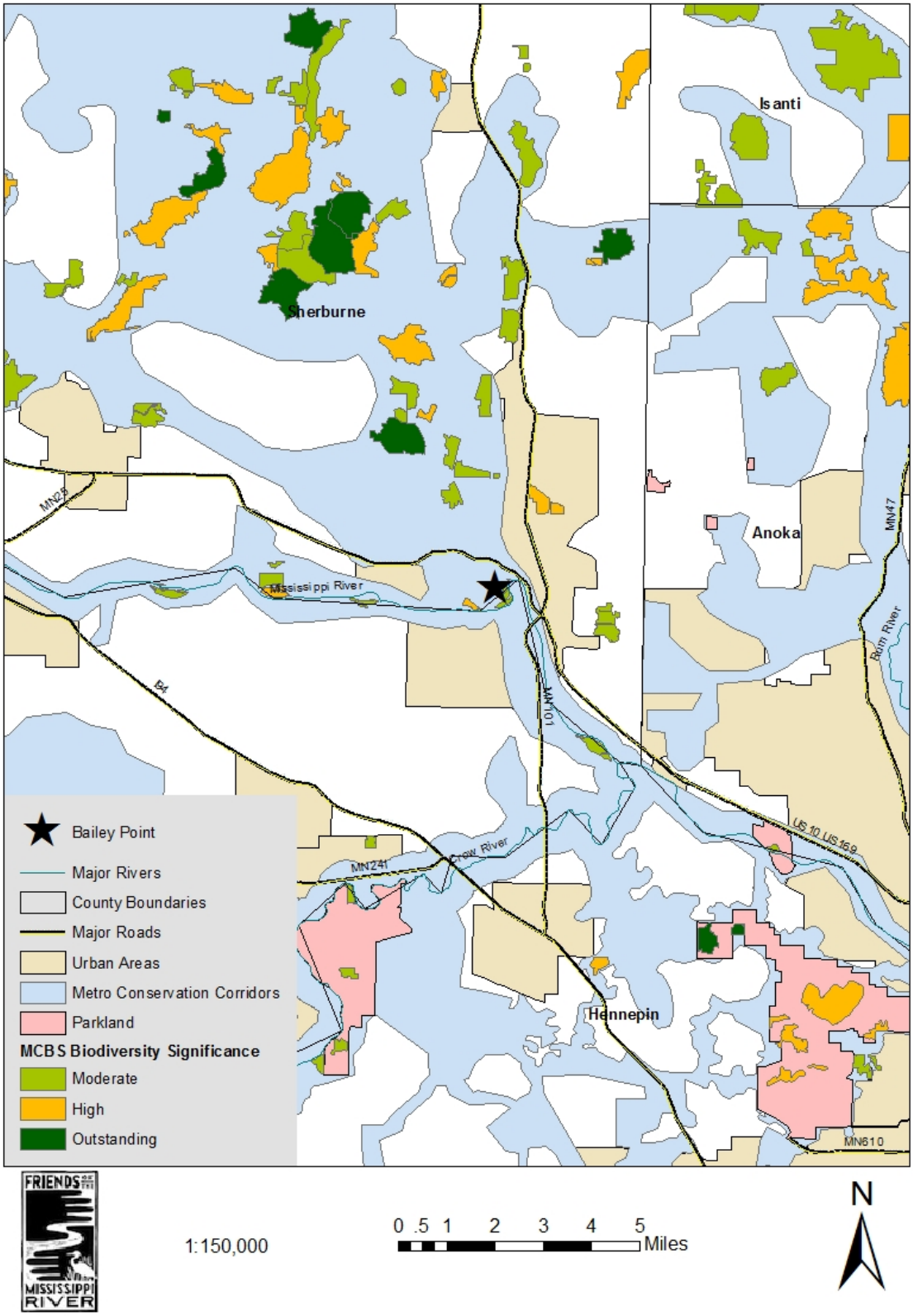
### Ecological significance and wildlife value

The property, although not ranked by the Minnesota County Biological Survey as biologically significant, is situated adjacent to areas ranked as having high and moderate ecological significance by the MCBS, including the Mississippi Islands SNA. It is also located west of county parks and a DNR Wildlife Management Area, and is adjacent to the WHHCA, which will be a large expanse of restored native prairie, savanna and forest. As part of the Elk and Mississippi rivers, this property has inherent wildlife significance. All forms of wildlife depend on these rivers for sustenance, especially invertebrates, amphibians, reptiles, and fish. Mammals and birds also benefit greatly from the water, shelter and nutrients provided by the river, and birds use the Mississippi river corridor as an important migratory flyway.

## FIGURE 2. ECOLOGICAL SUBSECTIONS



## FIGURE 3. LANDSCAPE CONTEXT



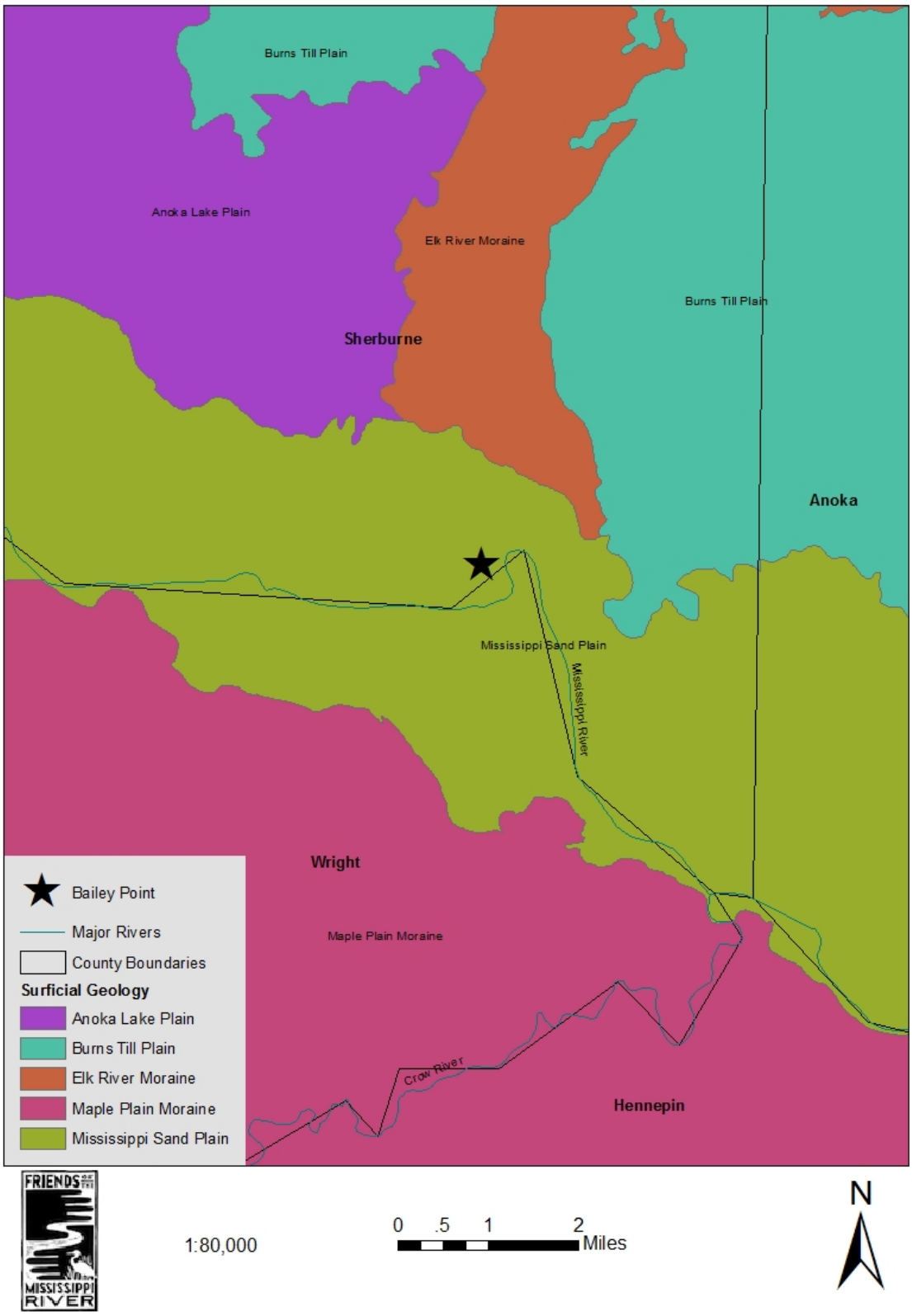
## SITE GEOLOGY AND GROUNDWATER

The surficial geology consists primarily of terraces – areas that were once channels or floodplains – left behind by the Mississippi River in the Pleistocene. These occur above current floodplain areas but below nearby moraine or outwash areas. The property itself is located within the Mississippi Sand Plain (Figure 4).

These terraces are principally sand, gravel, and some finer materials, especially along the Mississippi and its smaller tributaries (Hobbs and Goebel 1982). In and around Bailey Point, the depth from surface to bedrock is 200 feet or less (Olsen and Mossler 1982).

Throughout the site, the depth to groundwater ranges from 15 to 45 feet, which is quite shallow. Groundwater generally flows to the south across the site, roughly in the direction of the confluence of the Elk and Mississippi Rivers.

## FIGURE 4. SURFICIAL GEOLOGY



## TOPOGRAPHY AND SOILS

### TOPOGRAPHY

The site has a generally flat topography, though the land slopes slightly to the rivers as it approaches the Elk to the west and the Mississippi to the south and east. To the north of the property, the land slopes noticeably upward to the neighboring residences, and some of this slope is captured in the northwest corner of the property. Here, the land slopes steeply upward from a slight depression west of the field edge up to the houses; this slope ranges from 6 to 35%, while the majority of the site is between 0 and 6%. Elevation of the site ranges from a low of 854 ft above sea level to a high of 872 ft in the northwest corner. The majority of the site ranges between 858 and 862 ft above sea level.

### SOILS

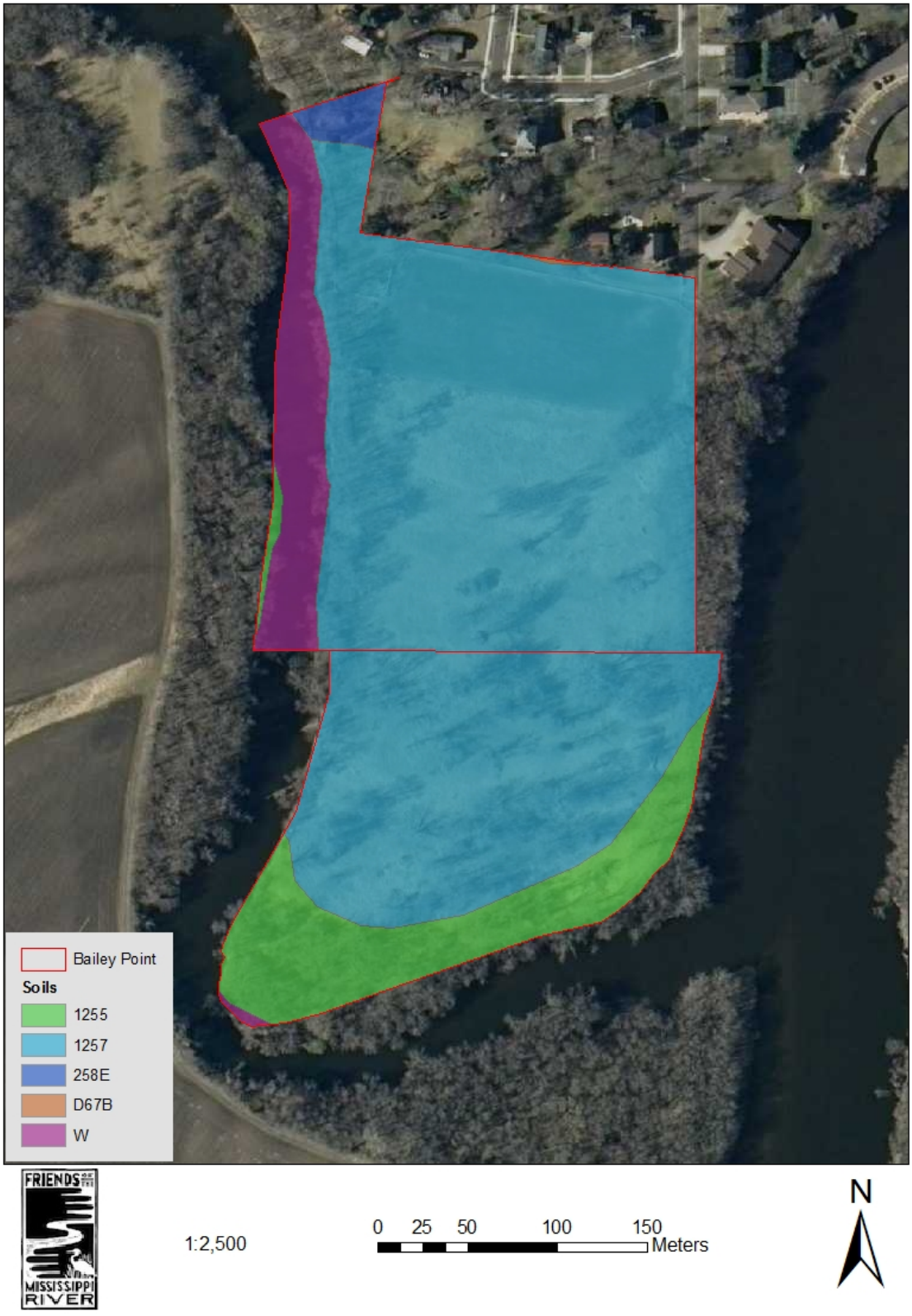
Soils vary relatively little in character across the site and are heavily influenced by the river features. Most of the soils on the site are loamy soils, meaning that they are a mix of sand and silt, with clay composing a small fraction of the mix. These soils are nutrient and moisture rich and are ideal for agriculture. Along the river channel on the south end of the site, the soil is generally fine sandy loam, meaning it contains a large percentage of fine sand deposited by the river flow. These areas experience occasional flooding, which works to routinely deposit new soil. A summary of soils and their associated characteristics is listed in Table 1, and can be visualized in Figure 5.

Soil formation is the result of the interaction of five soil-forming factors: parent material, climate, organisms, topographic position or slope, and time (Foth, 1990). Taken collectively, these factors can help determine the dominant floral and faunal communities that helped form the soils. Brodale, Copaston, Etter, Terril, Wadena, and Waukegan are all *mollisolls*, which are prairie soils, generally deep, dark in color, and rich in cations, and thus would have been dominated by graminoid vegetation (prairie or savanna) prior to European settlement. All of the soils of the project area are well drained or excessively well drained. None of them are considered hydric soils, which indicates that they are not wet enough for long enough to develop organic matter accumulations. Due to the fine, sandy nature of some of the soils, the erosion potential is mostly medium; none of the soil types present have a high erosion potential.

## TABLE 1. SOILS

| Soil Code* | Soil Name | Percent Slope | Acres | Soil Family | Hydric (yes or no) | Drainage | Erodibility (Susceptibility to water (Wa) & wind (Wi) ) |
|---|---|---|---|---|---|---|---|
| 258E | Sandberg loamy coarse sand | 12 to 35 | 0.29 | Sandy, mixed, frigid Calcic Hapludolls | N | Excessively drained | Wi, Wa |
| 1255 | Elkriver fine sandy loam, occasionally flooded | 0 to 2 | 3.03 | Coarse-loamy, mixed, superactive, frigid Cumulic Hapludolls | N | Somewhat poorly drained | Wi |
| 1257 | Elkriver-Mosford complex, rarely flooded | 0 to 6 | 18.48 | Coarse-loamy, mixed, superactive, frigid Cumulic Hapludolls / Sandy, mixed, frigid Typic Hapludolls | N | Moderately well drained | Wi, Wa |
| D67B | Hubbard loamy sand, Mississippi River Valley | 2 to 6 | 0.02 | Sandy, mixed, frigid Entic Hapludolls | N | Excessively drained | Wi |
| W | Water | 0 | 1.88 | NA | Y | NA | NA |

## FIGURE 5. SOILS



## RARE SPECIES

According to the DNR natural heritage database, there are no rare species recorded on the Bailey Point Nature Preserve. However, there were three elements recorded within five miles of the site. The closest element of occurrence exists about 0.6 miles to the east in the Mississippi River. There, surveys found *Ligumia recta*, or the black sandshell mussel, a species of special concern in Minnesota. Further to the east and southeast (roughly 3.5 to 4.2 miles from the property border), remnants of the native plant communities Dry Sand Gravel Oak Savanna (UPs14b), a state-threatened plant community, and Dry Barrens Oak Savanna (Ups14a2) occurred. The Dry Sand-Gravel Savanna was last observed in 1989 and had a "fair" estimated viability, while the Dry Barrens Oak Savanna was observed in 1989 and had a "poor" estimated viability. The field notes read as follows:

"Pin and bur oak dry sand savanna. Park-like canopy dominated by Quercus Ellipsoidalis and Quercus macrocarpa (DBH 20-30cm) with occasional Juniperus virginiana. Shrub layer approximately 25%: Zanthoxylum americanum, Juniperus virginiana, Corylus americana, and Rubus occip. Ground cover dominated by disturbance species: Poa pratensis, Bromus intermis, Agropyron repens and a few Linaria vulgaris, Berteroa incana, Verbena stricta and Achillea millefolium."

This description could be similar to the historical vegetation on what is now grassland at the site – minus the non-native species. The property lies within what was historically savanna – then called "oak openings and barrens" – lending support to this description as indicative of what may have historically occurred on the property.

Although rare species are not likely to occur at the site, a restored Bailey Point would provide habitat for a number of Species of Greatest Conservation Need (SGCN). SGCNs are species designated by the DNR and presented in *Tomorrow's Habitat for the Wild and Rare* (DNR 2006) as those in need of conservation, or species whose populations have experienced large declines in their respective ecological subsections. Thus, restoring wildlife habitat is still a priority for this plan. Habitat loss and degradation have been the primary causes of problems for SGCN species in the subsection, with the greatest number of species dependent on prairie, oak savanna, and grassland. The property's location at the confluence of two water bodies also makes it an important potential habitat for myriad plant and animal species. The DNR recommends stabilizing and increasing SGCN populations in oak savanna and prairie areas by managing invasive species, using prescribed fire and other practices to maintain savanna and prairie, to encourage restoration efforts, to manage grasslands adjacent to native prairie to enhance habitat, and to provide technical assistance and protection opportunities to interested individuals and organizations.

## EXISTING WILDLIFE POPULATIONS

As stated in previous sections, there are no rare species occurrences recorded on the property. However, a rare mussel species was found in the Mississippi River to the east of the property. It is possible that this species and others are present throughout this reach of the Mississippi, and indeed other mussel species – both live and dead – were found in the waters bordering the property (likely to be *Strophitus undulatus*, or the creeper mussel, though identification is difficult to confirm).

Although no longer a rare species, bald eagles remain on the DNR watch list and are frequently seen at Bailey Point. Besides the numerous eagles seen flying along the river and across the property (there is a nearby nest at the WHHCA), a large nest occurs in the grassland area. The nest has been recently successful, though no eagles fledged from the nest in 2015. Currently, signs denote nest viewing areas from a safe distance, though care must still be taken not to disturb the nest, especially during the nesting season.

Other wildlife seen in regularity at Bailey Point include white-tailed deer, gray squirrels, red tail hawks, mallards, great blue herons, and numerous insects, including honeybees, bumblebees, dragonflies, damselflies, and monarch butterflies. On occasion, coyotes, rabbits, and red squirrels have been seen on the property. There is also evidence of beaver activity on the property. Stumps left by beavers are visible throughout the floodplain forest, especially along the Elk River, though most if not all were not likely felled in the last one or two years.

## HISTORICAL VEGETATION

Based on interpretation of the 1850s public land survey (PLS), in which the dominant tree (bearing tree) and other vegetation was recorded at every one-mile interval, the boundaries of the Bailey Point Nature Preserve lie within what would have been oak openings and barrens in pre-European settlement times (Figure 6). The property lies on the border of historical floodplain forest and near areas of prairie as well. The land cover type in this region was mosaic of different habitats ranging from oak openings and floodplain forests, to prairie, big woods forests, and aspen-oak woodlands. The most common land cover type of the region was oak openings and barrens, which we today would call savanna. Savanna is an area of scattered trees, primarily bur oak, with areas of open prairie between them. Prairie was an area dominated by mixed height grasses and forbs (wild flowers), with patches of shrubs and very few to no trees. The difference between prairie and savanna is created by frequency and intensity of fire. Generally, frequent fire (every 2 to 5 years) will result in prairie, while slightly less frequent fire (3 to 8 years) will result in savanna.

Today, the south end of the Bailey Point property is classified as floodplain forest. However, whether trees historically lined the entirety of the river channels is unclear. While much of the current floodplain forest areas were likely floodplain forest in pre-settlement times, areas of the river may have been lined with savanna or prairie vegetation. Prairie and savanna grasses could have grown right up to the channel, perhaps forming lips over the banks and stabilizing the bank slopes, as currently occurs in other neighboring areas.

Bearing trees were noted by the 1850s PLS surveyors to help identify each section of land. If no trees were in the section, that was also noted. No bearing trees were recorded within the Bailey Point boundary, though two were identified on the adjacent WHHCA. Both trees were identified as “bur oak”, providing further evidence that this area was likely a mix of prairie and oak savanna vegetation. Note that the soils data and the pre-settlement vegetation data concur: soils are prairie soils and pre-settlement vegetation shows prairie and savanna land cover.

Historical aerial photos can also help us reconstruct what the vegetation was like during the last 75 years. The oldest aerial photo that we have for this site is from 1939 (Figure 7), and sheds light on past conditions of the area. At that time, the present day cropland was being cropped, but some of the natural areas of the property were much more open than present conditions. Many of the floodplain forest areas had a sparser canopy and looked more similar in structure to vegetation found in a savanna-type landscape. While a thin strip of tree cover lines the majority of the riverbanks, some areas were relatively open right up to the rivers’ edge. Moreover, in what is now some of the larger floodplain areas, it is easy to see the more open nature of the habitat, with trees interspersed with more open grassy areas. This is especially true on the northeast side of the property, where a small

savanna patch remains, and the northwest side, where what is now scrubby, mainly non-native forest once looked largely open. Furthermore, there is an increase in tree cover in the floodplain areas on the south side of the property.

The same changes can be noted on the south banks of the Mississippi River; trees were present but sparse – they did not form closed canopied forests. Currently, the vegetation there is largely forested, with pockets of grassland interspersed throughout. A progression of historical photos helps us to understand how the vegetative structure has changed over time (Figure 7; Figure 8; Figure 9). This all points to the likelihood that parts of what is now classified as floodplain forest or woodlands were once savannas 75 years earlier.

## FIGURE 6. PRESETTLEMENT VEGETATION

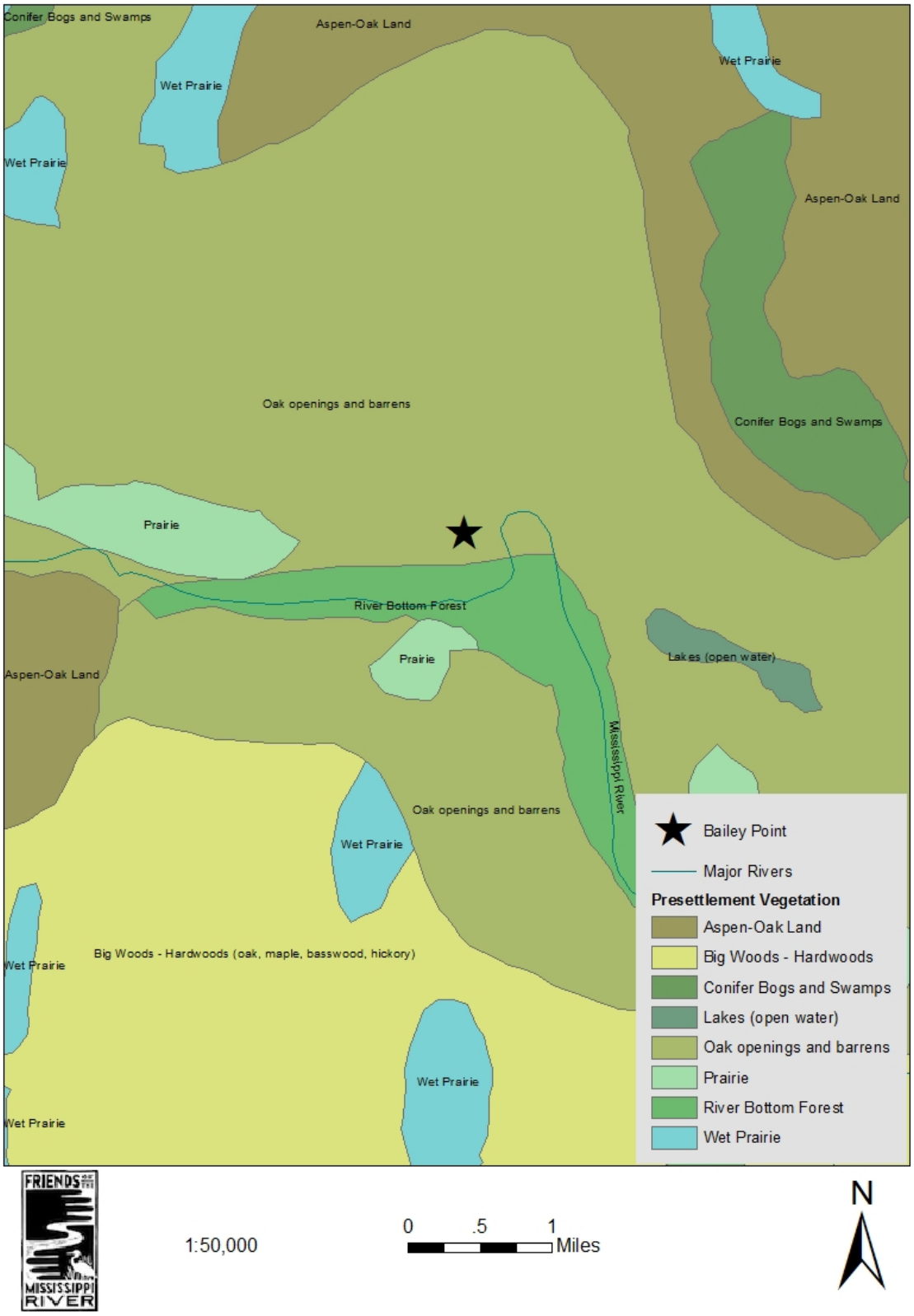


**FIGURE 7. 1939 AERIAL PHOTO**

**FIGURE 8. 1957 AERIAL PHOTO**

FIGURE 9. 2013 AERIAL PHOTO

## HISTORICAL AND EXISTING LAND USE

Records of land use before European settlement are lacking, but some evidence exists that this site may have been used in pre-European settlement days. Aside from the site's obvious importance at the confluence of two major rivers, the site is located in proximity to a number of other sites where evidence of Native American activity was found. A number of quartz flakes and projectile points (aka arrowheads, spearheads etc) have been found in and around Elk River, including just east of the site across highway 10. In 2005, researchers from St. Cloud State University conducted archaeological investigations on the WHHCA. They uncovered quartz and non-quartz flakes and a probable projectile point in the northern half of the farm field, and found further flakes and ceramic pieces at the confluence of the Elk and Mississippi rivers, just across from Bailey Point. While the investigation was halted, their report recommended further investigation of the area. In 2013, SCSU researchers conducted at dig at Bailey Point, finding a flake, as well as some tin cans and bottle caps dating to around 1900.

The site was the home to the Sherburne County fairgrounds from 1916 into the 1950s. A large pavilion (roughly 60 ft x 120 ft) was constructed on site, as were barns for farm animals. The site was also home to a nine-hole golf course, though three of the holes were located on what is now the WHHCA. These were connected

by a bridge that spanned the Elk River at the site of the old ox cart trail. The Elk River tourist camp was situated south of the golf course on the southern tip of the island. Later, the northern end of the site was used as the local high school's football field, and a tennis court was erected on the northwest corner of the property. While none of this is visible in the historical aerial photos, you can see evidence of the circular golf course greens in the 1939 photo (Figure 7).

In the 1939 aerial photos, agricultural fields dominated the landscape to the west of the site, and many occurred where they do not occur today. For example, the agricultural fields west of downtown Elk River are now largely residential subdivisions. North and east of the property, the city of Elk River looked much as it does today, though with fewer houses and other structures. The major streets throughout the area, including Main St., were all present in 1939. New road construction occurred when developing the neighborhoods to the west.

In the immediate area of the property, the river channels do not seem to have been altered, though the size and number of islands east of the property has changed. Comparing the 1939 and 2013 aerial photos, the water level was historically lower, with more islands visible in the channel. While this may simply be due to yearly fluctuations, aerial photos from the intervening period (1957 and 1991, not shown) seem to show a gradual loss of these islands. These smaller islands were both sandy and vegetated, creating many small channels that wove through this stretch of river.

The general vegetative structure of the property hasn't changed much, though comparing the 1939 and 2013 aerial photos shows woody encroachment in many of the open areas. The Bailey family kept horses and likely grazed and mowed areas of the property. Since then, these areas have become more densely vegetated. Invasive shrubs like buckthorn and honeysuckle have come to dominate many areas, and other shrubs and small trees have increased overall woody cover, creating more pockets of woodland vegetation in the matrix of prairie and savanna areas.

## WATER RESOURCES

### Surface Waters – Rivers

The Elk and Mississippi rivers are the obvious surface water resources in this area. The Orono Dam controls water flow rates in this lower stretch of the Elk River. Following large rain events, especially in the spring, flows can be quite high, though the river rarely floods. Since the river does not flood often, the floodplain tends to be quite narrow, and it tightly follows the course of the river. Flood resistant vegetation reflect this narrow band, with floodplain species occurring in a small band along the river channel. Therefore, prairie vegetation would broadly occupy the uplands, and come very near the river valley. Along the southern edge of the property and along the Mississippi, the situation is somewhat different. The floodplain forest is wider here and is influenced by the greater fluctuations in flow of the Mississippi River.

### Floodplain

In 1965, an historic flood occurred throughout the state. The city of Elk River suspended classes so that male students could help sandbag local establishments and other key areas of the city. Water levels from this flood rose to cover a large portion of the Bailey Point property. Today, more than half of the property lies within the floodway and more of the property is located within riverine zones. Boundaries for the 0.2% annual flood risk cover much of the remaining area.

Historically, erosion has not been a problem on the property. However, there are some smaller areas where the bank is eroding along the Elk River. These areas are mainly vegetated by non-native grasses, and do not have tree cover to hold the soil in place. Toward the northwest corner of the property, some vegetation management has occurred, and rip rap was installed to stymie any potential erosion.

### Buffer Areas

The floodplain forest surrounding the property acts as a natural buffer for the waterways. In areas where the forest is wider, is should provide very good water quality protection. Here, runoff from the property can settle before entering the river, and the forest in turn buffers the rest of the property from rapid changes in water levels. The buffer width on the south side of the property is wider than the buffers on the east and west edges. Attempting to increase the buffer sizes through re-vegetation would provide many benefits, including erosion reduction and mitigation of runoff into the river.

### Stormwater Management Issues

The property is somewhat affected by runoff from adjacent properties. The Orono dam largely controls the flow of the Elk River along the north and east sides of the property, while the Mississippi borders the property to the east. Thus, most runoff from adjacent land use flows into those two rivers before it can reach the Conservation Area. Natural flooding of the property can and does occur, especially on the southern tip and on the east side of the property. However, there are also residential properties on the north and west sides that supply some runoff to the

site. These properties are mostly located at a higher elevation than the property, and runoff from roads and driveways likely flows onto the property. Morton Avenue and the parking lot may also be a source of runoff, as the pavement is a large impervious surface. Re-vegetating the property with native prairie species with larger and deeper root systems will help to retain water and prevent runoff from rapidly entering the rivers.

## ADJACENT LAND USE

Land use around the Bailey Point Nature Preserve is dominated by residential and urban development (Figure 1). The Elk and Mississippi Rivers border the property on three sides. Residential neighborhoods and the city of Elk River exist to the north. The WHHCA, purchased by the City of Elk River in 2015, lies just across the Elk River to the west. Across the Mississippi River to the south and east is a mix of residential and agricultural use. Within the Mississippi River to the south and east are high quality natural islands, which are part of the Mississippi Islands SNA. The Elk and Mississippi Rivers run through rural and agricultural land to the west and north (upstream from the site), until they reach the outskirts of Elk River, where they begin to pass through more residential and eventually urban landscapes. This means that urban and residential runoff, agricultural nutrient loading, pollutants, and warm water from streets, roads, parking lots, buildings, etc., all affect these waters before they arrive at the site. At the southeast corner of the property, the Elk and Mississippi Rivers combine before turning southward, flowing southeast through a more urban landscape and eventually reaching the Twin Cities metro area.

# EXISTING LAND COVER & ECOLOGICAL MANAGEMENT RECOMMENDATIONS

The Department of Natural Resources (DNR) developed a system called the Minnesota Land Cover Classification System (MLCCS), which integrates cultural and vegetation features of the landscape into one comprehensive land classification system. This information was used as a basis for the site evaluation, which was conducted by FMR's ecologist in the summer of 2015.

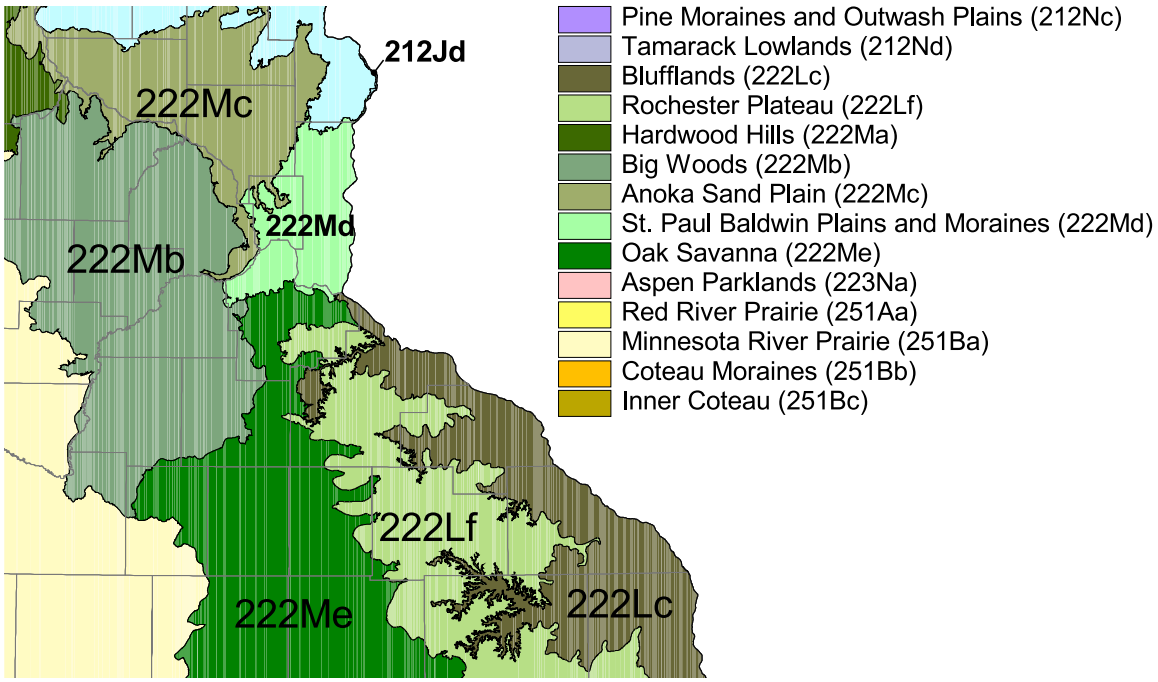
For determining target plant communities for restoration (Table 2), we considered the following: 1) historic conditions, 2) existing conditions, 3) relative effort vs. benefits, and 4) the desires of the City of Elk River. Relative effort vs. benefit simply means that if the amount of energy and work that needs to go into restoring a particular community is too great, in terms of the benefits received, then restoration would not be recommended. This helps us determine the optimal and most suitable goals for restoration. Target communities are in accordance with the DNR field guides and are described below.

As a guideline for the target plant community goals, we used the *Field Guide to the Native Plant Communities of Minnesota: the Eastern Broadleaf Forest Province* (DNR, 2005). This book describes the system developed by the Minnesota Department of Natural Resources for identifying ecological systems and native plant community types in the state, based on multiple ecological features such as major climate zones, origin of glacial deposit, plant composition, and so on.

There are four ecological provinces in Minnesota (prairie parkland, eastern broadleaf forest, Laurentian mixed forest, and tallgrass aspen parkland), ten sections within the provinces, and 26 subsections. The Bailey Point Nature Preserve is classified as follows (Figure 10):

Ecological Province: *Eastern Broadleaf Forest*
Section: *Minnesota and Northeast Iowa Morainal*
Subsection: *Anoka Sand Plain*

## FIGURE 10. ECOLOGICAL SUBSECTIONS OF SOUHEAST MINNESOTA




As stated earlier in the Historical Vegetation section, the pre-settlement vegetation at Bailey Point was most likely a mix of floodplain forest, oak savanna and prairie. This is still appropriate for most of the site, although there has been some woody encroachment. Some areas that had likely been prairie and savanna have succeeded to overgrown woodland/savanna. In addition, small amounts of mowed turf occur around the parking lot and around the current location of the buildings in the northwest corner. This may make maintenance of these areas easier for the city. For the majority of the site, however, oak savanna, prairie and floodplain forest is most appropriate.

## PLANT COMMUNITY ASSESSMENT

### Land Cover

The following are descriptions of the various cover types found on the property. The cover types were described and designated by Minnesota Land Cover Classification System (MLCCS). They were then arranged in order of size of area, with the largest cover types listed first and the smallest listed last. Cover types may be represented by multiple units of the same cover type (e.g. Floodplain forest represented by FF-1, FF-2, FF-3, etc.). Please refer to Figure 11 (Landcover), Figure 12 (Features of Interest) and Figure 13 (Target Plant Communities) throughout this section. Detailed plant lists surveyed from certain unit are provided in Appendix A.

## FIGURE 11. EXISTING LAND COVER

### Altered non-native grassland with sparse deciduous trees (13.45 acres)

This is the largest unit on the property and encompasses everything south of the hayfield and within the floodplain ring. This unit is roughly delineated on the north side by the band of ash trees that grow along an east/west wet depression (Photo 1). The northern portion of the savanna area is relatively open, with a few scattered trees. Moving south, the tree cover increases, and clumped stands of oaks and other species become more frequent. While the species composition may not reflect a typical savanna, the structure is more reflective of a typical oak savanna.

The grassland is dominated by smooth brome, though occasional native grasses and sedges are present. The large bur oaks grouped and scattered throughout the unit range in size from 51.4-88.0 cm dbh, and most have large laterally growing branches indicative of historically open-grown trees (Photo 2). Other species present include cottonwood (97.9 cm dbh), green ash (83.9, 105.7 cm dbh) and, further south, silver maple (82.6, 112.0 cm dbh). Invasive shrubs and herbaceous plants are common around the bases of these trees, and include species like buckthorn, honeysuckle, burdock, and thistles (Photo 3). Siberian elm seedlings are also present on occasion.

This grassland should be managed as a savanna, and fire must be used to prevent further woody encroachment. Native savanna seed should be added post-burns to establish cover that will help to compete with the non-native grasses. Small diameter trees can also be removed (except for any oaks), to mimic the composition and structure of historical savannas. Copses of oaks can also be added if time and budget allows.

Photo 1. Looking north at the row of ash separating the grassland unit from the hayfield/prairie area.

Photo 2. A copse of oaks growing in the grassland.

Photo 3. Oaks, ash and other trees dot the savanna. Notice the shrubs (prickly ash and buckthorn) below the larger trees.

## Floodplain Forest (4.43 acres)

This landcover unit exists as a narrow ring around the property on the east, south and west sides. The unit can be divided into two distinct subunits: FF1 is the narrow strip along the western edge of the property and FF-2 is the wider strip along the south and east edges. These sub-units are approximate, and serve to better aid the discussion of the vegetation types on the property. They are roughly delineated on the map.

### FF-1 (1.47 acres)

FF-1 is a narrow unit on the west side of the property with both traditional silver maple dominated areas as well as areas dominated by green ash, hackberry, and black walnut. A north/south path runs alongside this unit and separates it from the neighboring hayfield and savanna units. Many of the individual trees are younger and are interspersed with older silver maples. A common measure of tree size and size distribution is a tree's diameter at breast height, or dbh. Hackberries on the site range in size from 5-39.5 cm dbh, though a larger individual (44.4 cm dbh) exists further into the grassland. Green ash individuals range from 11-42.6 cm dbh, while some larger black walnut trees (55.0, 65.9 cm dbh) are interspersed throughout. In some areas, silver maple dominates almost to the point of a monoculture (11.0-82.3 cm dbh), with some prickly ash and wood nettle in the understory.

Moving from north to south along the bank, the City of Elk River has removed invasive shrubs in the northern portion of the unit. This is evidenced by large stumps of both honeysuckle and buckthorn, and by the open and relatively sparse remaining understory. In some areas, the only remaining woody plants are in a narrow belt right along the shoreline, though the unit itself may be considerably wider. Along the northern half of the unit, smaller riprap has been installed along the bank to prevent erosion (Photo 4). However, the lack of vegetation above the riprap line means that erosion could continue. Planting trees and shrubs in the removal areas is an important priority for this subunit.

Further to the south, the silver maple cover increases and the unit widens somewhat (Photo 5). Beaver evidence is abundant in this area, though there is no sign of recent activity. Further south, the silver maple overstory dissipates and the bank becomes dominated with shrubs, both native and non-native. Honeysuckle, buckthorn and prickly ash make up the majority of individuals, and the vegetation slowly grades to an open, grassy bank further to the south. This area, where a bench overlooks the Elk River, has experienced more erosion, as the bank is higher than the water level and is not rip-rapped or vegetated other than with a cover of non-native grasses (Photo 6). Here, native vegetation could help prevent further erosion, though sight lines from the bench will likely need to be preserved. If time and money allow, other erosion control measures (log vanes, rock vanes, root wads, rip-rap, etc) can be considered.

Overall, re-vegetating and expanding this unit can provide benefits, most important of which include erosion control water filtration, and protection of the property from flooding. The remaining woody invasive species should be removed, and native trees and shrubs should be added in some places. Further to the south, grasses and other savanna species should replace the non-natives grasses, and streambank stabilization measures can be installed if the budget allows.

Photo 4. Looking south at invasive removal along the Elk River. Rip-rap is visible along the shoreline, as is evidence of historical beaver activity.

Photo 5. One of the wider FF-1 areas. The area is dominated by silver maple, though scattered green ash and cottonwood are present as well.

Photo 6. The open bank area near the bench overlook at the south end of FF1. Re-vegetation of this area will help to stymie erosion along the bank.

### FF-2 (2.96 acres)

FF-2 is a slightly wider floodplain area along the southern and eastern edges of the site. Here, the vegetative community is dominated by more traditional floodplain species, including silver maple, green ash, and an occasional cottonwood and willow (Photo 7). These trees are, on average, larger than those in FF-1, with a smaller component of younger trees. The understory is a mix of more flood tolerant species, and is dominated by wood nettle, clearweed and creeping Charlie.

This unit encompasses the final stretch of the Elk River before it empties into the Mississippi (Photo 8). The unit is wider than FF-1, and contains more true floodplain areas. Many large silver maples dominate this unit, and range from 15.7-96.1 cm dbh. Green ash, scattered hackberry and the occasional American elm are present as well. At the edge of the unit, a path separates the floodplain area from the adjacent savanna area. Prickly ash and other shrubs dominate the edge of the path, where vines like Virginia creeper and wild grape are common as well.

In the fall of 2015, the city removed buckthorn and other invasive shrubs along the southern tip of the property (Photo 9). A large amount of material was removed, and

will be burned in the winter of 2016. Scattered buckthorn stems remain, and the southeastern and eastern side of the property has yet to be managed. Furthermore, the floodplain forest on the neighboring properties should be managed to avoid propagules re-entering the site.

Photo 7. A large willow along the bank of the Elk River

Photo 8. The confluence of the Elk and Mississippi Rivers. The Elk River enters from the right.

Photo 9. A long pile of buckthorn removed from FF-2. The path between the unit and the savanna can be seen in the center of the picture

### Hayfield (2.36 acres)

This area is a roughly rectangular section on the north edge of the property. It once served as a pasture for the Bailey family's horses, as well as the location of the Elk River high school's football field. Throughout its history it has been consistently mowed, and now contains a grassy trail running from the parking lot to the river (Photo 10). Non-native grasses still largely dominate the unit, including smooth brome and Kentucky bluegrass, though a few native species are interspersed throughout. However, pockets of reed canary grass exist in both the hayfield and neighboring grassland. These populations should be removed before the species is able to gain a greater foothold in the area. Overall, restoration to a mesic prairie is recommended.

Native species in the unit include common milkweed, yarrow, hoary vervain, violets, and wild bergamot. Other weedy and non-native species include white campion, creeping Charlie, dandelions, birdsfoot trefoil, common mullein, and motherwort. Many woody seedlings, including wild grape, box elder, green ash, and walnut, are present in the hayfield, signaling the need for an eventual prescribed burn to prevent further woody encroachment.

Finally, a small depression runs east to west along the southern side of the hayfield. This wet area contains a stand of young ash trees which effectively separate the hayfield from the more southerly grassland/savanna.

Photo 10. A view looking W/NW along the mowed path in the hayfield/prairie area.

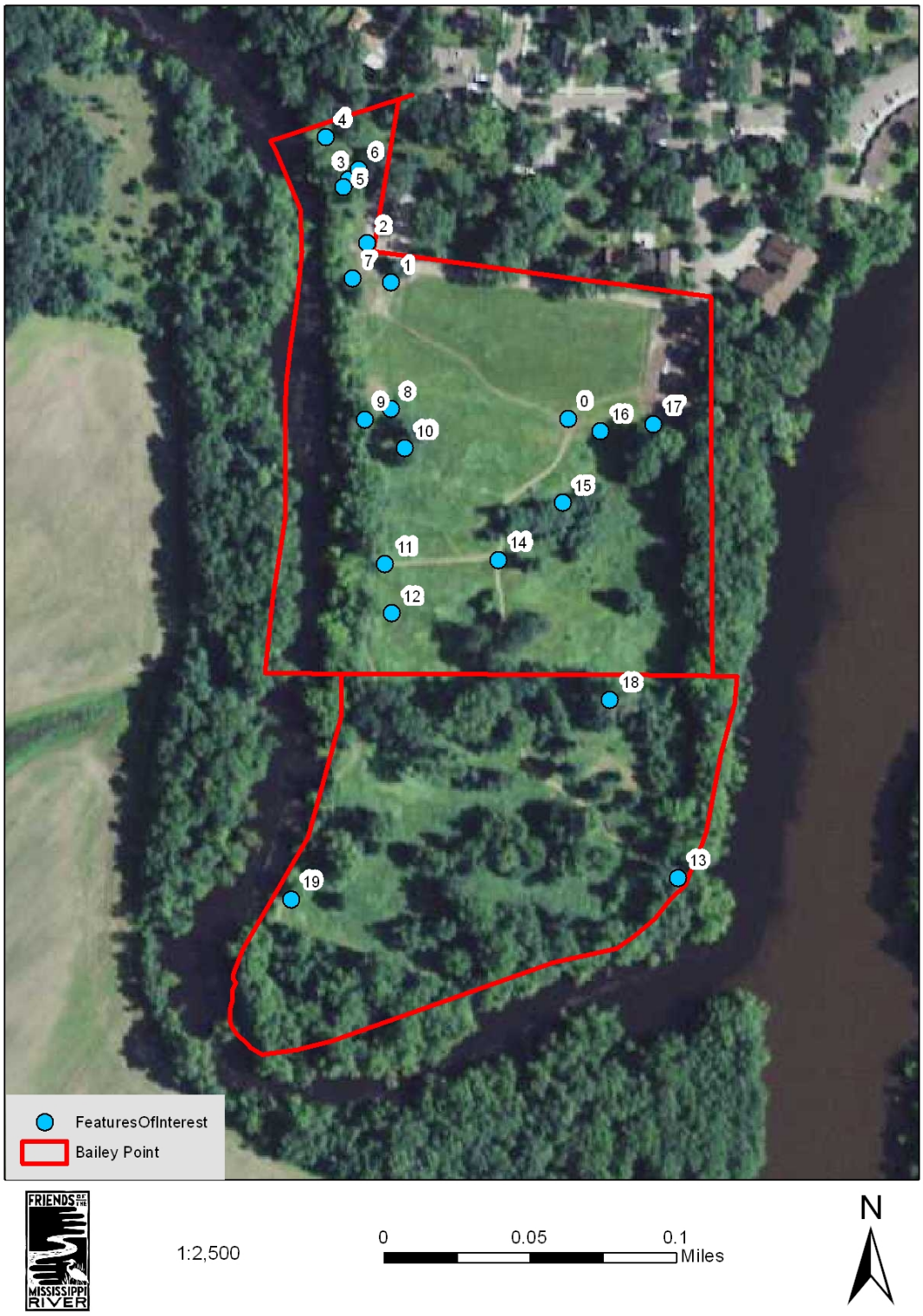
Photo 11. A view looking W/SW across the hayfield/prairie area. The row of ash trees on the left separates this unit from the grassland unit to the south.

### Lowland hardwood forest (0.92 acres)

This small unit is located in the northwest corner of the property and is one of the more ecologically degraded units. The unit contains the two buildings left on the property, as well as the area that once was the tennis court (Photo 12). While classified as lowland hardwood forest, the unit contains relatively few overstory trees, and the understory is a mix of mowed grass (mainly Kentucky bluegrass) and a variety of weedy species. The city plans to keep the structures to house maintenance equipment, and there are potential plans to build a picnic shelter in the area where the tennis court was located. The canopy is a mixed bag of species, from a sugar maple, to large bur oaks (67.9 cm dbh), green ash (46.2 cm dbh), and black walnut (54.4 cm dbh). There is little to no shrub layer, save for some *Ribes, Rubus*, and *Vitis* species around the remaining structures. The understory is dominated by Kentucky bluegrass, creeping Charlie, and a variety of patchy non-native species. The tennis court area was planted to turf grass to serve as temporary erosion control. Extension of the grassland units and re-vegetation with savanna species (due to the somewhat in-tact canopy) is recommended. However, a determination of the plans for the shelter should be made before putting time and resources into any restoration of the unit.

Photo 12. Two buildings in the northwest corner of the property. The city is using the buildings for equipment storage.

## FIGURE 12. FEATURES OF INTEREST



## TABLE 2. FEATURES OF INTEREST

Table 2 provides information for Figure 12 (Features of Interest). The following list of features corresponds to the labeled points on the map.

| | |
|---|---|
| 0 | Trail intersection: end of paved trail and beginning of mowed trails |
| 1 | Large sugar maple (52.1 cm dbh) on fenceline) |
| 2 | Confluence of mowed trail and grass access road along the northern boundary |
| 3 | Smaller of the two white houses/sheds on the property |
| 4 | 2nd, larger house with small shed. Large bur oaks and honeysuckle along edges |
| 5 | Large black walnut (65. 9 cm dbh) |
| 6 | Two large bur oaks on corner |
| 7 | Large hackberry along the trail |
| 8 | Buckthorn burn pile scar. Burdock, thistle and other weedy plants abundant |
| 9 | Large black walnut along the bank |
| 10 | Huge green ash (105. 7 cm dbh), large hackberry in grassland area |
| 11 | Intersection of riverside trail with grassland trail |
| 12 | Second burn scar. Fewer weedy species present here |
| 13 | Large old silver maple with evidence of an old tree fort; two benches |
| 14 | Trail intersection |
| 15 | Low wet swale running east/west across property; dominated by green ash |
| 16 | Two bird houses near paved path |
| 17 | Corner of parking lot area |
| 18 | Bald eagle nest |
| 19 | Bench and eroded streambank |

# RESTORATION

This section describes the restoration process on the Bailey Point Nature Preserve. This includes information on the target plant communities and community descriptions, taken from the DNR, for the proposed restoration on site. It also includes a description of the restoration process and the goals for the restoration, both broad and specific.

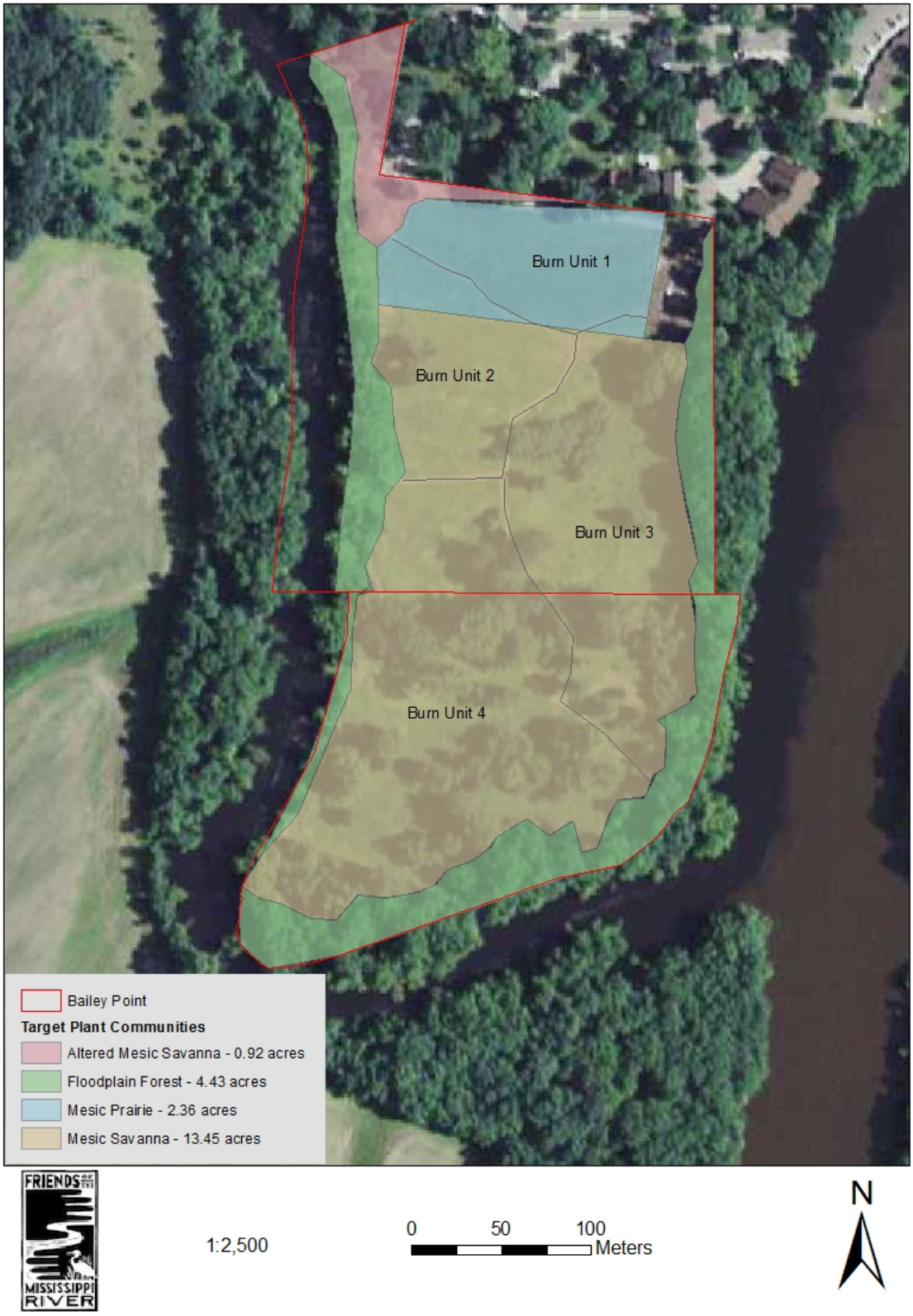
## Target Plant Communities

### Table 3. Restoration Target Plant Communities for Existing Landcover

| MLCCS Unit | Acres | Dominant Soil Types | Target Community |
|---|---|---|---|
| Floodplain Forest (FF 1) | 1.47 | Elkriver-Mosford (1257) | Southern Floodplain Forest (FFs68) |
| Floodplain Forest (FF 2) | 2.96 | Elkriver (1255), Elkriver-Mosford (1257) | Southern Floodplain Forest (FFs68) |
| Altered/non-native grassland with sparse trees | 13.45 | Elkriver-Mosford (1257) | Southern Mesic Savanna (UPs24) |
| Hayfield | 2.36 | Elkriver-Mosford (1257) | Southern Mesic Prairie (UPs23) |
| Lowland hardwood forest | 0.92 | Elkriver-Mosford (1257), Sandberg (258B)) | Southern Mesic Savanna (UPs24) |
| **TOTAL** | **21.16*** | | |

*The official property sale encompasses 24 acres. Using the MLCCS data to break the property into plant communities yields only 21 acres. The lost acreage occurs from the paved parking lot and driveway, as well as the portion of the property that is open water habitat along the Elk River.

## FIGURE 13. TARGET PLANT COMMUNITIES



### Southern Floodplain Forest – FFs68

This community type would be located in what are currently the FF units (1-2) on the periphery of the property. FFs68 would make up roughly 4.5 acres of the property. Over the first year, invasive species would be removed on units FF 1-2, with follow-up treatment occurring for the next few years.

According to the DNR (2005), Southern floodplain forests are:

> "Deciduous riparian forests on sandy or silty alluvium on low, level, annually flooded sites along medium and large rivers in the southern half of Minnesota. Community is characterized by evidence of recent flooding such as rows and piles of debris, ice scars on trees, high-water channels, and freshly deposited silt and sand.
>
> Ground-layer cover is generally very sparse during spring due to inundation and scouring by floodwaters, becoming variable by midsummer (5–50% cover) and characterized by annual or flood-tolerant perennial species. Important herbaceous species include false nettle (*Boehmeria cylindrica*), clearweeds (*Pilea spp*.), Ontario aster (*Aster ontarionis*), Virginia wild rye (*Elymus virginicus*), cut grasses (*Leersia virginica and L. oryzoides*), hop umbrella sedge (*Carex lupulina*), and cattail sedge (*C. typhina*). Wood nettle (*Laportea canadensis*) often forms dense patches. Species typical of wetland communities are also often present, including mad dog skullcap (*Scutellaria lateriflora*), southern blue flag (*Iris virginicus*), and beggarticks (*Bidens spp.*). The invasive species kidney-leaved buttercup (*Ranunculus abortivus*), creeping charlie, moneywort (*Lysimachia nummularia*), motherwort (*Leonurus cardiaca*), yellow wood sorrels (*Oxalis stricta and O. dillenii*), garlic mustard (*Alliaria petiolata*), and reed canary grass (*Phalaris arundinacea*) are present in many stands and sometimes abundant.
>
> Climbing plants and vines are important in this community; characteristic are climbing poison ivy (*Toxicodendron radicans var. negundo*), wild grape (*Vitis riparia*), and moonseed (*Menispermum canadense*).
>
> Shrub layer and subcanopy are mostly sparse (0–25% cover) and occasionally patchy (25–50% cover); silver maple, green ash, American elm, and hackberry are most common. Climbing poison ivy is occasionally present in the tall-shrub layer. Silver maple seedlings are often abundant.
>
> Canopy is interrupted to continuous (50–100% cover), and strongly dominated by silver maple with occasional green ash, cottonwood, or American elm."

### Southern Mesic Savanna – UPs24

This community type will occur on the existing grassland units. UPs24 would make up less roughly 13.5 acres on the restored property. Restoration will commence in

the first year with woody invasive species removal. Once invaders are removed, restoration will continue with spot and broadcast treatment of herbaceous invaders, prescribed burns and drill seeding.

According to the DNR, southern mesic savannas are:

> "Sparsely treed communities with tallgrass-dominated ground layers on somewhat poorly drained to well-drained loam soils mainly formed in unsorted glacial till, sometimes in a thin loess layer over till, and locally in lacustrine sediments and outwash deposits. Present primarily on level to gently rolling sites. Drought stress is irregular in occurrence and usually not severe.
>
> Graminoid cover is interrupted to continuous (50–100%). Tall grasses dominate, but several mid-height grasses are also important. Big bluestem (*Andropogon gerardii*) and Indian grass (*Sorghastrum nutans*) are the dominant tallgrasses, with prairie dropseed (*Sporobolus heterolepis*) either a codominant or subdominant component. On the drier end of the moisture gradient, little bluestem (*Schizachyrium scoparium*), porcupine grass (*Stipa spartea*), and side-oats grama (*Bouteloua curtipendula*) are important.
>
> Forb cover is sparse to patchy (5–50%). The most common species are heart-leaved alexanders (*Zizia aptera*), heath aster (*Aster ericoides*), stiff and Canada goldenrods (*Solidago rigida and S. canadensis*), purple and white prairie clovers (*Dalea purpurea and D. candida*), silverleaf scurfpea (*Pediomelum argophyllum*), stiff sunflower (*Helianthus pauciflorus*), white sage (*Artemisia ludoviciana*), northern bedstraw (*Galium boreale*), and smooth blue aster (*Aster laevis*). Maximilian's sunflower (*Helianthus maximiliani*), tall meadow-rue (*Thalictrum dasycarpum*), prairie phlox (*Phlox pilosa*), and gray-headed coneflower (*Ratibida pinnata*) are common in moister examples; rough blazing star (*Liatris aspera*), Missouri and gray goldenrods (*Solidago missouriensis and S. nemoralis*), and bird's foot coreopsis (*Coreopsis palmata*) are common in drier ones.
>
> Woody vines are a minor component. Virginia creeper (*Parthenocissus spp*.) is frequently present, and wild grape (*Vitis riparia*) is occasionally present.
>
> Shrub layer is patchy to interrupted (50–75% cover) and composed of low (< 20in [50cm]) semi-shrubs, taller (up to 6ft [2m]) shrubs, and oak seedlings and saplings (< 6ft). The low semi-shrubs leadplant (*Amorpha canescens*), prairie rose (*Rosa arkansana*), and poison ivy (*Toxicodendron rydbergii*) are generally common. Common taller shrubs are chokecherry (*Prunus virginiana*), American hazelnut (*Corylus americana*), smooth sumac (*Rhus glabra*), gray dogwood (*Cornus racemosa*), wolfberry (*Symphoricarpos occidentalis*), low juneberry (*Amelanchier humilis*), and wild plum (*Prunus americana*).

Trees are scattered or in scattered clumps, with total cover < 70% and typically 25–50%. Bur oak is most common, but northern pin oak is also usually present.

The exotic grasses Kentucky bluegrass (*Poa pratensis*) and smooth brome (*Bromus inermis*) are often problematic in UPs24. Pennsylvania sedge (*Carex pensylvanica var. pensylvanica*), a native graminoid that is naturally a minor component of UPs24, increases in abundance with prolonged heavy grazing. With fire suppression, trees other than the oaks become established, especially green ash, quaking aspen, and basswood."

### Southern Mesic Prairie – UPs23

This community type will occur in what is currently the old hayfield unit, and will transition into the existing grassland units. UPs23 will occur on roughly 3 acres. Restoration will commence in the second fall with prep work and seeding of the entire unit. Establishment mows will occur in the first and second growing seasons, with a prescribed burn in the third. Once these prairie areas are established, long term maintenance will include spot treatment of herbaceous invaders, rotating prescribed burns and interseeding.

According to the DNR:

"Southern mesic prairies are grass-dominated but forb-rich herbaceous communities on somewhat poorly drained to well-drained loam soils mainly formed in unsorted glacial till, sometimes in a thin loess layer over till, and locally in lacustrine sediments and outwash deposits. Communities in this class occur primarily on level to gently rolling sites. Drought stress is irregular in occurrence and usually not severe.

Graminoid cover is usually continuous (75–100%). Tallgrasses dominate, but several midheight grasses are also important. Species composition is fairly uniform, although relative abundances shift across the moisture gradient within the community. Big bluestem (Andropogon gerardii) and Indian grass (Sorghastrum nutans) are the dominant tallgrasses, with prairie dropseed (Sporobolus heterolepis) either a codominant or subdominant component. On the drier end of the gradient, little bluestem (Schizachyrium scoparium), porcupine grass (Stipa spartea), and side-oats grama (Bouteloua curtipendula) are important. On moister sites, switchgrass (Panicum virgatum) may be common, and prairie cordgrass (Spartina pectinata) is usually present. Leiberg's panic grass (Panicum leibergii) is distinctive, although usually minor in terms of cover.

Forb cover is sparse to patchy (5–50%). Forb species composition also responds to moisture. A number of species are common across the moisture gradient, including heart-leaved alexanders (Zizia aptera), heath aster (Aster ericoides), stiff and Canada goldenrods (Solidago rigida and S. canadensis),

purple and white prairie clovers (Dalea purpurea and D. candida), silverleaf scurfpea (Pediomelum argophyllum), stiff sunflower (Helianthus pauciflorus), white sage (Artemisia ludoviciana), northern bedstraw (Galium boreale), and smooth blue aster (Aster laevis). Maximilian's sunflower (Helianthus maximiliani), tall meadow-rue (Thalictrum dasycarpum), prairie phlox (Phlox pilosa), and gray-headed coneflower (Ratibida pinnata) are most common on the moister end of the gradient. Rough blazing star (Liatris aspera), Missouri and gray goldenrods (Solidago missouriensis and S. nemoralis), and bird's foot coreopsis (Coreopsis palmata) are common in the drier end. Rattlesnake master (Eryngium yuccifolium) and compass plant (Silphium laciniatum) are typical species in southeastern Minnesota but rare to absent in the community elsewhere. Narrow-leaved purple coneflower (Echinacea pallida) is common in the drier end of the gradient in the CGP but absent from the Eastern Broadleaf Forest Province.

Shrub layer is sparse (5–25% cover). The low semi-shrubs leadplant (Amorpha canescens) and prairie rose (Rosa arkansana) are generally common. Sparse patches of wolfberry (Symphoricarpos occidentalis) are occasional. Gray dogwood (Cornus racemosa), American hazelnut (Corylus americana), and wild plum (Prunus americana) are rare.

Trees are absent except where fire suppression has allowed invasion by woody species. Kentucky bluegrass (Poa pratensis), an introduced species, is invariably present; it increases in the prolonged absence of fire but becomes dominant only with heavy grazing pressure. Smooth brome (Bromus inermis), another exotic, is a very troublesome invasive species favored by disturbance, including natural disturbance by pocket gophers."

## RESTORATION PROCESS

Restoration is a process. It takes time to restore ecosystems to their former functionality and diversity. Sometimes this can only be approximated. It took many decades to degrade the ecosystem and biological communities on site, so it will not be restored overnight. Many steps are typically involved in a successful restoration; even deciding when a restoration is complete/successful can be very difficult. Restoration should be viewed as a process not a state of being. The ultimate goal is to achieve and maintain a diverse natural community at the site, though this will not always proceed in a linear fashion. Using the concept of *adaptive management* will be key to continual progress at the site. Adaptive management is a strategy commonly used by land managers, and integrates thought and action into the restoration process. It can be described as a strategy that uses evaluation, reflection, communication, and also incorporates learning into planning and management. It is set up like a feedback loop and looks like this: Assess Problem -→ Design -→ Implement -→ Monitor -→ Evaluate -→ Adjust -→ Assess Problem -→ and so forth. Thus, moving forward with restoration, each round of adaptive management refines and hones the process to better fit the conditions of the site. This strategy should be emphasized at the Bailey Point Nature Preserve.

Given the size and layout of the property, the restoration plan for the site will be relatively simple. However, to restore and maintain any site takes dedicated time and effort. The amount and type of "edge" (rivers, adjacent lands, etc) allows for a continual supply of seeds/propagules to Bailey Point, many non-native and invasive. While preventing propagules from arriving by way of the river is impossible, engaging neighbors in the importance of restoration on their lands will not only help the restoration on the property be more successful - as it will reduce the potential seed source of exotic invasive plants - but will also increase the size of natural communities being protected and managed in the area.

The restoration of the biological communities at the Bailey Point Nature Preserve will be broken into phases. Each phase will address the restoration of a given target plant community. Restoration tasks will also be prioritized, with the most important resources or vital areas taking precedence. However, restoration will ultimately be conducted based on available funds and resources and may not occur sequentially or as prioritized.

On this site, removal of woody invasive plants throughout the property is the highest priority. Without this crucial first step, prairie and savanna restoration will be consistently plagued by re-invasion. Prioritizing invasive removal first will lead to better results in subsequent restoration tasks. The second priority is restoring and improving prairie and savanna in the current grassland areas of the property. Savanna is a rare and vulnerable plant community, and increasing its presence on the landscape is an important goal. The third priority will be increasing pollinator and wildlife habitat throughout the property.

## RESTORATION GOALS

This property is designated as a nature preserve with mowed trails for passive recreation. Thus, the main goal of this restoration will be to create diverse, healthy habitats that support wildlife and engage visitors. Healthy ecosystems will support a variety of wildlife, and will provide a number of ecosystem services, including water retention and filtration. Toward achieving this goal, restoration will aim to improve the diversity, composition and structure of the plant communities throughout the property, which will also better reflect what would have been present at the time of European settlement. This includes the improvement of habitat (prairie and savanna) that has been historically decimated throughout the state, but does not mean that the restoration will go out of its way to convert current natural communities to what may have been present in the past. However, adding new habitat and restoring degraded areas will improve the ecological functions that both historic native plant communities and current healthy communities provide, including:

- habitat for a diversity of wildlife species,
- nutrient and water cycling,
- carbon storage,
- moderation of water-table levels,
- erosion control,
- filtration of nutrients, sediments and pollutants,
- development and enrichment of soils,
- local temperature moderation.

Though degraded by past uses, the existing plant cover retains a good variety of native species and could be readily improved. A healthy and diverse plant community can provide much greater wildlife value than a degraded one, and tends to be much more stable, and less susceptible to disease, invasive species, and other disturbances.

Management recommendations were developed for each land cover area, with the overall objectives for the property focused on protecting and restoring high quality habitat by removing invasive plant species, restoring savanna/prairie, and providing pollinator and wildlife habitat. Specific goals include the following, and should be attained by the fifth year of the restoration process:

1) Reduce invasive woody stems over ½ inch diameter to <10% on site by the end of the second year.

2) The roughly 17.5 acres of grassland and hayfield will be converted to native savanna and prairie with 90% coverage of native species by the fifth year.

2b) Reduce tree coverage in the savanna to 10-20% and shrub coverage to 25-50%.

3) The prairie restoration will have at least 25 native pollinator plant species, including an abundance of milkweed species, and these plants will have at least 30% coverage in the prairie.

3b) Use the prairie restoration as a "laboratory" to experiment with different seeding rates, mixes, and methods.

4) Engage the community and local volunteers through restoration events, including plantings and invasive species removals.
Overall management practices to achieve those goals are:

- remove non-native, invasive, woody species;
- control non-native invasive herbaceous species;
- remove or thin out native woody species encroaching on restoration areas;
- restore ground layer and shrub layer diversity in prairie and savanna areas;
- conduct periodic prescribed burning to maintain prairie and woodland vegetation and reduce invasive shrubs and overabundant tree seedlings;
- monitor annually for potential erosion, as well as for non-native invasive woody and herbaceous species;
- institute a monitoring plan to track effectiveness of management and restoration activities.
- engage volunteers in restoration activities and educational events
- explore other opportunities to create wildlife habitat, including but not limited to snake hibernaculums, osprey towers, turle nesting habitat etc.

## MANAGEMENT PRIORITIES

### PRIORITY 1: Invasive woody removal

*Woody Plant Removal*

Given the size of the property (roughly 24 acres), clearing non-native, invasive brush is a very feasible task. During this process, the site can be assessed for further woody removal, including native shrub species. Primary species to remove are common buckthorn and Tartarian honeysuckle, though black locust and Siberian elm may be encountered as well. Cut stumps should be treated with a triclopyr- or glyphosate-based herbicide, though aquatic formulas should be used within 100 feet of the river. Glyphosate can be applied to stumps on a calm day during the growing season when temperatures are above freezing but not above 85 degrees. Triclopyr can be applied even when temperatures are below freezing, and is the best choice for fall and winter application, though application earlier than late fall is not recommended due to potential non-target effects on native vegetation. If not treated, stumps will sprout with multiple stems, thus creating a difficult situation to control, since even more cutting and herbicide will be required on the multiple resprouts. Use of chemicals should be done with extreme care on this site given the proximity to the rivers and high potential for groundwater contamination. Glyphosate binds to soil particles and is generally not mobile, so may be a better choice than other herbicides that are more mobile, especially near the water. However, triclopry-based herbicides like Garlon are generally more effective at preventing resprouting. Due to the sensitivity of the site, Garlon 3A is preferred over Garlon 4. See Appendix C for more information on controlling both native and non-native species.

The locations of remaining non-native brush populations are sporadic, though both buckthorn and honeysuckle are ubiquitous around the property edge. Small populations also exist below many of the large trees that are scattered throughout the grassland. Hand cutting (with brush saws and chainsaws) will be the most efficient method given the distribution of invasive populations. Hand cutting can be done at various times of the year, though the fall is recommended, as native plants will have senesced and buckthorn and other invaders who hold their leaves longer will be easier to identify. For hand-cutting, brush pile locations will need to be determined in order to burn piles safely. Details should be worked out in the field at the time of removal.

Brush disposal includes several different options that will be determined as the project progresses, and will depend on the volume as well as site access. Cut brush may be stacked and burned, chipped and blown back on the site, or even removed for biofuels. The biofuels option requires a large amount of material (18 semi-trailer loads of chipped brush, for example), which is unlikely given size of the property, but could be combined with removal of some of the grassland trees (see Priority 2).

The paths around the grassland provide easy access for large equipment and vehicles. In some areas, chipping the material on site could provide mulch that would suppress buckthorn regeneration from the seedbank and protect against erosion. Access along mowed areas and field edges provides many possible areas to utilize a chipper.

The City of Elk River removed buckthorn and other invasive shrubs from a large portion of both the floodplain forest subunits in 2014 and 2015. However, pockets of these species remain, both in the central portion of FF-1 and on the southeast and eastern side of FF-2. City or volunteer labor could be used in place of the contractor estimates in this plan; however, follow up treatments may be better suited for contractor crews. Once the first phase of removal is complete, yearly follow-up treatments will be necessary. If done correctly, stump-sprouting should only occur in small numbers (if at all), though these sprouts will need to be treated by mowing, cut and paint herbicide application, or foliar spray. The seedbank will be more problematic, as buckthorn seeds can remain viable for at least five years. Treating germinating seedlings will be a difficult and repetitive process, but can be accomplished through foliar herbicide application. Prescribed fire is a seedling management option in drier areas, but will be difficult in many of the wetter floodplain areas. Prescribed burns should occur in the spring if possible, when buckthorn is actively growing and its carbohydrate stores are low. In the more open areas of the property, seeding may be necessary after buckthorn removal. Cover of native plants will help to fill unoccupied niches and compete with and suppress germinating buckthorn seedlings. See Appendix B for a list of native plant species for restoration of floodplain forests.

*Native Shrub Control (optional but encouraged – lower priority)*

Aggressive native shrubs such as prickly ash and smooth sumac can be controlled if time and budget allows. Prickly ash, a native shrub of open woodlands and savannas, can be controlled in areas that it is overabundant along the grassland edges. This will keep it from encroaching into the restored savanna and prairie areas. Cutting and treating of stumps is recommended to control overabundant populations, but eradication is not recommended. Burning will top-kill prickly ash, but will not kill the root.

**PRIORITY 2: Prairie and oak savanna restoration**

Prairie restoration will occur on the 2.36-acre hayfield, and 13.45 of savanna will be restored in the central and southern grassland portions of the property. Restoration can commence once woody invasive species are removed from the property. The difference in the two restorations will primarily be the seed mix used (mesic prairie versus mesic savanna mix).

Rather than break the property up into separate restoration sections, the entirety will be restored at once. However, restoration will still be a multi-year endeavor and will include at least three years of maintenance before the prairie and grassland can successfully establish. Conducting the restoration process all at once will help ensure that costs are kept to a minimum.

Mowed paths will serve as fire breaks so that portions of the units can be burned on a rotating schedule. It will be important to rotate burns in order to provide refugia for insects and other wildlife. Overall, restoration can also extend into the adjacent subunits, depending on the amount of woody removal along the field edges.

*Site preparation*

Because the hayfield and grassland are dominated by non-native, cool-season grasses, restoration is more difficult than if the area was in agricultural production. Apart from the current cover of smooth brome and other plants, the seedbank is likely full of a number of weedy species. The first step in site preparation will be to broadcast an herbicide to areas with dense brome cover. Once top-killed, the unit should be burned to remove dead vegetation. It can then be lightly disced or harrowed to help flush the weed seedbank. However, completely turning over the soil is not recommended. Herbicide should then be applied at least one more time, likely twice to kill the regrowth.

The fields can then be drill seeded with their respective mixed height mesic species mixes (prairie and savanna); these mixes will contain an abundance of pollinator species, including milkweeds and other nectar plants. See Appendix B for a list of plant species for restoration of prairie and savanna. Small forb seeds should be hand-broadcast rather than drilled to avoid burying them too deeply. Seeding in the fall or winter, referred to as dormant seeding, benefits forb species, as many require cold, wet stratification prior to germination. The seed will get worked into the soil by the freeze-thaw cycles of winter and will germinate in the spring. The melting snow will provide the necessary moisture to fuel the seed's germination. However, because the soils have medium erosion potential, a cover crop should be considered for inclusion in the fall seeding to help prevent erosion. Winter wheat is commonly used for this purpose.

*Maintenance: Mowing and burning*

In the summer following the seeding, the prairie and savanna will need to be mowed roughly three times. These establishment mows help to stimulate vegetative growth and to keep weed species from flowering and dispersing seed throughout the site. This also allows light to reach the new seedlings, which are mostly very small the first year. Mowing should occur when the vegetation reaches roughly 12 in, though it is difficult and unnecessary to be exact in this measurement. Because mowing is used to prevent annual weeds from seeding into the restoration, mowing should be timed to prevent weeds from setting seed, with height often being a proxy for these

events. Monitoring will determine the ultimate timing of the mows. Vegetation should be mowed to a height of 4-6 in, and the process repeated two or more times depending on the rate of growth throughout the season. During this time, weed species on the savanna edges and surrounding units can be treated by spot-spraying or mowing in order to prevent them from encroaching into the establishing prairie. In the second growing season, mowing is generally needed just once in the spring or early summer. However, spot-mowing and/or spot-spraying of problematic areas may be needed.

Eventually, the prairie and savanna will need to be burned. Depending on the condition of the units, this will likely occur in the third or fourth growing season. Burning will help stimulate root production and aboveground growth, and will help to control woody and herbaceous species establishing in the savanna. Burning can be done in the spring or fall, depending on weather conditions and goals of the burn (controlling non-native grasses, etc.). However, because of the eagle's nest on the property, burns will likely have to occur in the fall. After the burn, native seed can be added to the units to supplement cover and diversity in areas that have not taken well. In the long term, a burn rotation will need to be established so that the units are burned at repeated intervals. For prairies, this can be once every 3-5 years. Burning every 5+ years is a common interval in savannas, but can be hard on native shrubs. However, burning frequently will help to keep woody species (cottonwoods, boxelders etc.) from taking hold in the savanna. Ultimately, the interval length will depend on the desired balance of native shrubs and herbaceous plants, and can also be timed to respond to outbreaks of non-native woody or herbaceous species. If burning is not part of the management, the savanna will rapidly succeed to forest, since there are many woody seedlings (both native and non-native) encroaching from the surrounding units. The prairie and savanna units should be divided into 2 or more burn units that would be burned in different seasons or years to ensure the availability of unburned refugia for species. The current trails will serve as useful fire breaks, though multiple units can be paired for each burn. See the Prescribed Burning section below for more information (see Figure 13).

*Oak restoration*

The first priority for the savanna restoration is the establishment of herbaceous (and smaller woody) savanna species. Once the savanna has begun to establish, introduction of woody species, particularly oaks, can be considered. Very short woody plants such as leadplant and prairie rose will be introduced as part of the seed mix, helping to establish the 5-50% shrub cover typical of these savanna systems. Establishing the savanna canopy can come later, and will primarily include bur oaks. These can be planted in copses in the more open areas of the grassland.

Bareroot seedling of other woody species, including chokecherry, hazelnut and wild plum can be added to the restoration to increase structural diversity once the herbaceous savanna species have established. For the wetter areas, dogwoods may

be an appropriate addition. Like the oaks, these species should be planted in low densities in copse or clump orientations.

*Erosion control*

Currently, the non-native grasses stretch to the edge of the Elk river on the west side of the property. This area has no overstory vegetation, and the lack of root structure has caused erosion along the bank. While this is partly a natural process, establishing native vegetation along the bank will help stymie this process. Native prairie and savanna plants have much deeper and more complex root systems than the non-native vegetation currently present. During the restoration process, installation of a silt fence along this stretch of the river would prevent further erosion caused by the removing non-natives and restoring native plants to the area.

**PRIORITY 3: Supplement pollinator and wildlife habitat**

This priority will be accomplished through increasing diversity in the prairie, grassland and floodplain units. On the prairie unit, this will be accomplished through focused addition of pockets of herbaceous species as the restoration establishes. A goal of the restoration is to have at least 25 pollinator plants (including common and whorled milkweed) in the prairie and savanna restoration areas. These plants will provide important habitat and resources for pollinator populations in decline across the state and country. Milkweed plants in particular are important habitat and food sources for monarch butterflies, as well as a host of other insect species. Contractors will spot treat or spot burn small plots within the prairie unit, then broadcast seed particular native species into these areas, creating diverse pockets within the broader grassland matrix. Supplemental plantings of plugs can also increase the diversity and coverage of pollinator species, and provide a good opportunity to involve volunteers at the site. Watering events may be necessary depending on seasonal moisture conditions.

In the grassland areas, copses of trees (bur oaks) and shrubs can also be planted to add structural diversity to the unit. These species will also provide habitat for myriad insects, birds and other species.

Both native herbaceous seed and bare root shrubs and trees will be added to the floodplain unit to increase pollinator and wildlife habitat. This will help fill the open niche created when buckthorn is removed from the unit.

### Prescribed Burns—More Information

Once prairie and savanna are re-established on the property, it is recommended to split the entire site up into burn units, for ease of operation and for ecological

reasons. It is important to leave some areas unburned (refugia) to allow insect and animal populations to recover and repopulate burned areas. To do this, it is recommended to rotate the burn units from year to year, and try not to burn adjacent units in consecutive years. Prior to a prescribed burn, a burn plan must be devised. The burn contractor can help with the burn plan. Permits must be obtained from the DNR and local fire officials. Initially, burning would be rotated every one or two years, so that each year a different burn unit would be burned. Long-term, burns can occur every 3-5 years in prairies and savannas, though longer intervals could allow for the establishment of more woody shrubs if desired.

Prior to burning, burn breaks must be created to contain the fire. Burn breaks consist of a mowed swath in grassland areas, typically at least 8 feet wide. There should be burn breaks between restoration units and within the large prairie/savanna restoration (Burn Units 1-4, Figure 13). In woodland areas, the break line is created by clearing the leaf litter and any other debris down to the mineral soil. At Bailey Point, utilizing the mowed paths and edges of forests will be useful and easier than making breaks from scratch. The burn contractor can also help with the placement and installation of burn breaks. Allowing fire to run into adjacent land covers is another good practice. For example, breaklines in a prairie unit that is adjacent to woodland should be placed a short distance into the woodland, where feasible. This makes for a more natural looking and functioning landscape and helps to prevent the woodland from encroaching into the prairie.

Smoke management is a concern for burning on this property, since there are nearby residences, buildings, and roads. Care must be taken to select a burn date where smoke will not reduce visibility on Main Street or become a nuisance for the neighbors to the north.

### Long-Term Monitoring and Maintenance

Monitoring is very important to restoration success. Monitoring, evaluation and assessment should be done at least annually by an ecologist or a restoration professional. More frequent monitoring will be needed in the initial phases of restoration to evaluate the success of the methodologies and to inform future strategies. Adapting to issues or factors observed during monitoring and assessment is vital to the restoration process.

Once the primary restoration tasks are completed, the restoration process will convert to a monitoring and adaptive management phase. Long-term maintenance for the forest areas will consist managing for invasive species, and monitoring every year for potential new issues. For the prairie and savanna, burning should occur every 3 to 5 (or more) years to prevent woody encroachment and maintain the health of the units.

Restored areas must be regularly monitored to identify ecological issues such as erosion and sedimentation, invasive species, and disease. Monitoring is also

important for detecting human-related issues such as illegal activities (ATV use, tree harvesting, etc.) Early detection of concerns enables quick responses to address them before they become significant problems.

Monitoring animal as well as plant communities is also helpful for evaluating results of the restoration. A comparison of bird populations before and after restoration, for example, would be a valuable tool for quantifying positive impacts on the land. Trail cameras can also provide information on wildlife using the property. This is another area where citizens could be involved in the property, and tie-ins with programs like Monitoring Avian Productivity and Survivorship (MAPS) and eMammal would provide great citizen science opportunities.

# WORKPLAN

The following tasks and budget are based on known costs and project needs at the time of the restoration agreement. All parties, prior to implementation, will agree upon additional future tasks. Work units are shown in Figure 11.

## RESTORATION SCHEDULE AND COST ESTIMATES

A general time frame is shown in Table 3, but note that the year for any given task may shift, depending on when the project starts. Note also that that the costs shown are estimates, based on similar work at other sites, but actual costs may be higher or lower.

Because of the simplicity of the site, the work units are referred to by their land cover name (prairie, grassland, or floodplain forest). Undertaking the recommended restoration project in this plan will be a significant task, and assistance is available to help landowners with the process. Friends of the Mississippi River will continue to work closely with the landowners, if desired, to secure funding and implement all or parts of the management plan. FMR can hire and oversee contractors such as a professional firm listed in **Appendix D**.

### Table 4. Restoration Schedule and Cost Estimates

These tables are rough schedules and approximate costs for restoration and management tasks for the Bailey Point Nature Preserve. Both the project tasks and costs are likely to change as the project progresses - these tables should be used only as rough guides. Tasks were phased, with 1 being the highest priority. Work units correspond with those shown in Figure 11.

| Year | Season | Units | Activity | Acres | Cost/ Ac | Cost Est. |
|---|---|---|---|---|---|---|
| PHASE 1. REMOVE INVASVIVE WOODY AND UNDESIREABLE NATIVE WOODY SPECIES | | | | | | |
| 0/1 | June | All | Breeding bird survey before restoration occurs. | 24 | - | $2,000 |
| 1 | Fall/winter | Floodplain + Grassland | Cut and treat remaining non-native woody brush and trees and other undesirable native woody brush in the floodplain and grassland areas. Haul brush to piles and either chip, remove or burn in winter. | 10 | 1,000 | $10,000 |
| 1* | Fall/winter | Grassland | Remove smaller native trees (<30cm dbh; except oaks) from grassland unit. Dispose same as brush. | 4 | 1,000 | $4,000 |
| 2 | Fall | Floodplain + Grassland | Treat exotic brush seedlings and resprouts | 18 | 400 | $7,200 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 3 | Fall | Floodplain + Grassland | Spot/broadcast spray invasive seedlings from seedbank | 18 | 400 | $7,200 |
| 4 | Fall | Floodplain + Grassland | Spot/broadcast spray invasive seedlings from seedbank | 18 | 200 | $3,600 |
| 5 | Fall | Floodplain + Grassland | Treat exotic resprouts | 18 | 200 | $3,600 |
| Subtotal | | | | | | $37,600 |
| PHASE 2. RESTORE AND PROTECT PRAIRIE/SAVANNA | | | | | | |
| 0/1 | June | All | Breeding bird survey before restoration occurs. Should be the same as Phase 1 survey. | 24 | - | - |
| 1 | Late spring | Grassland + Prairie | Broadcast and/or spot spray non-native grasses (smooth brome, Kentucky bluegrass) and other herbaceous invasive species along floodplain edges and in existing grassland units. Avoid any areas with high diversity or low weedy cover and use sparingly around savanna trees. | 17 | 200 | $3,400 |
| 1 | Late spring | Grassland + Prairie | Burn the dead thatch on the grassland units. Do not burn within two weeks of the last herbicide spray. Burn could also occur before the spray. | 17 | 200 | $3,400 |
| 1 | Summer | Grassland | Purchase mesic savanna seed mix for use on the grassland and mesic prairie seed mix for use on the hayfield/prairie | 14 + 3 | 700 | $11,900 |
| 1 | Summer | Grassland | Harrow or lightly disc (no till) to stimulate weed growth. Avoid damaging the roots of savanna trees. | 17 | 200 | $3,400 |
| 1 | Summer | Grassland | Broadcast or spot spray areas of re-growth. | 17 | 200 | $3,400 |
| 1 | Summer | Grassland | Broadcast or spot spray areas of re-growth a third time if necessary | 17 | 200 | $3,400 |
| 1 | Fall | Grassland | Drill seed hayfield and grassland with mesic prairie and savanna seed mixes. Consider adding a cover crop (winter wheat) to prevent erosion. | 17 | 300 | $5,100 |
| 2 | Summer | Grassland | Conduct three establishment mows when vegetation reaches 12in in height. Mow to 4-6in. | 17 | $500 per mow | $1,500 |
| 3 | Summer | Grassland | Control weedy species: Conduct one establishment mow when vegetation reaches 12in in height. Mow to 4-6in. Spot mow or spray as necessary | 17 | - | $1,000 |
| 4 | Spring | Grassland | Conduct prescribed burn on one half of prairie and grassland (two burn units). Let fire run into floodplain units where possible. | 8 | 200 | $1,600 |
| 4 | Summer | Grassland | Re-evaluate establishment success after burn. | 8 | - | $500 |
| 5 | Spring | Grassland | Conduct prescribed burn on second half of prairie and grassland. Let fire run into floodplain units where possible. | 8 | 200 | $1,600 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 5 | Summer | Grassland | Re-evaluate establishment success after burn. | 8 | - | $500 |
| 6 | June | All | Breeding bird survey, after restoration | 24 | - | $2,000 |
| Subtotal | | | | | | $42,700 |
| PHASE 3. SUPPLEMENT DIVERSITY IN PRAIRIE, GRASSLAND AND FLOODPLAIN UNITS | | | | | | |
| 1 | Fall | Floodplain | Purchase and broadcast seed native herbaceous species in open areas of floodplain after woody removal | 5 | - | $2,000 |
| 3 | Spring/Fall | Floodplain | Plant bare root or potted shrubs and trees in floodplain. Mulch and protect shrubs. | 5 | - | $5,000 |
| 3 | Spring/Fall | Floodplain | Water newly installed shrubs and trees (if needed) | 5 | 300 per event | $900 |
| 4 | Spring | Prairie + Grassland | Add pockets of diversity to prairie and grassland. Spot spray/burn and broadcast seed pollinator plants into small pockets. Or seed into pockets after prescribed burns. | 10 | - | $2,000 |
| 5* | Spring | Grassland | Plant copses with bare-root or potted bur oaks throughout the grassland. Plant 3-5 copses of ~5 individuals each throughout the restoration. Other shrub species can be added as desired. Can plant after a burn to reduce competition. Mulch and protect trees. | 13 | - | $3,000 |
| 5* | Summer | Grassland | Water planted trees/shrubs as needed throughout summer. | 13 | 300 per event | $900 |
| Subtotal | | | | | | $13,800 |
| Total | | | | | | $94,100 |

* Items with an asterisk are lower priority and will be undertaken only if funds and logistics allow.

## LONG TERM MANAGEMENT

Once initial restoration tasks are completed, then long-term management ensues. Long-term management includes tasks that are required periodically to maintain healthy ecosystems. Table 4 lists these tasks with associated cost estimates.

### Table 5. Long-Term Management Schedule and Cost Estimates

| Season | Units | Activity | Acres | Cost/ Ac | Cost Est. |
|---|---|---|---|---|---|
| Spring or fall | All | Burn the prairie units every 3-6 years. Rotate burn units. To provide refugia, do not burn adjacent units in consecutive years. Do not burn more than 1/2 of the either unit in one year. Rotate burns from spring to fall. | 16 | 200 | $3,200 |
| Fall | All | Monitor and manage for invasive herbaceous and woody species. | 24 | 500 | $12,000 |
| July-Aug and Winter | All | Monitor ash for EAB, bur oaks for Oak Wilt disease (July-Aug) and for Bur Oak Blight (BOB) (July-Aug for leaf necrosis and winter for marcescent leaves (those that do not drop). | 24 | - | $500 |
| Fall, summer, spring | All | Evaluation and assessment by ecologist | 24 | - | $1,000 |
| June* | All | Yearly breeding bird surveys after restoration tasks are complete. Establish citizen science programs (MAPS, eMammal) | All | - | - |
| Fall* | All | Yearly community engagement or volunteer event. Possible events include invasive species removal, prairie seed collection, supplemental plantings, etc. | All | - | - |
| | | | | | $ 16,700 or more (at intervals) |

* Items with an asterisk are lower priority and should be undertaken only if funds and logistics allow.

# OTHER CONSIDERATIONS

## Hunting

There is no hunting allowed at Bailey Point. However, since the neighboring WHHCA will be open to hunting, there will be several measures that need to be taken in order to ensure that the property is not affected.

First, much of the restoration will occur after the property has been opened to hunting. Restoration crews will need to be alerted to the fact that hunting is permitted on the neighboring property, and should wear brightly colored clothing to denote their presence. While this is standard for most contractors, care should be taken to remind them of this during the RFP and site visit process. Temporary signage should also be erected at the parking are to alert visitors that restoration is occurring on the property. While the presence of crews will likely be obvious to visitors, signs will serve as a reminder that crews may be on the property.

Aside from the restoration process, the property must be monitored to ensure that no hunting is occurring. When hunting the neighboring property, the temptation to take birds and other animals on Bailey Point will be present given its proximity and visibility. While enforcement of these regulations should not be tasked to FMR, routine ecological monitoring should include checking for tree stands and other structures erected on the property. Semi-permanent structures should be reported and removed, as they can influence the use of the property by wildlife. Any other activities should be reported to the city and other necessary authorities.

## Tree Disease (Oak Wilt, BOB, DED, EAB, etc.)

### *Dutch Elm Disease and Emerald Ash Borer*

There are many elms and large green ash trees growing within the floodplain forests along the Elk and Mississippi Rivers at the site. These trees are not only ecologically valuable but are also at high risk to attack from non-native tree pests. Elms are susceptible to Dutch Elm Disease and Ash are susceptible to Emerald Ash Borer. These tree pests have caused widespread mortality of elms and ash throughout the eastern United States and in Minnesota.

Dutch Elm disease is a fungal infection caused by the fungus *Ceratocystis ulmi*, which is native to Asia, and is spread by both native and non-native bark beetles (family: Curculionidae). Once the fungus is introduced onto a tree, the tree reacts by sealing its own xylem tissues (conduits of water and nutrients) to prevent further spread. This effectively prevents water and nutrients from reaching the upper branches, causing gradual die-off as more and more of the xylem is sealed. Symptoms include a yellowing and browning of leaves that spreads from the outer crown toward the

trunk. Dutch elm disease was first recorded in Minnesota near Monticello in 1961, and has since spread throughout the state. Minnesota relied heavily on American Elms (*Ulmus americana*) as shade trees on streets, with about 140 million in the state at the time of the outbreak. The disease is now present in all Minnesota counties, though elms remain an important component of many Minnesota forests.

Emerald ash borer (EAB) is a non-native wood-boring beetle from Asia that was first identified in the United States in the summer of 2002. Likely transported from Asia to Michigan in ash wood used for pallets and other shipping materials, the beetle has now been confirmed in 15 states, including Minnesota. The beetle works by depositing larvae under the bark of the tree; these larvae then feed on the wood, eventually disrupting enough of the phloem to prevent the transport of nutrients throughout the tree. While Minnesota's cold weather can stymie the spread of the beetle, it continues to spread, with new outbreaks confirmed in and around the metro area. Quarantines are already in place around both Hennepin and Anoka counties, where infestations of the borer have been confirmed. Both of these counties share a border with Sherburne county, meaning that ash trees within the Conservation Area are at risk. With risks such as human movement of firewood and climate change ever-present, the likelihood that EAB might reach the property is high, though the search for effective biological controls and other deterrents is ongoing.

Unless viable control or treatment options are developed, the elms and ash on the property are at risk of dying in the near future. When such large trees die, it will have a pronounced effect on the vegetation and the water in the river. These trees act to shade the water and provide habitat and improve water quality for fish and other species. When large trees die, they open up the canopy and create gaps, which in turn releases the understory that was formerly suppressed by the shade from such trees. If desirable species like native forbs, grasses, sedges, and shrubs exist in the understory, then this can be a good thing, since the result will probably be a net increase in bank stability and diversity. In the case of this property, these canopy gaps will likely be filled by buckthorn and Tatarian honeysuckle, which are poised to take advantage of such a situation. In order to avoid this undesirable scenario, active management is recommended. Removal of undesirable shrub species and replacing them with desirable native shrubs and herbaceous plant species is a recommended management strategy.

For green ash in particular, the situation is particularly important, as this species makes up over 50% of the canopy in many areas of the floodplain forest. The principle of risk is highly applicable here; risk is often defined as the probability of a negative event weighted by its consequences. In the case of EAB, the consequences will be large and quite negative, as a loss of half the canopy on the property could have cascading consequences for invasive species, water quality, and wildlife. The probability that EAB arrives is high, though it is unclear when this will occur. While we plan to remove invasive species prior to this occurring, which will reduce some of the negative consequences, another potential strategy is to proactively remove

the ash from the property. This would be a large undertaking, as the ash would have to be removed and replaced by other floodplain species. Removal could be contracted to logging firms, which could potentially fund the work, though the market for ash in the county is relatively sparse and this technique unlikely to create any profit for the city. Ultimately, removal should occur once invasive species are removed, and could occur in stages (10-20% per year) to minimize disturbance to the community. However, removal will realistically have a large negative impact on the property, especially in floodplain areas and to neighboring trees. The removal would also have to be timed to minimize impacts on the prairie restoration process. Advice from the city or county should be solicited when making the final decision.

### *Oak Wilt and Bur Oak Blight*

Oak wilt is an increasingly common tree disease caused by the fungus *Ceratocystis fagacearum*. While the disease is present in many eastern US states, it is most prevalent in the Midwest US. Within Minnesota, it is an issue of serious concern in and around the seven-county metro area, including in Sherburne county. Oak wilt affects all of Minnesota's most common oak species (red oak [*Quercus rubra*], pin oak [Q*. ellipsoidales*], bur oak [*Q. macrocarpa*], and white oak [*Q. alba*]), though it does not affect these species equally. Red and pin oak are the most susceptible species, with infected individuals wilting in six weeks or less. Bur and white oaks may take years to wilt completely and may only do so one branch at a time. The fungus can be transported from tree to tree by sap beetles, but most commonly spreads through root grafts. The beetles are attracted to the fungal mats created when mature oaks die from oak wilt, and also to wounds on uninfected oaks, providing a convenient pathway of spread for the fungus. Oaks commonly form root grafts between individuals, allowing direct transfer of the fungus from infected to healthy individuals.

While Bailey Point has few red or pin oaks, there is a sizeable contingent of large bur oaks, especially in the grassland areas of the property. While this provides some hope that an outbreak of oak wilt at the property is less likely, the risk of infection remains. Careful monitoring of individuals will be necessary to identify and manage infected individuals. If infected individuals are found, root barriers may be installed around infected trees using a vibratory plow. Other options include soil sterilization and inoculation of high value individual trees. Care should also be taken to avoid injuring trees during the early growing season (April to July), when trees are most susceptible to the fungal spread. If a tree is injured during this time, covering the wounds is recommended. If pruning or other activities must be done, waiting for the winter is the safest option.

Bur oak blight (BOB) may be a more serious threat to the oaks on the property. BOB affects only bur oaks, and is most injurious to upland individuals in savanna remnants. Caused by a species of fungus in the *Tubaki* genus, BOB causes lesions and discoloration of the veins on the underside of the leaves, eventually causing large

portions of the leaf to die. In many cases, severe infections will cause tree death, though individual susceptibility to the disease varies. The fungus can overwinter on leaf petioles that remain attached to trees and is primarily spread by rain droplets moving spores throughout the tree. Early results suggest that inoculation of trees with fungicide may help slow or stop the spread of the disease within individual trees. At Houlton, monitoring existing oaks for symptoms will be an important first step; moreover, if oaks are planted in the future, it may be beneficial to avoid planting the variety *Q. macrocarpa var. oliviformis*, which has shown the most severe susceptibility to BOB.

## INFORMATION SOURCES

Bur oak blight. (http://www.myminnesotawoods.umn.edu/2010/09/bur-oak-blight-bob-in-minnesota/).

Dutch elm disease. (http://www.extension.umn.edu/garden/yard-garden/trees-shrubs/dutch-elm-disease/).

Emerald ash borer. (http://www.mda.state.mn.us/emeraldashborer).

Minnesota Department of Natural Resources (2001) Minnesota Land Cover Classification System. MNDNR.

Minnesota Department of Natural Resources (2005) Field Guide to the Native Plant Communities of Minnesota: The Eastern Broadleaf Forest Province. Ecological Land Classification Program, Minnesota County Biological Survey, and Natural Heritage and Nongame Research Program. MNDNR.

Minnesota Department of Natural Resources (2006) *Tomorrow's Habitat for the Wild and Rare; An Action Plan for Minnesota Wildlife*. Comprehensive Wildlife Conservation Strategy. Division of Ecological Services, MNDNR.

Oak wilt. (http://www.extension.umn.edu/environment/trees-woodlands/oak-wilt-in-minnesota/).

Olsen and Mossler (1982) Geologica map of Minnesota, depth to bedrock. Minnesota Geological Survey. University of Minnesota.

Rothaus, R, McFarlane J, Haug J. 2005. Prehistoric and Euroamerican Archaeology of Elk River Township, Minnesota: Probability Modeling and Reconnaissance Survey

Soil Conservation Service. 1995. Soil Survey of Sherburne County. United States Department of Agriculture.

# APPENDICES

## APPENDIX A. Plant Species Recorded at the Bailey Point Nature Preserve

The following plant species were identified at the site by Friends of the Mississippi River.

| Date: 6/15/15 | Site: Bailey Point | |
|---|---|---|
| Map Unit name: | Prairie | |
| **Scientific Name** | **Common Name** | **Abund[1]** |
| **Groundcover to 4 ft** | | |
| Acer negundo | Boxelder | R |
| Achillea millefolium | Yarrow | C |
| Achillea millefolium | Yarrow | P |
| Anemone canadensis | Canada Anemone | R |
| Arctium minus | Burdock | P |
| Artemesia absinthium | Absinthe | R |
| Asclepias syriaca | Common Milkweed | P |
| Asclepias verticillata | Whorled Milkweed | R |
| Bertorea incana | Hoary Alyssum | C |
| Bromus intermis | Smooth brome | A |
| Carex stipata | Awl fruited sedge | R |
| Celtis occidentalis | Hackberry | R |
| Cirsium spp. | Thistle | P |
| Crepis tectorum | Narrowleaf Hawksbeard | R |
| Fraxinus pennsylvanica | Green ash | P |
| Glechoma hederacea | Creeping Charlie | C |
| Hackelia virginiana | Stickseed | R |
| Juglans nigra | Walnut | P |
| Koeleria macrantha | Junegrass | R |
| Leonurus cardiaca | Motherwort | R |
| Leucanthemum vulgare | Oxeye daisy | R |
| Lotus corniculatus | Birdsfoot trefoil | P |
| Phalaris Arundinacea | Reed Canary Grass | P |
| Phleum pratense | Timothy | R |
| Poa pratensis | Kentucky Bluegrass | A |
| Quercus macrocarpa | Bur Oak | R |
| Rhamnus cathartica | Buckthorn | R |
| Rubus spp | Black raspberry | R |
| Silene latifolia | White campion | P |
| Taraxacum officinale | Dendelion | P |
| Trifolium pratense | Red Clover | P |
| Ulmus pumila | Siberium elm | R |
| Urtica dioica | Stinging nettle | P |
| Verbascum thapsis | Mullein | R |
| Verbena stricta | Hoary vervain | P |
| Viola spp | Violet | R |
| Vitis riparia | Wild Grape | R |
| | | |
| | | |

| | | |
|---|---|---|
| | | |
| **Understory/shrub layer** | | |
| Celtis occidentalis | Hackberry | C |
| Rubus occidentalis | Black raspberry | C |
| | | |
| | | |
| | | |
| **Canopy, subcanopy** | | |
| Acer saccharum | Sugar maple | P |
| Acer sacchirinum | Silver maple | A |
| Celtis occidentalis | Hackberry | A |
| Fraxinus pennsylvanica | Green ash | A |
| Juglans nigra | Black walnut | P |
| Picea mariana | Black spruce | R |
| Populus deltoides | Cottonwood | P |
| Quercus macrocarpa | Bur oak | P |

D= Dominant, C= Common, P= Present, R= Rare

Date: 6/24/15 Site: Bailey Point

Map Unit name: Shoreline/ Floodplain

| **Scientific Name** | **Common Name** | **Abund**[1] |
|---|---|---|
| **Groundcover to 4 ft** | | |
| Acer sacchirinum | Silver maple | C |
| Achillea millefolium | Yarrow | C |
| Amorpha fruticosa | False indigo | R |
| Amphicarpaea bracteata | Hog Peanut | P |
| Bertorea incana | Hoary Alyssum | P |
| Bromun intermis | Smooth brome | P |
| Carex brevoir | Shortbeak sedge | R |
| Carex intumescens | Bladder sedge | R |
| Carex pensylvanica | Penn Sedge | C |
| Carex urtriculata | Beaked sedge | R |
| Celtis occidentalis | Hackberry | A |
| Conyza canadensis | Horseweed | P |
| Crepis tectorum | Narrowleaf Hawksbeard | R |
| Eupatorium rugosum | White snakeroot | A |
| Fraxinus pennsylvanica | Green Ash | A |
| Galium aperine | Bedstraw | A |
| Glechoma heteracea | Creeping Charlie | A |
| Hackelia virginiana | Stickseed | C |
| Hesperis matronalis | Dame's rocket | R |
| Koeleria macrantha | Junegrass | R |
| Laportea canadensis | Wood nettle | P |
| Leonurus cardiaca | Motherwort | C |
| Lonicera spp | Honeysuckle | C |
| Menaspermum canadense | Common moonseed | P |
| Monarda fistulosa | Wild Bergamot | R |
| Oxalis stricta | Wood sorrel | P |
| Parthenocissus vitacea | Virginia creeper | C |

| | | |
|---|---|---|
| Phryma leptostachya | Lopseed | P |
| Prunus virginiana | Chokecherry | P |
| Quercus macrocarpa | Bur oak | R |
| Ranunculus abortivus | Buttercup | P |
| Rhamnus cathartica | Buckthorn | C |
| Ribes spp | Gooseberry | P |
| Rubus occidentalis | Black raspberry | P |
| Rudbeckia lacinata | Green coneflower | P |
| Smilax ecirrhata | Carrion flower | P |
| Solidago canadensis | Canada goldenrod | C |
| Taraxacum officinale | Dandelion | P |
| Trifolium repens | White clover | P |
| Vitis riparia | Wild grape | C |
| Zanthoxylum americanum | Prickly ash | C |

**Understory/shrub layer**

| | | |
|---|---|---|
| Amorpha fruticosa | False indigo | P |
| Celtis occidentalis | Hackberry | C |
| Lonicera spp | Bush honeysuckle | C |
| Rhamnus cathartica | Buckthorn | A |
| | | |

**Canopy, subcanopy**

| | | |
|---|---|---|
| Acer negundo | Box elder | P |
| Acer sacchirinum | Silver maple | A |
| Celtis occidentalis | Hackberry | C |
| Fraxinus pennsylvanica | Green ash | A |
| Juglans nigra | Black walnut | P |

D= Dominant, C= Common, P= Present, R= Rare

## APPENDIX B. Plant Species for Restoration at the Bailey Point Nature Preserve

### Prairie/Savanna:

| ***Forbs, Ferns & Fern Allies*** | | | | |
|---|---|---|---|---|
| Yarrow | *Achillea millefolium* | | Virginia ground cherry | *Physalis virginiana* |
| Prairie wild onion | *Allium stellatum* | | Tall cinquefoil | *Potentilla arguta* |
| Canada anemone | *Anemone canadensis* | | Smooth rattlesnakeroot | *Prenanthes racemosa* |
| Long-headed thimbleweed | *Anemone cylindrica* | | Virginia mountain mint | *Pycnanthemum virginianum* |
| Clasping dogbane | *Apocynum sibiricum* | | Gray-headed coneflower | *Ratibida pinnata* |
| White sage | *Artemisia ludoviciana* | | Canada goldenrod | *Solidago canadensis* |
| Common milkweed | *Asclepias syriaca* | | Missouri goldenrod | *Solidago missouriensis* |
| Heath aster | *Aster ericoides* | | Gray goldenrod | *Solidago nemoralis* |
| Smooth blue aster | *Aster laevis* | | Stiff goldenrod | *Solidago rigida* |
| Skyblue aster | *Aster oolentangiensis* | | Tall meadow-rue | *Thalictrum dasycarpum* |
| Silky aster | *Aster sericeus* | | American vetch | *Vicia americana* |
| Ground plum | *Astragalus crassicarpus* | | Bearded birdfoot violet | *Viola palmata* |
| Toothed evening primrose | *Calylophus serrulatus* | | White camas | *Zigadenus elegans* |
| Flodman's thistle | *Cirsium flodmanii* | | Heart-leaved alexanders | *Zizia aptera* |
| Bastard toadflax | *Comandra umbellata* | | | |
| Bird's foot coreopsis | *Coreopsis palmata* | | ***Grasses & Sedges*** | |
| White prairie clover | *Dalea candida* | | Big bluestem | *Andropogon gerardii* |
| Purple prairie clover | *Dalea purpurea* | | Indian grass | *Sorghastrum nutans* |
| Canada tick trefoil | *Desmodium canadense* | | Little bluestem | *Schizachyrium scoparium* |
| Narrow-leaved purple coneflower | *Echinacea pallida* | | Prairie dropseed | *Sporobolus heterolepis* |
| Daisy fleabane | *Erigeron strigosus* | | Porcupine grass | *Stipa spartea* |
| Rattlesnake master | *Eryngium yuccifolium* | | Side-oats grama | *Bouteloua curtipendula* |
| Common strawberry | *Fragaria virginiana* | | Switchgrass | *Panicum virgatum* |
| Northern bedstraw | *Galium boreale* | | Junegrass | *Koeleria pyramidata* |
| Maximilian's sunflower | *Helianthus maximiliani* | | Pennsylvania Sedge | *Carex pensylvanica* |
| Stiff sunflower | *Helianthus pauciflorus* | | Leiberg's panic grass | *Panicum leibergii* |
| Ox-eye | *Heliopsis helianthoides* | | Prairie cordgrass | *Spartina pectinata* |
| Alumroot | *Heuchera richardsonii* | | | |
| Rough blazing star | *Liatris aspera* | | ***Semi-Shrubs*** | |
| Northern plains blazing star | *Liatris ligulistylis* | | Leadplant | *Amorpha canescens* |
| Great blazing star | *Liatris pycnostachya* | | Prairie rose | *Rosa arkansana* |
| Wood lily | *Lilium philadelphicum* | | | |
| Hoary puccoon | *Lithospermum canescens* | | **Shrubs** | |
| Pale-spiked lobelia | *Lobelia spicata* | | Wolfberry | *Symphoricarpos occidentalis* |
| Wild bergamot | *Monarda fistulosa* | | Dogwood (wet areas) | *Cornus spp.* |
| Wood betony | *Pedicularis canadensis* | | Chokecherry (edges) | *Prunus virginiana* |
| Silverleaf scurfpea | *Pediomelum argophyllum* | | **Trees** | |
| Prairie turnip | *Pediomelum esculentum* | | Bur oak | *Quercus macrocarpa* |
| Prairie phlox | *Phlox pilosa* | | Pin oak | *Quercus ellipsoidalis* |

## Floodplain forest:

| **Forbs, Ferns & Fern Allies** | | **Grasses & Sedges** | |
|---|---|---|---|
| Three-seeded mercury | *Acalypha rhomboidea* | Ambiguous sedge | *Carex amphibola* |
| Green dragon | *Arisaema dracontium* | Gray's sedge | *Carex grayi* |
| Eastern panicled aster | *Aster lanceolatus* | Bladder sedge | *Carex intumescens* |
| Side-flowering aster | *Aster lateriflorus* | Hop umbrella sedge | *Carex lupulina* |
| Ontario aster | *Aster ontarionis* | Cattail sedge | *Carex typhina* |
| Bur marigold and Beggarticks | *Bidens spp.* | Stout woodreed | *Cinna arundinacea* |
| False nettle | *Boehmeria cylindrica* | Virginia wild rye | *Elymus virginicus* |
| Tall bellflower | *Campanula americana* | Rice cut grass | *Leersia oryzoides* |
| Honewort | *Cryptotaenia canadensis* | White grass | *Leersia virginica* |
| Dodder | *Cuscuta spp.* | | |
| Wild cucumber | *Echinocystis lobata* | **Climbing Plants** | |
| White snakeroot | *Eupatorium rugosum* | Canada moonseed | *Menispermum canadense* |
| Nodding or Virginia stickseed | *Hackelia deflexa or H. virginiana* | Virginia creeper | *Parthenocissus spp.* |
| Touch-me-not | *Impatiens spp.* | Greenbrier | *Smilax tamnoides* |
| Southern blue flag | *Iris virginica* | Climbing poison ivy | *Toxicodendron rydbergii* |
| Wood nettle | *Laportea canadensis* | Wild grape | *Vitis riparia* |
| Cut-leaved bugleweed | *Lycopus americanus* | | |
| Northern bugleweed | *Lycopus uniflorus* | **Shrubs/Trees** | |
| Common mint | *Mentha arvensis* | Black willow | *Salix nigra* |
| Clearweed | *Pilea spp.* | Serviceberry | *Amalanchier spp* |
| Virginia knotweed | *Polygonum virginianum* | Dogwood | *Cornus spp* |
| Kidney-leaved buttercup | *Ranunculus abortivus* | Hackberry | *Celtis occidentalis* |
| Tall coneflower | *Rudbeckia laciniata* | Silver Maple | *Acer saccharinum* |
| Mad dog skullcap | *Scutellaria lateriflora* | Cottonwood | *Populus deltoides* |
| Bur cucumber | *Sicyos angulatus* | | |
| Carrion flower | *Smilax spp.* | | |
| Woundwort | *Stachys palustris* | | |
| Narrow-leaved hedge nettle | *Stachys tenuifolia* | | |
| Germander | *Teucrium canadense* | | |
| Stinging nettle | *Urtica dioica* | | |
| Stemless blue violets | *Viola sororia and similar Viola spp.* | | |

## APPENDIX C. Methods for Controlling Exotic, Invasive Plant Species

### *Trees and Shrubs*

*Common Buckthorn*, *Tartarian Honeysuckle*, *Siberian Elm*, and *Black Locust* are some of the most common exotic woody species likely to invade native woodlands or prairies in Minnesota. Buckthorn and honeysuckle are European species that escaped and invaded woodlands in many parts of the country. They are exceedingly aggressive and, lacking natural diseases and predators, can out-compete native species. They remain photosynthetically active longer than most other native shrubs and trees, which gives them a competitive advantage. The seeds are disseminated by birds, which make them especially problematic in open woodlands, savannas, and overgrown prairies. They also benefit from the net actions of invasive earthworms, fire suppression, and high deer populations, forming a synergy that helps set the stage for their establishment and dominance. Invasions eventually result in dense, impenetrable brush thickets that greatly reduce ground-level light availability and can cause declines in native species abundance and diversity.

Siberian elm, native to eastern Asia, grows vigorously, especially in disturbed and low-nutrient soils with low moisture. Seed germination is high and seedlings establish quickly in sparse vegetation. It can invade and dominate disturbed areas in just a few years. Black locust is native to the southeastern United States and the very southeastern corner of Minnesota. It has been planted outside its natural range (it was promoted as an erosion control species and a soil stabilizer partly because it was falsely assumed to be a nitrogen fixer, and since it quickly colonizes bare slopes), and readily invades disturbed areas. It reproduces vigorously by root suckering and can form monotypic stands.

### *Biological Control*

Currently there are no biological control agents for non-native woody plants in Minnesota. Recently, an 11-year study conducted by the DNR and University of MN resulted in the conclusion that there were no viable biological control agents for common or glossy buckthorn, based in part on the lack of damage to the host plants and a lack of host specificity (http://www.dnr.state.mn.us/invasives/terrestrialplants/woody/buckthorn/biocontrol.html).

### *Chemical Control*

The most efficient way to remove woody plants that are 1/2 inch or more in diameter is to cut the stems close to the ground and treat the cut stumps with herbicide immediately after they are cut, when the stumps are fresh and the chemicals are most readily absorbed. Failure to treat the stumps will result in resprouting, creating the need for future management interventions.

In non-freezing temperatures, a glyphosate herbicide such as Roundup can be used for most woody species. It is important to obtain the concentrated formula and dilute it with water to achieve 10% glyphosate concentration. Adding a marker dye helps to make treated stumps more visible, improving accuracy and overall efficiency. In winter months, an herbicide with the active ingredient triclopyr must be used. *Garlon 4* is a common brand name and it must be mixed with a penetrating oil, such as diluent blue. *Garlon* 4 will also work throughout the year. Do not use diesel fuel, as it is much more toxic in the environment and to humans.

Brush removal work can be done at any time of year except during spring sap flow, but late fall is often ideal because buckthorn retains its leaves longer than other species and is more readily identified. Moreover, once native plants have senesced, herbicide will have fewer non-target effects on native vegetation. Cutting can be accomplished with loppers or handsaws in many cases. Larger shrubs may require brush cutters and chainsaws, used only by properly trained professionals.

For plants in the pea family, such as black locust, an herbicide with the active ingredient clopyralid can be more effective than glyphosate. Common brand names for clopyralid herbicides are Transline, Stinger, and Reclaim.

In the year following initial cutting and stump treatment, there will be a flush of new seedlings as well as possible resprouting from some of the cut plants. Herbicide can be applied to the foliage of these plants. Fall is the best time to do this, when desirable native plants are dormant and when the plant is pulling resources from the leaves down into the roots. Glyphosate, triclopyr and Krenite (active ingredient – fosamine ammonium) are the most commonly used herbicides for foliar application. Krenite prevents bud formation so the plants do not grow in the spring. This herbicide can be effective, but results are highly variable. Glyphosate or a triclopyr herbicide such as Garlon can also be used. Glyphosate is non-specific and will kill anything green, while triclopyr targets broadleaf plants and does not harm graminoids. All herbicides should be applied by licensed applicators and should not be applied on windy days. Care should be taken to avoid application to other plants. "Weed Wands" or other devices that allow dabbing of the product can be used rather than spraying, especially for stump treatment.

Basal bark herbicide treatment is another effective control method. A triclopyr herbicide such as Garlon 4, mixed with a penetrating oil, is applied all around the lower 6-12 inches of the tree or shrub, taking care so that it does not run off. If the herbicide runs off it can kill other plants nearby. More herbicide is needed for effective treatment of plants that are four inches or more in diameter.

Undesirable trees and shrubs can also be destroyed without cutting them down. Girdling is a method suitable for small numbers of large trees. Bark is removed in a band around the tree, just to the outside of the wood. If girdled too deeply, the tree will respond by resprouting from the roots. Girdled trees die slowly over the course

of one to two years. Girdling should be done in late spring to mid-summer when sap is flowing and the bark easily peels away from the sapwood. Herbicide can also be used in combination with girdling for a more effective treatment. Girdling has the added benefit of creating snags for wildlife habitat. While girdling a large number of trees is not feasible, girdling the occasional large tree will provide a matrix of habitat for species that depend on standing dead trees for food or nesting opportunities.

### *Mechanical Control*

Three mechanical methods for woody plant removal are hand pulling (only useful on small seedlings and only if few in number), weed wrenching (using a weed wrench tool to pull stems of one to two inches diameter), and repeated or "critical" cutting. Pulling and weed wrenching can be done any time when the soil is moist and not frozen. The disadvantage to both methods is that they are somewhat time-consuming, as the soil from each stem should be shaken off. Weed wrenching also creates a great deal of soil disturbance and should not be used on steep slopes or anywhere that desirable native forbs are growing. The soil disturbance also creates opportunities for colonization by other non-native plants. This method is the least preferable and is probably best used in areas that have hardly any desirable native plant cover.

Repeated cutting consists of cutting the plants (by hand or with a brush cutter) at critical stages in its growth cycle, typically twice per growing season. Cutting in mid spring (late May) intercepts the flow of nutrients from the roots to the leaves and cutting in fall (about mid-October) intercepts the flow of nutrients from the leaves to the roots. Depending on the size of the stem, the plants typically die within three years, with two cuttings per year.

## Prescribed Fire

Prescribed burning is the most efficient, cost effective, and least harmful way to control very small stems, seedlings, and resprouts of all woody plants. It also restores an important natural process to fire-dependant natural communities (oak forests, for example). Burning can only be accomplished if adequate fuel (leaf litter) is present and can be done in late fall or early spring, depending on site conditions.

## Native Shrubs

### *Prickly Ash*

A common native shrub, prickly ash can become excessively abundant, especially in areas that have been disturbed or grazed. Complete eradication may not be necessary, but management may target reducing the extent of a population. Removal is most easily accomplished in the same manner as for buckthorn – cutting shrubs and treating cut stumps with glyphosate herbicide. Cutting can be completed at any time of the year.

### *Smooth Sumac*

Like prickly ash, smooth sumac can become excessively abundant, especially in areas where fire has been suppressed for long periods of time. It can form dense, clonal stands that dominate other vegetation. Unlike prickly ash or buckthorn, however, controlling smooth sumac does not require herbicide applications, since that would require a tremendous amount of herbicide, be quite labor intensive, and probably cause heavy damage to surrounding plants. Control of smooth sumac can be easily accomplished by cutting and burning, or a combination of these two methods. To be effective, the sumac must be burned or cut twice a year: the first time in the late spring, just after it has fully leafed out (expended maximum energy), and the second time in late summer, after it has re-sprouted. Repeat this method annually for two to five years to deplete the clone of its energy, working back at the edges of the clone and reducing cover from the outside of the area towards the center. If cutting or burning is performed only once a season, the clone will persist, since this will not be enough to drain the root system of stored energy. Cutting twice a year without burning will be effective, but burning is doubly so, since fire tends to benefit herbaceous plants and suppress woody ones.

## *Disposal*

The easiest and most cost-effective method to handle large amounts of woody brush is usually to stack it and burn it. This is most typically done during winter to lessen the impacts to soil (compaction, erosion, rutting, etc.), though often brush will be piled soon after the removal and burned during the winter. In areas where brush is not dense, it can be cut up into smaller pieces, scattered, and left on the ground where it will decompose in one to three years (this method is especially useful on slopes to reduce erosion potential). Small brush piles can also be left in the woods as wildlife cover. Where there is an abundance of larger trees, cut trees may be hauled and chipped and used for mulch or as a biofuel. Alternatively, the wood can be cut and used for firewood, if a recipient can be found, or perhaps saved to be used later as waterbars for slope stabilization.

## *FORBS*

### *Spotted knapweed*

Knapweed is a perennial species that has become a troublesome prairie invader. Of all the typical prairie weeds, spotted knapweed is probably the most difficult to manage. It cannot be controlled with burning—like sweet clover it actually increases with fire. Hand-pulling individuals or small groups of individuals can be effective for small infestations, and is often a good volunteer group task. However, knapweed has a fairly large tap root and can be difficult to pull. Pulling is typically more difficult when soil is hard (dry), clayey, or compacted, but easier when soil is wet (following a rain), sandy, and friable. If knapweed populations are large, a bio-

control (knapweed beetles--weevils) is recommended. Knapweed beetles (weevils) are released during the summer. Weevils can be purchased online and they are sent via the mail. Knapweed populations should be monitored each year to keep a record of the effectiveness of the bio-control.

Weevils are effective for long-term control, but not a good short-term control option. Spot treatment with a systemic herbicide such as milestone or transline can be effective for short-term control. Applying herbicide to prairie restoration areas should be done with care. Remnants with high diversity should be spot treated, not broadcast-treated. It is recommended to treat first with the least impactful chemical, monitor to see if that works, and then try another if it does not work. Degraded and highly disturbed areas can be treated a little less gently, perhaps using broadcast applications. Always follow the product label when using any chemical for weed control. Treatment should be done before the target plants form seed, so late spring and early summer are best. Professional pesticide applicators are required for herbicide treatment.

### *Canada thistle*

While native thistles are not generally problematic, exotics such as Canada thistle are clone-forming perennials that can greatly reduce species diversity in old fields and restoration areas (Hoffman and Kearns 1997). A combination of chemical and mechanical control methods may be needed. Chemical control is most effective when the plants are in the rosette stage and least effective when the plants are flowering. Where native grasses and sedges are present, use of a broadleaf herbicide such as 2,4-D is recommended, since 2,4-D only affects dicots. 2,4-D is most effective when applied 10-14 days before the flowering stems bolt. It is applied at a rate of 2-4 lb/acre using a backpack or tractor-mounted sprayer or in granular form. Dicamba could also be used, with the advantages that it can be applied earlier in the spring at a rate of 1 lb/acre. Another chemical that has been used for thistles is aminopyralid ("Milestone"), which can be applied at bud stage. Aminopyralid will affect other species and it has longer residual activity than some other chemicals, so use with caution—typically use it on large patches/clones of thistles and avoid areas of higher diversity. Plants that do not respond to treatment or that are more widely dispersed could be controlled mechanically.

Mechanical control, involving several cuttings per year for three or four years, can reduce an infestation if timed correctly. The best time to cut is when the plants are just beginning to bud because their food reserves are at their lowest. If plants are cut after flowers have opened, the cut plants should be removed because the seed may be viable. Plants should be cut at least three times throughout the season. Late spring burns can also discourage this species, but early spring burns can encourage it. Burning may be more effective in an established prairie, where competition from other species is strong, rather than in an old field, where competition is likely to be weaker.

### *Sweet clover*

White and yellow sweet clover are very aggressive biennial species that *increase* with fire. Where sweet clover is found, it should be controlled in conjunction with treatment that attempts to eliminate smooth brome, if prairie restoration occurs. Sweet clovers are common plants in agricultural areas, so if restoration is implemented, the project area should be surveyed for this species on an annual basis. Often times, following initial brush removal and/or burning, a flush of weedy annuals and biennials such as sweet clover can occur. Well-timed mows and burnings are usually adequate to control these species. Mowing the site, as is typically prescribed for prairie restoration maintenance, should occur when all plants on the site (including sweet clovers) are approximately 12 inches in height. Sweet clover can bloom even at a height of 6 inches, but if it is burned or mowed in the following year in the late spring, it should be controlled. On steep sites, brush cutting can be substituted for mowing. Individual plants or small populations can be removed by hand-pulling. If seed production occurs, prodigious amounts of seed can be produced and spread, so pull before seeds appear or bag seed producing plants. Competition from native species also helps control sweet clovers and other weedy annuals and biennials.

To some extent, *Common burdock* and *common mullein* can be treated similarly to sweet clover, since they are both exotic, biennial forbs that are typically found in disturbed areas or restoration projects.

### *Garlic mustard*

Garlic mustard is an exotic biennial forb of woodlands and woodland edges that is very invasive and aggressive. Following the introduction of just a few plants, populations can rapidly increase and a dramatic "explosion" of garlic mustard plants can occur. In some areas it can form monotypic stands that crowd out other species, while recent studies have shown that in other locations it may simply occupy open ecological niches. Nevertheless, garlic mustard can be very invasive in woodlands, and it is recommended to monitor and remove it as soon as it is detected (early detection and rapid response). Garlic mustard also produces a flavonoid (root exudate) that suppresses myccorhizal inoculation. Thus species that are myccorhizae dependent, like oaks, will become stunted and easily out-competed by garlic mustard. The flavinoid persists in the soil years after garlic mustard plants are removed, which is a good reason to keep woodlands garlic mustard-free.

Probably the best way to control garlic mustard is to closely monitor your site, and if garlic mustard is found, hand pull it before it spreads. Hand-pulling should occur before siliques (seed pods) form. Once siliques form, removed plants should be bagged and transported from the site, since the plant may have enough energy in the stem and root to make viable seeds, even though it is not growing in the ground. If bagging and transporting are not an option, making weed piles is an option, but prepare to deal with garlic mustard plants in the future at each pile. Garlic mustard plants produce hundreds of seeds per plant—they are very prolific. When pulling

garlic mustard plants, take care to remove the entire root, since they may re-sprout if part of the root is left in the ground. This can be difficult, since roots are "S-shaped" and tend to break off at ground level.

Chemical control is not recommended except in cases where garlic mustard is growing in large monocultural patches. In such cases, a systemic herbicide may be appropriate. Glyphosate is non-specific, and will kill any actively growing plant. One technique that has been effective is applying a water soluble herbicide during warm days in the winter, when no snow cover or only a thin snow cover exists. Garlic mustard rosettes (first year plants) remain green mostly all year round, and can be killed during the winter when nearly all other plants are dormant. Another successful technique is to use an herbicide specific to broadleaved plants, like triclopyr ("Garlon"), but one that is water soluble, which can be dispensed with a backpack sprayer or the like; this will not kill grasses or sedges.

There are studies underway by the Minnesota DNR and University of Minnesota that show good potential for bio-control of garlic mustard via an exotic weevil (http://www.legacy.leg.mn/projects/biological-control-european-buckthorn-and-garlic-mustard). The testing phase is complete, but the approval process still needs to be performed. If approved, this method could revolutionize garlic mustard control. However, whether it will be effective or not on a landscape scale is yet to be determined.

### *GRASSES*

#### *Smooth brome*

Smooth brome is a cool season grass —active early in the growing season in southern Minnesota (April-May-June) and then going semi-dormant in July-September. It reproduces by means of underground stems (stolons and rhizomes) called "tillers". The most effective treatment is timed to occur at the same time as the brome is "tillering"—mid to late May in southern Minnesota. Burning two years in a row (late-season burns in June) followed by seeding has been shown to be effective in controlling smooth brome. Consider that this timing may be a week or two earlier on steep south-facing slopes or in very sandy or sand-gravel soils. Following this method will usually be sufficient to control smooth brome. Seeding following burns, preferably with native seed collected on-site, or purchased from a seller that provides local ecotypes, is important for restoring cover at the site. Evaluation can occur each year, and especially after two years. If this is not working, perhaps try a cool-season overspray of a grass-specific herbicide either in the spring (April) or in the fall (October). Using glyphosate as a cool-season overspray herbicide application is a last resort, since it is non-specific and can kill everything.

*Kentucky bluegrass* and *creeping fescue* can be treated similarly to smooth brome, since like smooth brome, they are both exotic, stoloniferous, cool-season grasses. Spring burns are the most effective tool against all of these species.

*Reed canary grass*

This species is extremely difficult to eradicate and requires repeated treatment over a period of one to three years. A combination of burning, chemical treatment and mowing can be used in accessible areas, or chemical treatment alone in inaccessible areas. The combination method starts by burning in late spring to remove dead vegetation and to stimulate new growth. When new sprouts have reached a height of 4 to 6 inches, the site can be sprayed with a 5% solution of a glyphosate herbicide appropriate for wetland habitat (e.g. Rodeo). The site is then mowed in late summer, followed by chemical application after re-growth. This treatment will stimulate new growth and germination to deplete the seed bank. The sequence of chemical treatment and mowing are repeated for at least a second season, and possibly a third until the grass is completely eradicated. Then native grass and forb seed can be broadcast or drilled.

If reed canary grass is eradicated from an area, future management of the grassland, namely burning, will likely keep the reed canary in check. Monitoring and mapping new individuals or clumps should continue, however, and those individuals should be treated if burning is not adequately controlling them. If the plants are small they can be removed by digging out the entire root. Generally though, chemical treatment is more feasible. If plants are clumped, they can be treated by tying them together, cutting the blades, and treating the cut surface with herbicide. Otherwise, herbicide should only be applied in native planted areas on very calm days to avoid drift to non-target plants.

## APPENDIX D. Ecological Contractors

Following is a list of contractors to consider for implementing the management plans. While this is not an exhaustive list, it does include firms with ecologists who are very knowledgeable with natural resource management. Unless otherwise noted, all firms do prescribed burning. Many other brush removal companies are listed in the yellow pages (under tree care), but most do not have knowledge or understanding of native plant communities. We recommend hiring firms that can provide ecological expertise. Additional firm listings can be found on the DNR website: http://www.dnr.state.mn.us/gardens/nativeplants/index.html

Friends of the Mississippi River (FMR) has extensive experience working with landowners to implement natural resource management plans. FMR can assist landowners with obtaining funding for restoration and management projects and providing project management, including contractor negotiations, coordinating restoration and management work, and site monitoring and evaluation.

Applied Ecological Services, Inc.
21938 Mushtown Rd
Prior Lake, MN 55372
952-447-1919
www.appliedeco.com

Conservation Corps Minnesota
2715 Upper Afton Road, Suite 100
Maplewood, MN 55119
(651) 209-9900

Great River Greening
35 West Water St, Suite 201
St. Paul, MN 55107
651-665-9500
www.greatrivergreening.org

Minnesota Native Landscapes, L.L.C.
14088 Highway 95 N.E.
Foley, MN 56329
(320) 968-4222
www.mnnativelandscapes.com

Prairie Restorations, Inc.
PO Box 305
Cannon Falls, MN 55009
507-663-1091
www.prairieresto.com

Stantec
2335 West Highway 36
St. Paul, MN 55113
651-604-4812
www.stantec.com

Wetland Habitats Restoration, LLC.
1397 Chelmsford St.
St. Paul, MN  55108
Cell:  612-385-9105
Fax:  636-333-8834
www.whr.mn