

Habitat Management Plan for City of Red Wing Parks: Barn Bluff



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Introduction

Barn Bluff is located on the northeast side of Red Wing, Minnesota (Map 1) and is considered by many city residents as a historical landmark. Barn Bluff is best described as a high knob or knoll with steep to very steep slopes and a relatively flat, narrow ridgetop (Map 2). The top of the bluff overlooks the Mississippi River to the north and the city of Red Wing to the south and southwest. Total park acreage is 73 acres, although the steep slopes add significant acreage for management purposes. Concrete steps, a kiosk, flagpole, and several hiking trails are the only developments within the park. This park and trail system receives heavy public use.

Human activities have altered the character and vegetation communities present on the bluff. Portions of the bluff have been removed by the operation of several quarries during the late 1800's, predominantly on the east end and the western portion of the south slope. The north flank was altered by construction of the railroad in the 1870's. Construction of Highway 61 and the approaches for the Eisenhower bridge removed portions of the south and west sides. These activities resulted in the exposure of limestone bedrock and nearly vertical rock faces at several locations on the bluff. Fire suppression has also altered the vegetation communities on the bluff. It is likely the entire south slope was historically prairie and oak savanna, but fire suppression has allowed woody vegetation to become established at several locations including the entire lower slope. These woody species continue to spread and encroach on the existing prairies and oak savanna. Presently, approximately 23 acres of Barn Bluff is bluff prairie and oak savanna, with some rock outcropping. The remainder of the park is deciduous forest, or is becoming established as deciduous forest.

Despite these alterations, Barn Bluff provides important wildlife habitat. Minnesota has lost most of its native tall grass prairie and oak savannas, and these plant communities are among the rarest in the U.S. The prairies and oak savanna on Barn Bluff are still of high quality and of large enough size to provide habitat for grassland and savanna bird species, reptiles, and insects. The deciduous forests provide habitat for forest bird species, mammals, reptiles, amphibians, and insects.

For management purposes the park is best divided into 7 areas: 1) west prairie, 2) east prairie, 3) oak savanna, 4) oak grove, 5) south prairie, 6) south forest, and 7) north forest (Map 3). The prairies and oak savanna are of high quality, but are threatened by invasion by woody species. The oak grove and south prairie have been extensively invaded by deciduous woody vegetation and will succeed into deciduous forest within 20 years. The south forest was likely oak savanna and prairie prior to fire suppression. It is now a mixed species deciduous forest that is badly invaded by the exotic species buckthorn and honeysuckle. The north forest is predominantly a mature maple-basswood forest with little to no exotic species invasion.

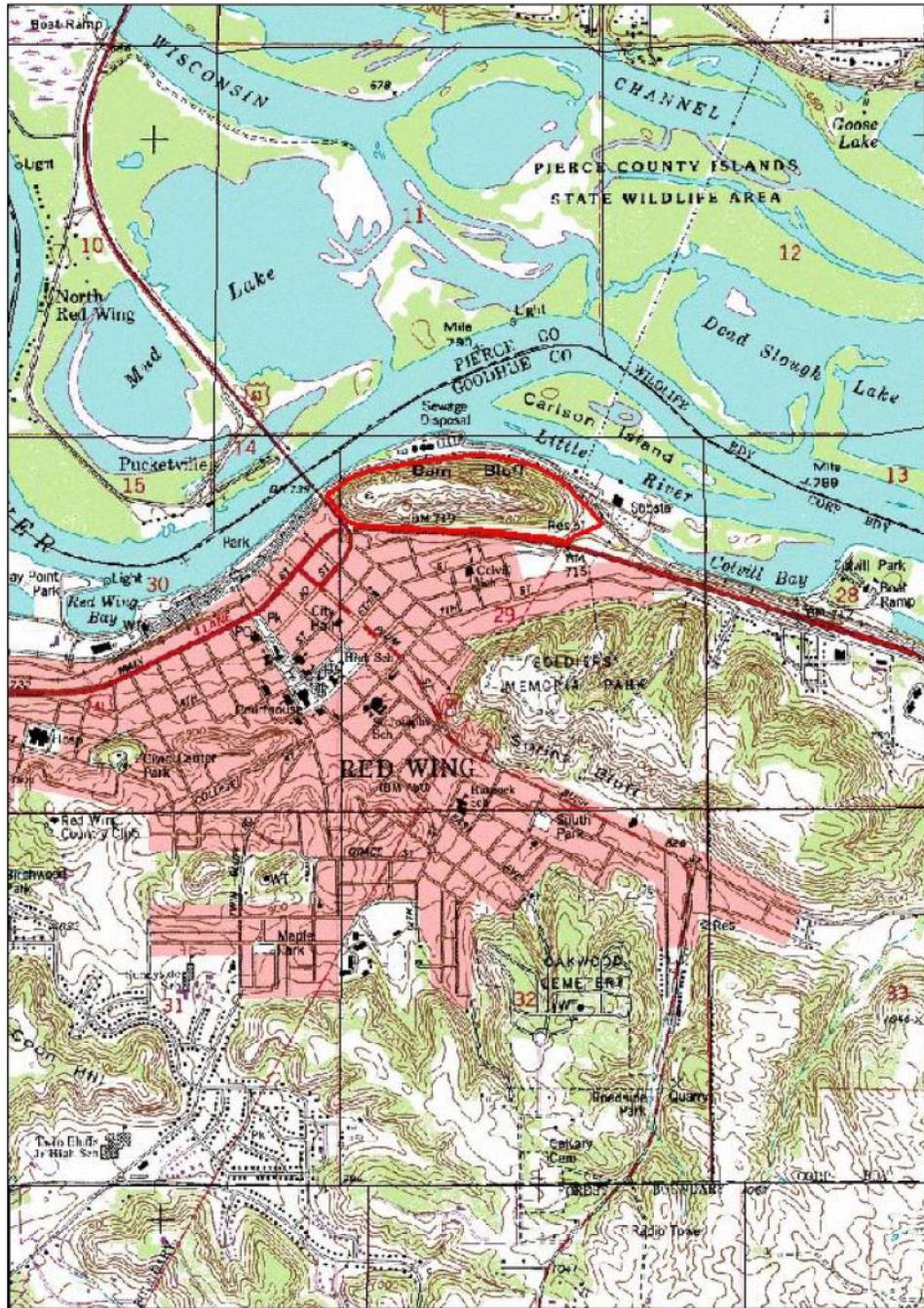
Management priorities for Barn Bluff are 1) maintain and restore open habitat types (prairies and oak savanna), and 2) control exotic species, primarily buckthorn and honeysuckle. On the following pages are descriptions of each area with management recommendations.



Map 1. Location of Barn Bluff on northeast side of Red Wing, Minnesota.

Red Wing Topo Quad

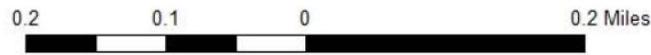
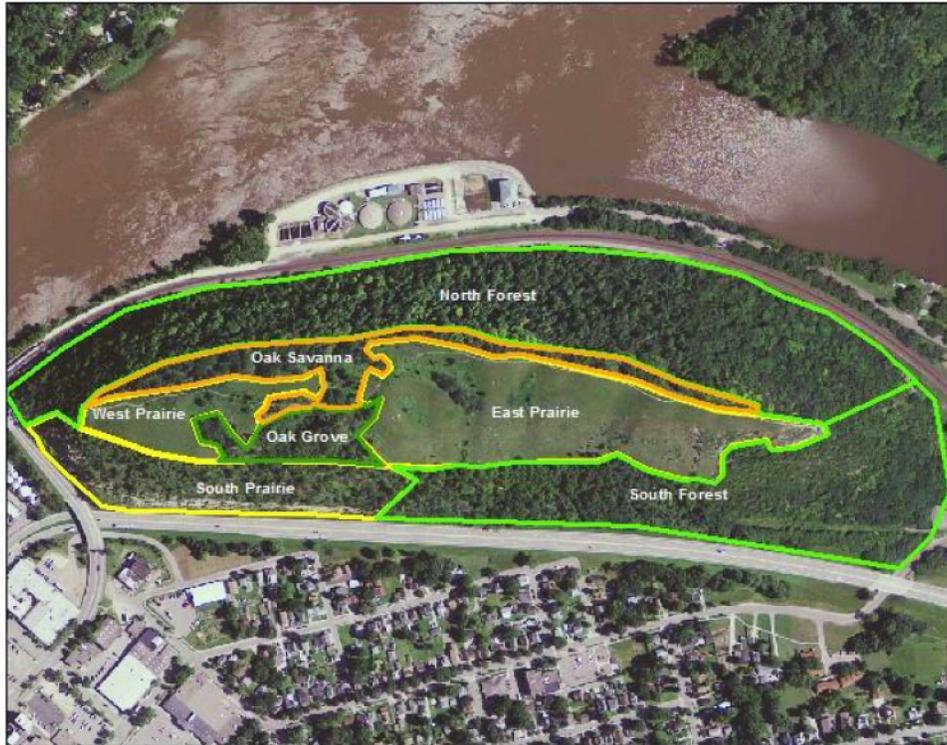
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Map 2. Topographic map for Barn Bluff.

City of Red Wing Barn Bluff Park

Section 29 T113N R14W
Goodhue County, Minnesota



Map 3. Management units for Barn Bluff Park



Map 4. 1953 Aerial photograph of Barn Bluff showing the openness of the south slope. Note that most of south slope had burned shortly before the photo was taken.

West Prairie (4 A) and East Prairie (13 A)



The west prairie and east prairie are located along the ridgetop and upper portions of the south facing slope. Soil types are Timula silt loam (TmC), Timula-Bold silt loams (ToD), and Brodale-Sogn flaggy loams (BoF). Slopes vary from relatively flat on the narrow ridgetop to very steep (up to 80%) as one descends on the east prairie. Prairies are of relatively high quality with numerous grass and forb species present (See Appendix 1). Porcupine grass, big bluestem, little bluestem, side oats grama, purple prairie clover, and lead plant are especially abundant. Bladderpod, a Minnesota state endangered plant, has been found on the east prairie. An excessive amount of litter has built up throughout much of the prairie.

Invasion by woody species is the greatest threat to the persistence of these prairies. Sumac is the biggest problem, invading at several locations within the prairie in dense stands. Quaking aspen is invading into the prairie from the north forest/oak savanna edge, and is especially severe in the northwest corner of the west prairie. Approximately 3 acres of dense sumac and 0.1 acres of relatively dense aspen are present, with individuals of each species scattered along the north edge. Silver buffaloberry, a shrub native to far western Minnesota, has become established and is spreading in the southeast corner of the west prairie. Buckthorn, honeysuckle, and deciduous trees are invading up the slope from the south and east.

In addition to the woody species, a dense stand of sweet clover has developed along the prairie trail within the east prairie and is spreading south down the slope. This stand is estimated at 0.6 acres. Smooth brome grass has become established within some of sumac stands on the prairie.

Grassland bird species that utilize bluff prairies include grasshopper sparrows, eastern meadowlarks, bobolinks, and dickcissels. Reptiles found on bluff prairies include eastern hognose snakes, North American racers, gopher snakes, timber rattlesnakes, and six lined racerunner. Numerous butterfly, wasp, bee, and other insect species feed on flowering plants on bluff prairies.

Management Goals:

- 1) Maintain prairie acreage by controlling and removing woody vegetation.
- 2) Maintain native prairie grass and forb species diversity.

Management Recommendations (See Appendix 2 for species specific control methods):

- 1) Remove aspen, sumac, silver buffaloberry, and other non-oak woody vegetation from prairies.
- 2) Control sweet clover.
- 3) Monitoring and follow-up treatment of invasive species will be required for several years.
- 4) Use prescribed fire on a 3 to 5 year rotation to help control woody species invasion and remove excessive litter buildup. To protect insects and other fauna, it would be best to burn east and west prairies (or other suitable division) in different years. Timing of burns should vary for different years (ie early spring, late spring, summer, or fall) to promote diversity of plant species. When possible, prairies should be burned in conjunction with the oak savanna. Although the trails would make natural firebreaks, portions of the prairies and oaks savannas lie outside the trails and it would be best to burn beyond the trail to include all prairie/oak savanna vegetation communities.

Limitations/hindrances to management: Although slope is steep, it should not impede management activities. Prescribed burning may pose several challenges to include 1) smoke in the city, 2) public use, and 3) establishment of firebreaks. These limitations can be easily overcome with a good burn plan and implementation. Use a qualified contractor or agency crew. It would be recommended the park be closed to the general public during prescribed burns until they are safely completed.



East prairie as seen from Memorial Park. The south forest is on the lower slope.



Thimbleweed, leadplant, and porcupine grass on the west prairie.



Rough blazing star blooming in east prairie during fall of 2013.



Thimbleweed, big bluestem, gray goldenrod, rough blazing star, false boneset, and others on east prairie.



Aspen invasion in west prairie.



Sumac invasion in east prairie.



Dense stand of sweet clover in the east prairie.



Silver buffaloberry in southeast corner of west prairie.

Oak savanna (6 A)



An oak savanna is a plant community where the tree density is low enough to allow sufficient sunlight to reach the ground to create a rich grass and forb ground layer. Tree canopy coverage ranges from 10 to 50%. Trees are described as open grown, with large lower limbs and a spreading, wide canopy.

The oak savanna is located along the very upper portion of the north slope along the ridge top, and also extends partially down the south slope, dividing the east and west prairies. The oak savanna consists of narrow band of trees on the east end, but broadens on the west. The soil type is Timula silt loam (TmC). Large, open grown bur oaks are the dominant tree species. A sufficient number of younger age bur oaks are present to replace the older bur oaks as they age and die. Although a number of native grass, sedge, and forb species are present, Canada goldenrod is the dominant ground species throughout much of the western portion of the oak savanna. Culvers root and columbine are found in the savanna. Cream gentian is found in one location on the savanna/prairie edge.

Growth of woody vegetation, both native and non-native, is the greatest threat to persistence of the oak savanna. Northern pin oak, aspen, basswood, white birch, and cottonwood have grown up within and along the edges of the oak savanna and add to the canopy cover. Sumac invasion is severe on the west end, and both aspen and sumac invasion is severe within the savanna area on the south slope. Low to

moderate buckthorn and honeysuckle invasion is present within the western portion. A few small, isolated patches of reed canary grass are also found within the western portion of the oak savanna.

Bird species that utilize oak savannas include red-headed woodpeckers, northern flickers, downy woodpeckers, hairy woodpeckers, and eastern bluebirds. Many of the same reptile and insect species found on bluff prairies also utilize oak savannas.

Management Goals:

- 1) Maintain savanna acreage by controlling and removing woody vegetation.
- 2) Increase native ground layer diversity.

Management Recommendations (See Appendix 2 for species specific control methods):

- 1) Remove invasive species: sumac, aspen, buckthorn, and honeysuckle. Follow-up treatment and monitoring will be required for several years.
- 2) Remove non-oak deciduous trees.
- 3) Remove northern pin oaks.
- 4) Control reed canary grass patches.
- 5) Use prescribed fire on a 3 to 5 year rotation to control woody and exotic species invasion and stimulate native ground flora diversity. Oak leaves under the Canada goldenrod stands should provide sufficient fuel to burn through these areas. Burn oak savanna in conjunction with prairies.

Limitations/hindrances to management: Prescribed burning may pose several challenges to include 1) smoke in the city, 2) public use, and 3) establishment of firebreaks. These limitations can be easily overcome with a good burn plan and implementation. Use a qualified contractor or agency crew. It would be recommended the park be closed to the general public during prescribed burns until they are safely completed.



Ground layer within the western portion of the oak savanna. Note buckthorn and sumac are also present.



Cream gentian located at edge of savanna and prairie.

Oak Grove (2 A)



The oak grove is located in the west-central portion of the south slope and divides the lower portions of the west and east prairies. The soil type is Timbula-Bold silt loams (ToD), and slopes are moderately steep to steep (12 to 60%). Large, open grown bur oaks are the dominant tree species, and this area was likely an oak savanna historically. Other tree species such as walnut and cottonwood now contribute to the canopy cover. Canopy cover is greatest on the east portion. The western portion of the oak grove is more open and a native savanna ground layer can still be found in some areas. Dense stands of sumac have become established at several locations throughout the oak grove and are spreading into the adjacent prairies. Buckthorn and honeysuckle are also present, but to a much lesser degree. The stairway connecting the south trail with the prairie trail is located within the eastern portion of the oak grove.

Management Goals:

- 1) Restore western portion of oak grove to oak savanna
- 2) Allow eastern portion of oak grove to succeed into deciduous forest.
- 3) Remove exotic and undesirable tree and shrub species from oak grove.
- 4) Increase native ground layer diversity.

Management Recommendations (See Appendix 2 for species specific control methods):

- 1) Remove invasive species: sumac, buckthorn, and honeysuckle. Follow-up treatment and monitoring will be required for several years.
- 2) Remove non-oak deciduous trees from western portion of oak grove.
- 3) Remove northern pin oaks from western portion of oak grove.
- 4) Use prescribed fire on a 3 to 5 year rotation to control woody and exotic species invasion and stimulate native ground flora diversity. Deciduous leaves should provide sufficient fuel to burn through this area. Burn oak grove in conjunction with prairies.

Limitations/hindrances to management: Although slope is steep, it should not impede management activities. Prescribed burning may pose several challenges as listed above for the prairies and oak savanna.



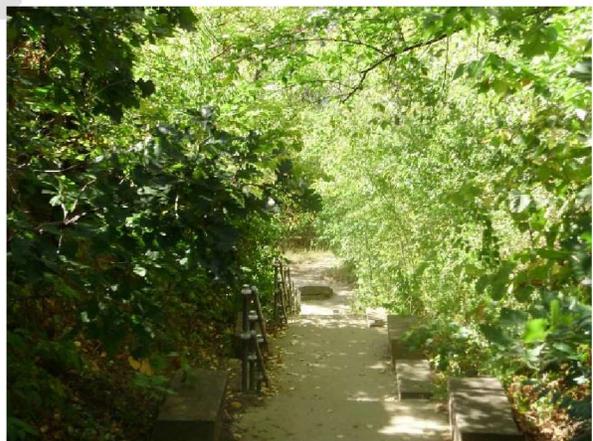
The oak grove separates the west and east prairies.



Large cottonwoods and sumac on the edge of oak grove.



View of the oak grove from the east prairie.



Stairs on the south trail run through the eastern portion of the oak grove.

South Prairie (7 A)



The south prairie is best described as former prairie and oak savanna due to the severe woody invasion that is occurring. Located on the western portion of the lower south slope, this area is the mostly heavily human altered portion of the bluff. Quarrying and material removal for Highway 61 and Eisenhower Bridge approach construction have resulted in bedrock exposure and nearly vertical rock faces in several areas. Many of these rock faces now have trees and shrubs growing on them. Bur oak, northern pin oak, walnut, box elder, elm, buckthorn, honeysuckle, and sumac are found throughout the area. Despite the woody invasion, most of the south prairie area still has a diverse native grass and forb ground layer. Big and little bluestem, porcupine grass, purple prairie clover, and leadplant are especially common. In addition to a few widely scattered mature bur oaks, bur oak seedlings and saplings are quite abundant throughout the area. The soil type is Marlean soils (MaF), a silt loam on very steep (40 to 80%) slopes.

Management Goals:

- 1) Restore area to prairie and oak savanna.
- 2) Maintain native prairie grass and forb species diversity.

Management Recommendations (See Appendix 2 for species specific control methods):

- 1) Remove sumac, buckthorn, and honeysuckle.
- 2) Remove non-oak deciduous trees.
- 3) Remove northern pin oaks.
- 4) Monitoring and follow-up treatment of woody species will be required for several years.
- 5) Use prescribed fire on a 3 to 5 year rotation to help control woody species invasion and remove excessive litter buildup. When possible, burn south prairie in conjunction with west prairie.

Limitations/hindrances to management: The several nearly vertical rock faces will provide challenges for management. Trees and shrubs growing on the upper portions of these faces will be very difficult to reach and cut. Judicious use of foliar application of herbicides may be justified on these sites. The rock faces will also serve as barriers to fire spread during prescribed burns. Crews should be able to navigate and light around these areas, but doing so will add time to completing burns.



Native prairie ground layer on south prairie.



Bur oak sapling on south prairie.



The west quarry is located in the south prairie.



Rock faces on south prairie.

South Forest (16 A)



The south forest is located along the east base of the south slope and extends around the east slope of Barn Bluff. It is best described as a maturing mixed species deciduous forest. The soil type is Terril Sandy loam (TeD), and was formed in loamy sediment. The historic native vegetation was tall prairie grasses. Slopes are moderately steep (2 to 25%).

Oaks are a significant portion of the canopy species, and many of the oaks are open grown with large spreading limbs suggesting a portion to majority of this area was once an oak savanna. Northern pin oaks, white oaks, bur oaks, and black walnut are dominant canopy species. Cottonwoods and white birch are present in some areas. Basswood, hackberry, and American elm are predominant in the sub-canopy, with severe invasion by buckthorn and honeysuckle in the understory. All ages of buckthorn and honeysuckle are present, and in some areas buckthorn seedlings have replaced the native ground flora.

As one moves up the south slope above the midland trail, the forest becomes very young. Except for a few large bur oaks, the area would better be classified as shrubland. Several red cedars are present, along with elm, buckthorn, honeysuckle, and other tree species. Height of woody vegetation is 6 to 10 feet, and a few small openings with native prairie vegetation are present in this area.

In addition to buckthorn and honeysuckle within the south forest, a small patch of creeping bellflower and a few oriental bittersweet vines are located along the south trail. These invasions are very localized

at this time. Scattered individual sweet clover plants are also located along the south trail. Garlic mustard was not observed in several site visits.

Several management options are available for the south forest:

- 1) Restore portion of the south forest north of the midland trail to prairie/oak savanna and allow portion of south forest south of midland trail to continue succession.
- 2) Allow all of south forest to continue succession.
- 3) Restore all of south forest to prairie/oak savanna.

As the portion of the south forest north of the midland trail is still early successional, restoration to prairie/oak savanna is still feasible. This area is approximately 2.2 acres in size.

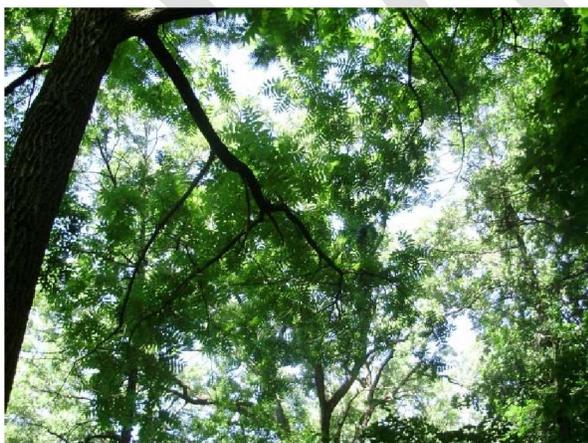
Management Goals:

- 1) Eliminate exotic invasive species.
- 2) Restore portion of the south forest north of the midland trail to prairie/oak savanna.
- 3) Allow portion of south forest south of midland trail to continue succession.
- 4) Increase native ground layer diversity.

Management Recommendations (See Appendix 2 for species specific control methods):

- 1) Remove exotic invasive species. As creeping bellflower and oriental bittersweet invasions are localized, these species should be controlled as soon as possible.
- 2) Control sweet clover along south trail, as seeds from these plants may be carried by hikers footwear onto the prairies.
- 3) Remove non-oak deciduous trees from north of midland trail.
- 4) Remove northern pin oaks from north of midland trail.
- 5) Follow-up monitoring and treatment of invasive species will be required for several years.
- 6) Use prescribed fire on a 5 to 20 year rotation to stimulate native ground flora diversity and help control woody and exotic species invasion. Deciduous leaves should provide sufficient fuel to burn through this area. South forest may be burned in conjunction with east prairie.

Limitations/hindrances to management: Although slope is steep, it should not impede management activities. Prescribed burning may pose several challenges as listed above for the prairies and oak savanna.



Black walnut in canopy of south forest.



White birch in south forest.



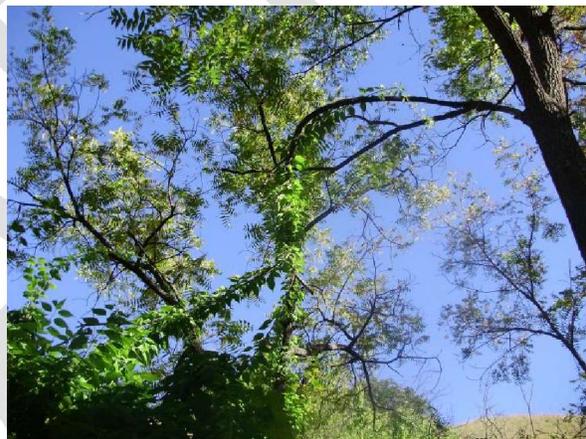
Native ground flora is still present in many portions of the south forest.



Severe buckthorn invasion along south trail.



Creeping bellflower is located along the south trail.



Oriental bittersweet climbing into a black walnut.



Upper portion of south forest (below rock face).



Upper portion of south forest looking upslope from midland trail.

North Forest (25 A)



The north forest is located on the north slope of Barn Bluff. Soil type is Frontenac silt loam (FrF), and slopes are very steep (40 to 80%). Current habitat type is deciduous hardwood forest, best classified as maturing/mature maple-basswood forest. Sugar maple, basswood, and hackberry are dominant in canopy and sub-canopy. Other tree species are also present including white birch. The shrub layer is largely absent. A healthy native forest ground layer is present and species include trillium, wild geranium, columbine, and maidenhair fern. No invasive species were located or identified during site visits.

Management Goals:

- 1) Maintain area as maple-basswood forest.
- 2) Prevent establishment of exotic species.

Management Recommendations (See Appendix 2 for species specific control methods):

- 1) Monitor yearly for invasive species.
- 2) Aggressively treat any invasive species locations when they appear.

Limitations/hindrances to management: Steepness of slope will limit management capability in some areas.

Summary/Other Considerations

Management actions can be summarized into two activities: 1) remove invasive species, some of which are native tree species that are not normally considered invasive species and 2) conduct prescribed burning. Initial costs in funding and time will be significant. Monitoring and follow-up treatment for invasive species will need to take place for several years following initial work. Eventually, it is hoped that prescribed burning will be the only management technique needed to maintain habitat types.

Woody invasives can be controlled in several ways. They can be cut using chainsaws and other tools, and stumps treated with a herbicide. Herbicides can be applied as a basal bark treatment or as a foliar application, although these methods may not be appropriate for most areas at Barn Bluff because of risk to non-target native plant species. Prescribed burning will kill seedlings and small saplings, and top kill larger individuals of some species. On most sites, cut trees and brush are piled and then burned. Unfortunately, the soil is usually sterilized at the burn pile site due to the intense heat, and it often takes several years before plants will grow. An alternative to piling and burning cut brush is to contact a biofuel company to determine the feasibility for them to pick up and haul away the cut brush. Movement of cut material to a convenient pickup site may prove difficult on this site, but this option should be explored further.

Some restoration sites are using goats in an effort to control invasive species. Repeated grazing within the same year and multiple years is necessary to achieve satisfactory control. Goat Peak Ranch, 29527 County 2 Blvd, Red Wing, MN 55066 (651/248-7443 or 651/368-2177) is a local source for goats for invasive species work.

Because annual funding is likely to be limited and the amount of work needing to be done will appear to be overwhelming, it would be best to choose priority habitat areas to begin work. The following areas are ranked from high priority to low priority:

- East and west prairies
- Oak savanna
- Oak grove
- South prairie
- South forest

Several funding and in-kind opportunities exist for management practices. These include: City of Red Wing funds, Friends of the Bluffs volunteer in-kind/funds, MN DNR in-kind for prescribed burning/funds, USFWS Partners for Fish and Wildlife Program in-kind/funds, and multiple grant opportunities (including National Fish and Wildlife Foundation-Pulling Together Grant). Local groups or clubs who use the trails regularly may also be willing to contribute volunteer time or funds for restoration work.

For each area several management recommendations are presented. As the property is a city park with heavy public use, public reaction should be considered before instituting any management actions as some of these actions may be controversial. Conducting good public outreach to explain management actions and goals will go a long way in preventing much of the controversy involved with management actions.

APPENDIX 1: Prairie and Savanna Plant Species List (partial)

June grass (<i>Koeleria macrantha</i>)	Porcupine grass (<i>Stipa spartea</i>)
Big bluestem (<i>Andropogon gerardii</i>)	Canada wild rye (<i>Elymus canadensis</i>)
Side-oats grama (<i>Bouteloua curtipendula</i>)	Little bluestem (<i>Schizachyrium scoparium</i>)
Indian Grass (<i>Sorghastrum nutans</i>)	Plains muhly (<i>Muhlenbergia cuspidata</i>)
Hairy grama (<i>Bouteloua hirsuta</i>)	Switch grass (<i>Panicum virgatum</i>)
Linear-leaved panic grass (<i>Panicum linearifolium</i>)	
Lead plant (<i>Amorpha canescens</i>)	Black-eyed susan (<i>Rudbeckia hirta</i>)
Purple prairie clover (<i>Dalea purpurea</i>)	Carolina larkspur (<i>Delphinium carolinarum</i>)
Hoary vervain (<i>Verbena stricta</i>)	Stiff Goldenrod (<i>Solidago rigida</i>)
Prairie rose (<i>Rosa arkansana</i>)	Evening primrose (<i>Oenothera biennis</i>)
Thimbleweed (<i>Anemone cylindrica</i>)	Ground plum (<i>Astragalus crassicaarpus</i>)
Pale spiked lobelia (<i>Lobelia spicata</i>)	Lance-leaf figwort (<i>Scrophularia lanceolata</i>)
False Gromwell (<i>Onosmodium molle</i>)	Prairie coreopsis (<i>Coreopsis palmata</i>)
Whorled Milkweed (<i>Asclepias verticillata</i>)	Common Milkweed (<i>Asclepias syriaca</i>)
Bergamot (<i>Monarda fistulosa</i>)	Daisy Fleabane (<i>Erigeron strigosus</i>)
Flowering spurge (<i>Euphorbia corollata</i>)	Painted leaf (<i>Euphorbia cyathophora</i>)
Missouri Goldenrod (<i>Solidago missouriensis</i>)	Harebells (<i>Campanula rotundifolia</i>)
Western ragweed (<i>Ambrosia psilostachya</i>)	Yellow coneflower (<i>Ratibida columnifera</i>)
Rough blazing star (<i>Liatris aspera</i>)	Dotted blazing star (<i>Liatris punctata</i>)
Pasqueflower (<i>Anemone patens</i>)	False boneset (<i>Kuhnia eupatorioides</i>)
Heath aster (<i>Aster ericoides</i>)	Sky blue aster (<i>Aster oolentangiensis</i>)
Aromatic aster (<i>Aster oblongifolius</i>)	Downy painted cup (<i>Castilleja sessiliflora</i>)
Clasping dogbane (<i>Apocynum sibiricum</i>)	Sage wormwood (<i>Artemisia frigida</i>)
Bastard toadflax (<i>Comandra umbellata</i>)	Smooth scouring rush (<i>Equisetum laevigatum</i>)
Stiff sunflower (<i>Helianthus pauciflorus</i>)	Woodland sunflower (<i>Helianthus strumosus</i>)
Ox-eye (<i>Heliopsis helianthoides</i>)	False dandelion (<i>Nothocallis cuspidata</i>)
Hoary puccoon (<i>Lithospermum canescens</i>)	Fringed puccoon (<i>Lithospermum incisum</i>)
Violet wood sorrel (<i>Oxalis violacea</i>)	Smooth cliff brake (<i>Pellaea glabella</i>)
Bladderpod (<i>Physaria ludoviciana</i>)	White snake root (<i>Ageratina altissima</i>)
Prairie ragwort (<i>Senecio plattensis</i>)	Grey goldenrod (<i>Solidago nemoralis</i>)
Upland white aster (<i>Solidago ptarmicoides</i>)	Blue-eyed grass (<i>Sisyrinchium capestre</i>)
Blue vervain (<i>Verbena hastata</i>)	Prairie bird-foot violet (<i>Viola pedatifida</i>)
Prairie willow (<i>Salix humilis</i>)	American bittersweet (<i>Celastrus scandens</i>)
Cream gentian (<i>Gentiana flavida</i>)	Culvers Root (<i>Veronicastrum virginicum</i>)
Red columbine (<i>Aquilegia canadensis</i>)	Canada Goldenrod (<i>Solidago canadensis</i>)
Northern bedstew (<i>Galium boreale</i>)	Elm leaved goldenrod (<i>Solidago ulmifolia</i>)
Yellow sweet clover (<i>Melilotus officinalis</i>)	White sweet clover (<i>Melilotus alba</i>)
Smooth brome (<i>Bromus inermis</i>)	Reed canary grass (<i>Phalaris arundinacea</i>)

APPENDIX 2: Species specific control methods

Aspen: Aspen can be controlled by cutting and applying herbicide to the cut stump(s). A 20% glyphosate (Roundup) solution should be applied to the cut stump with a low pressure hand-held sprayer or applied with a paint brush or wick applicator. A triclopyr herbicide (Garlon) may also be used for cut stump treatment. Aspens are notorious for root suckering, and will re-sprout from the root system if stumps are not treated.

Girdling can also be an effective method of controlling aspen. Removing a 6" or greater section of bark from the trunk in May or early June will eventually kill the tree and severely limit any root suckering. It often takes 2 to 3 years for trees to die, and the whole clone must be treated for girdling to be effective.

Sumac: To control sumac, stems should be cut in July or shortly after flowering. Stumps should be treated with a triclopyr (Garlon 4) or 20% glyphosate (Roundup) to minimize re-sprouting. Re-sprouts should be cut in August. Apply herbicide with a low pressure hand held sprayer, paintbrush, or wick applicator. Cutting and stump treatment are not as effective if conducted during the dormant season. If chemical treatment is not preferred, repeated cutting in July and then again in August for several years can be effective.

Basal bark treatment using Garlon 4 provides effective control of sumac. Foliar herbicide treatment using Garlon 3A or 1 to 2% Roundup can be effective as a control method. This method of control is not recommended on these sites because of the likelihood of overspray and drift injury to adjacent plants.

Prescribed burning in August will often kill mature plants if there is sufficient understory, but re-sprouting will occur.

Once sumac is controlled, an occasional August burn should be sufficient to prevent re-invasion of open areas.

Buckthorn: Buckthorn can be controlled by cutting and applying herbicide to the cut stump. Cutting and stump treatment are best done in the fall and winter, and should not be done in the spring when sap is rising. A 50% glyphosate (Roundup) solution can be applied to the cut stump with a low pressure hand-held sprayer or applied with a paint brush or wick applicator. Stumps that are not treated will re-sprout. Triclopyr (Garlon) herbicides or Trimec (a formulation of 2,4-D, MCPP, and Dicamba) may also be used for cut stump treatment. Treated sites should be monitored annually and follow-up cutting and stump treatment conducted as needed.

Seedlings and small saplings are easily hand-pulled, especially with moist soil conditions.

Dormant season basal bark herbicide treatment using Garlon 4 can also be used. Herbicide application should be to a height of 12 to 15" around the base of the woody stem. Avoid overspray and drift as Garlon 4 within the ground can still injure non-target plants.

Prescribed burning in late April to early May will kill seedlings and top-kill mature plants. Top-killed plants will re-sprout and repeated annual to biennial burns for 5 or more years will be necessary for effective control.

Honeysuckle: Bush honeysuckles are best controlled by cutting and applying herbicide to the cut stump(s). Cutting and stump treatment are best done in the fall and winter, and should not be done in the spring when sap is rising. A 20% glyphosate (Roundup) solution can be applied to the cut stump with a low pressure hand-held sprayer or applied with a paint brush or wick applicator. Stumps that are not treated will re-sprout. Other herbicides including 2,4-D, imazapyr (Stalker), picloram (Tordon), and triclopyr (Garlon) may be used for cut stump treatment, although some sources claim Garlon does not

provide effective control of bush honeysuckles. Treated sites should be monitored annually and follow-up cutting and stump treatment conducted as needed.

Basal bark herbicide treatment can also be used. Herbicide application should be at least 6" wide completely around the base of the woody stem. Do not use this method if there is heavy sap flow or snow is covering the application area. 2,4-D, imazapyr (Stalker), aminopyralid (Milestone), dicamba (Banvel), and triclopyr (Garlon) are effective herbicides for this treatment. Avoid overspray and drift to avoid killing other plants.

Foliar herbicide treatment is most effective as a control method when applied immediately after flower formation. Numerous herbicides are effective, but because of the likelihood of overspray and drift injury to adjacent plants this method of control is not recommended on these sites.

Prescribed burning in the spring will kill seedlings and top-kill mature plants. Top-killed plants will re-sprout and repeated annual to biennial burns for 5 or more years will be necessary for effective control

Sweet clover: Sweet clover is a biennial plant and may be controlled by several methods. For small infestations hand pulling is an effective method, but because of the long tap root is best done when there is good ground moisture. Pulling in the spring, before flowering is best. If mature flowers or seeds are present when pulled, then pulled plants should be bagged and removed off site for disposal.

Cutting or mowing close to the ground when the leaves on the lower stems have died and up to early stages of flowering before the seeds form can be an effective control method.

Prescribed burning can control sweet clover. An April burn is recommended the first year, followed up by a May burn the next year. If burning in May the second year cannot be done, then cut or mow close to the ground as above.

2,4-D can be applied to plants before the native prairie vegetation emerges in the spring. Timing is crucial, and because of possible injury to emerging native plants, this method is not recommended for this site.

Oriental Bittersweet: Oriental bittersweet is an exotic aggressively growing vine that grows around and over trees and other structures. Seedlings can be hand pulled. Cutting or mowing in the spring as close to root collar as possible will set back the plant. Repeated cutting every 2 weeks for an entire year may exhaust the root reserves. Prescribed burning in the spring may kill seedlings and young plants, but may promote spreading of established plants. The vines may act as a ladder fuel and carry fire into the crowns of trees, so caution should be applied when burning where bittersweet is present.

Treatment with glyphosate, imazapyr, and triclopyr herbicides is the most effective means of treating oriental bittersweet. Herbicides may be applied as a foliar spray, cut stump treatment, or basal bark treatment. Foliar or basal bark treatment is not recommended for this site due to likelihood of injury to native plants. Cut stump treatment would be the preferred method and can be used at any time of the year except when there is heavy sap flow or if snow covers the cut surface.

Reed canary grass: Prescribed burning can help control reed canary grass in those areas where fire adapted native species are present or in the seed bank. Repeated late autumn or late spring burning for a minimum of 5 to 6 years will be necessary. Fire is not effective in dense monocultures of reed canary grass where seeds or plants of native species are absent.

Glyphosate herbicides will control reed canary grass and should be applied to growing plants less than 6 inches tall. Application in early spring to young green plants and while native species are dormant is preferred. Mowing of mature stands and allowing regrowth before application is another method. Herbicide applications will likely need to be repeated in multiple years. As reed canary grass is

present as small monocultures within the oak savanna, judicious herbicide treatment on this site would be acceptable.

Creeping Bellflower: Creeping bellflower readily regenerates from perennial roots, spreads from rhizomes, and is tolerant of many broadleaf herbicides making it difficult to control. One of the best methods of control is to dig at least 6" deep and remove all rhizomes and perennial roots. If flowers are present, material should be bagged and disposed of in a landfill or burned.

Prescribed burning can kill germinating seedlings and suppress above-ground growth of established plants. Unfortunately, established plants will quickly re-sprout. Fire is not recommended as a control method unless used with other control methods.

Foliar applications of dicamba (Banvel), glyphosate (Roundup), or picloram (Tordon K) herbicides can control creeping bellflower. Herbicides should be applied during the flowering bud stage through the fall as long as leaves are green. Overspray and drift will kill non-target plant species.

Canada Goldenrod: Canada goldenrod has a fibrous root system and spreads by rhizomes, allowing it to form dense colonies. Small populations can be hand pulled when the soil is moist. Repeated pulling will be necessary as not all the roots will be removed,.

One of the more successful techniques for control of large colonies is carefully timed mowing early in the blooming period. Mowing for a minimum of 3 years and interseeding with other native species can eliminate a colony.

Foliar spraying with 2.5% glyphosate, 2% solution of Garlon 4, or a 3% solution of Garlon 3A can be used to control Canada Goldenrod. This method would not be recommended for this site due to likelihood of damage to desirable species.

Native deciduous trees: Deciduous trees are best controlled by cutting and applying herbicide to the cut stump(s) to prevent re-sprouting. A triclopyr herbicide (Garlon 4) is very effective for cut stump treatment. A 20% glyphosate (Roundup) solution can also be effective. Herbicides should be applied to the cut stump with a low pressure hand-held sprayer or with a paint brush or wick applicator.

Herbicide recommendations for cut stem treatment

Shrub	Herbicide
Japanese barberry	Glyphosate
Amur honeysuckle	Glyphosate
Morrow honeysuckle	Glyphosate
Tartarian honeysuckle	Glyphosate
Bells honeysuckle	Glyphosate
Common buckthorn	Triclopyr (Garlon 3A or 4)
Glossy buckthorn	Triclopyr (Garlon 3A or 4)
Multiflora rose	Triclopyr (Garlon 3A or 4)
Gray dogwood	Glyphosate
Red osier dogwood	Glyphosate
Smooth sumac	Garlon 4 as basal bark, either with or without previous cutting
Staghorn sumac	Garlon 4 as basal bark, either with or without previous cutting
Blackberries, raspberries, and dewberries	Triclopyr (Garlon 3A or 4)
Prickly ash	Triclopyr (Garlon 3A or 4)
Herbicides should be used at 20-30% active ingredient (the label will indicate the concentration of active ingredient in the product itself).	