Hastings SNA

ADAPTIVE MANAGEMENT PLAN

December 8, 2011

Prepared for:
The Scientific and Natural Areas Program
Division of Ecological and Water Resources
Minnesota Department of Natural Resources

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EXECUTIVE SUMMARY

State Scientific and Natural Areas

Minnesota's Scientific and Natural Areas (SNA) are established by Minnesota Statute 86A.05 (1997) as units of the State Outdoor Recreation System to "protect and perpetuate in an undisturbed state those natural features which possess exceptional scientific or educational value." Nominated areas must satisfy a set of rigorously drawn criteria to qualify for designation. Scientific and Natural Areas serve many purposes. They are places for the quiet appreciation and study of nature and serve as outdoor classrooms for teaching and research in the natural sciences. They are areas against which the effectiveness of resource management techniques employed elsewhere can be evaluated. The more than 150 Scientific and Natural Areas protect over 183,000 acres statewide and are home to a vast array of wildlife – including rare species and Species of Greatest Conservation Need (SGCN) – and the native habitats that support them. Despite their inherent quality, SNAs are facing a growing number of environmental, land use, and management challenges – such as new invasive species threats, lack of natural disturbance, and climate change.

Adaptive Management

Natural areas will decline in quality when not properly managed. Long term preservation of natural areas and their rare features and species requires management of native vegetation, control of invasive species, and providing for appropriate public use. Managers of Minnesota's SNAs are charged with maintaining or improving the habitat condition of these lands. Adaptive management is a systematic process for continually improving management planning, policies and practices by learning the outcomes of operational practices. Assessment and review of the effectiveness of management techniques (fire frequency, time/duration of grazing, invasive species management methods, etc.) will inform future plans and activities and help select the best management techniques.

Management planning is a prerequisite to effective and successful management. This document is part of a planning effort to meet program standards and reporting requirements of various funding sources. It establishes a strategy for stewardship that addresses biological management and monitoring, obligations of ownership, and visitor management.

The overall goals of SNAs are to "protect and perpetuate in an undisturbed state those natural features which possess exceptional scientific or educational value." The goals of the management plan are to improve quality and consistency of management on SNAs and to directly aim that management towards implementation of the State Wildlife Action Plan (SWAP) and conservation of SGCNs and key habitats. The management plan will also lay the basis for adaptive management and monitoring leading to current and ongoing improvements in processes of habitat management and SGCN and rare resource conservation. The plan will directly reflect and support the Adaptive Management Spatial Database (AMSD) function of tracking management and monitoring on SNAs.

This management plan specifically addresses goals from SWAP, *Tomorrow's Habitat for the Wild and Rare*, 2006, P.37, Goal 1–Stabilize and increase SGCN populations; and Goal 2-Improve knowledge about SGCN (from SWAP, *Tomorrow's Habitat for the Wild and Rare*, 2006. P.44)

This plan was prepared by Friends of the Mississippi River. Information was based on site visits, historic photos, and two prior DNR reports: *The 1979 Resource Inventory for Hastings Scientific and Natural Area* and *A Management Plan for Hastings Scientific and Natural Area*, 1985, both prepared by the Scientific and Natural Areas Program. An extensive amount of information was provided in the 1979 inventory. The 2011 inventory for this document was not nearly as

exhaustive, but wherever feasible provides an update and comparison to the 1979 information.

Protection History

The 64.9-acre site was identified as having significant natural resources in 1974. The land was transferred from the Minnesota Department of Public Welfare (Veterans Home) to the Minnesota Department of Natural Resources for an SNA by 'Transfer of Custodial Control', January 8, 1974.

Site Description

The Hastings SNA consists of a northwest and a southeast parcel, totaling 64.9 acres. The northwest parcel, about 26 acres, is entirely in the Vermillion/Mississippi River floodplain, and consists of floodplain forest, emergent marsh and open water. Silver maple dominates the forest, with green ash and small diameter American elm. The southeast unit, about 43 acres, is dominated by mesic oak forest, with old growth red oak, sugar maple, and basswood on steep north-facing bluffs and bluff tops. Sugar-maple basswood forest covers a small section of the mid-slope, and emergent marsh, pond and floodplain forest cover low-lying areas. A wide diversity of plant species occur on this site, including the very rare snow trillium. Talus slopes and steep escarpments of dolomitic limestone provide habitat for specialized plants, such as mosses, lichens, and liverworts. The site topography is varied, with a 52-meter (170 feet) difference from high to low. Most of that relief, however, is accounted for by the bluffs; there is little topographic change beyond them. Most of the native plant communities are relatively intact and undisturbed, but non-native invasive woody species are encroaching in the woodlands.

Preservation Value

The purpose for transferring the Hastings SNA property from the Veteran's Administration to the DNR in 1973 was to preserve the hardwood forest community and in particular to protect the snow trillium (*Trillium nivale*), a special concern species. There are presently only seven populations of snow trillium in the seven-county Twin Cities Area, plus Goodhue County. The Hastings SNA population was first documented in 1905. The SNA was also intended to provide an environmental study area for the Hastings High School District (DNR 1985). Presently, the site also provides habitat for two species of greatest conservation need – eastern wood pewee and least flycatcher.

General Management Considerations

The Hastings SNA has been degraded by invasive species, especially earthworms, common buckthorn, and purple loosestrife. Excessive flooding and sedimentation have also altered floodplain communities and potential ecological threats include erosion potential, oak wilt, emerald ash borer, garlic mustard, and narrow-leaf bittercress. However, while some loss of biodiversity has occurred, the oak-basswood forest and maple-basswood forest are still relatively intact, with excellent cover of native herbaceous species, a stable snow trillium population, and a low abundance of buckthorn. The floodplain forests were also relatively intact, with few non-native species, and fairly good tree regeneration.

The primary ecological management recommendations for the site are invasive shrub removal, eradication of daylily patches, and control of purple loosestrife. After buckthorn control, planting local genotype species can be considered for the lowland forest areas. The site also needs monitoring on several levels. A plan should be developed to monitor key features of the site including the snow trillium, breeding bird populations, and the plant community composition as

well as monitoring for new invasive species and tree diseases. A component of the plant inventory should be to assess the coverage of conservative species to better evaluate how the site may be changing over time. In addition, efforts should be made to halt the progression of very early-stage erosion on the slopes below the VA and City property.

Other recommendations for the site are to remove piles of new and old trash, conduct annual monitoring for violations, recruit a site steward, engage participation and support from the community and neighbors via tours and on-site activities, add a lock to the gated access north of Hwy 54, clear vegetation from wooden SNA sign, add boundary signage where needed, add information kiosk at C.P. Adams parking lot, and work with the city to better manage trash at the parking lot.

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INTRODUCTION

This Adaptive Management Plan presents the site analysis and management recommendations for the Hastings Scientific and Natural Area (SNA) in Hastings, Minnesota. The 65-acre property is divided into two parcels – the northwest floodplain parcel is about 29 acres, bisected by the Vermillion River. The southeast parcel is mostly bluff land forest that is divided by two highways – Ravenna Trail and Highway 291. The two parcels connect only at their southeast /northwest corners, respectively. The location of the SNA is significant for its proximity to multiple important ecological features within one or two miles (**Map 1a**): Gores WMA to the east, Hastings Sand Coulee SNA to the south, Old Mill Park to the west, and Hastings River Flats Park (Lake Rebecca) and other natural areas to the north. These sites all have moderate to outstanding biodiversity and harbor a total of 38 element occurrences. The confluence of the Vermillion and Mississippi Rivers and is about a mile north of the Hastings SNA, with the St. Croix River confluence about two miles downstream from there. The site is central to a much larger complex of connected riparian and bluff land habitats.

The property was transferred from the MN Department of Public Welfare, Veteran's Administration to the Minnesota Department of Natural Resources and designated an SNA in 1974. The property was in state ownership since 1898, when it was purchased for the Hastings State Hospital (DNR 1979) (**Map 1b**). The site is bordered by state and city-owned lands to the south and west and private lands to the east and north. Historic uses and alterations have included logging, grazing, ditches and culverts, and a former stagecoach road.

The SNA consists of about 60% floodplain and lowland habitats, and 40% upland forest. Specifically, the site is about 27% mesic oak forest, 24% emergent marsh, 19% floodplain forest, 8% lowland hardwood forest, and 7% maple-basswood forest, with small amounts open water, river and roadway.

The purpose of this plan is to:

- Evaluate the existing condition of vegetation cover on the property and compare to the previous inventory in 1979.
- Identify target native plant communities and restoration goals.
- Identify methods for improving the wildlife habitat value of the property.
- Specific ecological goals for the property are to*:*
- Restore the complement and composition of native plant communities (desired future condition)
- Improve wildlife habitat
- Provide connectivity with other natural areas in the landscape.
- Maintain and manage the property for water quality.
- Enhance and expand the ecological functions of the property and of the larger Metro Conservation Corridor/watershed/ecological landscape.

This plan provides background data on the site geology and soils, hydrology, historic ecological conditions, its context within the landscape, and any known rare features. It provides a detailed evaluation of the site conditions at the time of the survey in spring/summer 2011 and uses the combination of gathered information to propose ecological management and restoration recommendations. A schedule and approximate costs of management tasks are also provided.

BACKGROUND AND SIGNIFICANCE OF THE SITE

Site Summary

Table 1. Protection History

Protection Status/Action	Notes	Date
Project Evaluation (PE) -"Hastings SNA"	Very brief PE for orig. 1974 parcel; 1994 PE for proposed addition (never acquired)	1974 & 01 February 1994
CAC Recommendation	Recommendation for addition not acquired	06 April 1994
Transfer of Custodial Control #4360	From Dept. of Public Welfare to Dept. of Natural Resources	08 January 1974
Commissioner's Order No. 0003	For orig. 65 acres	16 October 1974

Purpose for Site Protection and Designation

The lands transferred to the DNR contain about 25 acres of marsh land, a series of rocky spring fed ponds, and a steep slope covered with a hardwood forest uncut since 1905. The waters within this SNA are open to fishing and boats. Rare plants found on the site include snow trillium and kittentails. Ginseng, a regulated plant, is also found close to Hastings SNA in surrounding forested areas, especially to the southeast. The proximity of the site to the Mississippi River is significant for providing habitat to SGCNs and migratory birds. Site management will consist mostly of removing and keeping exotic invasive plants out of the native habitat. Coordination with adjacent landowners and administrators (MN Dept. of Public Health and City of Hastings) is needed to curtail the litter deposition from the Vet's home and erosion from the farm fields on the City lands to the south.

Designation Order Number

#0003

County

Dakota

Legal Description

T115N, R17W, portions of sections 27, 34, and 35. Dakota County. The site is located east of downtown Hastings, along the bluffs of the Mississippi River valley, where the Vermillion River enters the Mississippi/Vermillion floodplain. The SNA is transected by Co Rd 54 (Ravenna Trail/E 10th St), and by Hwy 291 (Le Duc Dr).

Directions to site

From Hastings go south on Hwy 61 to 10th St E (Hwy 54). Turn east (left), go 1.3 miles to Le Duc Dr (Hwy 291). Turn west (right), go 0.3 miles to C.P. Adams parking lot on the right. (Alternative route from Hwy 61 in Hastings is to go through town, turn left at 18th St/Hwy 291, to C.P. Adams parking lot).

DNR Quad Code

T18a, Hastings

Ecological Subsection

The entire SNA is located within the Eastern Broadleaf Forest Province but the upper (southeast) and lower (northwest) units are within different sections and subsections. Most of the upper unit is within the Oak Savanna subsection of the Minnesota and NE Iowa Morainal section, with a land type association of the Coates Sand Plain. The lower unit is within The Blufflands subsection of the Paleaozoic Plateau section, with a land type association of the Mississippi River.

Size

65 acres

Species of Greatest Conservation Need (SGCN)

Eastern wood pewee (*Contopus virens*)
Least Flycatcher (*Empidonax minimus*)

Element Occurrences

Native Plant Communities: Maple-Basswood Forest
Rare Species: Snow trillium (*Trillium nivale*) – Special Concern.
Kittentail (*Besseya bullii*) – Threatened.

Permitted Uses and Special Rules

Hastings SNA is open to the public for hiking, nature photography, bird watching, snowshoeing, and other activities that don't disturb the natural conditions. Although fishing is allowed, camping, picnicking, swimming, hunting, trapping, horses, dogs, pets and use of wheeled vehicles are not allowed. Boat access is not provided in the SNA, however boats that enter from other locations are permitted in Bullfrog Pond and the Vermillion River.

Primary Site Administrator

MnDNR, SNA Program, Central Region Management Specialist,, 1200 Warner Rd, St. Paul, MN 551106

Watershed

Major watershed: Mississippi River.
Subwatershed: most of the site is within the Vermillion river subwatershed (No. 38025). About 7 acres on the eastern edge of the upper unit is within a subwatershed (No. 38028) of unknown name that is 16,878 acres. That subwatershed also encompasses the Hastings Sand Coulee SNA and follows that drainageway. The entire site is within the Vermillion River Watershed District.

Priority Features

The priority features - the key socioeconomic and ecological features - of the Hastings SNA for which it was preserved, are as follows.

According to the 1985 management plan (DNR 1985), "The portion of the SNA south and east of Hwy 291 and CSAH 54 meets the criteria for a Public Use Scientific and Natural Area as defined in the Outdoor Recreation Act of 1975 (ORA): 1) habitat supporting rare, threatened or restricted plants and 2) an area large enough to permit effective research and educational functions and to preserve the inherent natural values of the site (DNR 1985)." The remainder of the site "may have locally important recreational and environmental values, but does not meet the criteria for state SNA designation."

The specific priority ecological features are maple-basswood forest and snow trillium (*Trillium nivale*), both in the upland forest south of Hwy 291.

SGCN, Rare Features, and Key Habitats

Records of rare species, habitats and species of conservation need at the Hastings SNA are summarized in **Table 2a**. A detailed description for each species or feature listed is provided in the following paragraphs. The diverse plant communities at Hastings SNA area also potential habitat for numerous other rare species that occur nearby. All records of rare features recorded within one mile of the SNA are shown in **Table 2b**. Many of these organisms could potentially occur at Hastings SNA. The table also shows nearby plant communities, which offer the potential for linkages to the SNA natural communities.

Table 2a. Rare features and SGCNs at Hastings SNA

Feature	Status/ rank*	Date last recorded	Acres or no. indiv.	Data source
Snow trillium (*Trillium nivale*)	SPC	April 25, 2011	238 flowering, about 1,700 non-flowering	DNR Natural Heritage
Kittentail (Besseya bullii)	THR	May18, 1987	A few scattered plants	DNR Natural Heritage
Eastern wood pewee (*Contopus virens*)	SGCN	June 14, 2011	Two singing males	FMR breeding bird survey
Least flycatcher (*Empidonax minimus*)	SGCN	June 14, 2011	One singing male	FMR breeding bird survey
Maple-basswood forest	SNR	July, 2011	3.7 ac	DNR Natural Heritage

*Status: SPC-special concern species, THR-threatened, SGCN-species of greatest conservation need. Rank: SNR-rank not yet assessed

Table 2b. Rare features records within one mile of Hastings SNA.

All data are from the DNR Natural Heritage database 2009.

Scientific name	Common name	No. records	State Status	State rank	First observed	Last observed	EO Rank/Estimated viability*
Birds							
Buteo lineatus	Red-shouldered Hawk	1	SPC	S3B,SNRN	7/8/92	7/8/92	Not ranked
Falco peregrinus	Peregrine Falcon	2	THR	S2B	2000	2006	E - Verified extant. VNA
Haliaeetus leucocephalus	Bald Eagle	1	SPC	S3B,S3N	1991	5/17/07	E - Verified extant. VNA
Herpetofauna							
Elaphe vulpina	Western Fox Snake	1	NON	S4	7/19/93	7/19/93	Not ranked
Fish							
Cycleptus elongatus	Blue Sucker	1	SPC	S3	8/27/96	8/27/96	Not ranked
Mollusks							
Actinonaias ligamentina	Mucket	1	THR	S2	1988	9/18/01	Not ranked
Alasmidonta marginata	Elktoe	1	THR	S2	2000-Pre	2000-Pre	F - Failed to find
Arcidens confragosus	Rock Pocketbook	2	END	S1	7/19/00	6/19/02	E - Verified extant. VNA
Ellipsaria lineolata	Butterfly	2	THR	S2	1988-11	10/4/08	E - Verified extant. VNA
Elliptio crassidens	Elephant-ear	2	END	S1	1997-09-(22-24)	8/4/04	Not ranked
Elliptio dilatata	Spike	1	SPC	S3	7/19/00	8/6/03	
Epioblasma triquetra	Snuffbox	1	THR	S2	2002-Pre	2002-Pre	F - Failed to find
Fusconaia ebena	Ebonyshell	2	END	S1	11/9/88	8/4/04	E - Verified extant. VNA
Lampsilis higginsi	Higgins Eye	2	END	S1	9/26/00	10/5/08	E - Verified extant. VNA
Ligumia recta	Black Sandshell	2	SPC	S3	1988-11	8/5/03	E - Verified extant. VNA
Megalonaias nervosa	Washboard	1	THR	S2	1988-11	8/6/03	E - Verified extant. VNA
Obovaria olivaria	Hickorynut	3	SPC	S3	7/20/00	10/5/08	E - Verified extant. VNA
Plethobasus cyphyus	Sheepnose	2	END	S1	1988-11	1988-11	F - Failed to find
Pleurobema coccineum	Round Pigtoe	2	THR	S2	7/19/00	8/6/03	E - Verified extant. VNA
Quadrula fragosa	Winged Mapleleaf	1	END	S1	2002-Pre	2002-Pre	X? - Possibly extirpated
Quadrula metanevra	Monkeyface	2	THR	S2	1988	10/5/08	E - Verified extant. VNA
Quadrula nodulata	Wartyback	1	END	S1	7/24/00	10/5/08	E - Verified extant. VNA
Tritogonia verrucosa	Pistolgrip	1	THR	S2	1988-11	10/4/08	E - Verified extant. VNA
Plants							
Besseya bullii	Kitten-tails	3	THR	S2	6/12/87	5/17/05	C - Fair
Gymnocladus dioica	Kentucky Coffee-tree	1	NON	SNR	4/28/94	4/28/94	Not ranked
Panax quinquefolius	American Ginseng	1	SPC	S3	9/22/93	9/22/93	B - Good
Plant communities							
Dry Sand - Gravel Oak Savanna (Southern) Type		1		S2	8/26/92	6/20/97	C - Fair
Floodplain forest				SNR	7/18/94	7/18/94	BC - Good or fair
Maple-basswood forest (southeast)		2		SNR	4/28/94	4/28/94	B - Good
Oak forest (southeast) mesic subtype		4		SNR	6/27/93	6/20/97	C - Fair
Silver Maple -Floodplain Forest Type				S3		7/8/87	B - Good

Snow Trillium (*Trillium nivale*)

The snow trillium (**Photo 1**) population at Hastings SNA is the only known population in the Twin Cities Metropolitan Area and the one for which we have the oldest records. According to the CBS database, it was previously collected in 1979 and 1905, indicating that this population is now well over 100 years old. Most populations in the state occur in the Mankato area and in the southwestern part of the state.

The DNR database record from 1985 states: "100-200 flowering plants plus many non-flowering. In strip 50 m long near base of north-facing limestone bluff. (prev coll: eikum (1) 1979; lyon (882) 1905.)" A second record is located to the northwest of the SNA, on privately-owned property, with the following notes: "On northeast-facing bluff above Vermillion River floodplain, north of 18th Street. In mature maple-basswood forest on steep lower to mid-slope. About 200 plants, many in flower, most within an area of about 300 square meters under *Tilia*, *Celtis*, *Ostrya*, *Acer saccharum*, and moderately dense shrubs. On a northeast-facing bluff above the Vermillion River floodplain."

In 2011, the location of population was marked with GPS and provided to the Natural Heritage database. The number of flowering and non-flowering plants was recorded by locating small population centers and counting the number of individuals within small areas. As the patches sprawled or merged together, new counts were started to facilitate ease of tracking. A total of 238 flowering plants were counted, with 107 found among 17 small patches and 131 found in one long, large patch. Hundreds of non-flowering plants were also present – 852 were counted among the 17 patches. Non-flowering plants in the large patch were not counted but would have easily exceeded the total of the other 17 patches. A conservative total number of plants is1,942.

Photo 1. Snow trillium were abundant in 2011 on the limestone ledges. 4/12/11

Habitat requirements (taken from the DNR website) are as follows: "As is the case throughout its range, Minnesota's populations of *T. nivale* prefer fine, moist, calcareous soils in previously glaciated areas. More Minnesota populations are located on prairie soils than on forest soils, but in the most extreme southwesterly cases, microhabitats may be influenced by groundwater discharge. All but two populations in the state lie within 183 m (600 ft.) of a stream. All populations in the blufflands subsection of the Paleozoic Plateau are situated adjacent to designated trout streams. Despite their proximity to streams, the majority of Minnesota *T. nivale* populations occur on loamy soils on fairly steep slopes. In the prairie region of the state, five populations attain large size in forest floodplains and open floodplains on alluvial soils. Individual plants are reported to reach sexual maturity at three and to live to at least eight years of age (Nesom and La Duke 1985). The longevity of populations is not known, but one Minnesota population was first observed in 1908."

The greatest potential threats to the populations are development (including trails), intensive land use, direct conversion to lawns and recreational uses, and potential expansion of common buckthorn (*Rhamnus carthartica*) and garlic mustard (*Alliaria petiolata*). Loss of canopy trees, increased white-tailed deer populations, slope erosion, and earthworms are other potential threats whose impact is unknown.

At Hastings SNA, the population currently seems stable or even increasing, based on comparison of 2011 survey data to 1985 survey data. Multiple potential threats that could impact the species

include earthworms, buckthorn, white-tailed deer, oak wilt and possibly garlic mustard and/or narrow-leaf bittercress. Of these, the two most likely immediate threats are buckthorn and oak wilt.

Buckthorn, while present in significant abundance along the edges of the SNA, is not yet abundant in the snow trillium area. Buckthorn is known to alter soil chemistry and it is not known what impact it may have on the trillium. It should be managed before it becomes more abundant.

Oak wilt was not detected at the SNA, but both red and bur oak are abundant or dominant in the canopy. While located on a shady north slope, if oak wilt occurred here it would result in a much more open canopy and could significantly alter the microclimate for the trillium. The best management for oak wilt is to monitor and potentially manage for it if it occurs (see management recommendations section for more details).

Other herbaceous forbs such as garlic mustard and narrow-leaf bittercress were not observed at the site, but are prevalent in the landscape and could easily be transported to the site by wildlife. Again, the effects of these species are not known conclusively, but may be quite detrimental. Typically garlic mustard invades a site after earthworm infestations result in bare soils and few native herbaceous plants. Most of the site was well vegetated with natives, so there may be little opportunity for either of the mustard species. Some portions of the site did have nearly bare ground cover and may be more vulnerable. Active monitoring is very important for early detection of these plants.

It seems likely that the earthworms have been present for a very long time. The adjacent properties were developed in the 1800's, probably bringing earthworms to their gardens. There has been significant alterations to the SNA, with many eight or more inches of soil compaction/loss observed (see photo 25). Some ecologists have suggested that native plant communities can recover from earthworm infestation, given adequate time and without too much pressure from invasive species or herbivory. Nerstrand Woods, for example, was infested with earthworms in the 1800's. At that time non-native invasive species such as buckthorn and garlic mustard were not present, and deer populations were low, relative to present day. A similar situation may have occurred at Hastings SNA. In spite of evidence of significant earthworm populations, the native ground cover is quite lush and diverse.

Although deer are abundant throughout the area, this site has a very open understory and probably has less deer activity than other areas nearby. It does not seem likely that they are having a significant impact on the trillium.

Photo 2. Kittentail.
K.Schik FMR

Kittentail (Besseya bullii)

The 1987 record stated: "..Adjacent to Veterans home. A few scattered plants were observed…at base of steep slope. North-facing, partially open edge of rich, deciduous woods." May 18, 1987.

Although not detected in 2011 at the Hastings SNA, the presence of this species in a mesic oak forest, and near the base of the slope, presents an odd juxtaposition, as it is typically found in drier, fire-dependent communities (especially oak savanna). The following excerpt is from the MN DNR website:

"Besseya bullii (**Photo 2**) is primarily a species of oak savanna communities, though it also occurs in dry prairies and oak woodlands (including dry-mesic oak (maple) woodlands, dry-mesic oak-hickory woodlands, and dry-mesic pine-oak woodlands). Plants show a preference for partial to open light and upper slopes. Some populations exhibit a preference for less xeric north-facing

slopes in prairie habitats. Soils are most often sandy to gravelly, well-drained soil derived from alluvium or limestone bedrock.

Besseya bullii has suffered a significant decline because of habitat loss. Management techniques should be used to maintain or regain suitable habitat conditions. Active management does not appear to be as necessary at gravel prairie sites due to the xeric conditions and increased erosion. More intensive management may be required at savannas or wooded sites where species vigor is decreased. Management tools may include fire, which may be effective in reducing woody vegetation and encouraging flowering. However, careful timing of prescribed fires is critical. Fire should only be used in early spring before plants appear above ground, usually during late March or early April. Once the plants appear above ground, even 2.5-5.1 cm (1-2 in.), they can be severely damaged by fire. *Besseya bullii* occurs in isolated patches, which makes it conducive to protection from certain types of development, if protection of existing populations is incorporated into the early planning stages of development."

Fire is important for management of kittentails, yet fire would not historically been an important component of the mesic oak forest and associated maple-basswood forest. Additional survey work can be done to verify the presence/absence of the species. Substantial populations of kittentail are found in the City of Hastings Old Mill and Vermillion Falls Parks about a mile west of the SNA.

Eastern wood-pewee (*Contopus virens*)

According to the Cornell Lab of Ornithology, eastern wood-pewees use a variety of forest types including hardwood forest, bottomland forest and woodlots as well as parks, roadsides and suburban areas. They are somewhat tolerant of disturbance. In spite of being a more generalist species, it is declining throughout its range. The cause of decline is not fully understood, but likely includes loss of forest habitat in both its wintering and summering grounds. "Understanding this species' relationship with forest disturbance and fragmentation will be critical in maintaining future populations and reversing declines" (Cornell website).

Least flycatcher (*Empidonax minimus*)

Like the pewee, the least flycatcher is a common forest species, and a generalist that occurs in most types of deciduous forest. Nevertheless, it too is declining throughout its range (Kreitinger and Paulios 2007). The oak and sugar maple forests at Hastings SNA are the most common types of forest where it occurs. Preserving a closed canopy and larger tracts of contiguous forest is considered to be the most important factors for conservation of this species.

Maple-Basswood Forest

Maple-basswood forest has a state rank of SNR, meaning it is not yet ranked. The element occurrence rank was B, indicating "good estimated viability." The 1993 notes from the DNR survey of this site described it as: "Mature maple-basswood forest dominated by *Quercus rubra*, 30-60 cm dbh. Lesser amts of *Tilia*, *Acer saccharum*, *Quercus alba* and *Fraxinus americana*. Canopy patchy with 80% cover. *Ostrya* and *Acer saccharum* dominated subcanopy. All age classes of maple present except old-growth. Patchy open shrub layer. Rich spring flora with *Trillium nivale* and *Panax quinquifolia*. Moderate amount of snags and down logs. No disturbance since 1898. Site on 10-30% north-facing slope with rock outcrops; sandy loams. In Mississippi Valley outwash geomorphology region."

The 2011 survey found similar conditions to the 1993 notes except that sugar maple is now dominant in the canopy and subcanopy. *Panax* was not detected, although it was not specifically looked for.

Relationship to Sites of Biodiversity Significance

Hastings SNA is surrounded by other properties with biodiversity significance (**Map 1a**). On the SNA itself, the bluff slope of the south unit was ranked as a site of high biodiversity significance due to the presence of mature maple-basswood forest with a fairly intact plant community, including snow trillium, a state special concern species. These high biodiversity slopes continue east and southward out of the site on private property. The north part of the site in the Vermillion River Bottoms floodplain is ranked moderate biodiversity, and extends north and east onto mostly private lands.

About 1/4 mile west of the SNA are high biodiversity sites associated with the City of Hastings Old Mill Park and Vermillion Falls Park, with mesic oak forest, sand-gravel oak savanna, and kittentail populations. Just north of those areas are river bluff sites of high biodiversity on private property, with snow trillium, kittentail, Kentucky coffee-tree, mesic oak forest, and maple-basswood forest.

The roughly 6,500-acre Gores WMA, with outstanding biodiversity, begins 1/4 mile northeast of the SNA and is one of the largest contiguous floodplain complexes in southeast Minnesota. This 6,449-acre complex of floodplain forest, marshland and backwater along the Mississippi River and Vermillion River Bottoms constitutes one of the largest expanses of floodplain native plant communities in southeast Minnesota. It is also one of the top four sites in the state for rare forest birds, including cerulean warblers and red-shouldered hawks.

The 283-acre Hastings Sand Coulee SNA, less than a mile to the south, contains the largest sand-gravel prairie remnant in Dakota County and harbors over a dozen rare species. To the north is the city managed Hastings River Flats park as well as privately owned properties of outstanding biodiversity.

Site Geology and Soils

Figure 1. Orange box shows approximate location of Hastings SNA. Dark pink is very high sensitivity of Prairie du Chien to pollutants, light pink is high, orange is high-

Geology

The Hastings SNA site is defined by the geologic events that shaped it. The site is significant both for the geologic features exhibited there and for the resulting plant communities that evolved because of it. During the last glacial period – the late Wisconsinan period that ended roughly 10,000 years ago – torrential drainage from Glacial Lake Agassiz in northwestern Minnesota and Wisconsin created the Glacial River Warren, which carved the existing Mississippi River valley, now denoted by the bluffs at the Hastings SNA. As the glacial runoff decreased, glacial river levels dropped, resulting in down-cutting along tributaries such as the Vermillion River. The bluffs at Hastings SNA were primarily carved by the River Warren, but were also influenced by the Vermillion River as significant down-cutting occurred when glacial river levels dropped. Bedrock outcrops are common at the site, consisting primarily of Oneota Dolomite, a dolostone of the Prairie Du Chien group.

Oneota Dolomite is a sedimentary formation formed from marine deposits laid down by seas that

covered the area about 475 million years ago during Early Ordovician times (DNR 1979).

The geology of the site strongly influenced the plant community development. The north-facing bluffs and outcrops provide important niches for a variety of specialized plant species, while below the bluff, riparian floodplain communities developed that continue to be influenced by periodic flooding.

The primary bedrock formation at this site is the Prairie Du Chien Group (Balaban, N.H., and H.C. Hobbs, 1990). Jordan Sandstone underlies the northeast quarter of the upper unit. The depth to bedrock for most of the upper unit is less than 50 feet, and outcropping is common along the bluff faces. Depth to bedrock for the lower unit is 51-100 feet.

Due to the shallow depth to bedrock, nearly half of the site (the northwest and southeast corners) is rated as "High" for sensitivity of the Prairie Du Chien aquifer to pollution, signifying that water-borne surface contaminants could reach the aquifer in weeks to years (**Figure 1**). The sensitivity to pollution in the oak forest area to the southwest of highways 54 and 291 is ranked "very high", signifying a contamination time of hours to months, while most of the floodplain north of Ravenna Trail is ranked "High-Moderate", signifying years to decades.

Soils

The soil types originally described in the 1979 Resource Inventory were based on 1960's data. Current soils classifications (**Table 3**) are based on the Soil Survey of Dakota County (SCS 1983) and are significantly different from the earlier document. About 22 percent of the site is covered by hydric soils, with another 22 percent that is occasionally flooded. Most of the upland soils, about 28 percent, are on 18 to 50 percent slopes and are highly erodible.

Table 3. Soil Types

Soil code	Description	Acres	Percent of site	Hydric	Erodibility (water)
463	Minneiska loam, occ flooded	13.5	22%	N	L
W	Open water	13.2	21%		
1821	Algansee sandy loam, occ flooded	10.9	18%	Y	L
880F	Brodale-Rock outcrop complex, 18-45% slope	9.3	15%	N	H
173F	Frontenac loam, 25-40% slope	4.0	6%	N	H
611F	Hawick coarse sandy loam, 25-50% slope	3.2	5%	N	H
1055	Aquolls & Histosols, ponded	2.8	4%	Y	L
285B	Port Byron silt loam, 2-6% slope	2.1	3%	N	M
129	Cylinder loam	1.9	3%	N	L
1827B	Waukegan silt loam bedrock substratum, 2-6% slope	0.5	1%	N	M
299C	Rockton loam, 6-12% slope	0.3	1%	N	H
611C	Hawick coarse sandy loam, 6-12% slope	0.2	0%	N	H
251E	Marlean loam, 18-25% slope	0.2	0%	N	H

The primary soil on the SNA is Minneiska loam, which covers much of the lowland floodplain. It is a nearly level, moderately well-drained soil of large river floodplains (SCS 1983). The surface loam is about 8 inches thick of brown to dark brown loam, with thin layers of silt and sandy loam. The underlying material is 60 inches thick, consisting of loam and loamy find sand and is moderately alkaline. Permeability is moderately rapid, water capacity is high and runoff is slow. Organic content is moderate and depth to the water table is 3 to 6 feet. These soils are well-suited for cropland, pasture and hay.

Algansee sandy loam is the second most abundant soil at the SNA, and is also in the floodplain. As with Minneiska, it is also on nearly level terrain of major river floodplains. However, drainage is somewhat poor. The surface layer of 12 inches is very dark grayish brown sandy loam, with underlying material about 60 inches of sand. Permeability is very rapid, available water capacity is low, and runoff is slow. Organic content is moderate to moderately low and the seasonal high water table is 1 to 2 feet. Sites with this soil type are typically used for cropland or parks. Trees planted in these soils are limited by low available water capacity as well as flooding.

Brodale-Rock outcrop complex is the dominant soil of the uplands, located along the north-facing bluffs. These are steep to very steep excessively drained areas on side slopes of river valleys. The surface of Brodale soil consists of about 6 inches of very dark grayish brown flaggy loam, with 50 percent coarse fragments. The subsoil is about 4 inches thick, and is 50 percent coarse fragments. The underlying material to a depth of about 47 inches is very fine sandy loam with about 70 percent coarse fragments. Below that is limestone bedrock, with outcrops 10-50 feet long. Permeability is moderate to moderately rapid, available water capacity is low and organic matter content is moderate. Runoff is very rapid and erosion potential is high.

Frontenac loam, 25-40 percent slope, occupies about 6 percent of the site, at the upper bluff. The surface and subsurface layers are about 11 inches thick, with a subsoil of about 13 inches of loam. Permeability of the upper soil is moderate with moderately rapid permeability below. Available water capacity is moderate, runoff is very rapid and organic content is high. The erosion potential is severe. Seedling plants are subject to drought.

The remaining soil types are primarily sandy loams, loam and silt loams that occupy small areas of the site. Most have moderate or high erosion potential.

Topography

The total elevation change for the SNA is 170 feet, from a high of 850 feet on the north-facing bluff along the southern boundary, to 680 feet in the floodplain north of Ravenna Trail. The southern bluff has very steep slopes, up to 50 percent, that drop about 130 feet to the base. Limestone ledges (**Photo 3**) along the bluff are over 10 feet high in places and form two distinct terraces.

North and west of Hwy 291, the blufftop elevation is about 740 feet. The slopes have a more northeast aspect and are much less steep than the southern bluff, with no limestone ledges. The remainder of the SNA to the north of Ravenna Trail, occupying over half of the total area of the SNA, is floodplain, with slight elevation changes between 680 and 690 feet.

The steep slopes and northern aspect of the bluffs create the cooler microclimate that supports the more mesic plant community types. The limestone bluffs have a microcommunity of their own, with

Photo 3. Limestone ledges provide unique microclimate conditions that support various ferns and mosses. 4/29/11

mosses and ferns (**Photo 3**) not found elsewhere at the site. The steep slopes appeared stable, but any management activities should provide protective measures to prevent erosion.

Hydrology/Watershed

The hydrology of Hastings SNA is strongly influenced by the Vermillion River, which bisects the northern parcel, and by the Mississippi River, which lies to the north and east. Well over half of the SNA is at an elevation of 680 feet or less, making it subject to annual inundation during spring melt or heavy rain events. According to the National Weather Service, flood stage of the Mississippi River is 15 feet (measured at lock and dam no. 1), moderate flood is 17 feet and major flood is 18 feet (National Weather Service website).

During major flood events the Mississippi River floods into the lower Vermillion, reversing the flow of water and flooding the entire north unit of the SNA. In the past 61 years there have been 16 flood events (**Table 4)**, three of which have been in the past 1.5 years.

Table 4. Historic flood events of the Mississippi River.

Feet	Date	Feet	Date
15.5	5/11/1950	16.9	4/7/1986
18.9	4/18/1951	18.8	6/28/1993
20.9	4/16/1952	21.3	4/13/1997
16.6	6/30/1957	21.6	4/17/2001
25.9	4/17/1965	22	4/29/2001
24.3	4/16/1969	17.22	3/25/2010
15.1	7/29/1972	17.42	3/30/2011
17.1	5/4/1975	17.76	4/13/2011

Flooding is an important part of the ecology and disturbance regime of the bottomland area, maintaining the open structure of the floodplain forest, bringing sediment and nutrients to the floodplain, and creating new habitats. However, increased flooding frequency or duration at the SNA could have unknown consequences for the structure and composition of the natural communities. In 2011 there was significant prolonged flooding in spring and summer, with portions of the site still inaccessible by early August. According to the U.S. Global Climate Change Research Program, that trend is likely to continue, as climate change is expected to result in increased flooding frequency in the Midwest, though not necessarily increased flooding magnitude (USGCCRP website).

Hydrology of the south unit of the SNA is quite different than the north. The watershed of the site was not evaluated in detail, but seems to be quite small, consisting of the bluffs themselves, plus a fairly small area uphill that includes small portions of an agricultural field and a few buildings at the Veterans home.

Although the soil of the bluff slopes is rated as highly erodible, there were only a few locations showing small amounts of erosion. The combination of relatively loose soils and bedrock fissures, with good ground cover vegetation and leaf litter seem to be effective at capturing the runoff. Early-stage erosion was noted at two locations: near the southeast corner of the site (**Photo 4** and **Map 6**) and at the tall retaining wall of the VA home where it crosses a ravine

Photo 4. Rill erosion starting on oak forest slope (see Map 6). 7/21/11

(**Photo 5** and **Map 6**). There are other areas in the maple-basswood unit that are nearly devoid of leaf litter due to earthworms and may be susceptible to future erosion.

A natural spring, called Indian Springs (DNR 1979), is located at the base of the bluffs just east of Hwy 291 (**Map 6**). Water flow from the spring forms a small stream that feeds a pond located to the south of Ravenna Trail and east of Highway 291. Overflow from the pond flows through a WPA[1] culvert to the west side of Hwy 291. In some years the west side has just a small or ephemeral ponded area, but in 2011 it persisted throughout most of the summer.

Hydrology of the site is altered to some extent by the two highways that transect the site. Water is channeled to culverts and collects in ditches instead of flowing into the floodplain as it once would have. Remains of a limestone brick ditch, built by the WPA, are found along Hwy 291. It was apparently built to channel the spring water but no longer seems to carry any flow (**Photo 8**).

Photo 5. Erosion and trash at the wall and culvert by the VA home. 7/21/11

The National Wetlands Inventory shows about 20 acres of wetland at the SNA (**Map 5**), consisting entirely of PEMF wetland (palustrine emergent semi-permanently flooded). This wetland is all along the northern part of the SNA and includes Bullfrog Pond. In addition, there are two other wetland areas not identified in the NWI. Shown on **Map 5** as SFW units, these areas occupy about an acre just south of Hwy 54. They were not delineated. Both wetland areas are described in more detail in the "Existing Vegetation" section.

Most of the Hastings SNA, two-thirds or more of the site, is within the 100-year floodplain (FEMA boundary shown in **Map 2**). This includes essentially everything from the base of the bluff northward.

Historic Vegetation

A compilation of land surveyors notes from the 1850's (Marschner 1974) shows that the Hastings SNA was located in an area dominated by "oak barrens and openings" or what we now refer to as oak savanna (**Map 3**). Beyond the SNA, prairie dominated the upland areas south of the bluffs, while floodplain forest covered the riparian areas to the northeast. That land cover depiction is a generalization, however, and the landscape would have included many other plant communities corresponding with variations in the topography, hydrology and soils. At the SNA, it is likely that oak savanna covered only a small part of the site - the uppermost sections of the bluff in the southwest area, which would have merged into prairie beyond the bluffs to the south. The north-facing slopes were fire-protected, cooler and more mesic, suggesting they would have supported forest.

The area currently within the floodplain would also have been floodplain historically, not savanna and the presettlement map indicates. It may have been a complex of wetland and floodplain forest, possibly with some wet or mesic prairie areas. The historic floodplain was not likely as extensive as it is today - the watershed now has significantly more impervious surface and runoff than it did at the time of European settlement. Not to be overlooked, the lock and

[1] Work Program Administration – 1930's agency employed millions of unskilled workers to carry out public works projects, including building roads and public buildings, etc.

dam system as well as the older weir dams have profoundly affected the hydrology along the Mississippi River and its tributaries. Comparison of historic aerial photographs from 1937 and 1964 (**Maps 4a and 4b**) with present conditions (**Map 6**) support this impression of increased surface water. The Vermillion River is much wider, indicating it now carries much more water, the size of Bullfrog Pond is easily double what it was historically, and there are other additional ponded areas.

Records of the individual tree species (bearing trees) recorded on and near the site are very limited, but also suggest mesic forest in the upland areas, rather than savanna. American basswood and (green) ash were recorded at the SNA in what is now the edge of the floodplain. Other bluff areas nearby that currently support mesic oak forest had maple and elm trees, according to the surveyor records.

Historic Land Use

The 1979 Resource Inventory (DNR 1979) provides a detailed description of the site history, which is summarized here. The SNA has been in the ownership of the State of Minnesota since 1898, when it was obtained as part of the grounds for the V.A. Hospital. Other than possibly tapping the maple trees as well as depositing some debris, the hospital has apparently not had significant use of the site.

Photo 6. Killed by Dutch Elm disease, many large elm trees were removed from the SNA in the 1970's. This may be a relict elm tree stump. 4/29/11

According to the 1979 report, virtually all of the site has been used or affected by human activities, including agricultural crops, grazing, logging, draining of wetlands and fire suppression. Based on site observations, however, we believe that most of these activities either did not occur directly on the site, or occurred in very moderate levels. Very few areas in the SNA have been farmed, based on aerial photographs, but croplands have been adjacent to the site since at least the 1930's, and have no doubt impacted the plant and animal communities.The cultivated fields south of the site at one time came closer to the top of the bluff. Old fence line suggests that part of the floodplain in the SNA may have been grazed at one time. Likewise, given the proximity to Hastings and the relatively small diameter of the trees in many areas, it seems likely that at least portions of the site were logged in the past.. In 1977, Dutch elm disease hit the SNA, killing many of the large old elm trees. Diseased elms were removed from the SNA that winter, leaving tall stumps, some of which are still visible today (**Photo 6**). In addition to tree removal, there was also historic tree planting. On the west side of Hwy 291 is small grove of planted coniferous trees – red, white, and jack pine. An old tree stand in this grove of pine indicates that the area was used for hunting. Near the V.A. hospital are patches of daylilies (**Photo 7**). Presumably they

Photo 7. Daylilies are found in several patches in the oak forest. This location was also an old dump site.

migrated into the SNA from the edge of the hospital grounds, but this is not known for sure.

According to the 1979 report, the northeast corner of the southeast parcel was at one time (before 1979) a paved parking lot. The area has long-since been reclaimed by vegetation, but some disturbance is still visible in the old parking lot debris (concrete blocks) found there. Some of the old "parking lot" is located on the adjacent property to the north, and is currently used for dumping plant waste as well as small amounts of other debris. Some of that waste may be on the SNA property.

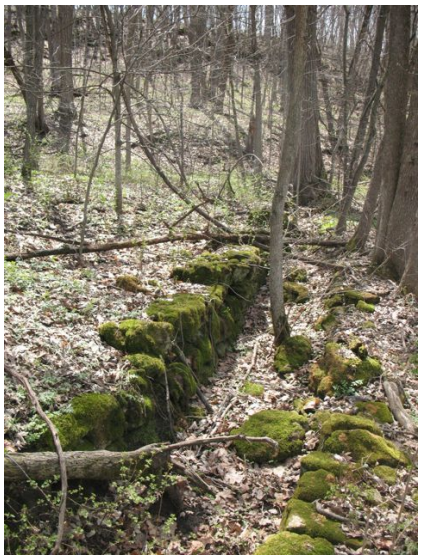

Photo 8. Remains of the (presumed) WPA ditch alongside Hwy 291. 4/29/11

Indian Springs, the natural springs at the base of the bluff east of Hwy 291, was used as a water hole by early pioneers (DNR 1979). During a severe drought in 1888, the springs was dug out and enlarged. In 1940, the Works Project Administration (WPA) built a wall near the springs. [This may be a reference to the ditch-type structure that can currently be found east of Hwy 291 – **Photo 8**]. A culvert and ditch were also built in later years to drain the spring to Bullfrog Pond to the north.

Hwy 54 was originally a stagecoach road that followed a path along the bluffs and around wet areas. In 1950 the road was straightened, moved northward to its present location, and the bridge over the Vermillion River was installed. Later the city deepened and widened the ditches along Hwy 54.

Conditions

Although degraded by non-native invasive species and an increased flooding regime, much of the native plant communities at Hasting SNA still retain a good representation of the structure and composition of historic communities. Improving degraded areas is a primary ecological goal for this site. Likewise, protection of the rare features will depend on regular, long-term adaptive management practices.

A few highlights regarding existing conditions are:

- Forested areas cover about 40 acres or 62% of the site
- Exotic woody species (primarily buckthorn) are abundant on about 20% of wooded areas
- About 60% of the SNA is lowland habitats, 40% is upland
- Snow trillium population, first recorded in 1905, appears to be stable

Existing Vegetation

Most of the Hastings SNA has retained native plant communities. Though all are altered, primarily by non-native species, they generally still have very good native plant diversity. A summary of the existing plant communities and associated soils as well as the intended target plant community is provided below (**Table 5**). Each of the vegetated areas is described in further detail in the following paragraphs, starting with the most upland areas. The land cover units are shown in **Map 5**. Plant species for each land cover are summarized in the descriptions, while full lists and scientific names are provided in **Appendix A**.

Table 5. Existing Land Cover

Map Code	MLCCS	Equiv. native plant community (DNR EBF plant guide*)	Ac	% of total cover	Dom soils	Target Plant Community (DNR plant guide)	Plant Comm Code
OF-e			1.5				
OF-s	Oak forest mesic subtype	Southern mesic oak-basswood forest	10.8	27	Brodale, Frontenac loam, (Hawick)	Southern mesic oak-basswood forest	MHs38
OF-w			5.3				
			17.6				
MB	Maple-basswood forest	Southern mesic maple-basswood forest	**4.6**	7	Brodale rock outcrop	Southern mesic maple-basswood forest	MHs39
			1.4				
TFW	Temporarily flooded altered woodland	Southern terrace forest	1.0	8	Cylinder loam, & Minneiska loam, occ fld	Southern terrace forest	FFs59
			2.2				
			0.6				
			5.2				
SFW	Seasonally flooded altered woodland & mixed emerg marsh cmplx	NA	0.8	2	Minneiska loam, occ fld	Southern terrace forest & Northern wet meadow/carr	FFs59 WMn82
			0.3				
			1.1				
			4.7				
FF	Floodplain forest	Southern floodplain forest	3.1	19	Minneiska loam	Southern floodplain forest	FFs68
			4.7				
			12.5				
			8.0				
EM	Emergent marsh/scrub-shrub	NA	7.5	16	Algansee sandy loam, muck	Northern wet meadow/carr	WMn82
			15.5				
SS	Seepage swamp/stream		**0.2**	0.3			
OW	Palustrine open water	NA	**1.2**	2	NA	NA	NA
R	River	NA	**3.0**	5	NA	NA	NA

Map Code	MLCCS	Equiv. native plant community (DNR EBF plant guide*)	Ac	% of total cover	Dom soils	Target Plant Community (DNR plant guide)	Plant Comm Code
RD-t RD-m	51% to 75% pavement & mowed roadside grass	NA	4.0	6	NA	NA	NA
	TOTAL		**64.9**				

*NA = Not applicable-the plant community was too altered to be classified as a native community.

Southern Mesic Oak-Basswood Forest (MHs38), Units OF-e, OF-w, OF-s

The oak forest units, totaling 17.7 acres, are characterized by fairly dense tree canopy, with an overall dominance of red oak, and a dense ground cover (**Photo 9**). Bur oak somewhat less abundant and American basswood is also very abundant. Other common species included sugar

Photo 9. The mesic oak-basswood forest has a dense canopy, open shrub layer and dense, diverse ground cover. 6/14/11

Photo 10. Abundant sugar maple seedlings indicate the oak-basswood forest will likely transition to maple-basswood, depending on the effects of climate changes. 8/17/11

maple, hackberry, black walnut, quaking aspen and white oak. There is a good diversity of age classes, with many very large diameter trees. Red oak again dominates the age classes, with one tree recorded at 152 cm (dbh). Large bur oak and white oak were also recorded, with 76 cm dbh. A small area of planted pines is located in OF-w, with large (up to 71 cm dbh) white pine, red pine and jack pine. A total of 14 native (and not planted) canopy and subcanopy tree species are recorded for the oak forest units.

The shrub layer is fairly open. Where cover is most dense it is dominated by non-native species – mostly common buckthorn with some Tartarian honeysuckle. These were especially abundant along edges and some buckthorn were large, 5 cm or more diameter. Pagoda dogwood and prickly ash are the only native shrubs recorded. Other species in the shrub layer are small trees of canopy species, as well as some bitternut hickory.

The ground layer is diverse and cover is moderately to very dense. Dominant species include wild ginger, wild sarsaparilla, rue anemone, and Virginia waterleaf. Pennsylvania sedge and zigzag goldenrod are abundant in some areas. Other common species include maidenhair fern, wild leek, wood anemone, Dutchmen's breeches, wild geranium, sharp-lobed hepatica, starry sedge, and blue cohosh. Both snow trillium and drooping trillium are located in the oak forest units. Most of the canopy tree species are well represented in the tree seedlings, with the exception of the oaks. Red oak seedlings were sparse and bur oak was not observed. Sugar maple seedlings were the most

abundant and sugar maple is likely to eventually become the canopy dominant (**Photo 10**).

The target plant community for these units is to retain the southern mesic oak-basswood forest. Allowing it to succeed to sugar-maple forest over time. Regular monitoring to detect and remove non-native invasive plant species will be the primary task. Monitoring and managing for oak wilt will also be important.

Southern Mesic Maple-Basswood Forest (MHs39), Unit MB

The maple-basswood unit covers just 4.6 acres on the mid, north-facing slope of the southeast parcel. The canopy was dense, dominated by sugar maple. Most of the maples were relatively small, with a few scattered large ones, up to 46 cm dbh. American basswood was subdominant, with trees up to 51 cm dbh. Red oak was also abundant and also found up to 46 cm dbh. Ironwood, butternut, and paper birch were smaller subcanopy species.

Photo 11. With a dense tree canopy, the shrub layer of the maple-basswood unit is quite open. Buckthorn was rare. 7/5/11

The shrub layer was very sparse and dominated by sugar maple. Other species noted were pagoda dogwood, green ash, and American basswood. Common buckthorn was found in very low amounts along some edges (**Photo 11**).

The ground cover was fairly dense over most of the unit, but there were some areas, especially on slopes toward the east end of the unit, with very sparse vegetation and leaf litter, presumably a result of earthworms. Where well-vegetated, wild ginger was a dominant species, with Virginia waterleaf, wood anemone, sharp-lobed hepatica also quite abundant. All of these are common species that do tolerate some disturbance (e.g. earthworms). More conservative species were uncommon. Many species found in the oak forest, such as blue cohosh, Dutchmen's breeches, drooping trillium, large-flowered bellwort, and bloodroot were present were also in the maple-basswood forest, but the total species diversity was lower. Sugar maple seedlings were abundant and basswood seedlings were common.

The target plant community for this unit is to retain maple-basswood forest. A primary management task will be to monitor and manage invasive species. Controlling earthworms is not feasible, but it may be possible to revegetate the bare slopes by installing native plants. This should only be done if the seed for plant material is sourced from on-site.

Temporarily Flooded Altered Deciduous Woodland, Units TFW

The temporarily flooded, altered deciduous woodlands occupy 5.3 acres, lies just above the floodplain areas in the southeast unit. Cottonwood and black walnut are the dominant canopy species, with green ash dominant in the subcanopy. Some of the cottonwoods were quite large (60-100 cm dbh). Common buckthorn was the dominant shrub layer species. It was absent in some areas, but was quite dense in the northeast area, where large diameter stems were abundant. The shrub layer was otherwise sparse, with *Ribes* the primary species. Other species in the shrub layer were sapling trees of sugar maple, green ash, basswood, and black walnut.

The ground layer cover was fairly dense, with wood nettle by far the most abundant species (**Photo 12**). Other common species were Virginia waterleaf, wild geranium, wild ginger in some areas, and spotted jewelweed. Obedient plant was present in small amounts and was being eaten by

Japanese beetles. Motherwort was the only non-native species seen in the ground layer. Seedling trees were sparse but included boxelder, hackberry, and American elm.

The target plant community for the TFW units is Southern terrace forest (FFs59). Removal of non-native shrubs will be the primary task toward that goal. Once controlled, it would be beneficial to install native shrubs to recreate a more typical composition. The total shrub cover should be sparse to patchy. Installing native herbaceous plants in the buckthorn-infested areas would also be beneficial. See **Appendix C** for species suitable for planting or seeding.

Photo 12. Wood nettle (*Laportea dioica)* forms a dense ground cover in much of the TFW units. 7/21/11

Seasonally Flooded Altered/Non-Native Deciduous Woodland and Emergent Vegetation Complex, Units SFW

These wetland/woodland complex areas occupied just 1.1 acres on either side of Hwy 291. Included in this cover type is a small ponded area on the east unit that has semi-permanent water (**Photo 13**). The woodland was dominated by a canopy of green ash, which was fairly dense. Silver maple was also common and boxelder, cottonwood and American elm were also present. Most of the trees were small diameter, less than 25 cm (10 inches). The shrub layer was sparse, with buckthorn dominant. Some sandbar willow was present. The ground layer was fairly dense and consisted primarily of emergent herbaceous species including water plantain, bur marigold, false stinging nettle, blue flag iris, water smartweed, and broad-leaved arrowhead. Reed canary grass, however, was most abundant overall, and purple loosestrife was common (**Photo 14**). The latter was being eaten by Japanese beetles. The wetlands are fed by seepage areas at the base of the bluff on the southeast parcel.

The target community for these units is southern terrace forest & northern wet meadow/carr complex. This would be accomplished by removing non-native invasive species and potentially planting native shrubs and herbaceous plants to increase the community assemblage. See

Photo 13. A semi-permanent pond east of Hwy 291 is fed by ground-water seepage that flows from the base of the bluffs northward, eventually reaching Bullfrog Pond. 7/5/11

Photo 14. West of 291, water levels are lower, with only temporary standing water. Purple loosestrife, shown here, is abundant among other emergent marsh species. 8/17/11

Appendix C for species suitable for planting or seeding.

Floodplain Forest, Units FF

Floodplain forest covered about 7.8 acres in the northwest parcel and 4.7 acres in the southeast parcel. In 2011 the floodplain was inundated several times in spring and early summer and was still muddy in August. Flooding frequency and duration have increased in the past decade or so. Silver maple was strongly dominant in the canopy, with green ash as subcanopy dominant. Silver maple trees ranged in size from about 20 to 56 cm. Other canopy trees included American elm, boxelder, bitternut hickory (few), hackberry and black walnut.

The shrub layer was very sparse. Common buckthorn was found, mostly along edges. Green ash was dominant and boxelder and American elm were present. The ground layer was very sparse in some areas after flooding (**Photo 15**), but where water receded earlier the ground was soon covered by wood nettle, which was strongly dominant (**Photo 16**). Other species detected were jewelweed, moonseed, green briar, and Virginia creeper.

Canopy tree species were not well represented in the seedlings and sapling trees. Silver maple seedlings were observed but few saplings. Green ash, hackberry and red oak were the other most common seedlings found. The most common sapling trees found were green ash, boxelder and American elm.

Photo 15. Flooded for much of the summer in 2011, the northwest forest floodplain was still barren of ground cover by the end of the season. 10/11/11

Photo 16. The southeast floodplain forest had a dense ground cover of wood nettle. Tree canopy was dense, and dominated by sliver maple and green ash. 6/14/11

Mixed Emergent Marsh, Units EM

The mixed emergent units covered 15.5 acres in the northwest parcel. These areas were flooded much of the season in 2011 so evaluation was limited (**Photo 17**). Dominant species in these units appeared to be sandbar willow, purple loosestrife, and reed canary grass (**Photo 18**). Broad-leaved cattail, arrowhead, and smartweed were also observed. It is very likely that narrow-leaved cattail and/or hybrid cattail were also present. The marshland is connected to and upstream of Bullfrog pond, which provides habitat for migrating shorebirds. This pattern of use seems to be declining in recent years, possibly due to the siltation of the pond (T. Lewanski, pers. comm.).

Photo 17. Viewed from Hwy 54 just upstream of Bullfrog Pond, the emergent marsh, though still flooded at the time of the photo, appeared to be dominated by sandbar willow and purple loosestrife. 7/28/11

Photo 18. This beaver lodge was located along the Vermillion River in the northwest part of the SNA. Reed canary grass was abundant in much of the emergent marsh unit. 10/11/11

Seepage Stream, Unit SS

This small area (0.2 ac) lies at the base of the slope on the southeast parcel (**Photo 19**). Groundwater seepage provides a nearly constant supply of cold water. There is also apparently a spring, historically known as Indian Springs according to the DNR 1979 report. However, the

Photo 19. Seepage from the base of oak forest slopes in southeast parcel flows east, then south to the ponded area. Photo toward the west, upstream. 5/5/11

Photo 20. Overflow from the pond southeast of Hwy 291 & 54 travels under 291 and flows west before departing the SNA under Hwy 54. Most years the water flow ceases by late summer. 8/17/11

spring was apparently not active at the time of the 2011 site visit. Vegetation of the seepage area was not very diverse and was dominated by watercress (a non-native species). Flow from the seepage area feeds the emergent marsh areas on the south side of Hwy 54 (**Photo 20**).

River, Unit RV

The Vermillion River, which covers about 3 acres as it winds through the northwest parcel of the SNA, is a central feature of Hastings SNA. The river enters the west side of the northwest unit, and flows east. Historically, the river was much narrower and followed an easterly path out of the SNA to the Mississippi River (see **Map 4a**), and Bullfrog Pond was an isolated body of water south of the river. According to aerial photographs, the river shifted direction in the late 1990's, turning to the south and connecting to Bullfrog Pond. The river is also much wider than it was historically The river carries substantial amounts of sediment, much of which is deposited in Bullfrog Pond where the velocity of the water slows (**Photo 21**). As a result of that deposition, Bullfrog Pond filled in on the upstream end and opened up at the downstream end, essentially migrating downstream. Where the pond was historically almost entirely within the northwest parcel of the SNA (**Map 4b**), today it is almost entirely east of the SNA (**Map 5**). A large amount of that sedimentation has occurred between 2008 (**Map 6)** and 2010 (**Map 5**). Reducing the amount of suspended solids in the Vermillion River is an important goal for management of the watershed, especially since Lake Pepin is listed as an impaired water for excessive sediment and nutrients. While there is not much course of action at the SNA itself, this document can serve as further evidence of the need to reduce runoff in the watershed.

Photo 21. The Vermillion River, viewed from the bridge at Hwy 54. After a long spring flood it was flooded again for much of the summer 2011. The brown water indicates the heavy sediment load carried by the river. 8/3/11

Photo 22. View of the Vermillion River, looking upstream from the northeast corner of the northwest parcel. The river is wide and shallow in this floodplain area. Reed canary grass lines the banks, but banks appear stable. 10/11/11

The river itself was flooded for most of the season in 2011, so bank conditions were not well evaluated. When viewed in October, the banks appeared stable. Reed canary grass dominated the ground cover, forming a nearly monotypic stand (**Photo 22**).

Roadsides, RD units

The roadside areas at Hastings SNA generally consist of pioneer species, and most areas are mowed. There are some non-native invasive plants, such as soapwort and buckthorn (**Photo 23**), but in low amounts. Most areas are mowed, which reduces seed production of weeds. Along Hwy

291 there is a problem with erosion from runoff, which is forming a gully next to the road (**Photo 24**). The City of Hastings has plans to re-build this portion of the road.

Photo 23. Roadside areas have some non-native species, such as this area near the bridge, but most areas are mowed.

Photo 24. Gully forming on south/east side of Hwy 291.

Existing Land Use

Existing public use of the SNA is primarily nature observation. The Minnesota Native Plant Society and the Hastings High School Biology class are known to visit the site on occasion. The site does not appear to get used on a regular basis and no walking trails were noted.

There is a gated access (**Photo 25**) on the north side of Hwy 54, east of Hwy 291, that provides access for a neighboring property owner to his parcel to the north, where vegetative debris (logs, yard waste) and other inorganic debris is deposited (**Photo 26**). A small amount of vegetative debris has also apparently been deposited on the SNA, along the same driveway.

Photo 25. Gated entry on the north side of Hwy 54, east of Hwy 291. Provides access for adjacent property owner to the north. 10/11/11

Photo 26. Debris deposited in the SNA 10/11/11

Adjacent Land Use

The city-owned land to the south and west includes a large mowed area with a frisbee golf course, but most of the park is natural woodland, with over half of the site located in the Vermillion bottoms floodplain complex. A hiking trail circles through the upland area. The VA hospital to the southwest includes extensive forested areas along the Vermillion River, as well as the building grounds with parking lots and mowed turf. South of the SNA is state-owned land that is cultivated (corn and beans). The three privately-owned parcels on the east and north sides of the SNA are all zoned agricultural. The southern parcel has a farmstead, but is mostly forested while the two northern parcels are mostly open water and floodplain forest. Northwest of the SNA is an industrial property (Intek Weatherseal Products Inc).

Existing Animal Impacts

The primary animal impact noted was earthworms. While it appears earthworms are distributed throughout the site, some areas were more affected than others. For instance, the slopes near the eastern side of the southeast unit were nearly devoid of leaf litter. The root collar of the trees and upper roots were exposed (**Photo 27**), and soils were compacted, with little vegetation. At most of the rest of the SNA, however, the earthworm affects were not that apparent; leaf litter was fairly abundant and the native woodland wildflowers were dense and diverse. There was evidence of white-tailed deer at the site and wild turkeys are likely present, but there were no significant impacts observed from either.

Photo 27. "Tree gingivitis" and soil compaction, caused by earthworm infestations. Eastern side of southeast parcel in maple-basswood forest.

Influencing Factors

Although influencing factors can include both positives and negatives, this section will focus on the primary potential ecological threats at this site. These include invasive plant and animal species, as well as erosion, altered flooding regimes, and undetermined impacts from climate change. Primary invasive animal species are earthworm and emerald ash borer. Wild Turkeys and white-tailed deer do not seem to present a significant concern, perhaps due to the relative lack of cover in the open understory. Oak wilt is another tree disease of concern.

In addition to the existing invasive species present

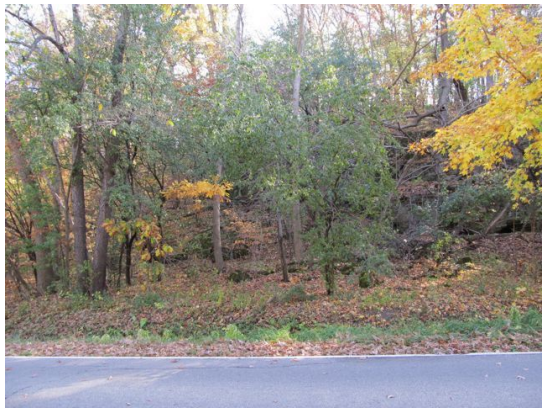

Photo 28. Buckthorn is sparse in most of the oak forest units, but very large shrubs flank the south side of Hwv 291 near the stairs. 10/11/11

at the site (common buckthorn (**Photo 28 & 29**), Tartarian honeysuckle, reed canary grass, purple loosestrife), other potential species include garlic mustard and narrow-leaf bittercress, both of which have invaded numerous sites in the area, especially along the Mississippi River. Suggested management methods are discussed under the Management Recommendations section.

The primary invasive animal threats are probably earthworms and emerald ash borer. Earthworms, however, are already present throughout the site and have likely been there for decades, since adjacent properties were settled over 100 years ago. If the worm invasion happened prior to some of the present-day pressures (garlic mustard, buckthorn, abnormally high deer and turkey populations) the native plant community could have recovered and re-established in the more mineral soils. That seems to be the case of what has happened, although the species diversity is not as high as one would expect for intact communities and some of the less conservative species such as wild ginger and Virginia waterleaf are very abundant.

Photo 29. The highest density of buckthorn at the SNA is in the TFW unit north of Hwy 54. 10/11/11.

Emerald ash borer has a high probability of occurring at the site within 10 years, based on trends in other areas, and is likely to virtually eliminate green ash from the floodplain, where it is a subcanopy dominant. If an ash tree seed program exists at the DNR, it may be possible to re-establish the trees as some future date, after the disease is gone. Detection of the disease at the site may warrant the need for a tree removal effort. An assessment at that time will be needed to determine what actions, if any, to take. Regular monitoring of the site is important for early detection and minimizing tree loss.

Besides emerald ash borer, the other most likely tree disease to occur at the site is oak wilt. Red oak, which is a dominant species in some areas and includes some very large trees, is especially susceptible to oak wilt. Loss of these trees would significantly alter the plant community. It will be important to regularly monitor the SNA and potentially take measures to halt the spread of the disease if it occurs. Tree removal efforts may be warranted to minimize spread of the disease.

Erosion was not presently a significant factor, but could become one. The gully below the wall at the VA home showed.

Other influencing factors include altered hydrology and climate change. Increased frequency and duration of flooding has likely altered and will continue to alter the composition and structure of the floodplain forest. In recent decades, elms and cottonwood trees have become less common in floodplains while silver maple, more tolerant of flooding than many species, has formed monocultures. Another shift has been observed along the Mississippi River, where open ground in floodplains is covered by reed canary grass, thus preventing even silver maples from regenerating. Floodplain forests could be converted to reed-canary grass stands. These processes may be happening at Hastings SNA, as some areas are already by dominated reed canary grass. Additional research needs to be done to determine if and how native floodplain trees can be re-established.

Objectives

The following objectives are intended for maintaining or improving the condition of the priority features, and to provide for designated uses of the site. All management activities should be aimed towards these objectives.

PUBLIC USE. Provide the public with safe access (e.g. designated parking) to the SNA to observe nature while protecting the natural resources from degradation due to human use or trespass. Parking is currently provided at the C.P. Adams parking lot. A SNA sign at the parking lot would better inform the public to the location of the SNA. A kiosk located there could provide a map of the SNA boundaries with best access points.

PLANT COMMUNITY BIODIVERSITY. Maintain regular monitoring for early detection and eradication of non-native plant species. If planting (seed or transplants) is needed, use only local native ecotypes originating as close to the restoration site as possible (within 25 miles).

PRESERVATION OF RARE SPECIES. Protect snow trillium during any site management or other activities. Monitor population. Avoid disturbances or use of chemicals (e.g. herbicide for invasive species control) near trillium plants.

NATURAL DISTURBANCES. While flooding is a natural, annual disturbance in a floodplain, physical disturbances such as fire, and windthrow are quite uncommon for the upland plant communities. Light surface fire could be considered if needed to control invasive species, but the historic frequency was 35 years (oak-basswood forest) to 50 years (maple-basswood forest).

Indicators

Quantitative measures that can be used to indicate the status of the priority features as well as the threats to the site ("Factors") include:

The number of flowering snow trillium. Flowering plants should be counted annually and tracked over time (see Snow Trillium section for 2011 data and prior). Vegetative plants can be counted as well, if feasible. The plant and/or patch locations should also be recorded via GPS.

The percentage of site with non-native, invasive woody species (particularly buckthorn). The site could be surveyed about every 2-4 years, and the buckthorn mapped via GPS. See **Map 6** for the buckthorn coverage recorded in 2011.

The percentage of site with non-native, invasive herbaceous species. **Map 6** shows the approximate coverage of purple loosestrife in 2011. A coverage survey could be repeated every few years for loosestrife as well as reed canary grass and any other new species detected, to determine trends. Narrow-leaf bittercress should be high on the watch list as the species is showing up at numerous river sites.

Table 6. Adaptive Management Spatial Database (AMSD) Priority Feature Worksheet

Priority Feature: Mesic oak-basswood forest

Condition variables	Condition Indicator	Condition Range	Objectives	Implementation Strategy
Native species dominance	% cover	Exel=90-100; Med=70-90 Poor<70	Maintain native species dominance	Monitor, cut/treat, hand-pull, biological control.
Native species diversity	No. of spp	Needs to be determined. High may be 14-20 tree spp, >40 forbs/graminoid. Low may be <9 tree spp, <25 forb/gram.	Maintain high native diversity, representative of historic community.	Conduct periodic inventory (5-10 yrs), compare to previous.
Native spp assemblage	% cover	TBD.	Representative of historic condition. E.g. ground cover 5% graminoid, spp char of OB forest.	Inventory and monitoring. Determine action if needed.
Plant community structure	% cover in each height class	Best: canopy 100%, shrub 10-30%, ground 80-100%	Maintain structure of dense canopy, open shrub layer, dense ground cover.	
Canopy tree regeneration	% cover of canopy tree seedlings in ground layer	Best: seedlings of all canopy trees represented.	Monitor condition , determine if change is occurring. If change deemed "unnatural" take action (e.g. planting).	Periodic monitor/inventory. If regeneration not happening, determine if any action necessary. Ultimately, succession to maple-basswood likely.
Conservative species frequency	Frequency of occurrence	Excel: high frequency (TBD e.g. FQI>35)* Moder: e.g. FQI=20-35 FQI poor: e.g. FQI <20	Maintain high freq in high quality areas. Increase frequency in low quality areas.	Develop assessment method based on coefficient of conservatism. Thorough plant inventory. Non-native plant removal, in sensitive manner.
Snow Trillium population	No of flowering plants, area (sq ft) of population.	TBD	Maintain existing population, which may be highest recorded.	Survey population periodically (2-4 yrs). Use extreme caution for any mgmt near plants.
Condition rank	Rank	A=excellent, B=good C=fair, D=poor	Use rank guidelines for mesic oak-basswood forest	
Invasive species	% cover	Excel=0, Med=1-10 Poor=10-50	Remove/reduce invasives, prevent spread.	Cut & stump-treat woody plants. Hand-pull herbaceous if feasible. Herbicide in disturbed areas.
Invasive species	Number of species	Excel=0, Med=1-8, Poor>8	" "	" "
Breeding bird species	Number. of species	TBD	Monitor breeding bird population, which is an indicator of natural community health, especially SGCN species	Follow standard site mgmt practices - leave snags, etc. Periodic (2-5 yrs) breeding bird surveys; use established protocol. Evaluate trends, take mgmt action if necessary/feasible,
Factor variables	**Factor Indicators**	**Factor Range**	**Objectives**	**Implementation Strategy**
Invasives from outside	Roadside plantings, landscape plantings (VA hospital)		Prevent intentional non-native plantings on roadsides or adjacent properties.	Work with City re: any road maintenance work, Work with VA hospital re: any landscape planting.
Herbicide drift	Die-off of native insects & plants near farm field.	Amount of boundary affected; depth of die-off into oak forest	Prevent drift into SNA.	Contact adjacent farmer to discuss practices.
Runoff	Erosion from farm field.	Runoff could cause erosion in SNA	Prevent/halt erosion	Contact adjacent farmer to discuss practices.
Trash			Cleanup and prevention	Cleanup existing trash at OF (map 6). Work with city to install trash receptacle at C.P.Adams parking lot.

*FQI = Floristic Quality Index, based on coefficient of conservatism (CC). MN does not have CC values determined, but WI and MI do, which could be used. (Herman et. al. 2001).

Priority Feature: Maple-basswood forest

Condition variables	Condition Indicators	Condition Range	Objectives	Implementation Strategy
Native species dominance	% cover	Exel=90-100 Med=70-90 Poor<70	Maintain native species dominance	Monitor, cut/treat, hand-pull, biological control.
Native species diversity	Number of species	Needs to be determined. High may be 14-20 tree spp, >40 forbs/gram. Low may be <9 tree spp, <25 forb/gram.	Maintain high native diversity, representative of historic community.	Conduct periodic inventory (5-10 yrs), compare to previous.
Native spp assemblage	% cover	TBD.	Representative of historic condition. E.g. ground cover 5% graminoid, consisting of spp char to MB forest.	Inventory and monitoring. Determine action if needed. Consider planting in bare soil (earthworm) areas.
Plant community structure	% cover in each height class	Best: canopy 100%, shrub 10-30%, ground 80-100%	Maintain structure of dense canopy, open shrub layer, dense ground cover.	
Canopy tree regeneration	% cover of canopy tree seedlings	Best: seedlings of all canopy trees represented.	Monitor condition to determine if change is occurring. If change is deemed "unnatural" take action to correct it.	Periodic monitor/inventory. If regeneration not happening, determine if any action necessary/feasible. Ultimately, climate change may cause uncontrollable alterations.
Conservative species frequency	Frequency of occurrence	Excel: high frequency (TBD e.g. FQI>35) * Moder: e.g. FQI=20-35 FQI poor: e.g. FQI <20	Maintain high freq in high quality areas. Increase frequency in low quality areas.	Develop assessment method based on coefficient of conservatism. Thorough plant inventory. Non-native plant removal, in sensitive manner.
Condition rank	Rank	A=excellent, B=good C=fair, D=poor	Use rank guidelines for mesic oak-basswood forest	
Invasive spp	% cover	Excel=0 Med=1-10 Poor=10-50	Remove/reduce invasives, prevent spread.	Cut & stump-treat woody plants. Hand-pull herbaceous if feasible. Herbicide in disturbed areas.
Invasive spp	Number. of species	Excel=0 Med=1-8 Poor>8	" "	" "
Factor variables	**Factor Indicators**	**Factor Range**	**Objectives**	**Implementation Strategy**
Unit is buffered from most factors. Addressing factors in Oak-basswood unit will address primary threats to this unit.				

*FQI is the Floristic Quality Index, based on the coefficient of conservatism (CC). MN does not have CC values determined, but WI and MI do, which could be used. (Herman et. al. 2001).

Priority Feature: Floodplain forest

Condition variables	Condition Indicators	Condition Range	Objectives	Implementation Strategy
Native species dominance	% cover	Exel=90-100 Med=70-90 Poor<70	Maintain native spp dominance	Monitor, cut/treat, hand-pull, biological control.
Native species diversity	Number of species	Needs to be determined. High may be 7-12 tree spp, >40 forbs/gram. Low may be <9 tree spp, <25 forb/gram.	Maintain high native diversity, representative of historic community.	Conduct periodic inventory (5-10 yrs), compare to previous.
Native spp assemblage	% cover	TBD.	Representative of historic condition. E.g. tree canopy 80-100%, consisting of spp char to floodplain forest.	Inventory and monitoring. Determine action if needed.
Plant community structure	% cover in each height class	Best: canopy 100%, shrub 10-20%, ground 80-100%	Maintain structure of dense canopy, open shrub layer, dense ground cover.	
Canopy tree regeneration	% cover of canopy tree seedlings	Best: seedlings of all canopy trees represented.	Maintain dominance natives, especially silver maple. Retain some cottonwood.	Periodic monitor/inventory. If regeneration not happening, determine if any action necessary/feasible. Ultimately, flood regime and invasives (reed canary) may cause uncontrollable alterations.
Condition rank	Rank	A=excellent, B=good C=fair, D=poor	Use rank guidelines for floodplain forest	
Invasive spp	% cover	Excel=0 Med=1-10 Poor=10-50	Remove/reduce invasives, prevent spread.	Cut & stump-treat woody plants. Hand-pull herbaceous if feasible. Herbicide in disturbed areas. Biological control for loosestrife.
Invasive spp	Number of species	Excel=0 Med=1-8 Poor>8	" "	" "

Priority Feature: Vermillion River

Condition variables	Condition Indicators	Condition Range	Objectives	Implementation Strategy
Aquatic animals (vertebrate and invertebrate)	Diversity	TBD	Maintain high native diversity, representative of clean water.	Conduct periodic inventory (3-5yrs), compare to previous.
Bank structure and vegetation	Erosion, vegetation cover	Excel=no erosion, diverse native vegetation. Poor= few native plant spp, bank erosion.	Maintain stable bank structure.	Follow established guidelines for evaluating stream bank health.
Condition rank	Rank	A=excellent, B=good C=fair, D=poor	Use rank guidelines for stream banks.	
Invasive spp	% cover	Excel=0 Med=1-10 Poor=10-50	Remove/reduce invasives, prevent spread.	Methods for long-term control RCG on flooded stream banks not known at this time.

Factor variables	Factor Indicators	Factor Range	Objectives	Implementation Strategy
Invasives from outside	RCG and purple loosestrife will constantly re-seed from upstream sources.			Stay abreast of research regarding applicable control of these species.
Sediment and nutrient load	Low diversity of macroinvertebrates and/or dominance of tolerant species.		Clear water, low nutrient levels.	Work on watershed issues to reduce agricultural and urban runoff.
Flooding	Excessive frequency, volume and duration of floods		Reduce flooding frequency & duration to historic norms.	Work on statewide watershed issues to increase infiltration and reduce runoff.

MANAGEMENT RECOMMENDATIONS

Activities

All activities to be carried out will comply with current SNA Operational Directives and approval.

Development Activities

Access Improvement

There is no official parking lot for the Hastings SNA, but the parking lot for the City of Hastings C.P. Adams park effectively serves that purpose. Although there is no good parking for other parts of the SNA, especially the northwest unit, there are not likely to be many visitors to that area, since much of it is floodplain. Parking alongside the road is adequate for one or two cars that may go there.

The parking lot at C.P. Adams park provides a good parking location for the SNA, but it also generates some problems. The facilities at the park are not adequate to serve the needs, so there are some resulting impacts to the SNA. The park provides picnic tables, tucked into the narrow strip of woods between the parking lot and the SNA, but there are presently no trash receptacles, so a large amount of trash will likely be left on the SNA. There is also considerable evidence that the SNA woods are used as a latrine. Portable toilets are available across the park, but none at the picnic/parking area where people are most likely to need them.

Fence

No problems were encountered with fences at this SNA. No fences were found transecting the site and only one border fence was noted. At the southeast unit, a wire fence separates the DNR property from the private property to the east. The gate on the north of 54, east of 291 provides access for the neighbors, however it is not locked and thus may provide access for others. Locking the gate so only the adjacent property owner has access will help to reduce dumping.

Signs

The current primary parking area for the SNA is the C.P. Adams parking lot. At that location there is no indication of the SNA other than DNR property signs, which are set back into the woods. Signage is needed in this area to clearly notify visitors of the presence of the SNA, to provide a rules sign, and to provide a map of the SNA. The official wood-routed SNA sign is located on Ravenna Trail, just east of Hwy 291, where it is tucked into the woods, faces the road, and is virtually invisible to passersby. Relocating the sign to the intersection of 291 and Ravenna trail, and positioning it diagonally (so that it faced the intersection) would make it visible to traffic in two directions. If that is not feasible, however, clearing some of the vegetation away from the sign would help to make it more visible. Lastly, there did not appear to be a corner sign at the southwest corner of the northwest parcel. There may be other boundary signs missing as well. A monitoring survey should make note of any additional boundary signs needed.

Site Cleanup

Several recent and very old trash/debris sites at the southeast unit of the SNA should be cleaned up. These are indicated on Map 6. In addition, there is a dumpsite on privately owned land to the north of the southeast unit, with an access driveway through the SNA. While the dump site is off

the property, there appeared to be some additional debris dumping occurring near the gated entrance of the driveway off of Hwy 54 (**Map 6**).

Management Activities

Invasive Species Control

Woody Invasives The primary management need at Hastings SNA is control of invasive non-native shrubs, primarily common buckthorn. Main locations are shown on **Map 6**. The control method should be cutting followed by immediate stump treating with Round-up, Garlon or other recommended herbicides (see **Appendix D** for more details). Aquatic formulas should be used in all lowland areas. Follow-up control will be needed every few years, using the same method. Do not use foliar treatment or basal bark unless approved by SNA staff.

For all upland forest, work should be done on frozen soils, preferably with snow cover, to prevent impact to the steep slopes and the herbaceous layer. The area where snow trillium are located should be flagged off in spring, and work there should be done by DNR approved individuals to ensure extra precaution is taken. Lowland work can be done in fall or winter or whenever water levels permit access.

Although most of this site would not have experienced wildfire very often, surface fires did occasionally occur in oak-basswood and, less often, in maple-basswood forests. If after buckthorn removal there is a significant flush of buckthorn seedlings, fire may be considered for selected areas.

Herbaceous Invasives In upland forests, the primary non-native species noted was daylily. The plant is spreading, with numerous scattered patches. It should be sprayed with glyphosate or other suitable herbicide that has minimal soil residual and toxicity.

Purple loosestrife is the most abundant invasive herbaceous plant of lowland areas. However, due to extensive flooding in 2011, the full extent of the population is not known. The plant typically responds well to biological control, and it is fairly likely that the loosestrife beetles are already at the site. They may, however, need to be reapplied, if the population was decreased by flooding. The SFW unit had a small population of loosestrife that could be controlled with herbicide, which would enable the fairly diverse native vegetation to expand.

Reed canary grass is prevalent in some areas of the floodplain. This grass cannot reasonably be controlled at the site at this time. New propagules will continually invade the site with every flooding event so control efforts would be futile. More research is needed to determine means for reducing reed canary grass in floodplains and regenerating native trees.

Garlic mustard (*Alliaria petiolata*) and narrow-leaf bittercress (*Cardmine impatiens*) are two mustard species that are prevalent in woodland and riverside locations nearby. The likelihood they could show up at this site is high, as they tend to follow earthworm-disturbed areas. It will be important to regularly conduct thorough surveys to detect these and other non-native species.

Oak wilt is a disease to also watch for at this site, given the abundance of red oak. There is some dispute if the disease is native or not, but it appears to be more prominent now than in the past. Although other SNA sites are not often managed for it, this site is so small and relatively fragile that early detection and management would be desirable.

Plant Community Restoration

Most of the Hastings SNA retains fairly good to very good native plant community diversity. The areas most degraded - the floodplain and low-lying areas - are those that have had the most disturbance, both natural and human-derived. The nearly annual flooding disturbance currently

experienced at the site probably exceeds the frequency of historic flooding, and certainly exceeds the duration and extent of historic flooding. Furthermore, there are many more factors present today that exacerbate or add to the impact of the flooding disturbance. Floodwaters carry high amounts of sediments and nutrients that alter soil and water conditions, numerous non-native invasive species present in the landscape are carried and deposited to the site by floodwaters, and changing climate conditions tend to favor more non-native pests and plants. In 2011, the emergent marsh appeared to have relatively low native plant diversity, and the floodplain forest diversity was lower than expected with low numbers of seedling canopy trees. Increasing plant diversity of the floodplain habitats could therefore be considered. This would require additional study to determine more precisely the cause of reduced diversity and the potential means for increasing it. Low-lying areas not in the immediate floodplain (TFW units), are have good potential for enhancement. Buckthorn chokes some areas and is spreading into others. As it is removed, suitable native shrubs and other plants could be installed (see Appendix C). to be One area that could more easily be enhanced would be the area between Hwy 54 and south to the base of the bluffs, and the area north of Hwy 54 at the far eastern boundary of the SNA.

SGCN Population Management

Eastern wood-pewee and least flycatcher are the only recorded SGCNs for this site. Maintaining the structure of the oak forest and maple-basswood forest is likely to be the primary factor for supporting these species. The closed canopy and open understory are key features. Removing buckthorn is the most critical step for managing for these species. Maintaining a closed canopy cannot be specifically controlled, but can be managed to some extent if it occurs. If oak wilt should occur, regular monitoring should detect it at an early stage and steps can be taken to minimize the spread. The canopy gap can therefore be minimized but not prevented or remediated. Likewise, if blow downs occur there is not any remedial action that can be taken to replace the canopy coverage.

Administration Activities

Planning

Vegetation Survey Plan. While the 2011 Adaptive Management Plan provides a general overview of the existing plant species at the SNA, a comprehensive plant inventory such as was done in 1979 was well beyond the scope of the project. It would be useful and informative, however, to conduct such a thorough inventory, repeating as much as possible the inventory work that was done in 1979. A vegetation survey plan and protocol should be developed that will be easily repeatable. It appears that the plant diversity has declined, especially in the herbaceous layer, and the canopy has been altered too. A full comparison with the 1979 data may not be feasible, but an inventory would provide a base-point for comparison with future inventories. Keeping methodologies simple and time-efficient will increase the likelihood that the plan will be followed. As the biotic and abiotic pressures on natural communities mount, natural communities such as Hastings SNA will be subject to more alterations. If nothing else, documenting those changes is vitally important for any future protection or restoration endeavors.

Animal Survey Plan. As with the plant inventory, it is vitally important to be able to track changes to the animal community as the SNA changes over time. The 1979 report provided information on bird species detected at the site in May and June. Although it is not feasible to use that data for direct comparison (due to incomplete data), nevertheless a breeding bird survey initiated in 2011 provided strong indications that the diversity of birds at the site is significantly less than it was in the past. It would be very valuable to conduct more detailed inventories of all the organisms surveyed in 1979, and to repeat the surveys at regular

intervals, such as every 5 years. The methodologies developed in 2011 **(Appendix B)** may be suitable for future surveys.

Monitor

Trespass. Site boundary and access-ways should be monitored annually and any evidence of illegal trespass should be reported to the Conservation Officer for enforcement action. Actions should be taken to repair damage due to trespass.

Vegetation monitoring. Using survey plots, photo points or other established methods, the site should be monitored regularly for restoration and management results.

Public Relations

Standard SNA procedures will be followed for all public relations.

- Recruit a site steward and train him/her in order to keep in regular contact with SNA staff regarding issues and problems at the site.
- Establish and maintain contact with the Veterans home. Meet with contact to discuss land use practices (especially as it relates to runoff and pollutants) and opportunities to engage residents (e.g. trash pickup).
- Contact individuals previously involved with site management to compile dates of various activities on site and other data.
- Offer field trips to the public to familiarize them with the site, its features, ecological significance and management activities as time permits.

Coordination

Contact other DNR divisions and programs, and other agencies and partners on issues that pertain to their area of expertise, including:

- Forestry for any necessary tree removal efforts;
- Wildlife regarding wildlife management issues;
- Non-game Wildlife, regarding management issues that may impact rare animals;
- Minnesota County Biological Survey ecologist to identify and discuss rare plant locations and plant community topics;
- Non-profit partner on agreement for work they are doing on an SNA;
- SWCD regarding funding for projects).

Permits

This is a public use unit. It is consistent with this designation that research is encouraged at this site. Permits will be considered for research that involves collecting, soil disturbance, or access into a sanctuary, as required.

Acquisition

The only possible area of interest for acquisition adjacent to Hastings SNA encompasses the bluff land to the east (see 1994 "Project Evaluation – Hastings SNA Addition" and CAC approval).

Implementation Strategy

All site management activities are summarized in **Table 7** below, including suggested sequencing and general cost estimates. These estimates were based on the author's past experience with similar projects, are likely to change with actual contractor bids. Cost for administrative tasks were not estimated, as those would be completed by the DNR.

Potential funding sources for the management tasks include: bonding, Legislative Commission on Minnesota Resources (LCCMR), Lessard-Sams Outdoor Heritage Council (L-SOHC), and grants such as State Wildlife Grant (SWG) and National Fish and Wildlife (NFWF).

Tasks would be accomplished by a combination of SNA staff, contractors, project partners, volunteers and Conservation Corps Minnesota. A list of suitable contractors in Minnesota can be found at: http://files.dnr.state.mn.us/assistance/backyard/gardens/native_plant/suppliers_central.pdf. This list may not include all suitable contractors, and none of the listed contractors are endorsed by the DNR.

The project could be divided into phases, but the management activities are relatively small, and could likely be accomplished at one time. The tasks are prioritized if phasing is desired.

TABLE 7. HASTINGS SNA MANAGEMENT PLAN - IMPLEMENTATION STRATEGY

Note: As other parcels are acquired, management needs will be added

Management Activities

Completed by SNA staff, contractors, partners

Year	Priority	Season	Activity Type	Description	Mgmt area	Cost unit	No. units	Cost per unit	Total est
1	1	Smr/fall	Enhancement	Cut/treat exotic brush	All	ac	10	$ 1,300.00	$ 13,000.00
1	2	Smr/fall	Enhancement	Treat daylilies	OF, MB	ac	0.1	$ 1,000.00	$ 100.00
1	2	Spr/smr	Enhancement	Purple loosestrife - spot-treat in SFW, release weevils if needed in EM.	SFW	ac	0.2	$ 800.00	$ 160.00
2	1	Smr/fall	Enhancement	Treat exotic brush - new and resprouts.		ac	10	$ 300.00	$ 3,000.00
2	1	Smr/fall	Enhancement	Follow-up daylily treatment		ac	0.1	$ 500.00	$ 50.00
2	2	Fall	Enhancement	Evaluate buckthorn seedling growth, determine if fire is needed, implement	OF, MB	ac	8	$ 290.00	$ 2,320.00
3	2	Spr	Enhancement	Install native shrubs in exotic removal areas	TFW	Shrubs	500	$ 7.00	$ 3,500.00
4	1	Smr/fall	Enhancement	Treat exotic brush - new and resprouts.		ac	10	$ 300.00	$ 3,000.00
									$ 25,130.00

Administration Activiites

Completed by SNA staff, contractors, partners. Listed costs assume a partner or contractor.

Year	Priority	Season	Activity Type	Description	Mgmt area	Cost unit	No. units	Cost per unit	Total est
1	1	April	Monitor rare spp	Survey snow trillium (every 3-5 years)	OF	ac	1	$ 600.00	$ 600.00
1	1	Spr	Monitor birds	Breeding bird survey (every 3-5 years)	All	ea	2	$ 600.00	$ 1,200.00
1	1	Winter	Plan	Develop vegetation monitoring plan	all	ea	1	$ 600.00	$ 600.00
1	2	Spr-fall	Monitor restoration site establishment	Set up and survey permanent veg plots. (Yrs 1-3 when mgmt starts, every 3-5 years).	All	ea	3	$ 800.00	$ 2,400.00
3	1	all	Monitor	Monitor for invasives and other mgmt needs - annually	All	ea	1	$ 600.00	$ 600.00
all		all	Monitor	Monitor for rules infractions - annually	All	ea	1	TBD	TBD
Any	1	any	Public relations	Meet with veterans home, discuss landuse practices, stewardship opportunities.	OF, MB	ea	1	$ 400.00	$ 400.00
Any	2	Any	Public relations	Host guided walking tour	All	ea	1	$ 250.00	$ 250.00
									$ 6,050.00

Development Activities

The development activities would be lead by SNA staff

Year	Priority	Season	Activity Type	Description
2	2		Adjacent site facilities.	Coordinate with city to get trash bins and portable toilets near the picnic tables.
2	2		SNA sign and information kiosk	Add SNA signs to parking lot area, along with site map and info. Add boundary sign to NW parcel and other areas as needed.
2			Cleanup	Remove debris from ravines and other locations in the SE unit.
1			Erosion	Contact farmer to discuss practices.

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Websites

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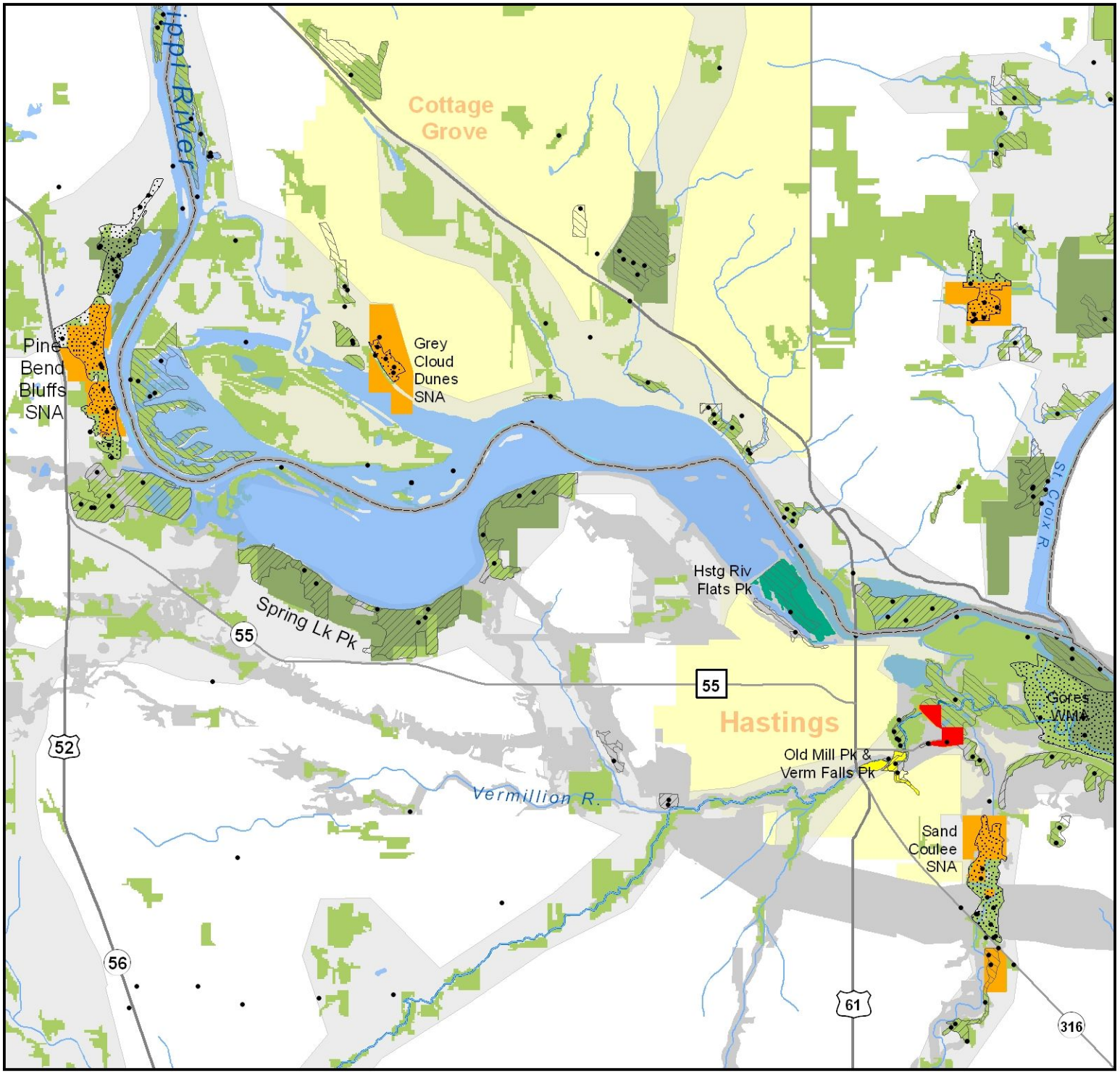
- DNR Natural Resources Index (includes: Animals, ECS, Forests, Invasive Species, Native Plant Communities, Plants, Rare Species Guide, Rocks & Minerals, Watershed Information) http://www.dnr.state.mn.us/nr/index.html
- DNR Invasive Species Guide http://www.dnr.state.mn.us/rsg/index.html
- DNR Ecological Classification System http://www.dnr.state.mn.us/ecs/index.html
- DNR Native Plant Communities Guides http://www.dnr.state.mn.us/npc/index.html
- DNR Ecological Evaluations http://eco-app.dnr.state.mn.us/eco_eval/eco_eval.php
- DNR kittentail description http://www.dnr.state.mn.us/rsg/profile.html
- DNR snow trillium description http://www.dnr.state.mn.us/rsg/profile.html
- National Weather Service flood data: http://water.weather.gov/ahps2/hydrograph.php?wfo=mpx&gage=hstm5&view=1,1,1,1,1,1,1,1%221http://globalU.S. Global Climate Change Research: change.gov/publications/reports/scientific-assessments/us-impacts/regional-climate-change-impacts/midwest
- Wisconsion All-Bird Conservation Plan http://www.wisconsinbirds.org/plan/species/lefl.htm

Hastings SNA
Adaptive Management Plan
T115, R17, Sections 34, 35, 27

Map 1a. Landscape Context



Sources: DNR data deli online data, DNR Natural Heritage database.

- Rare natural features
- Hastings SNA
- Outstanding biodiversity
- High biodiversity
- Moderate biodiversity
- OldMil-VermFallsPks
- Parks, WMA
- Scientific & Natural Areas
- Ecologically significant areas (DNR)
- Mississippi Greenway Plan
- Metro Conservation Corridors

N

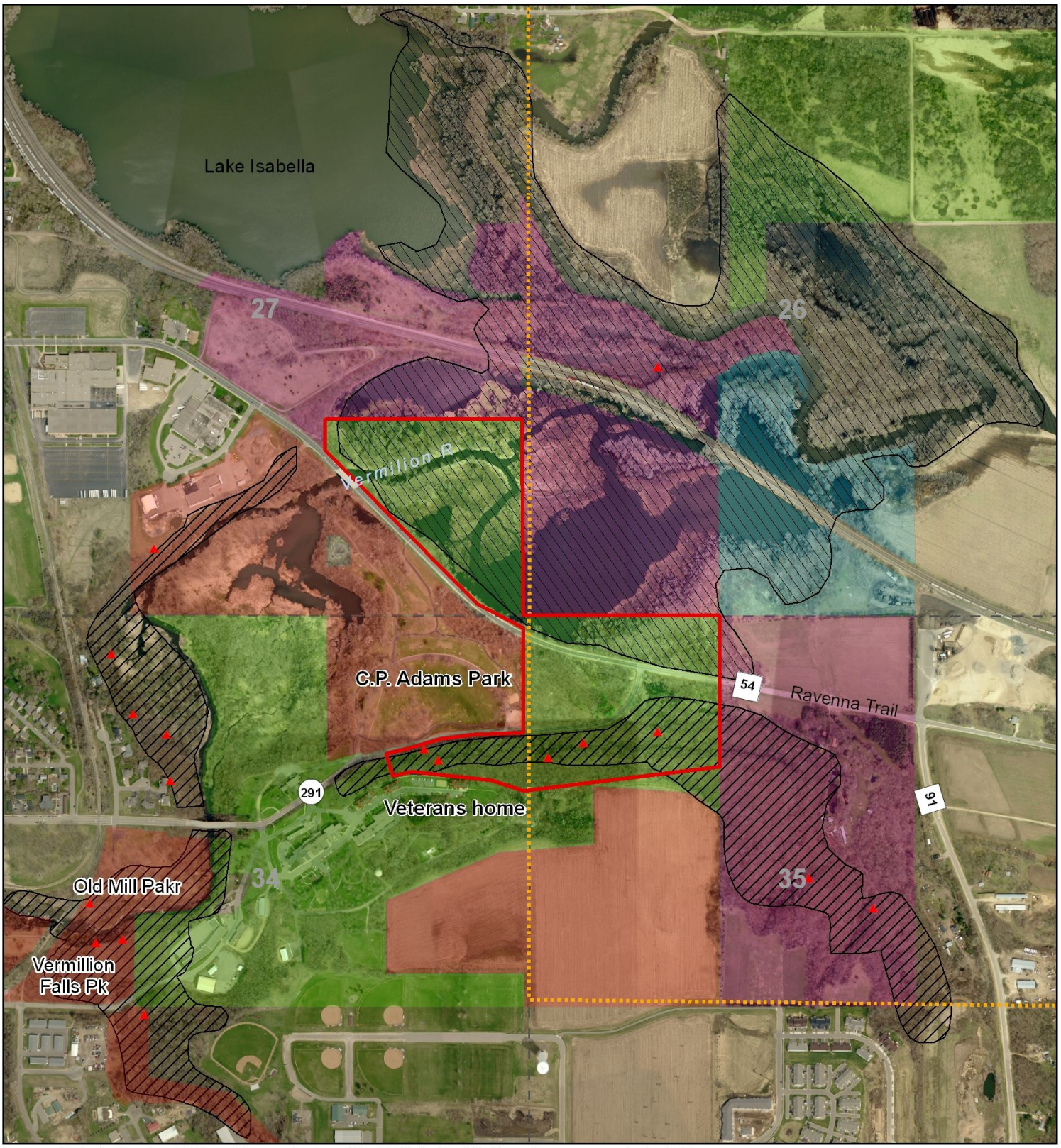
1:100,000

2 1 0 2 Miles

Friends of the Mississippi River
July 15, 2011

Hastings SNA
Adaptive Management Plan

Map 1b. Local Context



Sources: Dakota County -2008 aerial, parcel ownership. DNR Natural Heritage Program - ecological data.

Friends of the Mississippi River
Sept 19, 2011

1:11,000

N

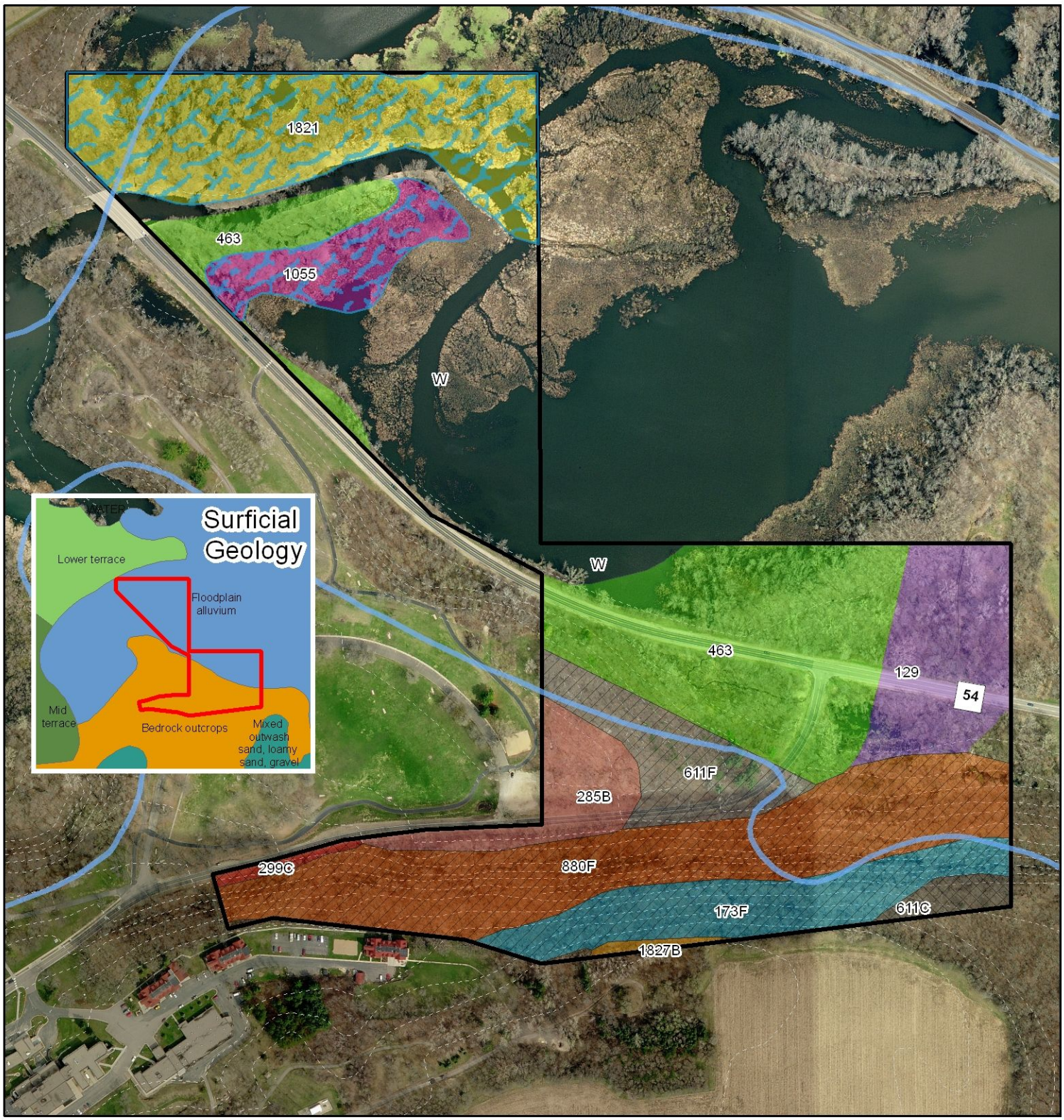
0 150 300 Meters

- Hastings SNA
- Rare features
- MNRRA corridor
- High biodiv significance
- Moderate biodiv sig

Adjacent ownership

- Private properties
- City of Hastings
- Metropolitan Council
- State of MN

Map 2. Surficial Geology and Soils



Sources: Dakota County: 2008 aerial. Soil Conservation Service data 1980. DNR data deli: contours, surficial geology.

1:4,600

1 cm = 46 meters

0 100 200 Meters

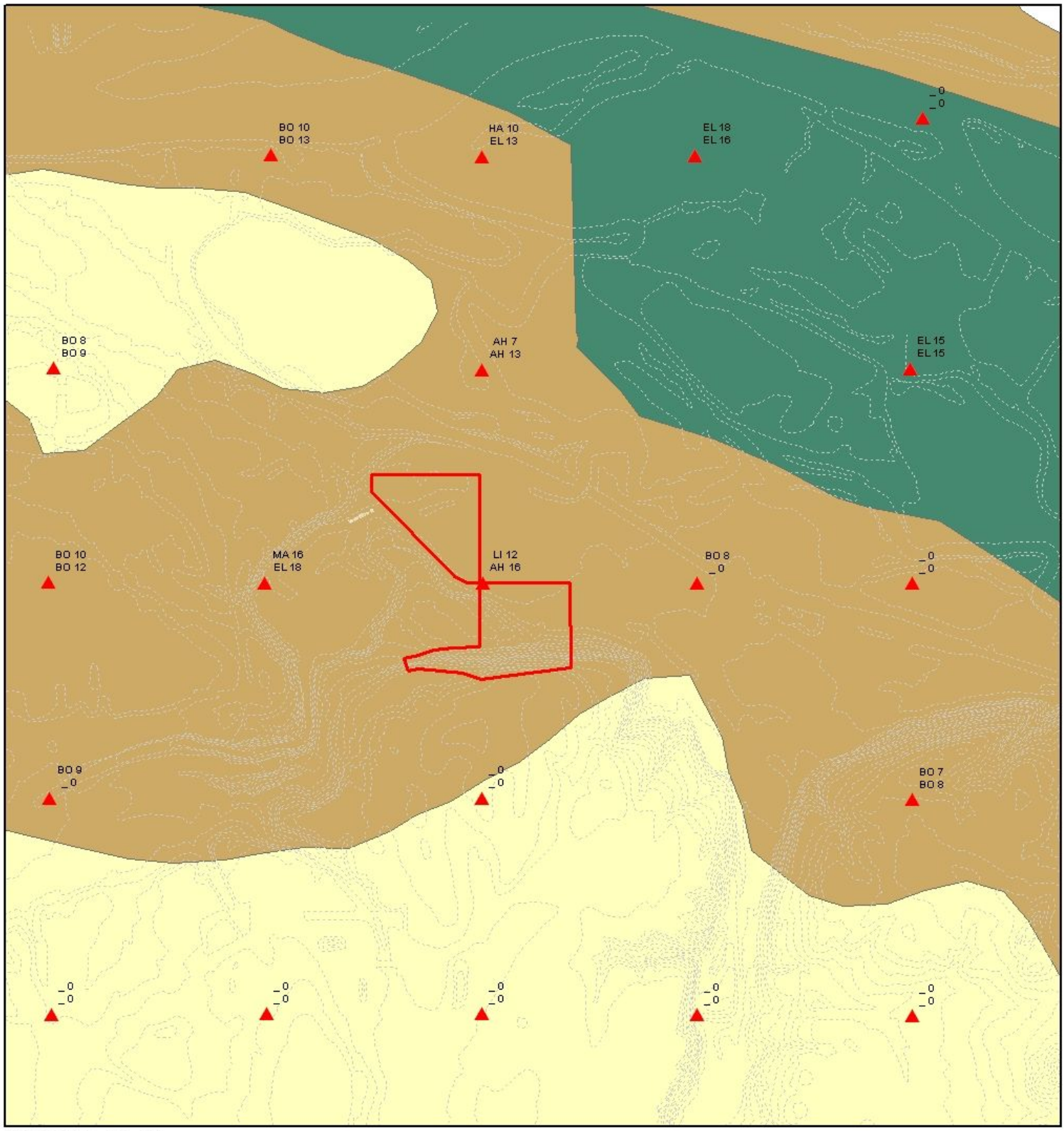
N

100-year floodplain
Highly erodible
Potentially erodible
Hydric soils
10-ft contours

Soils

129 Cylinder loam
173F Frontenac loam
285B Port Byron silt loam
299C Rockton loam
463 Minneiska loam, occ fld
611C Hawick coarse sandy loam
611F
880F
1055 Aquolls, histosols, ponded
1821 Algansee sandy loam, occ fld
1827B Waukegan silt loam

Map 3. Presettlement Vegetation



Source: DNR data deli

N

1:20,000

1 cm = 200 meters

0 150 300 600 900

Meters

Hastings SNA

10-ft contours

Bearing trees: LI=Basswood, AH=Ash, MA=Maple, BO=Bur oak, EL=Elm

Hastings SNA
Adaptive Management Plan
T115, R17, Sections 34, 35, 27

Map 4a. 1937 Aerial Photograph

Source: 11-9-37 aerial - Borchert Map Library. 10-ft contours - DNR data deli.

N

1:5,000

0 50 100 200
Meters

Friends of the Mississippi River
Dec 8, 2011

Hastings SNA
Adaptive Management Plan
T115, R17, Sections 34, 35, 27

Map 4b. 1964 Aerial Photograph

Source: 7-21-64 aerial - Borchert Map Library. 10-ft contours - DNR data deli.

N

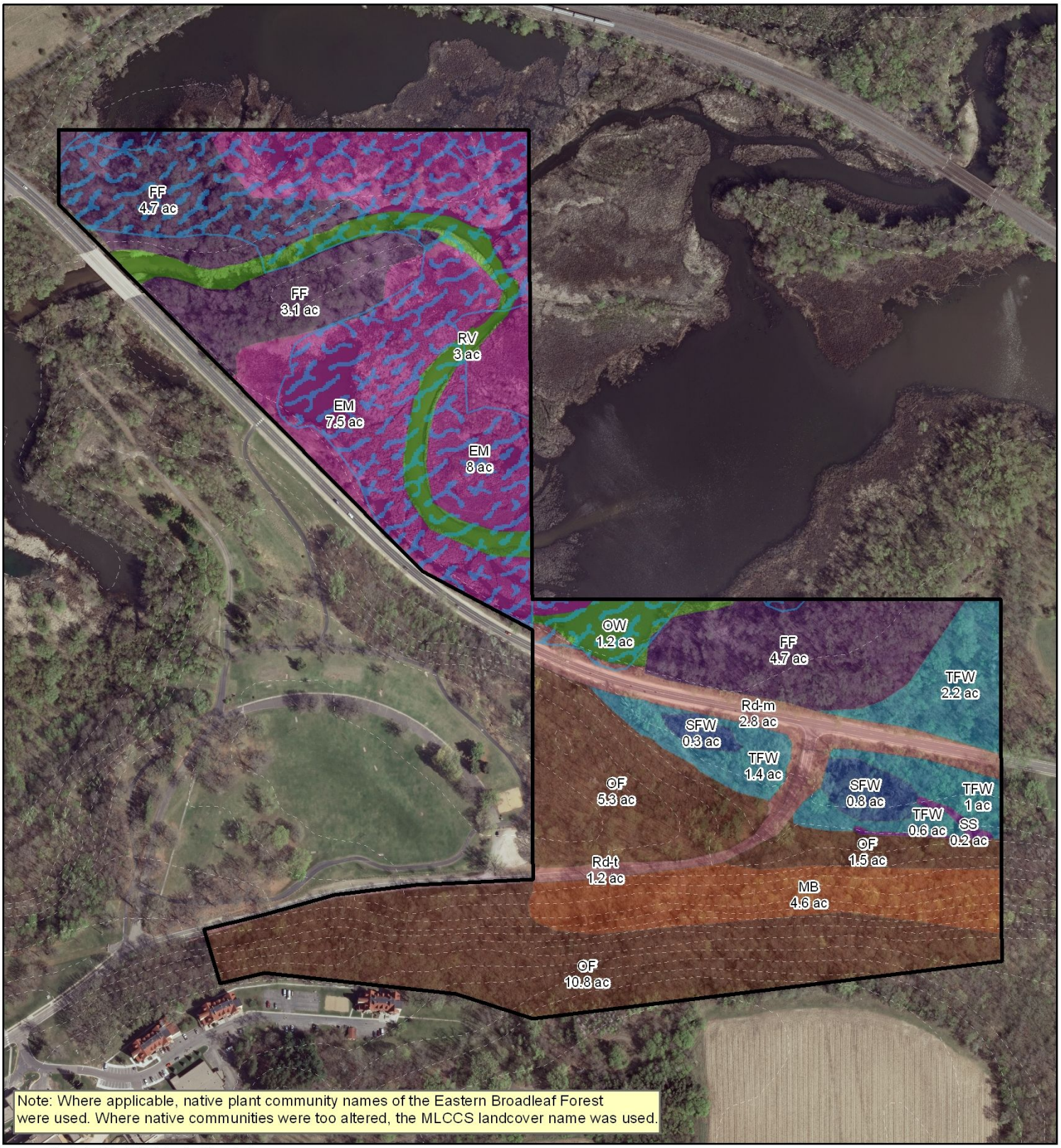
1:5,000

0 50 100 200
Meters

Friends of the Mississippi River
Dec 8, 2011

Hastings SNA
Adaptive Management Plan

Map 5. Existing Landcover



Note: Where applicable, native plant community names of the Eastern Broadleaf Forest were used. Where native communities were too altered, the MLCCS landcover name was used.

Sources:Dakota Co 2010 leaf-off aerial.
DNR data deli: contours, MLCCS.

N

1:4,600

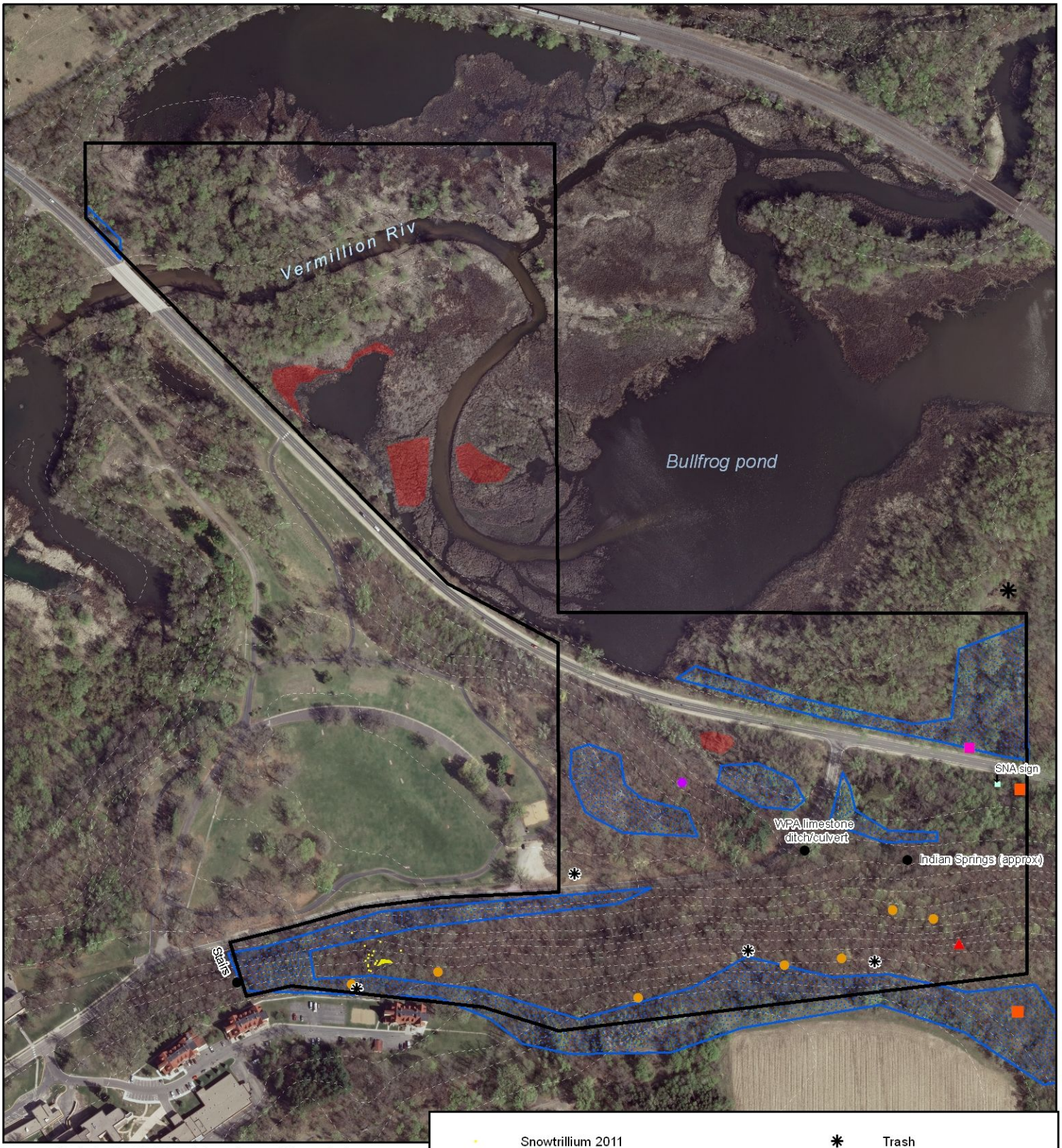
0 50 100 200
Meter

FRIENDS OF THE MISSISSIPPI RIVER

Sept 21, 2011

Hastings SNA
Adaptive Management Plan

Map 6. Site Features



Sources:Dakota Co 2008 aerial and parcel boundaries.
DNR data deli: 10-ft contours, MLCCS.

FRIENDS OF THE MISSISSIPPI RIVER

N

1:4,600

0 50 100 200 Meters

10/20/11

- Snowtrillium 2011
- Buckthorn- about 9 ac
- Purple loosestrife-extent unknown inNW
- Barberry
- daylilies
- Trash
- Veg debris/dump area
- Very small erosion starting
- Gate & driveway
- SNA corner sign
- SNA wooden sign

Plant Species Recorded

The species recorded at the Hastings SNA are listed below according to the land cover units shown in **Map 5.** All records were from surveys conducted in April and August 2011 by Friends of the Mississippi River (FMR).

Relative coverages for all species was generalized for the entire unit, using approximately the same coverage codes as standard releves: **+ = less than 1%, 1 = 1-5%, 2 = 5-25%, 3 = 25-50%, 4 = 50-75%, 5 = 75-100%.**

Southern Mesic Maple-Basswood Forest (MHs39), MB units

Mostly small diam trees with scattered large. Good regeneration of canopy trees. Very open understory. Very dense ground cover vegetation, but some patches devoid of plants and leaf litter. Leaf litter light, bare slopes. Extensive earthworm damage.

Non-Native	Family	Scientific Name	Common Name	Cov*	Diam (cm)	Comments
Ground layer to 2 m			Cover= 4			
	Forbs, ferns and allies					
	Polypodiaceae	*Adiantum pedatum*	maidenhair fern	1		
	Liliaceae	*Allium tricoccum*	wild leek	+		
	Ranunculaceae	*Anemone quinquefolia*	wood anemone	2		
	Araliaceae	*Aralia nudicaulis*	wild sarsaparilla	1		
	Aristolochiaceae	*Asarum canadense*	wild ginger	3		
	Polypodiaceae	*Athryrium filix-femina*	lady fern	1		
	Berberidaceae	*Caulophyllum thalictroides*	blue cohosh	+		
	Fumariaceae	*Dicentra cucullaria*	Dutchman's breeches	1		
	Ranunculaceae	*Enemion biternatum*	false rue-anemone	+		
	Ranunculaceae	*Hepatica acutiloba*	sharp-lobed hepatica	2		
	Hydrophyllaceae	*Hydrophyllum virginianum*	Virginia waterleaf	2		
	Balsaminaceae	*Impatiens cf pallida*	pale jewelweed	+		
	Papaveraceae	*Sanguinaria canadensis*	bloodroot	1		
	Asteraceae	*Solidago flexicaulis*	zigzag goldenrod	+		
	Ranunculaceae	*Thalictrum dioicum*	early meadowrue	+		
	Liliaceae	*Trillium flexipes*	drooping trillium	+		
	Liliaceae	*Uvularia grandiflora*	large-flowered bellwort	+		
	Liliaceae	*Uvularia sessilifolia*	sessile bellwort	+		
	Graminoids					
	Cyperaceae	*Carex blanda*	Carex blanda			
	Cyperaceae	*Carex pensylvanica*	Pennsylvania sedge			
	Woody species					
	Aceraceae	*Acer saccharum*	sugar maple	2		abundant
	Fagaceae	*Quercus rubra*	Red oak	+		
	Tiliaceae	*Tilia americana*	American basswood	1		Common
	Cornaceae	*Cornus alternifolia*	pagoda dogwood	+		
	Aceraceae	*Acer saccharinum*	silver maple	+		
Understory 2-5 m height			Cover =1-2			Mostly very open understory.
	Aceraceae	*Acer saccharum*	sugar maple	2	5	Dominant
	Cornaceae	*Cornus alternifolia*	pagoda dogwood	+		
	Oleaceae	*Fraxinus pennsylvanica*	Green ash	+		
X	Rhamnaceae	*Rhamnus cathartica*	common buckthorn	+		Very little - in edge areas
	Tiliaceae	*Tilia americana*	American basswood	+		
Canopy and Subcanopy	**5-35 m height**		Cover = 4-5			
	Aceraceae	*Acer saccharum*	sugar maple	3-4	25, 46	Dom in subcanopy and canopy. Few large.
	Betulaceae	*Betula papyrifera*	paper birch	+	15	Subcanopy
	Juglandaceae	*Juglans cinerea*	butternut	+	10	
	Betulaceae	*Ostrya virginiana*	ironwood	+	10	Subcanopy
	Fagaceae	*Quercus rubra*	Red oak	2	46	
	Tiliaceae	*Tilia americana*	American basswood	2-3	51	

* Relative Cover Classes for individual species and vegetation layers: + (0-1%), 1 (1-5%), 2 (5-25%), 3 (25-50%), 4 (50-75%), 5 (75-100%).

Southern Mesic Oak-Basswood Forest MHs38

Non-Native	Family	Scientific Name	Common Name	OF-S	OF-W	Dbh (cm)	Diam (In)	Comments
Ground layer to 2 m			Cover 4					
	Forbs, ferns and allies							
	Ranunculaceae	*Actaea pachypoda*	white baneberry	+	+			
	Ranunculaceae	*Actaea rubra*	red baneberry	+	+			
	Polypodiaceae	*Adiantum pedatum*	maidenhair fern	1	+			
	Roseacea	*Agrimonia gryposepala*	downy agrimonia		+			
	Liliaceae	*Allium tricoccum*	wild leek	1	+			
	Ranunculaceae	*Anemone quinquefolia*	wood anemone	1	1			
	Ranunculaceae	*Anemonella thalictroides*	rue anemone		2			
	Araliaceae	*Aralia nudicaulis*	wild sarsaparilla	2	2			
	Aristolochiaceae	*Asarum canadense*	wild ginger	3	3			
	Berberidaceae	*Caulophyllum thalictroides*	blue cohosh	+	1			
	Fabaceae	*Desmodium glutinosum*	pointed leaved tick trefoil	1	+			
	Fumariaceae	*Dicentra cucullaria*	Dutchman's breeches	1	1			
	Equiseteaceae	*Equisetum sp*	horsetail					
	Rubiaceae	*Galium triflorum*	sweet-scented bedstraw		1			
	Geraniaceae	*Geranium maculatum*	wild geranium		1			
x	Liliaceae	*Hemerocallis fulva*	day lily	+	1			
	Ranunculaceae	*Hepatica acutiloba*	sharp-lobed hepatica	1	1			
	Hydrophyllaceae	*Hydrophyllum virginianum*	Virginia waterleaf	2	2			
	Balsaminaceae	*Impatiens cf pallida*	pale jewelweed	+	1			
	Urticaceae	*Laportea canadensis*	wood nettle		2			Common in west unit, none in south
	Umbelliferae	*Osmorhiza claytonii*	sweet cicely		1			
	Verbenaceae	*Phryma leptostachya*	lopseed	+	+			
	Ranunculaceae	*Ranunculus abortivus*	small-flowered crowfoot		+			
	Papaveraceae	*Sanguinaria canadensis*	bloodroot	1	+			
	Apiaceae	*Sanicula gregaria*	black snakeroot	+	2			
	Liliaceae	*Smilacina racemosa*	false Solomon's seal	+				
	Asteraceae	*Solidago flexicaulis*	zigzag goldenrod	2	1			
	Ranunculaceae	*Thalictrum dioicum*	early meadowrue	+	+			
	Liliaceae	*Trillium flexipes*	drooping trillium		+			
	Liliaceae	*Trillium nivale*	snow trillium		+			
	Liliaceae	*Uvularia sessilifolia*	sessile bellwort	+	+			
	Violaceae	*Viola sp.*	violet		+			
	Bryophyte		moss	2				
	Graminoids							
	Cyperaceae	*Carex rosea*	Starry sedge		1			
	Cyperaceae	*Carex blanda*	Carex blanda		1			
	Cyperaceae	*Carex pensylvanica*	Pennsylvania sedge	1	2			
	Poaceae	*Leersia virginica*	whitegrass		1			
	Woody species							
	Aceraceae	*Acer negundo*	boxelder		+			
	Aceraceae	*Acer saccharum*	sugar maple	2	2			abundant
	Juglandaceae	*Carya cordiformes*	Bitternut hickory					
	Ulumaceae	*Celtis occidentalis*	Hackberry		+			
	Oleaceae	*Fraxinus pennsylvanica*	green ash	1				
	Roseaceae	*Prunus serotina*	black cherry		+			
	Fagaceae	*Quercus rubra*	Red oak		+			Very little regeneration
	Saxifragaceae	*Ribes cynosbati*	gooseberry		+			
	Tiliaceae	*Tilia americana*	American basswood	1	1			Common
	Anarcardiaceae	*Toxicodendron rydbergii*	poison ivy	+	+			
	Rutaceae	*Zanthoxylum americanum*	Prickly ash		+			
Understory 2-5 m			Cover 2-3					Fairly open understory overall.
	Aceraceae	*Acer saccharum*	sugar maple		+	5		
x	Berberidae	*Berberis vulgaris*	European barberry		+			1 plant located in west unit.
	Juglandaceae	*Carya cordiformes*	Bitternut hickory		+			
	Cornaceae	*Cornus alternifolia*	pagoda dogwood		1			
	Juglandaceae	*Juglans nigra*	Black walnut		+			
X	Caprifoliaceae	*Lonicera tartarica*	Tartarian honeysuckle		1			
X	Rhamnaceae	*Rhamnus cathartica*	common buckthorn		2	1, 10, 15		2" Diam on edges, small stems interior, dense or scattered. Very few in west unit.
	Tiliaceae	*Tilia americana*	American basswood		+			
	Rutaceae	*Zanthoxylum americana*	prickly ash		1			
Canopy and Subcanopy		**5-35 m height**	Cover = 4-5					Mostly closed canopy, some openings.
	Aceraceae	*Acer saccharum*	sugar maple	1	1	5, 25, 51, 61		Mostly subcanopy, a few large in canopy.
	Aceraceae	*Acer saccharinum*	silver maple		+	56	22	
	Betulaceae	*Betula papyrifera*	paper birch		+	10, 20	4, 8	
	Ulumaceae	*Celtis occidentalis*	Hackberry		1	15	6	
	Oleaceae	*Fraxinus pennsylvanica*	Green ash			15, 38	6, 15	
	Juglandaceae	*Juglans nigra*	Black walnut		1	20, 25	8, 10	Larger and more abund in west unit.
	Betulaceae	*Ostrya virginiana*	ironwood	1	+	15	6	Subcanopy
	Pinaceae	*Pinus banksiana*	jack pine		+	30	12	A few planted trees
	Pinaceae	*Pinus resinosa*	red pine		+	30	12	A few planted trees
	Pinaceae	*Pinus strobus*	white pine		+	56, 71	22, 28	A few planted trees
	Salicaceae	*Populus grandidentata*	big-toothed aspen		+	25		A few in west unit only
	Salicaceae	*Populus tremuloides*	quaking aspen		1	20, 36	8, 14	
	Fagaceae	*Quercus alba*	white oak	1	1	48, 76	19, 30	A few scattered or clustered large
	Fagaceae	*Quercus macrocarpa*	Bur oak	3	2	66,76	26,30	Dom in some areas
	Fagaceae	*Quercus rubra*	Red oak	3	3	45, 71, 152	18, 28, 60	Overall dominant
	Tiliaceae	*Tilia americana*	American basswood	1	2	20, 30	8, 12	
	Roseaceae	*Prunus serotina*	black cherry		+	36	14	Few

* Relative Cover Classes for individual species and vegetation layers: + (0-1%), 1 (1-5%), 2 (5-25%), 3 (25-50%), 4 (50-75%), 5 (75-100%)

Southern Terrace Forest (FFs59), TFW units

Woodland areas on the south side of Ravenna Trail, typically flooded for a short time in the spring.
Wood nettle dominates the ground cover, the tree canopy is dominated by cottonwood, green ash, black walnut.

non-Nat	Family	Scientific Name	Common Name	Cov*	Diam (cm)	Comments
	Ground layer to 2 m			**4**		
	Forbs, ferns and allies					
	Araceae	*Arisaema triphyllum*	Jack-in-the-pulpit	1		
	Aristolochiaceae	*Asarum canadense*	wild ginger	2		
	Asteraceae	*Bidens sp.*	bur marigold	1		
	Onagraceae	*Circaea leutetiana*	enchanter's nightshade	1		
	Geraniaceae	*Geranium maculatum*	wild geranium	2		
	Hydrophyllaceae	*Hydrophyllum virginianum*	Virginia waterleaf	3		abundant
	Balsaminaceae	*Impatiens capensis*	spotted jewelweed	2		
	Urticaceae	*Laportea canadensis*	wood nettle	4		dom
x	Lamiaceae	*Leonurus cardiaca*	motherwort	+		
	Lamiaceae	*Physostegia virginiana*	obedient plant	+		Japanese beetle eating.
	Urticaceae	*Pilea pumila*	clearweed	1		
	Asteraceae	*Rudbeckia laciniata*	Goldenglow	+		
	Papaveraceae	*Sanguinaria canadensis*	bloodroot	+		
	Apiaceae	*Sanicula gregaria*	black snakeroot	+		
	Solanaceae	*Solanum dulcamara*	bittersweet nightshade	+		
	Woody species					
	Aceraceae	*Acer negundo*	boxelder	+		
	Ulumaceae	*Celtis occidentalis*	Hackberry	+		
	Vitaceae	*Parthenocissus inserta*	Virginia creeper	+		
	Ulmaceae	*Ulmus americana*	American elm	+		
	Vitaceae	*Vitis riparia*	Wild grape vine	+		
	Understory 2-5 m			**1-2**		
	Aceraceae	*Acer saccharum*	sugar maple			
	Oleaceae	*Fraxinus pennsylvanica*	green ash			
	Juglandaceae	*Juglans nigra*	black walnut			
*	Rhamnaceae	*Rhamnus cathartica*	common buckthorn	2	1-5	Mostly west unit. Scattered 2" diam, abund 1/2" diam.
	Tiliaceae	*Tilia americana*	American basswood			
	Saxifragaceae	*Ribes sp*	currant			
	Canopy and Subcanopy 5-35 m height class			**4**		
	Aceraceae	*Acer saccharinum*	silver maple		68	On west- largest trees, multi-trunk
	Ulumaceae	*Celtis occidentalis*	Hackberry		13	
	Oleaceae	*Fraxinus pennsylvanica*	green ash	3	10-25	Subcanopy dominant
	Juglandaceae	*Juglans nigra*	black walnut	3		Dominant. Largest trees on East.
	Roseaceae	*Malus sp.*	Crab apple		24	One 50 ft tall, SE of 291 & 54. Not native??
	Salicaceae	*Populus deltoides*	cottonwood	3	60-100	
	Fagaceae	*Quercus rubra*	Red oak	1		
	Ulmaceae	*Ulmus americana*	American elm	1		

* Relative Cover Classes for individual species and vegetation layers: + (0-1%), 1 (1-5%), 2 (5-25%), 3 (25-50%), 4 (50-75%), 5 (75-100%).

Seasonally flooded altered/non-native dominated woodland and emergent vegetation

Intermixed woodland and emergent vegetation in the lowest areas on the south side of Ravenna Trail.
A good diversity but low abundance of native ground cover. Loosestrife dominates toward west. Buckthorn dominates shrub layer.

Native	Family	Scientific Name	Common Name	Cov*	Diam (cm)	Comments
	Ground layer to 2 m			**4**		
	Forbs, ferns and allies					
	Alismataceae	*Alisma subcordatum*	water plantain			Wetter areas
	Asteraceae	*Bidens sp.*	bur marigold			
	Urticaceae	*Boehmeria cylindrica*	False stinging nettle			
	Balsaminaceae	*Impatiens capensis*	spotted jewelweed	+		
	Iridaceae	*Iris versicolor*	Blue flag iris			
	Lemnaceae	*Lemna major*	Greater duckweed			Open water
x	Lythraceae	*Lythrum salicaria*	purple loosestrife			Dom at west end of west unit. Japanese beetles eating it.
	Lamiaceae	*Mentha arvensis*	Common mint			
	Urticaceae	*Pilea pumila*	clearweed			
	Polygonaceae	*Polygonum amphibium*	water smartweed			Wetter areas
	Alismataceae	*Sagittaria latifolia*	Broad-leaved arrowhead			
	Lamiaceae	*Scutellaria lateriflora*	Mad-dog skullcap			
	Graminoids					
*	Poaceae	*Phalaris arundinacea*	reed canary grass	2		
	Understory 2-5 m			**1-2**		
	Oleaceae	*Fraxinus pennsylvanica*	green ash	1		
*	Rhamnaceae	*Rhamnus cathartica*	common buckthorn	3		Dom
	Salicaceae	*Salix exigua*	Sandbar willow			
	Ulmaceae	*Ulmus americana*	American elm	1		
	Canopy and Subcanopy 5-35 m height class			**4**		
	Aceraceae	*Acer negundo*	boxelder			
	Aceraceae	*Acer saccharinum*	silver maple	2	22	multi-trunk
	Oleaceae	*Fraxinus pennsylvanica*	green ash	3	5-25	Dominant
	Salicaceae	*Populus deltoides*	cottonwood			
	Ulmaceae	*Ulmus americana*	American elm			

* Relative Cover Classes for individual species and vegetation layers: + (0-1%), 1 (1-5%), 2 (5-25%), 3 (25-50%), 4 (50-75%), 5 (75-100%).

Southern Floodplain Forest FFs68

Non-Native	Family	Scientific Name	Common Name	Cov*	Diam (cm)	Comments
	Ground layer to 2 m			**4**		**West unit coverage was 2, primarily reed canary**
	Forbs, ferns and allies					
	Balsaminaceae	*Impatiens sp*	jewelweed	+		
	Urticaceae	*Laportea canadensis*	wood nettle	4		
	Menispermaceae	*Menispermum canadense*	moonseed	+		
	Vitaceae	*Parthenocissus inserta*	Virginia creeper	+		
	Polygonaceae	*Polygonum amphibium*	water smartweed	1		
	Liliaceae	*Smilax tamnoides*	green briar	+		
	Anarcardiaceae	*Toxicodendron radicans*	poison ivy	+		
	Violaceae	*Viola sp.*	violet	+		
	Graminoids					
	Cyperaceae	*Carex sp.*	Sedge	+		
	Cyperaceae	*Carex lacustris*	lake sedge			
*	Poaceae	*Phalaris arundinacea*	reed canary grass	2		Especially west unit openings
	Typhaceae	*Typha latifolia*	broad-leaved cattail			
	Woody species					
	Aceraceae	*Acer saccharinum*	silver maple	1		East unit
	Ulmaceae	*Celtis occidentalis*	hackberry	+		East unit
	Oleaceae	*Fraxinus pennsylvanica*	green ash	1		East unit
	Fagaceae	*Quercus rubra*	red oak	1		East unit
*	Rhamnaceae	*Rhamnus cathartica*	common buckthorn	2		East unit
	Vitaceae	*Vitis riparia*	wild grape	2		
	Rutaceae	*Zanthoxylum americana*	prickly ash	+		East unit
	Understory 2-5 m			**1-2**		
	Aceraceae	*Acer negundo*	boxelder	1		
	Oleaceae	*Fraxinus pennsylvanica*	green ash	2		Dominant
*	Rhamnaceae	*Rhamnus cathartica*	common buckthorn	2		Primarily east unit
	Ulmaceae	*Ulmus americana*	American elm	1		
	Canopy and Subcanopy 5-35 m height class			**5**		
	Aceraceae	*Acer negundo*	boxelder	1	15, 25	East unit and edges
	Aceraceae	*Acer saccharinum*	silver maple	4	20, 36, 56	Canopy dom
	Juglandaceae	*Carya cordiformes*	bitternut hickory	+	5	East unit
	Ulmaceae	*Celtis occidentalis*	hackberry	1	10, 15, 20	East unit
	Oleaceae	*Fraxinus pennsylvanica*	green ash	3	20, 40	Subcanopy dom
	Juglandaceae	*Juglans nigra*	black walnut	1	5	East unit
	Ulmaceae	*Ulmus americana*	American elm	2	10, 25	East unit

Palustrine Open Water

Part of seasonally flooded woodland complex

Non-Native	Family	Scientific Name	Common Name
	Ground cover 0-2 m		
	Balsaminaceae	*Impatiens capensis*	spotted jewelweed
	Urticaceae	*Laportea canadensis*	wood nettle
	Lemnaceae	*Lemna spp*	duckweed species
*	Graminaceae	*Phalaris arundinacea*	reed canary grass
	Polygonaceae	*Polygonum amphibium*	water smartweed
	Understory 2-5 m		
*	Rhamnaceae	*Rhamnus cathartica*	common buckthorn
	Salicaceae	*Salix exigua*	Sandbar willow
	Canopy and Subcanopy 5-35 m height class		
	Aceraceae	*Acer negundo*	boxelder
	Aceraceae	*Acer saccharinum*	silver maple
	Oleaceae	*Fraxinus pennsylvanica*	green ash
	Salicaceae	*Populus deltoides*	cottonwood
	Ulmaceae	*Ulmus americana*	American elm

Emergent Marsh

Non-Native	Family	Scientific Name	Common Name	Cov*	Comments
	Ground layer to 2 m			2	
	Apocynaceae	*Apocynum cannabinum*	Indian hemp		upland edge
	Asclepiaceae	*Asclepias syriaca*	common milkweed		upland edge
	Lemnaceae	*Spirodela polyrhiza*	Greater duckweed		floating
x	Lythraceae	*Lythrum salicaria*	purple loosestrife	2	Dom forb
x	Graminaceae	*Phalaris arundinacea*	reed canary grass	2	
	Polygonaceae	*Polygonum amphibium*	water smartweed		
	Alismataceae	*Sagittaria latifolia*	Broad-leaved arrowhead		edges
	Cyperaceae	*Schoenoplectus fluviatilis*	river bulrush		
	Typhaceae	*Typha latifolia*	broad-leaved cattail		
	Understory 2-5 m			**2**	
	Aceraceae	*Acer negundo*	boxelder		Upland edge
	Aceraceae	*Acer saccharinum*	silver maple		Edge
	Oleaceae	*Fraxinus pennsylvanica*	green ash		Edge
	Roseaceae	*Rosa cf blanda*	smooth rose		upland edge
	Salicaceae	*Salix exigua*	Sandbar willow	2	Dominant
	Vitaceae	*Vitis riparia*	wild grape		Edge
	Canopy 5-10 m height class			**1**	
	Oleaceae	*Fraxinus pennsylvanica*	green ash	+	Edge
	Salicaceae	*Salix nigra*		+	Edge

Roadsides along Hwy 54

A variety of mowed grasses and forb with shrubsand small trees between the mowed vegetation and the native plant communities. Most herbaceous species were not recorded.

Non-Native	Family	Scientific Name	Common Name	Cov*	Comments
	Ground layer to 2 m			3	
x	Caryophyllaceae	*Saponaria officinalis*	soapwort		
*	Asteraceae	*Taraxacum officinale*	dandelion		
	Mixed				Mowed grasses and forbs
	Understory 2-5 m			**3**	
	Aceraceae	*Acer negundo*	boxelder		
	Aceraceae	*Acer saccharinum*	silver maple		
*	Moraceae	*Morus rubra*	red mulberry		Few
*	Rhamnaceae	*Rhamnus cathartica*	common buckthorn		Few, scattered, large
	Anarcardiaceae	*Rhus glabra*	smooth sumac		
	Caprifoliaceae	*Viburnum trilobum*	highbush cranberry		
	Vitaceae	*Vitis riparia*	wild grape		

* Relative Cover Classes for individual species and vegetation layers: + (0-1%), 1 (1-5%), 2 (5-25%), 3 (25-50%), 4 (50-75%), 5 (75-100%).

Breeding Bird Survey

Survey methods

A point-count method was used to survey the breeding bird population, based on protocols and methods used by the DNR County Biological Survey. Although this site is really too small for adequate point sampling, points were nevertheless established with 250 m spacing, as much as possible within one contiguous habitat type, and away from roads and other edges (Map B). The points were surveyed on June 14 and July 5, 2011 using a 5-minute, 50-meter radius as the basis, and expanded to include species detected outside the 50 meters and up to 8 minutes. Points 2, and 3 were flooded for the first survey date and point 2 was flooded the second survey date, so these points were not surveyed.

Breeding Bird Survey 2011
Hastings SNA

Point counts - 5 points, 50 m radius, 250 m between pts
Species of Greatest Conservation Need (Minnesota Department of Natural Resources) are highlighted.

6/14/11
5 minute surveys only
Points 2 & 3 were flooded (not surveyed)
Surveyor: Karen Schik
Noise: Traffic, train, plane

7/5/11
Point 2 was flooded (not surveyed).
Surveyor: Karen Schik
Noise: Traffic, train, plane

	Scientific name	Common name	Code	5 minute, < 50 m				5 min >50 m					5 minute, < 50 m					5 min >50 m					Addl 3 min, < 50 m					Addl 3 min, > 50 m						
				1	4	5	Sub Ttl	1	4	5	Sub Ttl	TTL 6/14	1	3	4	5	Sub Ttl	1	3	4	5	Sub Ttl	1	3	4	5	Sub Ttl	1	3	4	5	Sub Ttl	TTL 7/5	TOTAL ALL DATES
1	*Corvus brachyrhynchos*	American Crow	AMCR								0	0								1	1	2										2	2
2	*Carduelis tristis*	American Goldfinch	AMGO	2			2				0	2	2				2														1	1	3	5
3	*Setophaga ruticilla*	American Redstart	AMRE	1			1				0	1		2			2																2	3
4	*Turdus migratorius*	American Robin	AMRO	2			2				0	2		1		1	2																2	4
5	*Parus atricapillus*	Black-capped Chickadee	BCCH								0	0		2			2				1	1											3	3
6	*Polioptila caerulea*	Blue-gray Gnatcatcher	BGGN	1			1				0	1		1			1						1				1						2	3
7	*Molothrus ater*	Brown-headed Cowbird	BHCO					1			1	1																					0	1
8	*Bombycilla cedrorum*	Cedar Waxwing	CEWA	1			1				0	1																					0	1
9	*Hirundo pyrrhonota*	Cliff Swallow	CLSW					12			12	12																					0	12
10	*Geothlypis trichas*	Common Yellowthroat	COYE	1			1	1			1	2																					0	2
11	*Picoides pubescens*	Downy Woodpecker	DOWO	2			2				0	2				1	1																1	3
12	*Sayornis phoebe*	Eastern Phoebe	EAPH								0	0						1				1											1	1
13	*Contopus virens*	Eastern wood pewee	EWPE		1		1		1	1	2	3	1				1				1	1							1			1	3	6
14	*Myiarchus crinitus*	Great-crested Flycatcher	GCFL					1			1	1																					0	1
15	*Troglodytes aedon*	House Wren	HOWR								0	0								1		1											1	1
16	*Passerina cyanea*	Indigo Bunting	INBU								0	0						1				1											1	1
17	*Empidonax minimus*	Least Flycatcher	LEFL							1	1	1																					0	1
18	*Anas platyrhynchos*	Mallard	MALL								0	0	1				1																1	1
19	*Colaptes auratus*	Northern Flicker	NOFL							1	1	1							1		1	2											2	3
20	*Melanerpes carolinus*	Red-bellied woodpecker	RBWO			2	2				0	2	1				1																1	3
21	*Vireo olivaceus*	Red-eyed Vireo	REVI		1	1	2			1	1	3								1		1											1	4
22	*Agelaius phoeniceus*	Red-winged Blackbird	RWBL								0	0						1				1											1	1
23	*Melospiza melodia*	Song Sparrow	SOSP								0	0		1			1																1	1
24	*Vireo gilvus*	Warbling vireo	WAVI								0	0		1			1	1				1											2	2
25	*Sitta carolinensis*	White-breasted Nuthatch	WBNU		1		1				0	1																					0	1
26	*Aix sponsa*	Wood duck	WODU					1			1	1																					0	1
27	*Dendroica petechia*	Yellow Warbler	YEWA	1			1				0	1		1			1						1				1						2	3
		TOTAL Number birds		11	3	3	17	16	1	4	21	38	5	9		2	16	4	1	3	4	12	2						1		1	2	32	70
		TOTAL Number species		8	3	2	12	5	1	4	9	18	4	7	0	2	12	4	1	3	4	10	2	0	0	0	2	0	1	0	1	2	19	27

Results and analysis

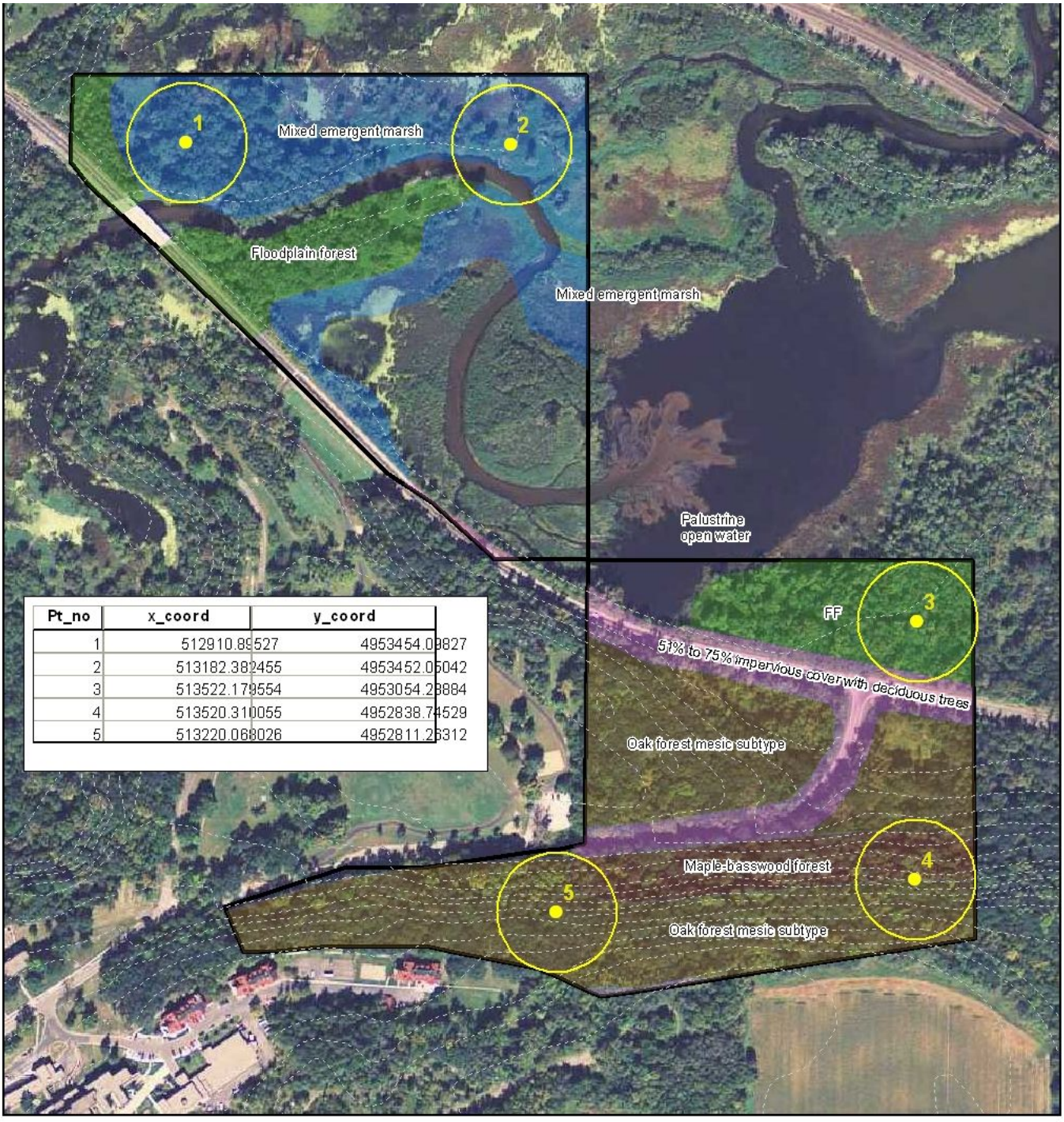
This is a challenging site to gather meaningful data from because it is small, oddly-shaped, has varied natural communities, and is sound-impaired by roads, railroads and airplane routes. Only a few survey points are possible (to meet the 250 m distance protocol) and some span multiple plant communities. A simple walk-through survey may be a better way to get a more complete list of the species, if not the number of individuals. Traveling during a walk may enable better detection in different areas away from

roads.

A total of 27 species were recorded during two visits. Two species – eastern wood pewee and least flycatcher – are species of greatest conservation need. Otherwise they were all fairly common species, many of them generalists. This is not surprising, as the site is essentially edge habitat. The 2011 record is significantly less than the 1979 inventory, which found 65 species. Three reasons why the 1979 survey results are higher may be the timing and frequency of the surveys and the number of survey points. The 1979 survey included dates in May, which would have included numerous migrant species. At least 20 of the species recorded are not known to breed in this area. That would leave the total number of breeding bird species at or near 45, which is still significantly higher than the 2011 record. The 1979 survey had a greater frequency of counts (weekly) and more survey points (nine versus 5 in 2011). None of the 1979 species were unusual, although two are now on the SGCN list (rose-breasted grosbeak and wood thrush).

The 1979 survey used 50-m point counts, but there were nine points rather than five, so the points were closer together than today's standard. Unfortunately, the locations of the point counts were not recorded in the report.

Map B. Breeding bird survey points at Hastings SNA, 2011.



Pt_no	x_coord	y_coord
1	512910.89527	4953454.09827
2	513182.382455	4953452.05042
3	513522.179554	4953054.23884
4	513520.310055	4952838.74529
5	513220.068026	4952811.26312

Sources: LMIC 2010 aerial. DNR data deli: contours, ecological data.

1 cm = 45 meters

N

1:4,500

0 125 250 Meters

Bird Pts-250m apart

BirdPt-50mbuffer

Hastings SNA - 62 ac

Plant Species for Restoration

For each of the plant communities at the Hastings SNA where enhancing the native plant diversity may be desired, below are lists of species that may be suitable for planting. Species in gray font are those that belong in the community, but likely should not be planted due to disease factors, or because they are common, early-successional species that tend to be overly abundant in the landscape. Lists were obtained from *Species Lists for Terrestrial and Palustrine Native Plant Communities in East-central Minnesota* (DNR 2004), and from *Field Guide to the Native Plant Communities of Minnesota: The Eastern Broadleaf Forest Province* (DNR 2005)

Northern Wet Meadow/Carr Species WMn82

Genus	Species	Common Name	Freq %
Shrubs			
Alnus	*incana*	Speckled alder	24
Betula	*pumila*	Bog-birch	14
Cornus	*sericea*	Red-osier dogwood	24
Salix	*bebbiana*	Bebb's willow	20
Salix	*discolor*	Pussy willow	29
Salix	*petiolaris*	Slender willow	42
Spiraea	*alba*	Meadowsweet	23
Forbs, ferns and fern allies			
Acorus	*calamus*	Sweet flag	11
Asclepias	*incarnata*	Swamp milkweed	22
Aster	*borealis*	Bog aster	12
Aster	*puniceus*	Red-stemmed aster	19
Bidens	*spp.*	Beggar-ticks	21
Caltha	*palustris*	Swamp marsh-marigold	17
Campanula	*aparinoides*	Marsh bellflower	58
Cicuta	*bulbifera*	Bulb-bearing water-hemlock	46
Dryopteris	*cristata*	crested fern	24
Epilobium	sp	Willow-herb	44
Eupatorium	*maculatum*	Spotted Joe-pye weed	34
Eupatorium	*perfoliatum*	Common boneset	11
Galium	*trifidum*	Three-cleft bedstraw	46
Impatiens	*spp.*	Touch-me-not	39
Iris	*versicolor*	Northern blue Flag	22
Lathyrus	*palustris*	Marsh vetchling	17
Lycopus	*americanus*	Cut-leaved bugleweed	17
Lycopus	*uniflorus*	Northern bugleweed	45
Lysimachia	*thyrsiflora*	Tufted loosestrife	59
Mentha	*arvensis*	Common mint	19
Onoclea	*sensibilis*	Sensitive fern	20
Polygonum	*amphibium*	Water smartweed	42
Polygonum	*sagittatum*	Arrow-leaved tearthumb	28
Potentilla	*palustris*	Marsh cinquefoil	38
Rubus	*pubescens*	Dwarf raspberry	11
Rumex	*orbiculatus*	Great water dock	52
Sagittaria	*latifolia*	Broad-leaved arrowhead	22
Scutellaria	*galericulata*	Marsh skullcap	53
Scutellaria	*lateriflora*	Mad-dog skullcap	12
Thelypteris	*palustris*	Northern marsh-fern	40
Triadenum	*fraseri*	Marsh St. John's wort	23
Viola	sp	Big-leaf violet	12
Grasses, Rushes and Sedges			
Calamagrostis	*canadensis*	Bluejoint	80
Carex	*aquatilis*	Water sedge	11
Carex	*lacustris*	Lake-sedge	72
Carex	*lasiocarpa*	Wire-sedge	29
Carex	*stricta*	Tusssock-sedge	41
Carex	*utriculata*	Beaked sedge	33
Scirpus	*cyperinus*	Wool-grass	22

3Frequency: Number of releve plots in which species occurs divided by total number of releve plots, multiplied by 100
4Abundance: Average percent cover of species within the community. It is most appropriate to interpret each value as a cover class similar to those used for original data collection
5Index of Commonness: Frequency multiplied by Abundance

Southern Terrace Forest Species FFs59

Genus	Species	Common Name	[3]Fr	[4]Ab	[5]In
Trees					
Acer	*negundo*	Box elder	71	5	355
Acer	*saccharinum*	Silver maple	86	22	1892
Acer	*saccharum*	Sugar maple	14	15	210
Carya	*cordiformis*	Bitternut hickory	14	1	14
Celtis	*occidentalis*	Hackberry	14	38	532
Fraxinus	*nigra*	Black ash	43	43	1849
Fraxinus	*pennsylvanica*	Green ash	29	10	290
Ostrya	*virginiana*	Ironwood	14	38	532
Populus	*deltoides*	Cottonwood	57	15	855
Salix	*nigra*	Black willow	29	20	580
Tilia	*americana*	Basswood	14	1	14
Ulmus	*americana*	American elm	57	6	342
Ulmus	*rubra*	Slippery elm	29	3	87
Shrubs					
Cornus	*amomum*	Silky dogwood	14	1	14
Euonymus	*atropurpureus*	Wahoo	29	3	87
Prunus	*virginiana*	Chokecherry	43	8	344
Ribes	*missouriense*	Missouri gooseberry	43	4	172
Ribes	*americanum*	Wild black currant	29	5	145
Ribes	*cynosbati*	Prickly gooseberry	14	3	42
Sambucus	*canadensis*	Common elder	57	3	171
Sambucus	*racemosa*	Red-berried elder	29	2	58
Viburnum	*lentago*	Nannyberry	14	3	42
Forbs, ferns and fern allies					
Allium	*tricoccum*	Wild leek	29	3	87
Anemone	*quinquefolia*	Wood-anemone	14	3	42
Arisaema	*triphyllum*	Jack-in-the-pulpit	71	3	213
Aster	*ontarionis*	Ontario aster	14	3	42
Aster	*cordifolius*	Heart-leaved aster	14	1	14
Aster	*pubentior*	Flat-topped aster	14	15	210
Boehmeria	*cylindrica*	False nettle	14	3	42
Campanula	*americana*	Tall bellflower	14	3	42
Caulophyllum	*thalictroides*	Blue cohosh	14	3	42
Cryptotaenia	*canadensis*	Honewort	57	4	228
Dicentra	*cucullaria*	Dutchman's-breeches	14	5	70
Enemion	*biternatum*	False rue-anemone	14	5	70
Erythronium	*albidum*	White trout-lily	14	5	70
Galium	*triflorum*	Three-flowered bedstraw	14	3	42
Geranium	*maculatum*	Wild geranium	29	3	87
Geum	*canadense*	White avens	29	4	116
Hackelia	spp.	Stickseed	14	3	42
Hydrophyllum	*virginianum*	Virginia waterleaf	71	18	1278
Impatiens	spp.	Touch-me-not	71	15	1065
Lilium	*michiganense*	Michigan lily	14	3	42
Maianthemum	*canadense*	Canada mayflower	14	3	42
Matteuccia	*struthiopteris*	Ostrich-fern	29	9	261
Osmorhiza	*claytonii*	Clayton's sweet cicely	14	3	42
Phlox	*divaricata*	Blue phlox	14	5	70
Pilea	spp.	Clearweed	29	9	261
Polygonatum	*biflorum*	Giant Solomon's-seal	14	3	42
Ranunculus	*abortivus*	Kidney-leaf buttercup	29	3	87
Rudbeckia	*laciniata*	Goldenglow	57	4	228
Sanguinaria	*canadensis*	Bloodroot	14	3	42
Sanicula	*gregaria*	Gregarious black snakeroot	14	15	210
Smilacina	*racemosa*	Racemose false Solomon's-seal	29	3	87
Smilacina	*stellata*	Starry false Solomon's seal	14	5	70
Smilax	cmx.	Carrion-flower	57	3	171
Stachys	*palustris*	Woundwort	14	1	14
Thalictrum	*dioicum*	Early meadow-rue	29	3	87
Thalictrum	*dasycarpum*	Tall meadow-rue	14	3	42
Trillium	*cernuum*	Nodding trillium	14	5	70
Trillium	*flexipes*	Drooping trillium	14	1	14
Urtica	*dioica*	Stinging nettle	43	4	172
Uvularia	*grandiflora*	Yellow bellwort	14	3	42
Viola	spp	Violet	29	4	116
Grasses, Rushes and Sedges					
Calamagrostis	*canadensis*	Bluejoint	14	3	42
Carex	*amphibola*	Ambiguous sedge	14	3	42
Carex	*pedunculata*	Long-stalked sedge	14	15	210
Carex	*sprengelii*	Sprengel's sedge	14	15	210
Carex	*radiata*	Stellate sedge	14	5	70
Cinna	*arundinacea*	Stout woodreed	14	3	42
Elymus	*hystrix*	Bottlebrush grass	14	3	42
Elymus	*virginicus*	Virginia wild rye	14	3	42
Elymus	*wiegandii*	Canada wild rye	14	3	42
Glyceria	*striata*	Fowl manna-grass	14	3	42

3Frequency: Number of releve plots in which species occurs divided by total number of releve plots, multiplied by 100
4Abundance: Average percent cover of species within the community. It is most appropriate to interpret each value as a cover class similar to those used for original data collection
5Index of Commonness: Frequency multiplied by Abundance

Methods for Controlling Invasive Plant Species

Methodologies for control of select species are provided below, including least toxic methods for herbicide use. However, for all exotic species management at the SNA, herbicide will be used only with prior approval from SNA staff, typically in areas that have had prior disturbance and are dominated by non-native species.

Trees and Shrubs

Common Buckthorn, Tartarian Honeysuckle, Siberian Elm, and Black Locust are some of the most common woody species likely to invade native woodlands or prairies in Minnesota. Buckthorn and honeysuckle are European species that escaped urban landscapes and invaded woodlands in many parts of the country. They are exceedingly aggressive and, lacking natural disease and predators, can out-compete native species. Invasions result in a dense, impenetrable brush thicket that reduces native species diversity.

Siberian elm, native to eastern Asia, readily grows, 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, and readily invades disturbed areas. It reproduces vigorously by root suckering and can form a monotypic stand.

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 much greater removal difficulty.

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 can help to make treated stumps more visible. 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. Do not use diesel fuel, as it is much more toxic in the environment and for humans. Herbicide should only be used in distubance area,

Brush removal work can be done at any time of year except during spring sapflow, but late fall is often ideal because buckthorn retains its leaves longer than other species and is more readily identified. 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. For Scotch pine, red cedar and all other conifers, removal consists of simply cutting the tree and disposing of it. No herbicide is needed as conifers do not resprout.

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.

Basal bark herbicide treatment is another effective control method. A triclopyr herbicide such as 10% Garlon 4, mixed with a penetrating oil, is applied all around the base 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.

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.

Mechanical Control Three mechanical methods for woody plant removal are *hand-pulling* (only useful on 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 cutting*. Pulling and weed-wrenching can be done any time when the soil is moist and not frozen. In both cases the soil must be shaken off the stems after removal. The disadvantage to both methods is that they are very slow and labor intensive, and create a great deal of soil disturbance, especially weed wrenches. They should not be used on steep slopes or anywhere that desirable native forbs are growing. The soil disturbance also creates opportunities for weed germination. This method is probably best used in areas that have very little cover of desirable native plants or where the invasive shrubs are not very abundant and are fairly small.
Repeated cutting consists of cutting the plants (by hand or with a brush cutter) at critical stages in its growth cycle. Cutting in mid spring (late May) intercepts the flow of nutrients from the roots to the leaves. 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 may die within three years, with two cuttings per year. This method is also very labor intensive and costly and depends on a very consistent effort. The success rate varies depending on the size of the plant.

Stems, Seedlings and Resprouts In the year following initial cutting and stump treatment, there will be a flush of new seedlings as well as resprouting from some of the cut plants. Prescribed burning is the most efficient, cost effective, and least harmful way to control very small seedlings 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 site conditions. Disadvantages to burning are that fire coverage is inconsistent over the site and there will be areas that are missed. Fires are typically “cool” in order to be conducted safely, so that even very small stems sometimes survive and resprout. Burning alone may reduce saplings plants, but only if burns are repeated annually for several consecutive years (which will likely also reduce native shrubs). Even then, the level of control is only moderate. Burning is best combined with chemical treatment for greatest effectiveness.
Fire will not likely be feasible (or desireable) at Hastings SNA. An alternative may be cutting new seedlings (e.g. with a brush-cutter), if doing so would not eliminate desirable plants. Hand-pulling may be a good option for small stands of very small plants or in sensitive areas (e.g. near rare species), but should be avoided on slopes or used with caution.
Foliar application of herbicide may be considered for highly disturbed areas (in consultation with SNA staff). 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. Roundup (glyphosate), Garlon (triclopyr), are the most commonly used herbicides for foliar application. Glyphoste is non-specific and will kill anything green, while triclopyr targets broadleaf plants and does not harm graminoids. Extreme caution with Garlon should be used, because the surfactants added that allow it to penetrate bark also seep into the soil and kill many plants within a radius of the treated plant. Aquatic formula herbicides should be used in all lowland areas