**M.L. 2016 Project Abstract**
For the Period Ending June 30, 2019

**PROJECT TITLE:** Bluffland Restoration and Monitoring in Winona
**PROJECT MANAGER:** Neal Mundahl
**AFFILIATION:** Department of Biology, Winona State University
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**WEBSITE:** https://www.winona.edu/outdoored/arboretum.asp
**FUNDING SOURCE:** Environment and Natural Resources Trust Fund
**LEGAL CITATION:** M.L. 2016, Chp. 186, Sec. 2, Subd. 08h

**APPROPRIATION AMOUNT: $99,000**
**AMOUNT SPENT: $92,189**
**AMOUNT REMAINING: $ 6,811**

**Sound bite of Project Outcomes and Results**

The 40 acres of dry bluff prairies, bur oak savannahs, and mixed oak-basswood forests within Garvin Heights Natural Area were restored by removing invasive plants (MN Conservation Corps, goat grazing), replanted with native species, monitored to assess recovery, enhanced with signage for visitors, and demonstrated with workshops for regional stakeholders.

**Overall Project Outcome and Results**

A 40-acre bluffland park in Winona, MN, containing rare dry bluff prairies and bur oak savannahs adjacent to a heavily visited (40,000+ visitors annually) overlook, became overrun with invasive buckthorn and honeysuckle. This project planned to restore the native plant community by 1) surveying the existing plant community, 2) removing invasive plants, 3) planting and seeding native plants, 4) conducting workshops on invasive plant management for the public, and 5) surveying the recovering plant community. Pre-restoration plant surveys indicated low numbers of native plant species. Cutting, treating, and burning by the MN Conservation Corps and browsing by goats (five separate periods over 3 years) were used to help reduce and manage the invasive plants. Native plants were planted and seeded to restore the natural community. During restoration, two public workshops were held to educate area citizens on methods for managing invasive plants on their own lands and restoring native plant communities. Recent plant surveys have documented the presence of 181 species at the site to date, with 127 of those not present before restoration. A large, reproducing population (>600 plants) of a state threatened species, Great Indian Plantain, has developed after buckthorn removal from one area of a savannah. A Winona State University (WSU) graduate student completed a thesis focused on the restoration effort and the workshops, developing a basic management plan for the site moving forward. Restoration efforts will continue, with ongoing management of buckthorn emerging from the seedbank and the germination and spread of newly planted native species. WSU has funded a new graduate assistantship (tuition plus stipend) to continue the restoration and monitoring work at the site. This project, along with new educational signage for the site, will demonstrate to the public the methods and benefits of managing invasive plants on natural habitats.

**Project Results Use and Dissemination**

1. Throughout the project period, various information about the project was posted on the project web site maintained by Winona State University (https://www.winona.edu/outdoored/garvin.asp ), on a project-specific Facebook page (https://www.facebook.com/Garvin-Heights-Natural-Area-Blufflands-Restoration-Project-357534101286304/ ), and on the Winona State Biology Department Facebook page (https://www.facebook.com/biologyWSU/ ). The community was informed of upcoming workshop opportunities via hard-copy postings within the community, targeted mailing, Facebook postings, group

email lists, newspaper notifications, and a radio broadcast. Workshops, community presentations, on-site signage, and presentations at regional science meetings further served to present the project and its findings to the public.

2. Prior to site restoration, plant surveys on-site were used to produce a list of species present. In addition, a list species in the WSU herbarium collected from Garvin Heights was generated. (spreadsheets included via email)
3. Presentations about the project and its results were given by the PI (Winona Master Gardeners, Mississippi River Research Consortium) and by several undergraduate students (WSU Ramaley Undergraduate Research Celebration).
4. Graduate student Ryan Walsh recently completed his thesis (Walsh, R. 2019. Garvin Heights Restoration Project. Professional Science Masters Thesis, Winona State University, Winona, MN. 56 p.) that focused on the Garvin Heights project in general, the first workshop, and the effects of goat browsing on buckthorn. Included in his thesis are a series of recommendations for future management at the project site that will form the basis for a future management plan. In the near future, we plan to develop a manuscript from his thesis, on the effects of goat browsing, for submission to a peer-reviewed scientific journal. (thesis included via email)
5. Graduate student Tamberlain Jacobs is creating an up-to-date plant inventory list for the project site. She also is developing a bloom calendar for the site, which will allow visitors to determine what plants may be in bloom at various times of the year. (spreadsheets included via email)

# Environment and Natural Resources Trust Fund (ENRTF)
# M.L. 2016 Work Plan Final Report

**Date of Report:** August 15, 2019

**Final Report**

**Date of Work Plan Approval:** June 7, 2016

**Project Completion Date:** June 30, 2019

**PROJECT TITLE: Bluffland Restoration and Monitoring in Winona**


**Project Manager:** Neal Mundahl

**Organization:** Department of Biology, Winona State University

**Mailing Address:** 175 West Mark St.

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**Location:** Winona, Wabasha, Olmsted, Fillmore, Houston, Goodhue

| **Total ENRTF Project Budget:** | | |
|---|---|---|
| | **ENRTF Appropriation:** | **$99,000** |
| | **Amount Spent:** | **$92,189** |
| | **Balance:** | **$ 6,811** |

**Legal Citation:** M.L. 2016, Chp. 186, Sec. 2, Subd. 08h

**Appropriation Language:**

$99,000 the second year is from the trust fund to the Board of Trustees of the Minnesota State Colleges and Universities system for Winona State University to inventory, restore, and monitor the 40-acre Garvin Heights Natural Area in Winona and provide related public outreach and education. Plant and seed materials must follow the Board of Water and Soil Resources' native vegetation establishment and enhancement guidelines. This appropriation is available until June 30, 2019, by which time the project must be completed and final products delivered.

**I. PROJECT TITLE: Restoration/Monitoring of Winona's 40-acre Blufflands Natural Area**

**II. PROJECT STATEMENT:**

The 40 acres of dry bluff prairie, bur oak savannah, and bordering oak-basswood forest within Garvin Heights Natural Area will be restored by removing invasive plants (via goat grazing and MN Conservation Corps) and replanting with native species, monitored to assess ecological recovery, enhanced with new and expanded environmental education signage for site visitors, and explained and demonstrated with hands-on workshops for regional landowners and other stakeholders.

*This restoration site is of special significance because:*

- It contains a mix of dry bluff prairies and bur oak savannahs, ecosystems becoming increasingly rare throughout southeastern Minnesota and the greater Driftless Area Ecoregion.
- It is an accessible, high-visibility location, situated in a City park that attracts 40,000 to 50,000 residents and visitors annually during all seasons.
- It can serve as a model for invasive species management and habitat restoration to a large public audience and provide opportunities for landowner education.
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*This project is unique because:*

- Under faculty mentorship, undergraduate and graduate students will delineate habitats and collect pre- and post-restoration community data to assess the success of the restoration effort.
- The project will blend innovative (goat grazing) and conventional invasive plant control (with significant public volunteer effort: Friends of the WSU Landscape Arboretum) in a highly visible, public location, allowing the public to observe and experience the entire process.
- It will educate regional landowners and others about invasive plant management via workshops, using the project site as the model and nearby sites for experiential learning/application of techniques.

**III. OVERALL PROJECT STATUS UPDATES:**

**Project Status as of January 1, 2017:** *Prior to the beginning of the project period, the Conservation Corps of MN and IA used the project site to train new crew members in chain saw use and safety. As a result, buckthorn and honeysuckle were removed from 0.5 hectare of bur oak savannah. After July 1, major habitat types were delineated via GPS. Plant lists were generated for 1) species currently present on savannah and prairie sites, 2) species seeded on site during various efforts since 2002, and 3) species from the site currently preserved in the Winona State University herbarium. Remaining standing trees in the cleared savannah were identified and measured, and canopy coverage was determined. A herd of 35 goats browsed on buckthorn and honeysuckle for 21 days during fall, eating leaves, shoots, and bark. Informational signage was designed and installed on-site to provide the public with information about the project. A press release to regional news outlets, and interview and photos in a local newspaper, and a presentation to the Winona County Master Gardeners provided additional information to the public. An informational web site is being developed for project postings and updates.*

**Project Status as of July 1, 2017**: *The Conservation Corps of MN and IA worked at the project site two times during 2017: in January to burn buckthorn brushpiles on the savannah (cut the previous winter), and in May to perform a prescribed burn on savannah and prairie sites. A herd of 70 goats browsed on buckthorn and honeysuckle for 23 days in June. An informational web site was established by Winona State University personnel (https://www.winona.edu/outdoored/garvin.asp). The web site now includes photos and updates on the project. Additionally, a Facebook page was created for the project for more rapid communication and posting of project activity photos. Project personnel met with ecological consultants to discuss and plan for upcoming community workshops dealing with invasive species control.*

**Project Status as of January 1, 2018**: *During 19 days in October, a herd of 60 goats browsed on buckthorn and honeysuckle in savannah and prairie habitats. On July 5, a local newspaper featured the earlier, summer goat browsing with a front-page photo and article that included an interview with the goats' owner. During the fall, two Winona State University biology majors conducted a small mammal survey on the savannah and prairie restoration site. Conservation Corps personnel were unable to perform additional clearing of buckthorn because they were called away to work on hurricane relief in Texas.*

**Project Status as of July 1, 2018**: *The Conservation Corps of MN and IA returned to Garvin Heights in April to cut and chemically treat buckthorn on the north savannah between the two bluff prairies, where goats had not been willing to penetrate the dense stand of young buckthorn. A herd of 40 goats browsed on buckthorn and honeysuckle in savannah and prairie habitats during three weeks in June. On June 9, Winona State University hosted a 1-day workshop on management of invasive plant species, with a field trip to the Garvin Heights project site.*

**Project Status as of January 1, 2019**: *The Conservation Corps of MN and IA used propane torches to kill seedling buckthorn and honeysuckle on the south savannah. The crew also cut and piled some dead trees on the savannah for later burning. Plant surveys on cleared savannahs found a large population of Great Indian Plantain, but few other natives. During late fall, the south savannah was seeded with a mix specifically designed for the site.*

**Overall Project Outcomes and Results:** *A 40-acre bluffland park in Winona, MN, containing rare dry bluff prairies and bur oak savannahs adjacent to a heavily visited (40,000+ visitors annually) overlook, became overrun with invasive buckthorn and honeysuckle. This project planned to restore the native plant community by 1) surveying the existing plant community, 2) removing invasive plants, 3) planting and seeding native plants, 4) conducting workshops on invasive plant management for the public, and 5) surveying the recovering plant community. Pre-restoration plant surveys indicated low numbers of native plant species. Cutting, treating, and burning by the MN Conservation Corps and browsing by goats (five separate periods over 3 years) were used to help reduce and manage the invasive plants. Native plants were planted and seeded to restore the natural community. During restoration, two public workshops were held to educate area citizens on methods for managing invasive plants on their own lands and restoring native plant communities. Recent plant surveys have documented the presence of 181 species at the site to date, with 127 of those not present before restoration. A large, reproducing population (>600 plants) of a state threatened species, Great Indian Plantain, has developed after buckthorn removal from one area of a savannah. A Winona State University (WSU) graduate student completed a thesis focused on the restoration effort and the workshops, developing a basic management plan for the site moving forward. Restoration efforts will continue, with ongoing management of buckthorn emerging from the seedbank and the germination and spread of newly planted native species. WSU has funded a new graduate assistantship (tuition plus stipend) to continue the restoration and monitoring work at the site. This project, along with new educational signage for the site, will demonstrate to the public the methods and benefits of managing invasive plants on natural habitats.*

## IV. PROJECT ACTIVITIES AND OUTCOMES:

### ACTIVITY 1: Habitat delineation via GPS/GIS, pre- and post-restoration inventory and monitoring of invasive, native, and rare/indicator species, and educational signage development and placement

**Description:** Dry bluff prairies, bur oak savannahs, and oak-basswood woodlands will be delineated and mapped (GPS/GIS) throughout the project site. The project site includes three separate dry bluff prairies, two separate bur oak savannahs, and oak-basswood forests on east-facing, west-facing, and north-facing slopes. Habitats will

be delineated and mapped to document the locations and acreages of each habitat type within the project site, producing a digital GIS database that will be used to guide the current project and future management efforts.

All habitats will be monitored to inventory existing plant communities prior to and after restoration and to determine the abundance of rare, threatened, and/or indicator species (plants, birds, pollinators), to assess the success of the restoration. Local herbarium and county biological survey records also will be used to document past flora and fauna within the project site. Plot, transect, and random stratified sampling will be used to assess plant communities, point counts will be used to document breeding bird populations, and a combination of active netting, light traps, and pit traps will be employed to survey the abundances or pollinators and other invertebrates.

New and expanded educational signage will be developed and installed within each habitat. Existing signage is limited to historical photographs and general information and photographs describing invasive species, prairies, and savannahs, all in a single location. New, habitat-specific signage will be developed and placed in each habitat type to highlight the restoration process and flora and fauna within the various habitats. Signage will emphasize the roles of the CC of MN and goat grazing in the restoration process. Temporary signage will be developed and placed during various stages of the project to keep the general public informed of ongoing activities.

**Summary Budget Information for Activity 1:**

**ENRTF Budget: $ 46,984**
**Amount Spent: $ 44,667**
**Balance: $ 2,317**

| Outcome | Completion Date |
|---|---|
| **1.** Habitat delineation via GPS/GIS | May 31, 2017 |
| **2.** Pre-restoration inventory of existing plant communities | May 31, 2017 |
| **3.** Pre-restoration assessments of rare, threatened, and/or indicator species | May 31, 2017 |
| **4.** Post-restoration inventories of recovering plant communities | June 30, 2019 |
| **5.** Post-restoration assessments of restored rare, threatened, and/or indicator species | June 30, 2019 |
| **6.** Development and placement of educational signage | June 30, 2019 |

**Activity Status as of January 1, 2017:** *We began the process of delineating the various habitats within the project area. We used a GPS unit to mark the approximate boundaries of bur oak savannah, dry bluff prairie, and mixed oak/hickory/basswood/maple woodland. Our GPS unit produced files that have proven difficult to transfer and incorporate as a layer in GIS, so we will be repeating the process with a different system.*

*We have conducted some initial surveys of the plant communities at the project site, specifically within savannah and prairie habitats. Our working list currently contains 18 species of trees, 9 species of shrubs, 8 species of grasses, and 42 species of forbs. Of these, 2 species are listed as State Special Concern (Plains Wild Indigo, White Wild Indigo) and 1 species is a State Threatened Species (Great Indian Plantain, 3 plants). In addition, we noted the presence of an orchid, Great Plains Ladies'-Tresses. Many species characteristic of regional savannahs and dry bluff prairies were observed, as were several nonnative and/or invasive species. During the next growing season, we will attempt to locate those species on a WSU Herbarium list of species collected from Garvin Heights, plus species that were listed as seeded on the site during past projects.*

*Informational signage was developed and erected on-site to inform the public of the various aspects of the project. Included on a large sign is acknowledgement of funding by ENRTF (including a logo) and a list of all collaborators and subcontractors (plus logos).*

**Activity Status as of July 1, 2017:** *The prescribed burn in May and goat browsing in June prevented any additional plant surveys from being conducted during spring.*

**Activity Status as of January 1, 2018:** *Summer examinations of savannah and prairie habitats suggested that the combination of spring burn and goat browsing suppressed the growth of many species on both habitats during the 2017 growing season. Most species observed in 2016 were found during 2017, although abundances and vigor appeared to be reduced. Most grasses also were reduced in abundance compared to 2016. Futher examinations will be needed during 2018 to determine if additional species from the herbarium list can be located on the project site. Any native species present historically, but still missing from the current species list, will be included in the list of plants to be seeded (or transplanted) later during 2018. Post-restoration inventories will begin after a final goat browsing in early summer 2018.*

**Activity Status as of July 1, 2018:** *Due to the late arrival of spring, prairie and savannah plants were slow to emerge during 2018. Post-restoration inventories will begin in July (after the final goat browsing) to aid in development of a list of seeds needed to restore native diversity to both savannah and prairie habitats.*

**Activity Status of January 1, 2019:** *Plant inventories on the dry bluff prairies generally found the same species as during 2016 and 2017. Although common on the prairie below the undeveloped overlook, leadplant was very rare on the prairie below the developed overlook. We will work with our nursery consultants to determine if this and a few additional species should be selected for seeding and/or planting on this habitat. Plant surveys of the cleared, south savannah were plagued by a thick ground cover of seedling buckthorn and older honeysuckle—few other plants were observed, and they were uncommon. Surveys found buckthorn densities of 120 plants/$m^2$ on the savannah. On the north savannah, which was cleared of buckthorn in April 2018, we located >600 plants of Great Indian Plantain, a state threatened species. These plants were found in 18 groupings, and contained 48 plants that flowered during summer 2018. Previously, we had located only 3 clusters of this species, all on the dry bluff prairie near the developed overlook.*

**Final Report Summary:** *Habitat delineation at the project site resulted in a mosaic of varying habitats, including multiple dry bluff prairies, bur oak savannahs, and mixed oak/hickory/basswood/maple woodlands. New graduate student Tamberlain Jacobs repeated delineations performed earlier in the project and is confirming agreements and rectifying differences. Pre-restoration plant inventories were created by repeated seasonal surveys, seed lists from previous restoration efforts, and herbarium collection records. During 2019, post-restoration plant surveys have confirmed the presence of 181 species to date, making note of rare, threatened, and/or indicator species (e.g., Great Indian Plantain). We are still working to confirm the presence of 50 additional species (e.g., several species of trees, prairie/savannah species still being examined for proper identification [awaiting blooms or seeds]). This year, 127 species have been added to the project site species list. To date, we also have produced a project site bloom calendar comprised of 148 species, with more species to be added as late-summer and fall-blooming plants come into season. Plant communities are slowly recovering after project disturbances (goat grazing, fire, cutting) and seeding/planting activities, with recovery expected to continue for the next several years. Efforts to suppress buckthorn in the prairies and savannahs will continue (cutting, treating, burning), allowing for better establishment of seeded/planted native plants. As plant communities take hold, informational project signage will be replaced by more permanent signage using a small, endowed funding source for site restoration.*

**Activity 2: Invasive plant removal by goats and CC of MN, and reseeding/replanting of 40 acres of bluff prairies, savannahs, and bordering woodlands**

**Description:** Buckthorn, honeysuckle, oriental bittersweet, and red cedar will be removed from dry bluff prairies, bur oak savannahs, and oak-basswood forests by grazing goats, the Conservation Corps of Minnesota, and community volunteers. CC of MN will begin by removing large buckthorn from oak savannah habitat and conducting prescribed burns on savannah and prairie sites. Some non-buckthorn trees also may be thinned from savannahs to restore the native, open condition. Goat grazing (twice per year, each year) will remove woody vegetation (small or re-sprouted buckthorn and honeysuckle) on savannah habitats and severely invaded sections of prairie. CC of MN personnel and volunteers will remove buckthorn, honeysuckle, bittersweet, and

red cedar from sensitive, less-invaded bluff prairie and forest habitats.

Prairies and savannahs will be restored by seeding and planting with native forbs (emphasizing flowering species to enhance pollinator populations) and grasses, and savannahs and forests will be restored by planting bur oak saplings and other tree species as needed to enhance natural reproduction. Appropriate seed mixes for southeastern Minnesota dry bluff prairie and bur oak savannah will be prepared by a regional seed source company. Inter-seeding of prairie and savannah habitats will occur during fall, winter (over snow), and/or spring to maximize effectiveness. Young trees will be hand-planted on savannah and forest habitats as needed to restore native species that are absent, low in abundance, or lacking in successful recent recruitment.

**Summary Budget Information for Activity 2:**

**ENRTF Budget: $ 44,573**
**Amount Spent: $ 41,104**
**Balance: $ 3,469**

| Outcome | Completion Date |
|---|---|
| 1. Invasive plants removed by goats, CC of MN, volunteers | June 30, 2018 |
| 2. Bluff prairies and savannahs reseeded and planted | June 30, 2019 |
| 3. Bur oak saplings, other species planted in savannahs and woodlands | June 30, 2019 |

**Activity Status as of January 1, 2017:** *Prior to the beginning of the project period, the Conservation Corps of MN and IA used the project site to train their 2016 crew members in proper chain saw use and safety. They limited their activities to a 0.5-hectare area of bur oak savannah immediately adjacent to the parking area. This land is owned by the City of Winona, which granted them special permission for this activity. During a single day in late February, the Corps cut and piled buckthorn and honeysuckle on-site. The now dried piles will be burned by a Corps crew this winter. The Corps also will decide this winter when to perform further cutting of buckthorn and honeysuckle, and examine the possibilities for prescribed burns on both savannah and prairie habitats.*

*We encountered a problem between lawyers for the City of Winona and those for one of our subcontractors, relating to wording of contracts concerning liability. Because the City required that the entire project "package" of agreements be approved by the City Council prior to beginning of work, we faced many weeks of delays in getting Activity 2 underway. Appropriate language was eventually worked out, allowing work to commence.*

*For 21 days during November, 35 goats owned by Diversity Landworks LLC were used to browse on invasive plants. The goats were confined by solar-powered electrified fencing to 3 different paddocks (1.5 to 2.7 acres) during the period: 11 days in Paddock 1, consisting of unmanaged savannah; 3 days in Paddock 2, consisting of the Corps-cleared savannah; and 7 days in Paddock 3, a mixed dry bluff prairie and oak savannah where invasive plants had been "managed" several times over the past 15 years. The public enjoyed the opportunity to see goats at work on the invasive plants at this high-visibility site. Diversity Landworks personnel indicate that this was the "most public" location in which their goats have been used, and they answered many questions from curious people about the goats, the project, what can be expected on-site in the future.*

**Activity Status as of July 1, 2017:** *Crews from the Conservation Corps of MN and IA burned brush piles on the cleared savannah during January 2017. These brush piles were the results of clearing of buckthorn and honeysuckle by the Corps the previous year. In total, 47 brush piles containing >350 $m^3$ of brush were burned. Despite burning brush on frozen ground with snow, burning sterilized the ground beneath piles, preventing plant regrowth during spring. However, as the ground surrounding the burn sites was largely covered in seedling buckthorn plants, sterilization was likely beneficial.*

*The Corps crew conducted a prescribed burn of savannah and prairie habitats at the project site on May 12. Fuel for the fire on the savannah was mostly oak leaves, which produced a spotty, but hot fire that killed seedling and older buckthorn. However, because fuel was not evenly distributed, many areas did not burn. Fuel was much more abundant on the prairie, and the burn was more effective for most areas. However, two areas dominated by young buckthorn did not contain much fuel for the fire, so buckthorn survived.*

*For 23 days in June 2017, 70 goats browsed on buckthorn and honeysuckle in savannah and prairie habitats. They spent 7 days in Paddock 1 (unmanaged savannah), 6 days in Paddock 2 (cleared savannah), and 10 days in Paddock 3 (prairie). Browsing was effective on non-seedling buckthorn, with goats eating leaves, branch tips, and girdling older plants by eating bark. Plants girdled by goats during fall 2016 resprouted from their bases, and goats browsed those sprouts. A local newspaper, the Winona Post, took photographs of the goats while they were browsing on Garvin Heights, and interviewed one of the co-owners of the goat-browsing business, Diversity Landworks LLC, for an article/photo that appeared on the front page of the paper a few days after the goats finished their summer browsing (article appeared in the 5 July 2017 edition).*

**Activity Status as of January 1, 2018:** *Goats (60 head) returned to the project site for 19 days of browsing during October 2017. Since the June browsing, young buckthorn and honeysuckle on the cleared savannah had sprouted and/or grown vigorously. The seedbank for buckthorn appears to be rich in the soils of the cleared buckthorn. Even after the October browsing, buckthorn seedling densities were high (dozens of plants/$m^2$), although the majority (~75%) had been browsed by goats. We may consider using a propane-fueled flame weeder, in conjunction with additional spring burns if adequate fuel is present, to kill buckthorn seedlings on the cleared savannah in coming years. Planting the cleared savannah with a grass-heavy seed mixture may provide the fuel needed to produce hot prescribed burns capable of killing young buckthorn, that likely will continue to sprout for several years.*

*We had planned for the Corps to continue with additional buckthorn clearing on the project site during summer or fall 2017, particularly in the uncleared savannah, along the edges of the prairie, and in the woodland along the public walkway. However, those plans were canceled when many Corps crews responded to the national call for workers to assist with storm damage clean-up in Texas following the hurricane. A few individual citizen volunteers cut and chemically treated some buckthorn within the project site, but their efforts were minimal.*

**Activity Status as of July 1, 2018:** *The Conservation Corps worked at the project site during April, hampered by late-season snowfalls, to cut and chemically treat buckthorn on a strip of savannah habitat separating the two dry bluff prairies. Young buckthorn in this habitat were very dense (~9 saplings/$m^2$), and goats have appeared unwilling to penetrate this growth to eat the brush. Instead, goats browsed only the peripheral plants. Corps personnel cut and piled buckthorn, which will be burned later this fall when the Corps will attempt to perform a prescribed burn on the savannah habitats.*

*Goats browsed buckthorn and honeysuckle on the project site for 3 weeks in June. For this period, 40 does (all with nursing young) were used to create a more significant impact on buckthorn. Nursing does eat more browse than wethers (castrated males, which comprised the majority of the herd used on the project site previously), and it was hoped that they would browse and kill shoots from buckthorn girdled last year. Goats had browsed at the project site three times previously without incident. However, during June the goats were targeted with paintballs, driving the entire herd from their enclosure into an off-site field. They were returned to their enclosure by their owners after a nearby resident reported the escapement and vandalism. Only days later, Winona police officers captured four juveniles with a stolen goat in their car at the project site after park closure. These same juveniles also were in possession of a paintball gun. The juveniles have been charged with vandalism and theft.*

**Activity Status of January 1, 2019**: *The Conservation Corps had hoped to perform a prescribed burn on the cleared savannahs during fall to kill young invasive plants, but again were hampered by a lack of fuel (mostly a ground cover of seedling buckthorn and young honeysuckle with scattered oak leaves). Consequently, Corps personnel used propane torches to kill the invasives on the cleared south savannah, leaving two small "control" patches unburned to examine the effects of their efforts. Plant counts in both burned and unburned areas found that nearly 90% of buckthorn seedlings had been killed by the propane torches.*

*On the south savannah, Winona State University's BIOL 418 Plant Ecology class spread a seed mix containing 36 species of forbs, sedges, and grasses during late fall/early winter. The seed mix was specially prepared for this site by Bill Carter from Prairie Moon Nursery. We hope that these plants can become established over the*

*next few years as the buckthorn seedbank diminishes. In the interim, we expect to maintain the savannah by periodic mowing or browsing, using propane torches to control young buckthorn and honeysuckle, until growth of the seeded plants provides adequate fuel to support periodic prescribed burns.*

**Final Report Summary:** *Goats were browsed on the project site a total of five different periods, with their final visit during June 2019, a year later than expected completion. The extended use of goats resulted from a strong seed bank of buckthorn within the savannah habitats, and an apparent inability of goats to access dense patches of buckthorn within the prairie. In general, goat browsing in this very public area was well received. Site visitors were intrigued by the goats, enjoyed photographing them, and asked numerous questions about the restoration project.*

*The Conservation Corps of MN and IA cut and treated buckthorn, thinned the bur oak savannah, conducted controlled burns, burned brush piles, and used weed torches to control seedling and yearling buckthorn during multiple visits throughout the project period. Even with these efforts, canopy coverage within the savannahs remains on the high end for quality savannah habitat. Corps personnel have recommended a long-term, gradual thinning of young bur oaks to either maintain or reduce canopy coverage.*

*Multiple seedings of native vegetation have taken place within the savannahs as the buckthorn population was reduced by browsing, cutting, treating, and burning. Because these seedings took place during the final year of the project period, the effects of these likely will not be observed for a few years. Consequently, we planted >400 plugs of grasses and forbs in the savannah to accelerate the process. We also will consider planting a cover crop of Canada rye to provide more fuel for future prescribed fire to further suppress buckthorn seedlings.*

**Activity 3: Invasive management workshop development and initial delivery to regional landowners, interested public**

**Description:** One-day and two-day, hands-on workshops will be developed for and presented to regional landowners and other stakeholders to explain and demonstrate the process and methodology of invasive plant management and habitat restoration. Workshops will use 1) the project site as a model and 2) nearby City-owned (Bluffside Park) and University-leased (Krueger Woods) lands for hands-on, experiential learning and experimentation.

The WSU Arboretum and Land Stewardship Committee will develop a series of workshops, grounded in Aldo Leopold's Land Ethic, to provide participants with practical approaches for developing and maintaining environmentally sustainable landscapes. With the Garvin Heights project site as a model, and using a learning-by-doing approach, workshops will demonstrate the principles and best practices (e.g., methods, skills, and techniques) of invasive plant control. A hands-on approach will educate participants in the safe use of tools, equipment, and materials.

**Summary Budget Information for Activity 3:**

**ENRTF Budget: $ 7,443**
**Amount Spent: $ 6,418**
**Balance: $ 1,025**

| Outcome | Completion Date |
|---|---|
| 1. One-day and two-day management/restoration workshops developed | June 30, 2017 |
| 2. Management/restoration workshops delivered to public | June 30, 2019 |

**Activity Status as of January 1, 2017:** *Planning and development of workshops has been delayed slightly due to the hiring of a new Arboretum Director and the retirement of our Land Steward. A search for a new Land Steward is underway, and this person will work with our new Arboretum Director and a new University Arborist to develop the workshops. They will be assisted by a new graduate student, personnel from our goat browsing contractor, and Conservation Corps personnel.*

**Activity Status as of July 1, 2017:** *A new Arboretum Director, Lisa Pearson, was hired by Winona State University to oversee management of the University's public lands and spaces. Project personnel (PI, grad student Ryan Walsh) met with the Arboretum Director, other members of the WSU Landscape Arboretum, and representatives of a private ecological consulting firm to discuss possibilities for the development of the invasives management/restoration workshops. General workshop formats were discussed based on attendees' past experience, and budgeting was examined. With oversight from the Arboretum Director, it was planned that workshops would be developed and presented by the PI, the yet-to-be-named Land Steward, and grad student Ryan Walsh, with assistance from other project partners (goat browsing contractor, Conservation Corps personnel, additional local ecological restoration specialists).*

**Activity Status as of January 1, 2018:** *Winona State University appointed Dr. Amy Runck, Associate Professor of Biology, as its new Land Steward. She has been proactive at getting up to speed regarding the Garvin Heights project. She is able to assist with the development and delivery of the invasives management/restoration workshops. Grad student Ryan Walsh took a leave of absence during fall semester and will return to the project (and working on workshop content) in January 2018.*

**Activity Status as of July 1, 2018:** *Winona State University hosted a 1-day workshop on the management of invasive plants, using the Garvin Heights project site for a field trip. Grad student Ryan Walsh, working with WSU Camps and Conferences staff, planned and organized the workshop. The workshop was designed to provide information to area residents interested in invasive plant management, and to connect them with various public agencies and private contractors that could assist them with managing invasives on their lands. The workshop attracted 27 citizens from the region. During the morning session, participants had the opportunity to connect with and ask questions of public agencies (e.g., Conservation Corps of MN and IA, MN Department of Agriculture, City of Winona), NGOs (e.g., The Nature Conservancy), and private contractors (e.g., Diversity Landworks, Landspirit Design, Prairie Restorations Inc., Prairie Moon Nursery, Acer Forestry). Participants also heard speakers talk about identifying invasive plants, where to find assistance, how to develop a management plan, and how to restore a site after invasive eradication.*

*During the afternoon session, workshop participants were transported to the Garvin Heights project site, where they learned to identify various invasive plant species and heard presentations from project participants: WSU staff (basic project plan and goals), the Conservation Corps (demonstration of the tools and techniques used on-site), and Diversity Landworks (goat browsing). Goats had been brought on-site 6 days prior to the workshop, allowing participants to see the impact of goat browsing on both young and older buckthorn and honeysuckle.*

***Although the workshop took place in early June, bills for the various services associated with the workshop have yet to cycle through the WSU Business Office. Therefore, funds have been encumbered, but not spent, as of this report.*

**Activity Status as of January 1, 2019**: *Unsolicited feedback from workshop participants indicated that several landowners used information gained during the workshop to initiate invasive plant control activities on their properties. One participant sent a series of workshop photos, and made the decision to control invasive plants on her dry bluff prairie. She previously had been reluctant to do so, afraid that the use of chemical controls would have an adverse effect on the native plant community. We view this as a major accomplishment, as her property is enrolled in the Minnesota Land Trust, but habitat quality continued to decline due to lack of invasive control actions. Several other participants have connected directly with our workshop presenters and vendors for assistance with their property.*

*After the June workshop, participants were contacted to determine if they were interested in a workshop sequel—a more applied, hands-on field activity at Garvin Heights and nearby University and City lands. The response level was poor, so a potential fall workshop was not conducted. However, we continue to field questions from local residents who did not attend the workshop, connecting them to our workshop participants and vendors. During spring, we plan to again explore the possibility of offering a hands-on workshop.*

**Final Report Summary:** *Winona State University hosted two workshops centered on invasive species management and habitat restoration. The first workshop attracted 27 people to learn about various methods for dealing with invasive plant species in the Winona area. Representatives of public agencies, NGOs, and private businesses gave presentations and interacted with participants to provide methodology and guidance for handling invasive species on private lands. The Garvin Heights project site served as demonstration area, where workshop participants learned to identify various invasive species and observed various methods for their control (cut and treat, burning, goat browsing).*

*Immediately after the final goat browsing at the Garvin Heights project site in June 2019, a second workshop provided 12 participants with hands-on experience in restoring a bur oak savannah. Planned by graduate student Tamberlain Jacobs and led by Gabe Ericksen of Landspirit Design, participants planted 8 species of grasses and forbs to help jumpstart the new plant community. Mr. Ericksen demonstrated various techniques for planting, showed participants how to group and/or space different species for maximum growth, and instructed how to select the proper locations for planting (e.g., soil depth, sun exposure, expected plant height). Among the participants were two families, the City of Winona's sustainability director, and a local city council member. Because this planting workshop took place during a very warm period of summer, the City of Winona delivered water daily to fill on-site rain barrels, and all plants were watered each day for two weeks by volunteers.*

**V. DISSEMINATION:**

**Description:**

Products resulting from this project will be disseminated via a web site, news releases, workshops, community presentations, on-site signage, and presentations at regional science meetings. These diverse methods are intended to reach a variety of audiences, allowing us to share information with site visitors, local residents, and the broader regional citizenry.

The web site for the Winona State University Landscape Arboretum will provide a key link between the project and its benefactors (https://www.winona.edu/outdoored/arboretum.asp). The web site will provide a source for all information about the project, from schedules of proposed activities to photos, videos, and reports of on-site happenings. Links will be provided for workshop registration, to access news releases, and to volunteer as a Friend of the Landscape Arboretum.

News releases will be produced and disseminated through the Winona State University Communications and Marketing office. This office prepares and distributes information and news items to regional newspapers, radio, and television, as well as preparing web content and a periodic news magazine.

Project workshops (Activity 3) and community presentations will be prepared and delivered by project leadership and affiliated members of the WSU Landscape Arboretum throughout the project cycle and beyond. On-site signage will be produced and updated throughout the project period to keep site visitors apprised of current activities, with placement of permanent signs planned for the end of the 3-year project period.

Finally, the scientific findings of the project (before/after surveys of invasive plants, success of various management techniques, habitat recovery, SGCN surveys) will be presented at regional science meetings by project leadership and graduate and undergraduate students. Potential venues may include state meetings of the Society of American Foresters and The Wildlife Society, the Mississippi River Research Consortium, the Upper Midwest Invasive Species Conference, the North American Prairie Conference, and undergraduate science symposia hosted by Winona State University, Saint Mary's University of Minnesota, and Viterbo University.

**Status as of January 1, 2017:** *A variety of approaches have been used to date to inform the general public about the project and its activities. The WSU Communications and Marketing Office produced a press release for regional news outlets at describing the project and its major goals. We received significant, positive feedback from friends and alumni who heard about the project through the press release.*

*We are developing several different platforms for use on digital media. The web site for the Winona State University Landscape Arboretum will be used as a major link for the project, but management of that web site is restricted to a particular webmaster. To allow for more frequent and detailed postings about the project, we are developing a separate web site that will be linked directly to the Arboretum website. The Arboretum website still*

*will be used for major posting and workshop details, whereas the additional site will be available for day-to-day updates, photos, and related communications. We also will take advantage of a dedicated Facebook page for the project for similar project updates and postings. This latter also will provide the opportunity for immediate feedback about the project from the public.*

*We were invited to give a presentation about the project to the Winona County Master Gardeners group in late October. During that presentation, we informed the group about the project goals and major activities, provided them with a photographic survey of the project site and the various plants identified in our species inventory, and solicited volunteers from the group to help with various project activities.*

*A large sign was developed and erected on the project site to inform the public about the project and its major activities, provide contact info for questions, and to give credit to the projects supporters (especially ENRTF) and collaborators. We also included logos from all of these groups/organizations. The sign framework was designed to allow for placement of additional information as needed. Vandals pulled the empty sign framework from the ground shortly after it was placed, requiring us to make the signposts more secure (with cement).*

*Two undergraduate students and one graduate student have been collecting species inventory data (plants, birds) at the project site, and have been documenting the effects of the goats on the invasive plants during the first grazing session. The undergraduates will present their findings at undergraduate science symposia this coming spring at WSU and/or Saint Mary's University of MN. We also are providing data on buckthorn damage from goat grazing to our goat grazing contractors to use in a presentation about goat grazing that they will be making at a regional sustainable farming conference this winter. They also have asked to post this information on their business website to inform the public about the impacts of goats on invasive plants.*

**Status as of July 1, 2017:** *We continue to inform the community about the project and its activities in a variety of ways. In addition to the project web site maintained by Winona State University (https://www.winona.edu/outdoored/garvin.asp ), with content provided by the PI, we maintain a project-specific Facebook page (https://www.facebook.com/Garvin-Heights-Natural-Area-Blufflands-Restoration-Project-357534101286304/ ) for more immediate communication with the community. We have used this to quickly highlight the arrival of goats at the project site, as well as showing photographically the results of prescribed burns and goat browsing. We also make postings about the project on the Winona State Biology Department Facebook page (https://www.facebook.com/biologyWSU/ ) to reach a larger audience.*

**Status as of January 1, 2018:** *During the 2017 fall semester, two Winona State Biology students have been conducting small mammal surveys via live-traps on savannahs and prairies at the Garvin Heights project site. To date, only two species (deer mouse, short-tailed shrew) have been collected in the project site, with deer mice dominating catches. Students will be presenting their findings at the annual meeting of the Minnesota Chapter of The Wildlife Society in February 2018.*

*Two students who either conducted surveys on birds or monitored the effects of goat browsing on buckthorn last fall graduated after fall semester 2017. Each student was honored as the top graduate in their respective major (Ecology or Environment Science) at a University-sponsored ceremony on December 7. One of these students presented her research findings at a University-sponsored research symposium in April 2017, whereas the other provided her data to the goat-browsing business in support of their statements that browsing severely injures buckthorn.*

**Status as of July 1, 2018:** *Two undergraduate students presented the results of their small mammal survey of the Garvin Heights project site at a University-sponsored research symposium in April 2018. Deer mice dominated collections, especially in prairie habitats. Similar surveys will be conducted in future years to determine if small mammal diversity changes with invasive species management.*

*During April, the PI gave a presentation about goat browsing impacts on buckthorn at the Annual Meeting of the Mississippi River Research Consortium in La Crosse, WI. Specifically, selective girdling of buckthorn by goats*

*(avoidance of large- and small-diameter stems) and reductions in density of young buckthorn after goat browsing were highlighted.*

*During May and June, the invasive plant management workshop was advertised via hard-copy postings within the community, targeted mailing, Facebook postings, group email lists, newspaper notifications, and a radio broadcast (by grad student Ryan Walsh). We were successful in reaching a diverse group of local residents, from city dwellers to farmers. Some were simply curious about the Garvin Heights project and wanted to learn more about it, whereas others owned property enrolled in the Minnesota Land Trust and wanted to learn how to better manage invasive plants.*

*The invasive plant management workshop provided participants with an up-close introduction to the project, as well as an in-person examination of the results of the project to date. Participants saw how Conservation Corps personnel removed invasive plants from savannah and prairie habitats, and also how bad the problem was before work began by examining an untreated plot nearby. They also had the opportunity to view goat browsing in person, observing exactly how goats browsed leaves and branch tips and nibbled bark.*

**Status as of January 1, 2019**: *We continued to highlight project activities on a timely basis on the Winona State Biology Department Facebook page (https://www.facebook.com/biologyWSU/ ). This enables us to reach a larger audience than either the specific project Facebook page or the project web site. In fact, some of our posts have been re-posted by a City of Winona council member to highlight important activities within Garvin Heights Park. Recent photos and videos of WSU students working on the project have had several thousand views on the Winona State Biology Department Facebook page.*

*We met with two City of Winona council members prior to the council taking action on a new City Parks improvement funding initiative. The City council passed the initiative, proposing to spend between $27 million and $42 million on parks and trail improvements and expansions. Specifically, the initiative proposes a new, $3.2 million Bluffland Traverse Trail that will pass through Garvin Heights Park, connecting with and expanding trails east and west of the park. This trail would increase visitor use of the park, making it one of several hubs for hiking and biking trails throughout the City. Hopefully these activities will bring additional funding for continued invasive species management activity within Garvin Heights Park and on other properties along the trail system.*

**Final Report Summary:** *Throughout the project period, various information about the project was posted on the project web site maintained by Winona State University (https://www.winona.edu/outdoored/garvin.asp ), on a project-specific Facebook page (https://www.facebook.com/Garvin-Heights-Natural-Area-Blufflands-Restoration-Project-357534101286304/ ), and on the Winona State Biology Department Facebook page (https://www.facebook.com/biologyWSU/ ). The community was informed of upcoming workshop opportunities via hard-copy postings within the community, targeted mailing, Facebook postings, group email lists, newspaper notifications, and a radio broadcast. Workshops, community presentations, on-site signage, and presentations at regional science meetings further served to present the project and its findings to the public.*

*Graduate student Ryan Walsh recently completed his thesis (Walsh, R. 2019. Garvin Heights Restoration Project. Professional Science Masters Thesis, Winona State University, Winona, MN. 56 p) that focused on the Garvin Heights project in general, the first workshop, and the effects of goat browsing on buckthorn. Included in his thesis are a series of recommendations for future management at the project site that will form the basis for a future management plan. In the near future, we plan to develop a manuscript from his thesis, on the effects of goat browsing, for submission to a peer-reviewed scientific journal.*

*Graduate student Tamberlain Jacobs continues to identify more plants within the project area, using her plant taxonomy expertise acquired while working at previous natural resources jobs in various locations in MN and elsewhere. She is developing a more complete, up-to-date plant inventory list for the project site. She also is developing a bloom calendar for the site, which will allow visitors to determine what plants may be in bloom at various times of the year.* ***Winona State University has funded a graduate assistantship for work at Garvin Heights for the next 2 years****, with Tamberlain Jacobs filling that role for the upcoming academic year. As part of her assistantship, she will work to update the WSU herbarium collection for Garvin Heights, work more closely with the WSU Landscape Arboretum Committee and Friends of the Arboretum to develop a citizen stewardship*

*group and a series of volunteer work projects (additional invasive plant management, seed collecting), and develop updated signage for the various habitats at the restoration site.*

**VI. PROJECT BUDGET SUMMARY:**

**A. ENRTF Budget Overview:**

| Budget Category | $ Amount | Overview Explanation |
|---|---|---|
| Personnel: | $ 49,427 | 1 project manager at 84% salary, 16% benefits, for 2 weeks in the summer, for 1 year ($6,484); Land Steward at 84% salary, 16% benefits, for 2 weeks in the summer, for 1 year ($5,443); 1 graduate student at GA stipend for 2 years ($37,500). |
| Professional/Technical/Service Contracts: | $ 33,000 | 1 contract with Diversity Landworks LLC for grazing goats to control invasive plants ($ 20,000); 1 contract with Conservation Corps of Minnesota for removal of invasive plants ($ 13,000) |
| Equipment/Tools/Supplies: | $ 15,573 | GPS units, cameras, inventory supplies ($ 2,000); workshop materials and supplies ($ 2,000); prairie/savannah seed ($ 8,573); native trees ($ 3,000). |
| Printing: | $ 1,000 | Educational signage |
| **TOTAL ENRTF BUDGET:** | **$ 99,000** | |

**Explanation of Use of Classified Staff:** N/A

**Explanation of Capital Expenditures Greater Than $5,000:** N/A

**Number of Full-time Equivalents (FTE) Directly Funded with this ENRTF Appropriation:** 1.1 FTE

**Number of Full-time Equivalents (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation:** 0.4 FTE

**B. Other Funds:**

| Source of Funds | $ Amount Proposed | $ Amount Spent | Use of Other Funds |
|---|---|---|---|
| **Non-state** | | | |
| Private donations (cash) | $ 11,000 | $ 3,212 | Undergraduate student salary |
| City of Winona (in-kind) | $ 24,000 | $ 24,000 | Park maintenance, security |
| **State** | | | |
| Conservation Corps of MN (in-kind) | $ 13,000 | $ 13,000 | Invasive plant removal |
| WSU Arboretum Director (in-kind) | $ 29,209 | $ 29,209 | Facility coordination, oversight (10% annual) |
| WSU Land Steward (in-kind) | $ 31,262 | $ 31,262 | Workshop development, delivery (10% academic year) |
| Project Manager (in-kind) | $ 77,378 | $ 77,378 | Student supervision (20% academic year) |
| **TOTAL OTHER FUNDS:** | **$ 185,849** | **$ 178,061** | |

**VII. PROJECT STRATEGY:**

**A. Project Partners:**

Project Team/Partners Receiving Funds
**Neal Mundahl** (WSU Department of Biology, Ecologist, project manager, student mentoring; $6,484)
**Bruno Borsari** (WSU Land Steward, workshop and interpretive signage development; $5,443)
**Graduate and Undergraduate students** (WSU Department of Biology, habitat delineation, plant inventories, SGCN surveys: graduate student, $37,500; undergraduate salaries from private donations)
**Pure Prairie Vision LLC** (Goat grazing management; $20,000)
**Dustin Looman**, MN DNR and Conservation Corps of Minnesota (Invasive plant removal, consultation; $13,000)
**Prairie Moon Nursery** (Seed, plant source, consultation; $11,573)

Project Team/Partners Not Receiving Funds
**City of Winona** (Park maintenance)
**New Hire TBD** (WSU Landscape Services and Arboretum Director)
**Carol Jefferson** (Plant Ecologist, Department of Biology emerita: historical site consultant, past species inventories, MN DNR contacts)
**William Beatty** (WSU Department of Geosciences: GIS)
**WSU Arboretum and Land Stewardship Committee** (WSU institutional facilitation)

**B. Project Impact and Long-term Strategy:** The Garvin Heights Natural Area project site is located in the central part of the Blufflands Subsection of the Paleozoic Plateau. The Blufflands has the most Species in Greatest Conservation Need (SGCN) of any subsection in Minnesota, including 82 species that are federal or state endangered, threatened, or of special concern. Oak savannahs and prairies are key habitats for SGCN within the Blufflands, but most (97% and 99%, respectively) have been lost since the 1890s. The proposed project will restore and enhance bur oak savannahs and dry bluff prairies, protect additional cliff and bluff habitats, and enhance pollinator populations by managing invasive plants and replanting with native species. The high-visibility project site will showcase invasive species management and habitat restoration to a large public audience, inventory/monitor for SGCN, encourage public participation in the restoration, and provide additional and continuing opportunities for landowner education in invasive plant management and habitat restoration.

Winona State University and the City of Winona are committed to retaining project lands in a restored state for continuing education of students, the public, and regional stakeholders. Friends of the WSU Landscape Arboretum will be actively involved in the restoration, and will be instrumental in long-term maintenance through continued monitoring and removal of invasive plants and the initiation and conduct of regular, prescribed burns on prairie and savannah habitats. The WSU Environmental Club and WSU classes (e.g., General Ecology, Plant Ecology) will continue their modest monitoring and management efforts on a regular schedule. The City of Winona will continue to maintain access infrastructure (e.g., road, parking lot, paved walkways, overlooks), provide visitor services (restrooms, trash removal), and other services as needed (security, fire supervision).

**C. Funding History:**

| Funding Source and Use of Funds | Funding Timeframe | $ Amount |
|---|---|---|
| Xcel Energy (trail construction, invasive plant removal) | 2013-2014 | $ 10,000 |
| Private donations (trail maintenance, tree removal) | 2011-2013 | $ 2,000 |
| Winona State University (sign replacement, repair) | 2013 | $ 800 |

**VIII. FEE TITLE ACQUISITION/CONSERVATION EASEMENT/RESTORATION REQUIREMENTS:**

**A. Parcel List:** See attached Parcel List

**B. Acquisition/Restoration Information:** N/A

**Restoration**

1. **Provide a statement confirming that all restoration activities completed with these funds will occur on land permanently protected by a conservation easement or public ownership.**

   All lands involved in this project currently are in public ownership: State of Minnesota, City of Winona, and City of Winona Park Board.

2. **Summarize the components and expected outcomes of restoration and management plans for the parcels to be restored by your organization, how these plans are kept on file by your organization, and overall strategies for long-term plan implementation.**

   We expect that our restoration plans for the Garvin Height Natural Area will lead to improved condition of the dry bluff prairies, bur oak savannahs, and oak-basswood forests that comprise the project site. We anticipate a dramatic reduction in the abundance of buckthorn and honeysuckle after their removal by goats and the CC of MN personnel, and continuing reduction/suppression through efforts of the Friends of the WSU Arboretum. In addition, we anticipate an increase in the diversity of flowering forbs in prairie and savannah habitats.

   Management plans for the restoration of the Garvin Heights Natural Area will be filed and maintained by the grant author, by the WSU Arboretum and Land Stewardship Committee, the office of the V.P. of Facilities and Finance, and office of the Provost and V.P. for Academic Affairs. Management plans for the site will become a continuing part of the mission of the WSU Arboretum and Land Stewardship Committee.

   The WSU Arboretum and Land Stewardship Committee will be tasked with managing the site in its restored state, working with the City of Winona and other community partners to maintain the restored site by suppressing invasive plants, conducting prescribed burns, and monitoring and encouraging a diverse community of flowering forbs for pollinators. The WSU Arboretum and Land Stewardship Committee will explore funding sources, following the expiration of the LCCMR grant, to enable continued monitoring and maintenance efforts on the restored parcels. Sources of funding include University-budgeted landscape funds, privately donated funds available through the WSU Foundation, and external grant sources (e.g., Winona County, MN, Department of Agriculture, U.S. Department of Agriculture, and others). Additionally, long-term maintenance and restoration will enable WSU undergraduate and graduate students (classes, small group projects, senior capstone research, and graduate projects), as well as interested community members to learn-by-doing through engaging in the long-term maintenance of this property.

3. **Describe how restoration efforts will utilize and follow the Board of Water and Soil Resources "Native Vegetation Establishment and Enhancement Guidelines" in order to ensure ecological integrity and pollinator enhancement.**

   Restoration activities will follow the guidelines as established in the 2015 Board of Water and Soil Resources publication, "Native Vegetation Establishment and Enhancement Guidelines". Specific habitats (dry bluff prairie, bur oak savannah, oak-basswood forest) will be delineated to quantify the acreage of each habitat type within the project area. After removal of invasive plants, habitats will be inter-seeded/planted with seeds/plants obtained from a regional supplier (Prairie Moon Nursery) within 30 miles of the project site. Seed mixes for dry bluff prairies and bur oak savannahs will incorporate a high diversity of forbs to stimulate development of rich flowering communities, to provide habitat for pollinators during all seasons.

4. **Describe how the long-term maintenance and management needs of the parcel being restored with these funds will be met and financed into the future.**

Following restoration, the Garvin Heights Natural Area will need regular maintenance and management to sustain the restored condition. These maintenance and management activities will include removal of re-sprouting or new invasive woody and herbaceous vegetation, regular prescribed burns on prairie and savannah habitats, and possible inter-seeding and/or replanting to maintain high plant diversity in all habitats. These activities will occur under the direction and guidance of the WSU Arboretum and Land Stewardship Committee, the WSU Arboretum Director, and the WSU Land Steward. University funds are allocated for maintenance and management of the WSU Arboretum on an annual basis. In addition, a private endowment for Garvin Heights has been established within the WSU Foundation. Funds generated from this endowment are to be used exclusively to pay for supplies, materials, and student salaries associated with maintaining the Garvin Heights Natural Area. Additional funding will be sought from other sources for any large projects that may develop in future years.

5. **Describe how consideration will be given to contracting with Conservation Corps of Minnesota for any restoration activities.**

   The Conservation Corps of Minnesota has been contracted (contact Dustin Looman) for this project to remove invasive plants on habitats that are too sensitive (e.g., dry bluff prairie) and/or too steep for goat browsing. In addition, CC of MN personnel will be needed to remove buckthorn and other invasive woody vegetation too tall for goats to browse effectively. CC of MN will provide 50% of their services as in-kind contributions for this project, to help advertise and promote their activities within southeastern Minnesota at a highly visible, public location.

6. **Provide a statement indicating that evaluations will be completed on parcels where activities were implemented both 1) initially after activity completion and 2) three years later as a follow-up. Evaluations should analyze improvements to the parcel and whether goals have been met, identify any problems with the implementation, and identify any findings that can be used to improve implementation of future restoration efforts at the site or elsewhere.**

   Activity 1 will involve both pre- and post-restoration surveys and inventories of plant communities and SGCN. These surveys and inventories will be used to evaluate the effects of the prescribed treatments in reducing the abundance of invasive vegetation and improving the diversity of native plants within the dry bluff prairies, bur oak savannahs, and oak-basswood forests that comprise the Garvin Heights Natural Lands project site. This before/after assessment will provide feedback on the immediate success of restoration efforts and/or problems with those efforts within the 3-year project period, allowing for management course corrections prior to beginning long-term site management.

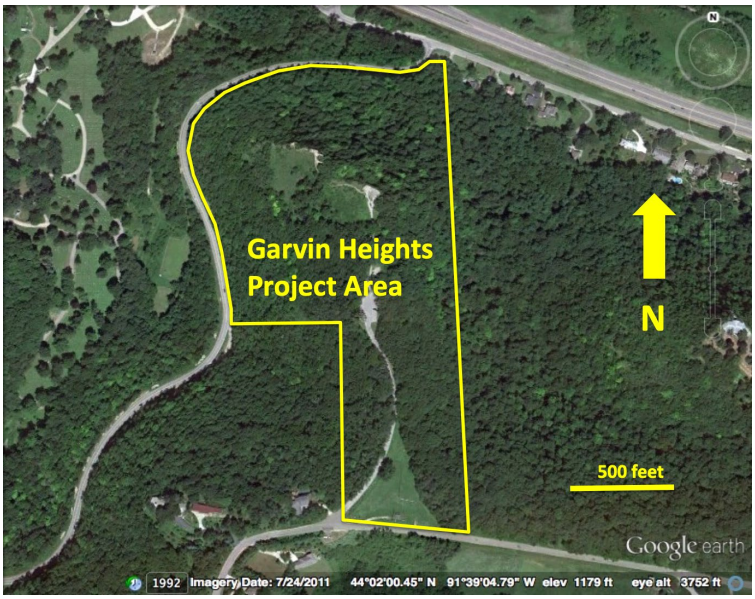
   Follow-up evaluation of the habitat restoration efforts will be undertaken by WSU students and faculty, after expiration of the LCCMR grant (2019-2022 and beyond), based upon the availability of needed funds from the University, private donations, and external grant sources. Long-term maintenance and continued restoration of these parcels, as a public demonstration site within the southeastern Minnesota region, and as a resource for teaching and research for undergraduate and graduate education, is a high priority of the WSU Landscape Arboretum.

**IX. VISUAL COMPONENT or MAP(S):** See attached map

**X. RESEARCH ADDENDUM:** N/A

**XI. REPORTING REQUIREMENTS:**

**Periodic work plan status update reports will be submitted no later than January 1, 2017, July 1, 2017, January 1, 2018, July 1, 2018, and January 1, 2019. A final report and associated products will be submitted between June 30 and August 15, 2019.**





Location of the Garvin Heights project area in Winona, MN.

Goats browsing on a cleared bur oak savannah at Garvin Heights, Winona, MN.

Contrast between a section of woodland invaded by buckthorn browsed by goats (left) and an unbrowsed section (right) at Garvin Heights, Winona, MN.

Minnesota Conservation Corps workers clearing buckthorn from a dry bluff prairie at garvin Heights, Winona, MN.

Winona State University Plant Ecology students surveying the population of Great Indian Plantain, a state threatened species, on a bur oak savannah at Garvin Heights, Winona, MN.


Workshop participants watching a demonstration of how to manage invasive plant species by Minnesota Conservation Corps personnel.

WSU students hand-seeding a bur oak savannah after the first snowfall at Garvin Heights, Winona, MN.

Workshop participants planting grass and forb plugs in a bur oak savannah at Garvin Heights, Winona, MN.

Workshop participants learning about the role of goat browsing in habitat restoration at a bur oak savannah at Garvin Heights, Winona, MN.

**Environment and Natural Resources Trust Fund**
**Final M.L. 2016 Project Budget**

**Project Title:** Bluffland Restoration and Monitoring in Winona
**Legal Citation:** M.L. 2016, Chp. 186, Sec. 2, Subd. 08h
**Project Manager:** Neal Mundahl
**Organization:** Winona State University
**M.L. 2016 ENRTF Appropriation:** $ 99,000
**Project Length and Completion Date:** 3 Years, June 30, 2019
**Date of Report: August 15**, 2019

| ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET | Activity 1 Budget | Amount Spent | Activity 1 Balance | Activity 2 Budget | Amount Spent | Activity 2 Balance | Activity 3 Budget | Amount Spent | Activity 3 Balance | TOTAL BUDGET | TOTAL BALANCE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **BUDGET ITEM** | **Habitat Delineation, Monitoring, Signage** | | | **Invasive Plant Removal, Replanting** | | | **Workshop Development, Delivery** | | | | |
| **Personnel (Wages and Benefits)** | $43,984 | $41,754 | $2,230 | | | | $5,443 | $5,000 | $443 | $49,427 | $2,673 |
| Neal Mundahl, Project Manager: $6,484 (84% salary, 16% benefits); 7% FTE for 1 year | | | | | | | | | | | |
| Bruno Borsari, Land Steward: $5,443 (84% salary, 16% benefits); 7% FTE for 1 year | | | | | | | | | | | |
| 1 Graduate Student: $37,500 (90% salary, 10% benefits); 50% FTE each year for 2 years | | | | | | | | | | | |
| **Professional/Technical/Service Contracts** | | | | | | | | | | | |
| Diversity Landworks, LLC (goat grazing of invasives) | | | | $20,000 | $20,000 | $0 | | | | $20,000 | $0 |
| Conservation Corps of Minnesota (invasive plant removal) | | | | $13,000 | $10,710 | $2,290 | | | | $13,000 | $2,290 |
| **Equipment/Tools/Supplies** | | | | | | | | | | | |
| Field equipment (GPS units, cameras, inventory supplies) | $2,000 | $1,917 | $83 | | | | | | | $2,000 | $83 |
| Workshop materials/supplies | | | | | | | $2,000 | $1,418 | $582 | $2,000 | $582 |
| Prairie/savannah seeds | | | | $8,573 | $8,454 | $119 | | | | $8,573 | $119 |
| Native trees | | | | $3,000 | $1,940 | $1,060 | | | | $3,000 | $1,060 |
| **Printing** | | | | | | | | | | | |
| Educational signage | $1,000 | $996 | $4 | | | | | | | $1,000 | $4 |
| **COLUMN TOTAL** | **$46,984** | **$44,667** | **$2,317** | **$44,573** | **$41,104** | **$3,469** | **$7,443** | **$6,418** | **$1,025** | **$99,000** | **$6,811** |