

M.L. 2013, Chapter 52, Sec., Subd. 06g and M.L. 2014, Chapter 226, Section 2, Subdivision 19 Project Abstract

For the Period Ending June 30, 2017

PROJECT TITLE: Controlling Terrestrial Invasive Plants with Grazing Animals

PROJECT MANAGER: John Beckwith, Executive Director

AFFILIATION: Hiawatha Valley Resource Conservation & Development Council

MAILING ADDRESS: 63005 172nd Lane

CITY/STATE/ZIP: Janesville, MN 56048

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WEBSITE: Not applicable

FUNDING SOURCE: Environment and Natural Resources Trust Fund

LEGAL CITATION: M.L. 2013, Chapter 52, Sec., Subd. 06g and M.L. 2014, Chapter 226, Section 2, Subdivision 19

APPROPRIATION AMOUNT: \$52,000

AMOUNT SPENT: \$ 48,104.60

AMOUNT REMAINING: \$ 3,895.40

Overall Project Outcomes and Results

The Hiawatha Valley Resource Conservation and Development Council, Inc., (HVRCD) began implementation of a program to control terrestrial invasive species through grazing with a pilot project in 2011. With the help of the USDA-NRCS a baseline inventory of selected sites was initiated along with documenting the effects of grazing on terrestrial invasive species.

In 2013 HVRCD received funding through the Environmental and Natural Resources Trust Fund (ENRTF). The project goals were: (1) develop a cost effective and environmentally friendly alternative to chemical and mechanical control methods for these species, (2) demonstrate that multi-species grazing techniques can be used effectively to control invasive plants, (3) distribute results during field day demonstrations to connect livestock producers with landowners and (4) develop a Best Management Practice for invasive species control using grazing management as a component.

Three sites were selected as part of this project; Gamehaven Boy Scout Camp, approximately 10 miles southeast of the City of Rochester; River Bend Nature Center in the City of Faribault; and Eden Acres, roughly 5.4 miles southeast of the City of Faribault.

Results show little change in seasonal buckthorn sapling density, an increase in buckthorn seedlings, and variable results for adult buckthorn mortality. However, results show a change in the age stand of buckthorn within treatment areas as fewer live adult and large saplings were documented within the treatment sites. This change makes further treatments by various means more attainable.

Garlic mustard density was dramatically reduced in two growing seasons at the River Bend site, showing a 94% decrease in density by 2016.

Additional documents included with this report: Prescribed Grazing (Goat) Project Final Report Covering Years 2014, 2015, and 2016; Final Project Report Gamehaven Boy Scout Camp; Minnesota Practice 528 Biological Brush Management Implementation Guide; Minnesota Practice Implementation Guide Biological Herbaceous Weed Control 528.

Project Results Use and Dissemination

- 1) We were very fortunate to have one of our sites within the River Bend Nature Center near Faribault, MN. Small grazing animals created a great deal of interest amongst their visitors and staff. Handouts were available explaining the project, local newspapers did feature stories, and River Bend shared photos and explanations on their website. Signs were posted at the River Bend Nature Center grazing site appropriately crediting the project and to provide basic information of why there are goats there. These signs also had qr code allowing cell phone users more detailed information on the project. This kept the project in the news during 2015 and 2016 on a regular basis.
- 2) Tours were conducted involving garden clubs, Soil and Water Conservation District employees, USDA-NRCS, other professionals, public land managers, farmers and potential grazers.
- 3) The project has been featured on several radio and television stations in the Twin Cities market over the projects timeframe.
- 4) Project information was shared through brochures at annual conferences of the Association of MN Counties and also the MN Association of Soil and Water Conservation Districts through the MN Association of RC&D Councils exhibit booth.



Environment and Natural Resources Trust Fund (ENRTF) M.L. 2013 Work Plan

Date of Status Update Report: June 30, 2017

Date of Next Status Update Report: NA

Date of Work Plan Approval: June 11, 2013

Project Completion Date: June 30, 2017

Is this an amendment request? No

PROJECT TITLE: Controlling Terrestrial Invasive Plants with Grazing Animals

Project Manager: John Beckwith, Executive Director

Affiliation: Hiawatha Valley Resource Conservation & Development Council

Mailing Address: 63005 172nd Lane

City/State/Zip Code: Janesville, MN 56048

Telephone Number: (612) 599-5864

Email Address: john.e.beckwith@gmail.com

Web Address: Not applicable

Location: Olmsted County plus one other site within the eleven county area including: Rice, Steele, Dodge, Freeborn, Mower, Fillmore, Houston, Winona, Wabasha, Goodhue, Olmsted.

Total ENRTF Project Budget:

ENRTF Appropriation: \$52,000.00

Amount Spent: \$48,104.60

Balance: \$3,895.40

Legal Citation: M.L. 2013, Chapter 52, Sec., Subd. 06g and M.L. 2014, Chapter 226, Section 2, Subdivision 19

Appropriation Language:

\$52,000 the first year is from the trust fund to the commissioner of natural resources for an agreement with Hiawatha Valley Resource Conservation and Development, Inc. to develop cost effective best management practices to control invasive terrestrial species through planned grazing. This appropriation is available until June 30, 2016, by which time the project must be completed and final products delivered.

Carryforward: (b) The availability of the appropriations for the following project is extended to June 30, 2017: Laws 2013, chapter 52, section 2, subdivision 6, paragraph (g), Controlling Terrestrial Invasive Plants with Grazing Animals.

I. PROJECT TITLE: Controlling Terrestrial Invasive Plants with Grazing Animals

II. PROJECT STATEMENT: Terrestrial invasive plants including buckthorn, wild parsnip, garlic mustard and others are becoming dominate species at an alarming rate in many ecological sites in SE Minnesota. Present chemical and mechanical control methods are costly, effective only in the short-term or have other negative environmental impacts. Prescribed grazing for invasive plant management has been used in many parts of the western US to manipulate patterns of defoliation and disturbance to place target plant species at a competitive disadvantage. This is often done by grazing at a time and frequency when target plants are most vulnerable to prevent flower and seed production. Grazing management that employs multispecies (goats, sheep and cattle) grazing techniques takes advantage of each animal's inherent dietary preferences among different livestock classes. Benefits include reducing the competitive advantage of one plant over another by creating equal pressure on grasses and forbs in a community.

The goal of this project is to: 1) develop a cost effective and environmentally friendly alternative to chemical and mechanical control methods for these species, 2) demonstrate that multispecies grazing techniques can be used effectively to control invasive plants, 3) distribute results during field day demonstrations to connect livestock producers with landowners in the SE Minnesota Driftless Area and 4) develop a Best Management Practice for invasive species control using sustainable grazing management as a component of an overall management plan.

Sites with the target species will be selected and grazed at different durations and intensities using multispecies grazing techniques. The grazing duration, intensity, frequency and timing will be evaluated to determine the most successful method for invasive plant control. Monitoring will be conducted during the spring, summer and fall for three years to document the effect of prescribed grazing management. Control plots will also be established and managed with mechanical or chemical treatments for comparison.

This project will allow Hiawatha Valley RC&D to continue grazing efforts already initiated during the 2011 and 2012 growing seasons to expand federal funds previously earmarked for the Driftless Area Initiative. We envision this project will be the mechanism to transfer small localized prescribed grazing knowledge and sustainable techniques to a broader audience across the SE Minnesota Driftless Area.

III. PROJECT STATUS UPDATES:

Project Status as of January 2014:

Since the awarding of this grant, Hiawatha Valley Resource Conservation and Development Council has done much of the work to prepare for the 2014 grazing season. Initially, staff worked with NRCS Grazing Specialists to determine sites for the project. While several sites were visited, two sites have been determined to be the best fit with the proposed project. The City of Rochester and Steele County Landfill have verbally committed to act as hosts for the project, and formal agreements (as needed) are currently being finalized. The presence of the NRCS Grazing Specialist helped make sure that the grazing stock was appropriate for the types of animals we anticipate having on the sites.

Once the sites were determined, staff turned to locating herders with appropriate grazing stock. By the end of this reporting period, a Request For Proposals had been circulated to partners for feedback and then finalized. In addition, a mailing list of potential herders was received from the Midwest Grazers Association. The RFP will be sent to those on this list as they either have operating herds or have an interest in establishing an operating herd.

Hiawatha Valley RC&D also requested an extension to the original grant end date. Due to the nature of the project, having three full grazing seasons is more illustrative of the effect grazing would have on controlling invasive plant species instead of one full seasons and two half seasons, as the original terms of the grant

dictated. The request has been tentatively approved (pending legislation) and grazing will begin in spring of 2014 and end in fall of 2016.

Amendment Request

Leadership of this project has also undergone a change with staffing transitions at Hiawatha Valley RC&D. John Beckwith will now serve as project leader for the organization (contact information updated above).

Amendment Approved: 05/09/14

Project Status as of July 2014:

Seven potential sites were identified in our RFP and search process. After reviewing the sites for presence of invasive species, interest of landowner after increased awareness of the overall process and responsibilities, and whether grazing animals were available to the site, we narrowed the sites for the project to three sites. Two of these sites will have grazing animals contracted in the upcoming years, and the third site, Gamehaven Scout Camp, will be monitored in relationship to past grazing on this parcel. We will also evaluate the potential of mechanical or chemical treatments on all three sites in an effort to gain the most information from the grazing project.

In the process of evaluating grazers and available sites we have contracted with two individuals. In one case the grazer is the landowner as well. The landowner is building a goat herd for the purpose of invasive species control. We are working with this individual on a related effort to document a business plan related to grazing animals that might be used by others with interest in providing grazing services in their communities. The lack of grazers for this purpose has been a hurdle to overcome in our project. On the second site, the Steele County Landfill, we were able to locate a livestock owner with cattle to put on this more open site with a moderate but increasing infestation of wild parsnip. This grazer is interested in the overall project success, and is experienced in pasturing land away from his home site.

In addition to contracting landowners and grazers an RFP was sent to 25 agencies and partners in the area seeking responses and requesting that they also share the RFP with anyone they know of with the skill set required. We also sent the RFP to four individuals we were aware of with the expertise needed for the work. We heard back from three individuals. One did not make a proposal. After review of the proposals received a selection was made and a draft agreement with that firm is being reviewed with hopes we will enter an agreement with them within the next week.

We have excellent cooperation and contributions from the outside agencies projected to be involved. In addition we have had input from additional naturalist and plant specialists. These activities have us on track to meet the scheduled activities of the work plan.

Project Status as of January 2015:

The project is proceeding on schedule. Two sites have been contracted along with the vegetative specialist for monitoring.

Soon after the Steele County site was contracted it became apparent that that site was not going to work out due to flooding. The grazer requested termination of the contract and returned the payment check to be voided. The site was unsafe due to high water. Although he had started preparation for fencing and purchased the fencing materials he requested no payment for his efforts.

We soon contracted a site at River Bend Nature Center near Faribault. White Sweetclover and buckthorn were the primary invasive species. Garlic Mustard was also found on site, but due to existence of dwarf trout lily in the vicinity grazing will probably not be a control method of choice. This site has provided a very public

opportunity to graze the species of concern. They have used their website to share the project. We will have signs in place next year to better explain the project.

The Aqua Eden site continues to be grazed as well. This has been a very intensively managed site, made possible because the grazer lives at this site. We have received reports for the grazing management of this site and have monitored the change.

WSB & Associates was contracted to complete the vegetative monitoring.

Project Status as of July 2015:

The project sites and contracts are proceeding as scheduled and described above.

The River Bend Nature Center site continues to provide great public exposure, and challenging grazing opportunities. New invasive species have been identified, but we continue to focus on buckthorn, and sweetclover. Lack of sweetclover this year has allowed us to add seasonal grazing of wild parsnip and garlic mustard.

Focus of the Aqua Eden site remains on buckthorn. We did revise the management plan to allow for earlier grazing this year. Winter fencing was a challenge, but the grazer did accomplish this effectively. The goats were monitored closely for potential damage to native vegetation but this did not present a problem.

Staff changes at the monitoring consultant resulted in some additional time to confirm the project expectations for the monitoring phase. The process is now confirmed and we are continuing as planned.

There has been a great deal of interest resulting in local tours/demonstrations, TV and radio spots, and local paper coverage. The grazer has also actively presented the project in you tube videos he has produced.

Project Status as of January 2016:

The project is entering its final grazing year. The Aqua Eden site will not be grazed this year as a part of the contract unless a minor budget revision is approved. This amendment will be requested in near future. With that minor request, I feel we can renegotiate the contract to include grazing on the Aqua Eden site, with the grazer maintaining records, and involve him to a greater level in the outreach and BMP development process. The River Bend Nature Center site has one more season of grazing on the contract.

We met earlier this week with the firm conducting the monitoring and reporting. We are on track with the projects as planned. The vegetative monitoring plan and results have become an area of interest in others involved in grazing of invasive species. This project seems to be the pioneer of these efforts in MN.

Another spin-off of this project has been the establishment of a "service grazing network" under the umbrella of MN Sustainable Farming Association. We are actively engaged with this group of professionals and farmers as we see this group being very helpful in considerations regarding BMP development. This group has grazers, private consultant ecologists, public land managers, UM extension, NRCS, and other nonprofit organizations. It was a result of a meeting at our River Bend Nature Center site.

We are having a great number of discussions regarding the value of grazing in controlling invasive plants, and the best ways to encourage more grazers to get into this service industry. We have applied for grants to help us use what has been learned in this project to develop a business model template, to identify grazing options that maximize profits of such a business, and also to reach out to youth and minority communities to determine interest in service grazing as a part of a beginning farmers operation.

Amendment Request (02/15/2016)

This is a request for a minor budget adjustment needed to most effectively use the available funds within the remaining timeline. Specific adjustments are requested as follows:

- Activity One, *Equipment/Tools/Supplies “for chemical and manual removal for control plots”* reduced from \$1,000 to \$0. The funding is not needed because chemical and mechanical controls were available from partners, without ENRTF funds.
- Activity Two, Professional/Technical/Service contracts for *“vegetative monitoring, grazing plan development, manage and monitor control plots, BMP Development”* reduced by \$73 due to actual contracted value.
- Activity Two, Professional/Technical/Service contracts for *“Landowner/Herdsman (TBD): Service Contract to manage herd, plan decision maker, implement and manage BMP, monitor economic, herd and vegetative status”* reduced by \$150 due to actual contracted value.
- Activity Three, *“Professional/technical/Service Contracts, “John Beckwith, Project Manager: project facilitation, coordination, monitoring, outreach and reporting”* increased by \$1,223 in order to better address the BMP development and economic considerations of service grazing animal enterprises.

Amendment Approved: 2/16/16

Project Status as of July 2016:

The project continues on schedule.

The grazing contract on the Aqua Eden site has expired. Monitoring will continue through this growing season on that site.

A grazing contract remains in effect on the River Bend Nature Center site through this grazing season. This remains a great site for visibility and to generate interest in the project.

We have received a grant from MDA SARE in order to evaluate the potential for winter grazing of invasive plants. This will help us evaluate the profitability and environmental impact of grazing animals through a longer contract season.

We are beginning to look at how the final report will be used to pull together all that has been learned in this project.

Project Status as of January 2017:

The project continues on schedule for completion by June 30th.

Grazing and monitoring are completed for this project in entirety. Draft annual reports are prepared and the final report is being worked upon.

Project Status as of July 2017:

The Hiawatha Valley Resource Conservation and Development Council, Inc., (HVRCD) began implementation of a program to control terrestrial invasive species through grazing with a pilot project in 2011. With the help of the USDA-NRCS a baseline inventory of selected sites was initiated along with documenting the effects of grazing on terrestrial invasive species.

In 2013 HVRCD received funding through the Environmental and Natural Resources Trust Fund (ENRTF). The project goals are: (1) develop a cost effective and environmentally friendly alternative to chemical and mechanical control methods for these species, (2) demonstrate that multi-species grazing techniques can be used effectively to control invasive plants, (3) distribute results during field day demonstrations to connect livestock producers with landowners and (4) develop a Best Management Practice for invasive species control using grazing management as a component.

Three sites were selected as part of this project; Gamehaven Boy Scout Camp, approximately 10 miles southeast of the City of Rochester; River Bend Nature Center in the City of Faribault; and Eden Acres, roughly 5.4 miles southeast of the City of Faribault.

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Garlic mustard density was dramatically reduced in two growing seasons at the River Bend site, showing a 94% decrease in density by 2016.

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Project Results Use and Dissemination

- 1) We were very fortunate to have one of our sites within the River Bend Nature Center near Faribault, MN. Small grazing animals created a great deal of interest amongst their visitors and staff. Handouts were available explaining the project, local newspapers did feature stories, and River Bend shared photos and explanations on their website. Signs were posted at the River Bend Nature Center grazing site appropriately crediting the project and to provide basic information of why there are goats there. These signs also had QR code allowing cell phone users more detailed information on the project. This kept the project in the news during 2015 and 2016 on a regular basis.
- 2) Also at the River Bend site, a volunteer group was organized to combat invasive species. This group conducted buckthorn removal activities through mechanical and chemical means. They also monitored and sought to eliminate other terrestrial invasive plants in the Center. Working along with the grazing efforts provided the members firsthand knowledge of grazing benefits.
- 3) Tours were conducted involving garden clubs, Soil and Water Conservation District employees, USDA-NRCS, other professionals, public land managers, farmers and potential grazers
- 4) The project results were shared at a grazing workshop in Rushford, MN. This workshop was hosted by Hiawatha Valley RC&D and MN DNR. The workshop provided information from a number of sources on the opportunities available for starting a grazing business to control undesirable plants.
- 5) The project has been featured on several radio and television stations in the Twin Cities market over the projects timeframe.
- 6) Project information was shared through brochures at annual conferences of the Association of MN Counties and also the MN Association of Soil and Water Conservation Districts through the MN Association of RC&D Councils exhibit booth.
- 7) A meeting and tour was held with MN Sustainable Farming Association, UM Extension, Three Rivers Park District, Private Consultants, RBNC staff and Hiawatha Valley RC&D leadership to discuss the project, results, consider recommendations, and need for BMP's. In addition, we discussed the opportunities grazing of invasive species might have for beginning farmers.
- 8) The project was presented at the 2016 MN organic agriculture conference and also the 2016 Midwest invasive species conference in LaCrosse, WI.
- 9) The Grazer and Hiawatha Valley RC&D are actively engaged in, and important to the initiation of, a network of ecological grazing partners organized under the MN Sustainable Farming Association.
- 10) Through an AgStar grant we are also utilizing the knowledge gained to develop a business plan model for ag entrepreneurs interested in starting an ecological services grazing enterprise.
- 11) John Beckwith met with the Minnesota Invasive Species Advisory Council to share the project to date and issues being encountered that could benefit from their attention.

- 12) The state grazing specialist of USDA-Natural Resources Conservation Service was very engaged in development and management of this project. During that timeframe he also utilized the information from this project, along with other resources, to develop job sheets for use of grazing in controlling invasive plants in both brush and herbaceous settings. Those job sheets are included with this report and also available on-line through USDA-NRCS.
- 13) The reports were published in hard copy in a limited supply and will be used as handouts for folks interested in the project results.
- 14) The reports will also be put on line on the Hiawatha Valley web page. They will also be made available to link from the MN Sustainable Farming Website – Ecological Grazing Network page.

IV. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1: Inventory, Monitoring, Evaluation and Documentation

In this project, at least two sites will be selected with terrestrial invasive species present and herdsman available to graze animals on these sites in an attempt to disrupt the growth of these plants in favor of more desirable species. We will carry out a detailed monitoring plan to include information on vegetative change, general animal health and weight gains, and the related economic implications.

Site conditions will be documented through photographs and vegetation transects at initiation and as the project progresses (spring, summer and fall).

Grazing management techniques will be monitored and evaluated to determine grazing duration, intensity, frequency and timing modifications required to determine the most effective management for target and non-target species.

Animals will be monitored to determine optimal animal and herd size. Producers will be asked to monitor weight of animals at initiation of grazing and at conclusion, amount of supplemental feed provided to animals, any other supplements received, types of veterinary treatments received, and amount of time for caring for herd and moving fences.

Control plots will be established using alternative methods of species control including chemical controls, burning, and physical removal. These plots will be monitored for method comparisons for outreach at field demonstration days.

Summary Budget Information for Activity 1:

ENRTF Budget: \$ 17,000.00
Amount Spent: \$ 16,366.48
Balance: \$ 633.52

Activity Completion Date:

Outcome	Completion Date	Budget
1. Baseline data collection, vegetation transects, and photograph documentation	September 2015	\$3,000
2. Evaluation of grazing modifications (if necessary) for targeted and non-targeted species.	May 2015	\$7,000
3. Inventory, evaluate & document control sites receiving mechanical and chemical treatment	September 2015	\$7,000

Activity Status as of January 2014:

Two sites have been selected with help from the NRCS Grazing Specialist as noted below. While an initial evaluation of the sites was offered by the Specialist, no official transects or other measures have yet been taken on the sites.

Activity Status as of July 2014:

Site one, Jake Langeslag, owner of Aqua Eden LLC and livestock owner, has had initial data collection made and documented by USDA-NRCS persons. In addition, a second review of plants and initial response to grazing was conducted on-site by NRCS grazing specialist, NRCS forester, a private consultant landscape restoration specialist, and the landowner. Through these site visits and input a draft grazing management plan with recommendations for monitoring have been prepared.

Site two, Steele Co. Landfill with Nick Anderson grazer, has had an initial review by the NRCS grazing specialist. We are awaiting a more detailed assessment in the near future. The extremely wet weather and access to the site has hampered fence building but this should be underway during this week.

Both grazers have been given guidance on the information they are required to provide regarding livestock management and related grazing activities.

In addition, we are in final development stages of an agreement with a plant specialist to conduct the monitoring for the duration of the project. This firm will assume leadership in the monitoring activities in the near future, working closely with the other specialists providing services in-kind.

Activity Status as of January 2015:

Work contracted with WSB & Associates has been conducted primarily by Nicole Lehman. Site assessments and monitoring plans are complete. Monitoring was also completed for 2014. The annual report is being prepared at this time. This report will be available for the July status report. This activity is on schedule.

Project Status as of July 2015:

Staff changes at WSB & Associates delayed some of the reporting requirements. The new staff has been in the field and completed the monitoring. Reports will be secured prior to further payment. We have met with the staff and have confirmed expectations for reporting and monitoring.

Project Status as of January 2016:

The final report for the Gamehaven site near Rochester has been prepared. This site was grazed prior to this ENTRF funded project and was a part of this project for monitoring of changes. The site was not grazed as intensively as our sites in the current project, but has offered some insight as to the impact of grazing on buckthorn.

A draft annual report has been prepared and is out for comment by myself and the grazer for the current grazing sites. The methodology is well documented and the data and information coming from the project appears to be useful in assessing the impact on the plant community. We are looking both at the impact on invasive plants, and also attempting to document impacts on desirable native plants. Perhaps the project would have been better served by extending the timeframe of monitoring. Each year and each species attacked is a learning experience. There is temptation to expand the species being targeted and the acres served but we have maintained a focus to gain the most from what we started with.

We will have some information on plants including buckthorn, white sweetclover, garlic mustard and wild parsnip specifically. The grazer and plant specialists are communicating well on timing of monitoring in order to capture information prior to grazing and during the grazing season. Weather, grazing rotation, plant stage, and

other factors all cause adaptive management of the monitoring plan, but we are capturing the information needed to report out on grazing impacts on these plants.

Activity Status as of July 2016:

The plant specialists continue on schedule in accordance with the prescribed schedule. They have also agreed to look at a site adjacent to the River Bend Nature Center site where garlic mustard has been grazed over past two years. This is a Nature Conservancy owned site.

Activity Status as of January 2017:

All inventory and monitoring has been completed for the project.

Documentation is in draft form for the 2016 annual report. The final report is being worked on and will be completed by March. At that time we will begin the final report for submittal.

Final Report Summary:

Analysis of the project has been completed and is provided in detail in the following documents submitted with this final report:

- Prescribed Grazing (Goat) Project Final Report Covering Years 2014, 2015, and 2016
- Final Project Report Gamehaven Boy Scout Camp

Generally the results on invasive plant species are:

Results show little change in seasonal buckthorn sapling density, an increase in buckthorn seedlings, and variable results for adult buckthorn mortality. However, results show a change in the age stand of buckthorn within treatment areas as fewer live adult and large saplings were documented within the treatment sites. This change allows further treatments by various means more attainable.

Garlic mustard density was dramatically reduced in two growing seasons at the River Bend site, showing a 94% decrease in density by 2016.

Our monitoring was planned and carried out with an emphasis on stem counts of vegetation present. In hindsight, there would have been benefits to also measure the change in total understory composition. The report does note changes to the extent we could with the monitoring plan we carried out. However, there is another story obvious in the photographic monitoring in how the buckthorn sites moved from a very dense, almost impenetrable stand of invasive plants, to a stand of seedlings and saplings under 12" in height that is now a much more manageable situation.

As we have worked with numerous land managers, grazers, city administrators, and natural resource specialist we have come to realize that effective monitoring plans for this activity is a very valuable item. Through this project we have shared our systems of monitoring as a point of reference for others contracting similar services.

ACTIVITY 2: Prescribed Multispecies Grazing of Target Species

Description: At least two sites will be used for this project. One has already been identified (and used in the past) and the other will be identified through an RFP process. Once identified, these sites will be inventoried as to the type of ground cover, presence of invasive species, and other relevant factors as outlined in the previous activity.

Next, livestock producers will be sought to implement prescribed grazing. These producers would need to have the capacity to provide a large enough herd and appropriate animals for the grazing project. Producers would also need to have the capacity to move fences and animals as needed. Finally, any producer chosen for this

project would have to have the ability to measure and provide data on the evaluation points outlined in the previous activity.

The final decision on producers has not yet been made. Currently, a veterinarian with a small goat herd has provided the grazing herd. It may also be possible to use this project as an opportunity to work with young people managing herds or diverse members of the population. A side benefit of this project is to determine whether managing herds to control invasive species is a viable business model.

Once the site and producers are identified, a grazing plan will be developed for each site. In addition to involving the producers and landowners, grazing and other technical experts will also be involved in the development of this plan including Soil and Water Conservation District, NCRS, DNR and others. The plan will identify paddock locations, grazing duration, intensity and frequency during the plants' most vulnerable stage in the reproductive cycle to interrupt flower/seed production. Producers will implement the grazing plan, monitor, and adjust stocking rates as needed. They will also gather the data outlined in Activity 1.

Summary Budget Information for Activity 2:

ENRTF Budget: \$ 23,777.00
Amount Spent: \$ 23,677.00
Balance: \$ 100.00

Activity Completion Date:

Outcome	Completion Date	Budget
1. Select sites with target species & develop site-specific grazing plans (annually)	March 2014	\$8,000
2. Commit to management plans including grazing strategy, paddock enclosures & water sources	September 2015	\$11,777
3. Adjust stocking rates and duration to provide desired control of target species	July 2014	\$4,000

Activity Status as of January 2014:

Staff worked with a NRCS Grazing Specialist to determine sites for the project. Two sites have been determined to be the best fit with the project proposed in this grant. The City of Rochester Park and Recreation Department and Steele County Landfill have verbally committed to act as hosts for the project and formal agreements (as needed) are currently being finalized.

Hiawatha Valley RC&D staff worked closely with the local NRCS Grazing Specialist to make sure that the grazing stock was appropriate for the types of animals we anticipate having on the sites.

Activity Status as of July 2014:

An agreement has been signed with Jake Langeslag. Jake is owner of Aqua Eden, who does landscape improvements including pond design and construction. This site is near Faribault, MN. He is interested in goat grazing to improve the landscape if this project shows success in reducing invasive species. He is also very knowledgeable of birds in the area and how this project may improve habitat. He has fenced several smaller paddocks and will be managing up to eight. He has a draft grazing management plan prepared. He has also met several times with the NRCS grazing specialist in the development of this plan. This site will be grazed by goats of multiple type. We see potential on this site to work with the landowner on the economics of using grazing animals for invasive control, as well as some assessment of related environmental/habitat improvements resulting from grazing.

An agreement has also been signed with Steele County Landfill (landowner) and Nick Anderson (grazer). This site is on the north end of the landfill property, adjacent to a state wildlife management area, and has a deep

pond for watering. The site has moderate infestation of wild parsnip, which if left unchecked would be a major infestation in 3 to 4 years. Due to weather conditions fencing has been delayed but is underway now. The NRCS grazing specialist has been contacted to assist with a grazing plan. This will be completed and the fence location will be documented with a GPS system. This site will be grazed by cattle, primarily long-horns. We see potential on this site to compare grazing to other invasive control practices on the neighboring wildlife management area. Wet access to this site is a concern that remains, but the grazer feels he can make it work.

USDA NRCS and the local SWCD's have been very helpful in identifying potential sites and assisting those selected with management plans.

Activity Status as of January 2015:

The Steele County Landfill site was abandoned due to unsafe conditions created by flooding access to the site.

A contract was entered into with River Bend Nature Center as a substitute for the Steele County site. This has proven to be an excellent location. Species of concern include white sweetclover and buckthorn. Garlic Mustard was also discovered in 2014. Grazing of this area may not be recommended due to the presence of dwarf trout lily. This site is a very public site with many visitors. The goats have attracted attention of many individuals and groups. The site has had numerous visits from groups and wonderful media coverage in print and on WCCO radio. In addition, there have been spin off benefits through the creation of an invasive species workteam/club who are mapping and trying to control invasive plants on the site. Also, the Nature Center is working toward an invasive species management plan for the entire acreage, not just the area of the grazing plan. We have secured some additional funds for this effort as well as several very qualified volunteer and paid professionals.

The Aqua Eden site continues to be managed with very intensive grazing rotations.

Project Status as of July 2015:

Aqua Eden site: Minimal snow fall provided the opportunity to graze this site very early, in March. Electric drills were used to install the fencing, and provided adequate electric ground. We wanted to see which species the goats would consume at this early season grazing event. The vegetation was closely monitored to determine if native species would be grazed and damaged. The goats seemed to have a preference for the buckthorn and dogwoods in this situation. Perhaps the sap was more active, making the trees more palatable. In any case this early grazing was successful in regard to species consumed. The goat density was reduced in this tract due to reduced amount of browse available.

River Bend Nature Center site: The white sweetclover invading the prairie was not a problem this year. There are several possible explanations for this, including weather conditions as compared to last year, the plant being biannual, and perhaps grazing pressure. This species will warrant monitoring next year to determine the grazing impact. Two additional species were identified and the grazing plan adjusted to determine grazing impact on wild parsnip and garlic mustard. Garlic mustard was found on the site during an inventory of dwarf trout lily plants. The life cycle timing is very close to the dwarf trout lily, so grazing on sites with that plant was not deemed advisable. There were sites where the dwarf trout lily was not present that were grazed. Information available suggested that goats would not find this plant palatable. We found the opposite to be the case. They consumed the garlic mustard with enthusiasm. This particular site is along a riparian corridor, very steep with some rock outcrops and generally not accessible for mechanical, human or chemical treatment. It is an excellent site to attempt control with grazing and particularly with goats. In addition, it is adjacent to a residential area and the project was well received by the neighbors. We were able to graze a reasonably sized paddock prior to flower/seed production to determine the impact next spring. We also included the grazing of wild parsnip on site this year. Because the animals were on garlic mustard early, they were put in the wild parsnip after what would be optimal timing. This may have affected the palatability, and also allowed significant grass growth prior to grazing. The goats did consume the wild parsnip, but had a preference for the grasses. This is a case where

multispecies grazing may have an advantage with grass feeders consuming the bulk of the grass and goats forced to consume more wild parsnip. We did attempt a smaller scale multispecies effort on another site with horses and goats. The goats will now be moved back to the buckthorn site, which is less time sensitive.

Project Status as of January 2016:

Grazing of the Aqua Eden site is complete at this time. We will attempt to extend this at a reduced level if a minor budget amendment is approved. Otherwise we will continue monitoring the site through the year to determine the impacts of grazing.

The River Bend Nature Center site continues to provide a wealth of opportunities. The grazing described in July has continued. The white sweetclover site did not regrow in 2015 and was not grazed as a result. The supposedly unpalatable garlic mustard not only was deemed highly palatable by the goats, these goats were also amongst the healthiest through the season. We can not directly attribute the health to the plant, but is noteworthy and warrants further study/experience. It also suggests that knowledge specific to grazing animal and specific invasive plant is lacking and we would benefit from a system of capturing these experiences.

The grazer continues to be very cooperative and presents very good ideas on how to make the most of our project. He is also an excellent communicator and has shared what is being learned from the farmer standpoint on many occasions.

We met earlier this week to confirm the final grazing year plans and to coordinate with the plant specialists. All reports are up to date.

We have collaborated with the grazer in applications for a SARE grant to demonstrate effective invasive plant control with winter season grazing, and also for a corporate grant to help us develop a business model template for future grazers. These are positive spinoffs from this current grant and would be very valuable if funded.

Activity Status as of July 2016:

Grazing is occurring according to schedule. There is interest in extending the grazing contract, or finding other funding sources to continue this treatment on our sites and other sites of interest. To date we have not sought funding for expanding or extending similar funding. Interest is high and we have documented a list of potential sites to be grazed.

Activity Status as of January 2017:

Grazing was completed according to schedule during the final grazing period.

Final Report Summary:

Grazing had ended last fall for this project.

Through this project we developed grazing plans initially to address the vegetative change we intended. We were assisted in this planning process through technical specialists of USDA Natural Resources Conservation Service and very interested grazers.

Through the timeline of the project these initial plans required adjustment for reasons varying from a flooding that resulted in a total loss on one initial site, to accommodating public concerns with electric fencing around children. Having flexibility in the grazing plans is a key issue to address in this type of project. There are too many moving parts to use a cookie cutter plan that requires X head of livestock for a given time period on Y acres of land. We were able to provide some animal density numbers in the reports that will be helpful. There are also good figures from other sources that provide animal density ranges for planning purposes.

While we were forced to focus on goats as grazers primarily, we did on a small scale also incorporate horses on some paddocks. There is value in eliminating some of the grasses and other lush desirable vegetation in order to force the goats to go after the brushy undesirable plants. We are also seeing benefits in our winter grazing project, an off-shoot of this project, in snow and loss of grasses forcing the browsing instincts toward undesirable woody vegetation. Clearly this is an area we will learn more of in the future.

ACTIVITY 3: Outreach, Education, BMP Development and Reporting

Description: As the grazing implementation progresses, information will be distributed using a variety of methods including publications, websites, and media releases. At least twice during each year of the grant, field days will be held. The field day will educate the public and land use professional about effective alternative control methods for invasive plant management. Field days will include tours and will request input from participants for BMP development. Additional information will be shared in press releases and articles in appropriate publications and websites. Information will also be shared with other partners (for example site partners Gamehaven Ranch).

Summary Budget Information for Activity 3:

ENRTF Budget: \$ 11,223.00
Amount Spent: \$ 8,061.12
Balance: \$ 3,161.88

Activity Completion Date:

Outcome	Completion Date	Budget
1. Host 2 field demonstrations per year (6 total)	May 2016	\$6,500
2. Develop multispecies prescribed grazing BMP for invasive plants and business enterprise considerations for a service grazing enterprise.	March 2016	\$3,223
3. Distribute results and final reporting	June 2016	\$1,500

Activity Status as of January 2014:

No progress- these activities will coincide with the three grazing seasons.

Activity Status as of July 2014:

The Langeslag site has scheduled a tour for a local garden organization. They have shown interest in how the goats are impacting the various plants and wildlife habitat.

Activity Status as of January 2015:

The project results to date were shared at a grazing workshop in Rushford, MN. This workshop was hosted by Hiawatha Valley RC&D and MN DNR. The master gardener tour was also completed as scheduled on the Aqua Eden (Langeslag) site. In addition, a brochure was produced to help inform individuals of the project, print media has had stories on the grazing of invasive plants, social media of the grazer and River Bend Nature Center has featured the project throughout the year, and the project was shared on WCCO radio.

Project Status as of July 2015:

A meeting and tour was held with MN Sustainable Farming Association, UM Extension, Three Rivers Park District, Private Consultants, RBNC staff and Hiawatha Valley RC&D leadership to discuss the project, results, consider recommendations, and need for BMP's. In addition, we discussed the business enterprise opportunities grazing of IS might have for beginning farmers. We agreed to continue these discussions and assist each other with this and similar projects.

Seventeen individuals from Hiawatha Valley RC&D and local SWCD and NRCS personnel discussed and toured the project on July 27th. A good discussion was held. The goats were on the wild parsnip site at the time. We

also discussed the need for improved BMP's for grazing of IS species and some of the shortcomings in guidance documents.

The grazer has shared the project success on Fox 9 News, and through you tube videos.

We have initiated the BMP development process. Several good examples have been found. In MN the BMP's will likely be supplements or revisions of local Field Office Technical Guides, SWCD/BWSR guidance documents, of DNR IS management guides. All are lacking in use of grazing as a management tool. Some of the shortcomings we will attempt to address are: need for databases searchable for a tract of land rather than by invasive species in order to improve overall awareness of a landowner prior to identifying a problem plant – usually too late; and, need for grazing schedules similar to the old carrying capacity charts that indicate the best time to impact through grazing, normal flowering/seed set dates, and species preferences or toxicity. This level of science will be beyond the scope of this funded project but we do seek to provide examples for consideration through collecting the best available knowledge from the team we've put together.

We are also working to develop a model grazing management plan for the entire RBNC site. This process will provide us the opportunity to further identify shortcomings in guidance documents that slow or prevent incorporation of IS control at the decision maker level.

Project Status as of January 2016:

NRCS has been actively engaged with this project through their state grazing specialist John Zinn. John has prepared draft fact sheets and standards for grazing as a tool in weed management. These documents are the foundation of communicating BMP's in MN as the local and state agencies utilize the NRCS local field office technical guide as their conservation practice standards. These documents will provide the needed information to provide incentives to landowners in future years.

The grazer was nominated and invited to present the project at the MN Organic Farming Conference earlier this month. The session was well attended with a full room, and there was a great deal of dialogue and interest amongst the attendees.

The meeting of organizations interested in service grazing has now organized as a Network of the MN Sustainable Farmers Association. This provides some organizational and risk management opportunities to the group. It has met two more times and is becoming very active in furthering the cause of service grazing as an enterprise and tool to control undesirable plants.

The public continues to enjoy the goats at River Bend Nature Center. RBNC staff has also been excited about them and relate that the goats are very popular with visitors. We did put out signs this year crediting the ENTRF funds received through LCCMR. Brochures were also produced and will be republished for next year.

Activity Status as of July 2016:

Local organizations continue to tour the site. We are planning an event for fall where we can share our project outcomes to date with other resource managers and professionals. We are also gathering ideas and recommendations on improving the BMPs within MN for grazing of invasive plants.

Activity Status as of January 2017:

Local organizations continue to tour the site. A significant tour was conducted this fall (brochure and flyer provided with this report). Although the day was cool and drizzly, we had approximately 45 in attendance from across MN. RC&D, grazer and monitoring specialist were all on program. The audience was a mix of private landowners, public land managers, resource professionals, and local agencies. An additional grant was received

from Thrivent Financial to provide some signage, printing, and refreshments. In addition, we have participated in the development of an “Environmental Services Grazing Network” with the MN Sustainable Farming Association. Through them we will be posting the BMP’s and a template business plan for public use as a part of our project report/completion.

Final Report Summary:

During the final time period our focus has been on completing the final reports and their publication. Those reports are provided with this report. We have published a supply of these documents for distribution and will have them available on the Hiawatha Valley RC&D web page. We will offer links to this information to the MN Sustainable Farming Association, Ecological Grazing Services Network.

John Beckwith also met with the MN SFA Network leaders and we are planning additional professional and public events to improve awareness of grazing as a tool to control invasive terrestrial plants.

During this time period the project was shared with the Root River Watershed Advisory Committee and also was the focus of the May meeting of the Hiawatha Valley RC&D Council.

A summary of dissemination of information throughout the project period is provided below.

V. DISSEMINATION:

Description: At least twice during each year of the grant, field days will be held. The field day will educate the public and land use professional about effective alternative control methods for invasive plant management. Field days will include tours and will request input from participants for BMP development. Additional information will be shared through written and on-line media. Media to be included are regional farm publications, local news sources, and through related agency publications such as USDA and Soil and Water Conservation District Newsletters. Finally, information will be shared with other partners (for example, site partners Gamehaven Ranch).

Activity Status as of January 2014:

No progress.

Activity Status as of July 2014:

The Langeslag site has scheduled a tour for a local garden organization. They have shown interest in how the goats are impacting the various plants and wildlife habitat.

We have begun discussion of having a tour with a state forester’s organization later in the year. At that time we will have more to share, and the mosquitos will hopefully be fewer in number.

Activity Status as of January 2015:

The project results to date were shared at a grazing workshop in Rushford, MN. This workshop was hosted by Hiawatha Valley RC&D and MN DNR. The master gardener tour was also completed as scheduled on the Aqua Eden (Langeslag) site. In addition, a brochure was produced to help inform individuals of the project, print media has had stories on the grazing of invasive plants, social media of the grazer and River Bend Nature Center has featured the project throughout the year, and the project was shared on WCCO radio. Brochures were also shared at the annual conventions of the Association of Minnesota Counties and Soil and Water Conservation Districts at the MN Association of RC&D Councils exhibit.

Project Status as of July 2015:

A meeting and tour was held with MN Sustainable Farming Association, UM Extension, Three Rivers Park District, Private Consultants, RBNC staff and Hiawatha Valley RC&D leadership to discuss the project, results, consider recommendations, and need for BMP's. In addition, we discussed the opportunities grazing of IS might have for beginning farmers. We agreed to continue these discussions and assist each other with this and similar projects.

Seventeen individuals from Hiawatha Valley RC&D and local SWCD and NRCS personnel discussed and toured the project on July 27th. A good discussion was held. The goats were on the wild parsnip site at the time. We also discussed the need for improved BMP's for grazing of IS species and some of the shortcomings in guidance documents.

The grazer has shared the project success on Fox 9 News, and through you tube videos.

Through sharing of this project we have also requested to present at the MN organic agriculture conference in January of 2016, and been asked to work with the Midwest IS conference in October of 2016 in La Crosse, WI. Our participation will be dependent on obtaining funds for travel and any registration. We do not have this in our budget at this time.

Project Status as of January 2016:

Signs were posted at the River Bend Nature Center grazing site appropriately crediting the project and to provide basic information of why there are goats there. In addition brochures are available on site.

The group identified in the previous status report has organized now into a functioning network under the umbrella of MN SFA. It has expanded to 12 individuals and will now expand further to other organizations, agencies and individuals interested in service grazing enterprises.

The grazer has done an outstanding job of sharing his experience, although not always crediting the project or sponsors to the extent we would hope. We continue to work with him and provide him wording to credit appropriately. He is a wonderful vendor to work with though, and has made greater efforts to acknowledge the funding and other sources of project collaboration.

The grazer did present the project to date at the MN Organic Farming Conference. John Beckwith met with the Minnesota Invasive Species Advisory Council on July 28 to share the project to date and issues being encountered that could benefit from their attention.

Activity Status as of July 2016:

This project continues to receive excellent coverage in various news media.

Activity Status as of January 2017:

This project has become a foundation piece for several related projects underway. All of these combined continue to have significant media coverage from TV, radio and newspaper. The grazer spoke at a significant invasive species meeting in La Crosse, WI which also generated a great deal of attention to the project.

Final Report Summary:

Overall Project Outcomes and Results

The Hiawatha Valley Resource Conservation and Development Council, Inc., (HVRCD) began implementation of a program to control terrestrial invasive species through grazing with a pilot project in 2011. With the help of the USDA-NRCS a baseline inventory of selected sites was initiated along with documenting the effects of grazing on terrestrial invasive species.

In 2013 HVRCD received funding through the Environmental and Natural Resources Trust Fund (ENRTF). The project goals are: (1) develop a cost effective and environmentally friendly alternative to chemical and mechanical control methods for these species, (2) demonstrate that multi-species grazing techniques can be used effectively to control invasive plants, (3) distribute results during field day demonstrations to connect livestock producers with landowners and (4) develop a Best Management Practice for invasive species control using grazing management as a component.

Three sites were selected as part of this project; Gamehaven Boy Scout Camp, approximately 10 miles southeast of the City of Rochester; River Bend Nature Center in the City of Faribault; and Eden Acres, roughly 5.4 miles southeast of the City of Faribault.

Results show little change in seasonal buckthorn sapling density, an increase in buckthorn seedlings, and variable results for adult buckthorn mortality. However, results show a change in the age stand of buckthorn within treatment areas as fewer live adult and large saplings were documented within the treatment sites. This change makes further treatments by various means more attainable.

Garlic mustard density was dramatically reduced in two growing seasons at the River Bend site, showing a 94% decrease in density by 2016.

Additional documents included with this report: Prescribed Grazing (Goat) Project Final Report Covering Years 2014, 2015, and 2016; Final Project Report Gamehaven Boy Scout Camp; Minnesota Practice 528 Biological Brush Management Implementation Guide; Minnesota Practice Implementation Guide Biological Herbaceous Weed Control 528.

Project Results Use and Dissemination

- 15) We were very fortunate to have one of our sites within the River Bend Nature Center near Faribault, MN. Small grazing animals created a great deal of interest amongst their visitors and staff. Handouts were available explaining the project, local newspapers did feature stories, and River Bend shared photos and explanations on their website. Signs were posted at the River Bend Nature Center grazing site appropriately crediting the project and to provide basic information of why there are goats there. These signs also had qr code allowing cell phone users more detailed information on the project. This kept the project in the news during 2015 and 2016 on a regular basis.
- 16) Also at the River Bend site, a volunteer group was organized to combat invasive species. This group conducted buckthorn removal activities through mechanical and chemical means. They also monitored and sought to eliminate other terrestrial invasive plants in the Center. Working along with the grazing efforts provided the members firsthand knowledge of grazing benefits.
- 17) Tours were conducted involving garden clubs, Soil and Water Conservation District employees, USDA-NRCS, other professionals, public land managers, farmers and potential grazers
- 18) The project results were shared at a grazing workshop in Rushford, MN. This workshop was hosted by Hiawatha Valley RC&D and MN DNR. The workshop provided information from a number of sources on the opportunities available for starting a grazing business to control undesirable plants.
- 19) The project has been featured on several radio and television stations in the Twin Cities market over the projects timeframe.
- 20) Project information was shared through brochures at annual conferences of the Association of MN Counties and also the MN Association of Soil and Water Conservation Districts through the MN Association of RC&D Councils exhibit booth.

- 21) A meeting and tour was held with MN Sustainable Farming Association, UM Extension, Three Rivers Park District, Private Consultants, RBNC staff and Hiawatha Valley RC&D leadership to discuss the project, results, consider recommendations, and need for BMP's. In addition, we discussed the opportunities grazing of invasive species might have for beginning farmers.
- 22) The project was presented at the 2016 MN organic agriculture conference and also the 2016 Midwest invasive species conference in LaCrosse, WI.
- 23) The Grazer and Hiawatha Valley RC&D are actively engaged in, and important to the initiation of, a network of ecological grazing partners organized under the MN Sustainable Farming Association.
- 24) Through an AgStar grant we are also utilizing the knowledge gained to develop a business plan model for ag entrepreneurs interested in starting an ecological services grazing enterprise.
- 25) John Beckwith met with the Minnesota Invasive Species Advisory Council to share the project to date and issues being encountered that could benefit from their attention.
- 26) The state grazing specialist of USDA-Natural Resources Conservation Service was very engaged in development and management of this project. During that timeframe he also utilized the information from this project, along with other resources, to develop job sheets for use of grazing in controlling invasive plants in both brush and herbaceous settings. Those job sheets are included with this report and also available on-line through USDA-NRCS.
- 27) The reports were published in hard copy in a limited supply and will be used as handouts for folks interested in the project results.
- 28) The reports will also be put on line on the Hiawatha Valley web page. They will also be made available to link from the MN Sustainable Farming Website – Ecological Grazing Network page.

VI. PROJECT BUDGET SUMMARY:

A. ENRTF Budget:

Budget Category	\$ Amount	Explanation
Personnel:	\$ 0	
Professional/Technical/Service Contracts:	\$ 47,000	Herdsmen/Monitoring contractors (0.32 FTE), Inventory and monitoring contractor (0.35 FTE), project manager (0.13 FTE)
Equipment/Tools/Supplies:	\$ 0	Chemicals for control plots
Printing:	\$ 4,000	General copying required for detail site plans and evaluations; publication of results as handouts for related tours and meetings; publishing results of demonstration, BMP's, and economics on an appropriate website; and, publication and printing of the BMP document to be shared with conservation professionals and livestock farmers.
Travel Expenses in MN	\$1,000	Mileage, Lodging, Meals
Other:	\$0	
TOTAL ENRTF BUDGET:	\$ 52,000	

Explanation of Use of Contracted Staff Also Serving as Executive Director: The Hiawatha Valley RC&D is a small nonprofit serving southeast Minnesota. At this time staff assistance is provided through contracted services of an executive director/program manager, a temporary part-time contracted program manager assigned a specific project during the funding period of that project (ending September 30, 2013), and bookkeeping services. The contracted executive director/program manager would be assigned this project due to the three year timeframe associated with the project, and the experience of that individual in working with farmers of southeast Minnesota. Time and expenses of this individual are accounted for in detail, and not comingled with the responsibilities carried out in service as executive director. We do request approval to utilize the contracted executive director/program manager for project management of this proposal.

Explanation of Capital Expenditures Greater Than \$3,500: N/A

Number of Full-time Equivalent (FTE) funded with this ENRTF appropriation: N/A

Number of Full-time Equivalent (FTE) estimated to be funded through contracts with this ENRTF appropriation: 0.80

B. Other Funds:

Source of Funds	\$ Amount Proposed	\$ Amount Spent	Use of Other Funds
Non-state			
In-kind	\$ 24,000	\$25,486	Professionals involved in development and monitoring of Grazing plans
In-kind	\$ 36,000	\$36,000	Grazing land (value of rental)
State			
TOTAL OTHER FUNDS:	\$ 60,000	\$61,486	

VII. PROJECT STRATEGY:

A. Project Partners:	John Zinn	NCRS-USDA	\$0
	George Poch	Private Soil Scientist	\$0
	Mike Muzzy	NRCS-USDA	\$0
	Kurt Hinz	Minnesota DNR	\$0

B. Project Impact and Long-term Strategy:

Terrestrial invasive plants including buckthorn, wild parsnip, garlic mustard and others are becoming dominate species at an alarming rate in many ecological sites in SE Minnesota. Present chemical and mechanical control methods are costly, effective only in the short-term or have other negative environmental impacts. Establishing a BMP using grazing for wider spread use to control invasive species has potential in several areas: minimizing use of physical or chemical interventions, cost effectiveness, introduction of a business model for managing herds for invasive species management, and of course, controls of invasive plants and return to native species.

This project builds on grazing efforts already initiated by Hiawatha Valley RC&D during the 2011 and 2012 growing seasons and expands on federal funds previously earmarked for the Driftless Area Initiative. We envision this project will be the mechanism to transfer small localized prescribed grazing knowledge and sustainable techniques to a broader audience across the SE Minnesota Driftless Area.

C. Spending History:

Funding Source	M.L. 2007 or FY08	M.L. 2008 or FY09	M.L. 2009 or FY10	M.L. 2010 or FY11	M.L. 2011 or FY12-13
USDA-NRCS Conservation Technical Assistance Program-Driftless Area Initiative					\$16,500

VIII. ACQUISITION/RESTORATION LIST: N/A

IX. MAP(S): N/A

X. RESEARCH ADDENDUM: N/A

XI. REPORTING REQUIREMENTS:

Periodic work plan status update reports will be submitted not later than January 2014, July 2014, January 2015, July 2015, January 2016, July 2016 and January 2017. A final report and associated products will be submitted between June 30 and August 1, 2017 as requested by the LCCMR.

Final Attachment A: Budget Detail for M.L. 2013 Environment and Natural Resources Trust Fund Projects

Project Title: *Controlling Terrestrial Invasive Plants with Grazing Animals*

Legal Citation: M.L. 2013, Chapter 52, Sec., Subd. 06g and M.L. 2014, Chapter 226, Section 2, Subdivision 19

Project Manager: John Beckwith

M.L. 2013 ENRTF Appropriation: \$ 52,000

Project Length and Completion Date: July 2017 (Four Years)

Date of Update:06/30/2017

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Activity 1 Budget	Amount Spent	Balance	Activity 2 Budget	Amount Spent	Balance	Activity 3 Budget	Amount Spent	Balance	TOTAL BUDGET	TOTAL BALANCE
BUDGET ITEM	<i>Inventory, Monitoring, Evaluation & Documentaiton</i>			<i>Prescribed Multispecies Grazing of Target Species</i>			<i>Outreach, Education, BMP Development and Reporting</i>				
Professional/Technical/Service Contracts											
John Beckwith, Project Manager: project facilitation, coordination, monitoring, outreach and reporting	2000	1999	1	2000	2000	0	5223	4858	365	9223	366
TBD (competitive bid): vegetative monitoring, grazing plan development, manage and monitor control plots, BMP development	14400	14213	187	4327	4327	0	1700	1700	0	20427	187
Landowner/Herdsman (TBD): Service Contract to manage herd, plan decision maker, implement and manage BMP, monitor economic, herd and vegetative status.	0	0	0	17350	17350	0			0	17350	0
Equipment/Tools/Supplies											
chemicals/manual removal for control plots	0	0	0	0	0	0	0	0	0	0	0
Printing											
General copying (Sharing of Inventory and Evaluation Plans as well as Grazing Plans and Findings between partners, Outreach for Field Days)	100	0	100	100	0	100	300	47	253	500	453
Publications and Information (Development, Printing and Distribution of final print piece on Project Findings/Best Practices)	0	0	0	0	0	0	3500	1268	2232	3500	2232
Travel expenses in Minnesota											
mileage, lodging, meals. (To Field Days and for management of herders/supervision of sites)	500	154	346	0	0	0	500	188	312	1000	658
COLUMN TOTAL	\$ 17,000	\$ 16,366	\$ 634	\$ 23,777	\$ 23,677	\$ 100	\$ 11,223	\$ 8,061	\$ 3,162	\$ 52,000	\$ 3,895

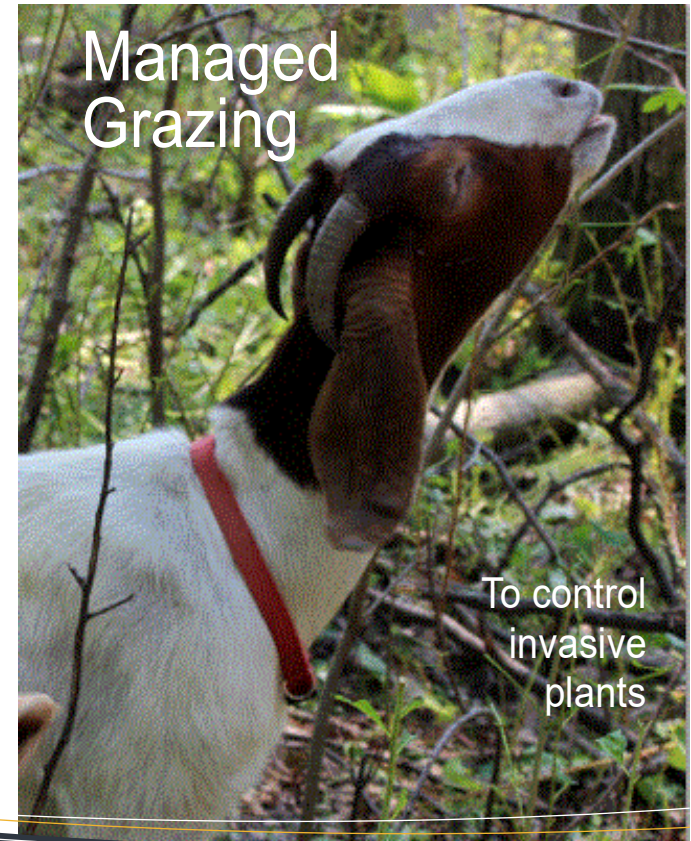


According to the U.S. Fish and Wildlife Service
 "... These invaders, large and small, have devastating effects on U.S. wildlife. Invasive species are one of the leading threats to native wildlife. Approximately 42% of threatened or endangered species are at risk primarily due to invasive species."

FOR MORE INFORMATION

Hiawatha Valley RC&D
 1639 5th Avenue S.E.
 Rochester MN 55904

Phone | 612.599.5864
 Email | john@minnesotarcd.org



Managed
 Grazing

To control
 invasive
 plants

PRESCRIBED GRAZING HAS ADVANTAGES OVER OTHER MANAGEMENT METHODS.

- Treatments can be removed at any time without leaving chemical residues or long-term effects.
- Treatments can be applied to steep, rocky, and remote terrain.
- Grazing animals convert the target species into saleable product such as meat or wool.
- Grazing can provide long-term management while reducing the use of herbicides.

PARTNERING WITH HIAWATHA VALLEY RC&D

This project was developed by Hiawatha Valley RC&D to demonstrate the value of grazing in the control terrestrial invasive species in a cost effective and environmentally friendly manner. Funding for this project was provided by the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR).



CONTROLLING TERRESTRIAL INVASIVE PLANTS WITH GRAZING ANIMALS

Hiawatha Valley
 Resource Conservation
 and Development

ADVANCING OUR KNOWLEDGE OF GRAZING INVASIVE PLANTS TO HELP SLOW THEIR ADVANCE

Grazing is part of the system

This project recognizes that our desired control invasive plants will require our constant attention. We also believe that grazing will be only one tool used in addressing the problem. In some cases, grazing alone can be effective in control. In other cases grazing can improve the effectiveness of other treatments.

Prescribed Grazing can open up densely vegetated areas, allowing access to further control the area with physical or chemical methods.

Grazing in itself is a biological control of plants. We are evaluating how grazing might create opportunities to conduct prescribed burning for additional control - under professional guidance.

In addition, we are interested in demonstrating how livestock can be used to deter invasive plants while incorporating the seeds of desirable native plants.

Additional benefits of the project

Hiawatha Valley RC&D strives to carry out projects that improve the environment while creating economic benefits for our communities and citizens.

Whether it is a larger livestock producer seizing the opportunity for inexpensive forage; an urban person taking on the invasive species while providing sustenance similar to a community garden; or a young person's livestock project – utilizing livestock to control invasive species can be a supplement to a family's income.

This project will evaluate the “gains” provided and educate others on the business aspects of grazing invasive plants.

Also, it is preferable to catch species early and contain or eradicate them before they spread. This project supports the establishment of experienced herdsman with portable equipment for rapid response

Grazing Management Plans

Grazing Management plans were developed to address the specific site and invasive species of concern.

These plans considered alternatives for fencing systems, determined paddock sizes and rotations to effectively diminish the plant vigor and/or interrupt reproduction.

Plans also laid out trails and openings to allow safe and effective fencing of the paddocks and planned for water and supplemental feed options.

Implementation is monitored and the plans are adjusted as needed.



If you're interested in the project results, or considering a grazing enterprise to help battle invasive or otherwise undesirable plants, contact Hiawatha Valley RC&D for assistance.



Final Project Report

Gamehaven Boy Scout Camp

September 22, 2015

Prepared For
Hiawatha Valley Resource Conservation and Development



Acknowledgement: Funding for this project was provided by the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative Citizen Commission on Minnesota Resources (LCCMR).



WSB Project No. 02791-00

**Prescribed Grazing (Goat) Project
Gamehaven Site Final Report**

For:

Hiawatha Valley Resource Conservation and Development

October 6, 2015

Prepared By:

**WSB & Associates, Inc.
701 Xenia Avenue S., Suite 300
Minneapolis, MN 55416
(763) 541-4800
(763) 541-1700 (Fax)**

Executive Summary

In 2011, McGhie & Betts Inc. was contracted with the Hiawatha Valley Resource Conservation and Development (HVRCD) to monitor a research project aimed to develop invasive species control alternatives using biological control methods as opposed to mechanical or chemical. The biological control method that this project focuses on is prescribed grazing using goats. Six plots were originally chosen for monitoring buckthorn and wild parsnip (**Figure 1**). Following the first year of grazing, the scope of the project was limited to buckthorn monitoring in a single plot. Heavy grazing by 103 mature goats was completed in multiple plots at Gamehaven Boy Scout Camp in Rochester, Minnesota. By 2012, the grazed plots did not show significant decreases in concentration of buckthorn. It was suspected that grazing in the latter end of the growing season did not damage the buckthorn plants to a large degree. Targeted grazing continued through the entire growing seasons of 2012 and 2013, limited to a single plot (Plot 1) with fewer goats (an average of 25 rotating goats from May 11).

Site Description

The Gamehaven Boy Scout Camp is a 262 acre parcel in Section 31, Township 106, Range 13 in Rochester, Minnesota. Twelve plots were originally identified as potential grazing sites. Of the 12 potential sites, 6 were chosen based on accessibility, proximity to a water supply, and the presence of invasive species. Out of the six plots chosen, Plots 1 through 5 received monitoring. See **Figure 1** for the original plot and transect locations.

The 7.6 acre Plot 1 was used for targeted grazing after 2011, where three transects, 6-1, 6-2, and 6-3 were established (**Figure 2**). Plot 1 consists of a relatively flat area with forested cover and Frankville silt loam soils.

Species of Concern

European buckthorn, *Rhamnus cathartica*, and wild parsnip, *Pastinaca sativa*, were the principle targeted species for grazing at the Gamehaven site.

Buckthorn is known for having an extended growing season, often leafing out early in spring, and continuing to hold leaves until late autumn and being a prolific seeder. Once buckthorn plants reach 3 to 4 years of age, it begins to produce fruit. Seeds are dispersed through bird droppings and are viable in the soil for an average of 6 years, allowing buckthorn to quickly colonize an area with open canopy and few competitors. When heavily damaged or cut down, buckthorn readily resprouts from the base of the trunk, unless treated with herbicide.

Wild parsnip is a biennial herbaceous plant, producing vegetative growth in the first year, and flowering in the second. It is often found along roadsides, in abandoned fields, on pastures and restored prairies, and disturbed open areas. Bare skin contact with wild parsnip results in blistering, irritation, and discoloration of the skin. When goats were introduced to parsnip plots, they would eat more palatable plants such as raspberries, grape, and honeysuckle before parsnip vegetation. Five goats died during 2011, raising suspicions that wild parsnip was toxic to goats.

However, symptoms of the sick goats matched meningeal worm, a parasite that infects deer and may be spread through deer droppings.

Originally, goats grazed Plots 1 through 6 in August, 2011. After a lack of noteworthy progress, it was determined that grazing should begin early on in the growing season, to remove foliage and increase effectiveness of grazing treatments on buckthorn. Grazing during spring months began in May 2012 and continued for each year of treatment.

Methodology

In 2011, 8 100-foot transects were established in Plots 1 through 5. Three 100-foot transects were established in Plot 1, and 1 100-foot transect was established in each Plot from 2 through 6. Plots 2-5 were monitored for wild parsnip in 2011, while Plot 1 was monitored for buckthorn growth in 2011, 2012, 2014 and 2015. Buckthorn frequency was recorded based on canopy hits per 100 feet of transect and converted to a percentage.

Results

Both buckthorn and wild parsnip data were collected in Plots 1 through 6 in 2011, until the scope of the project was reduced to only buckthorn in Plot 1 in 2012. The first year's results are summarized in **Table 1**.

Table 1: 2011 Grazing Results

Plot Number	Buckthorn	Wild Parsnip
1	6-1 – 76% 6-2 – 32% 6-3 – 32%	Not surveyed
2	Not surveyed	Flower – 5.9% Rosette – 17.6%
3	Not surveyed	Flower – 5.4% Rosette – 23.6%
4	Not surveyed	Flower – 9.7% Rosette – 20.7%
5	Not surveyed	Flower – 3.9% Rosette – 9.9%
6	Not surveyed	Not surveyed

During the four years of monitoring, little change was recorded in buckthorn frequency. A summary of the Plot 1 intersections can be found in **Table 2**.

Table 2: Gamehaven Transect Data

Transect	Number of Occurrences			
	6/23/2011	4/10/2012	8/15/2014	5/19/2015
6-1	76	99	75	73
6-2	37	37	33	88
6-3	37	29	50	86

Due to buckthorn’s prolific seed production, and extended seed dormancy for an average of 6 years, a multi-year plan is necessary to eradicate buckthorn from an area. Since grazing only occurred for 4 years, it is likely that seeds within the forest soil were able to germinate and sprout after older buckthorn plants were grazed and allowed sunlight to reach the forest floor. While goats were able to defoliate mature buckthorn plants, seed consumption and droppings likely exacerbated seedling growth due to an increase of available nutrients. Additionally, goats will need to be fenced in areas to prevent spreading seeds through droppings. Repeated treatments over more years would likely yield more effective buckthorn reduction.

Costs for goat grazing removal totaled approximately \$1,300/acre. Buckthorn removal using chemical and mechanical means total between \$1,000 and \$2,000 based on site location. Given the lack of noticeable reduction of buckthorn and the need for repeated treatments over numerous years, goat grazing may not be the most economically viable option, but a larger dataset would need to be generated to sufficiently determine that. However, combining grazing with chemical or mechanical removal has not been evaluated yet, and the presence of grazing goats at sites has garnered considerable interest from pedestrians and locals, opening the possibility for invasive species education opportunities.

APPENDIX A

Figure 1: Original Grazing Plots

Figure 2: Original Transects

Figure 3: Plot 1 and Transects

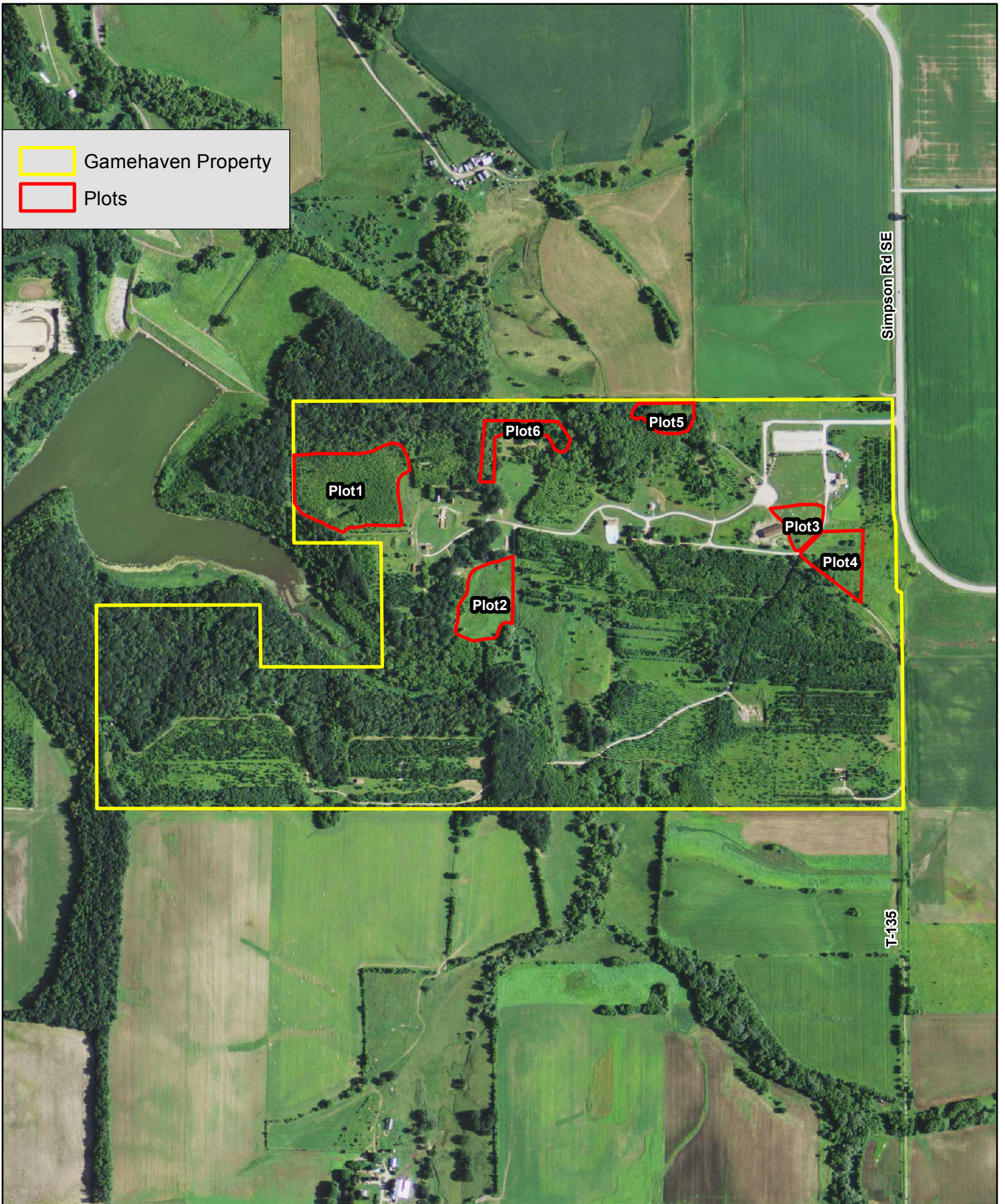
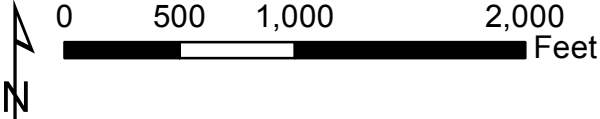


Figure 1: Original Grazing Plots

Gamehaven Scout Reservation
 5615 Simpson Rd SE
 Rochester, MN



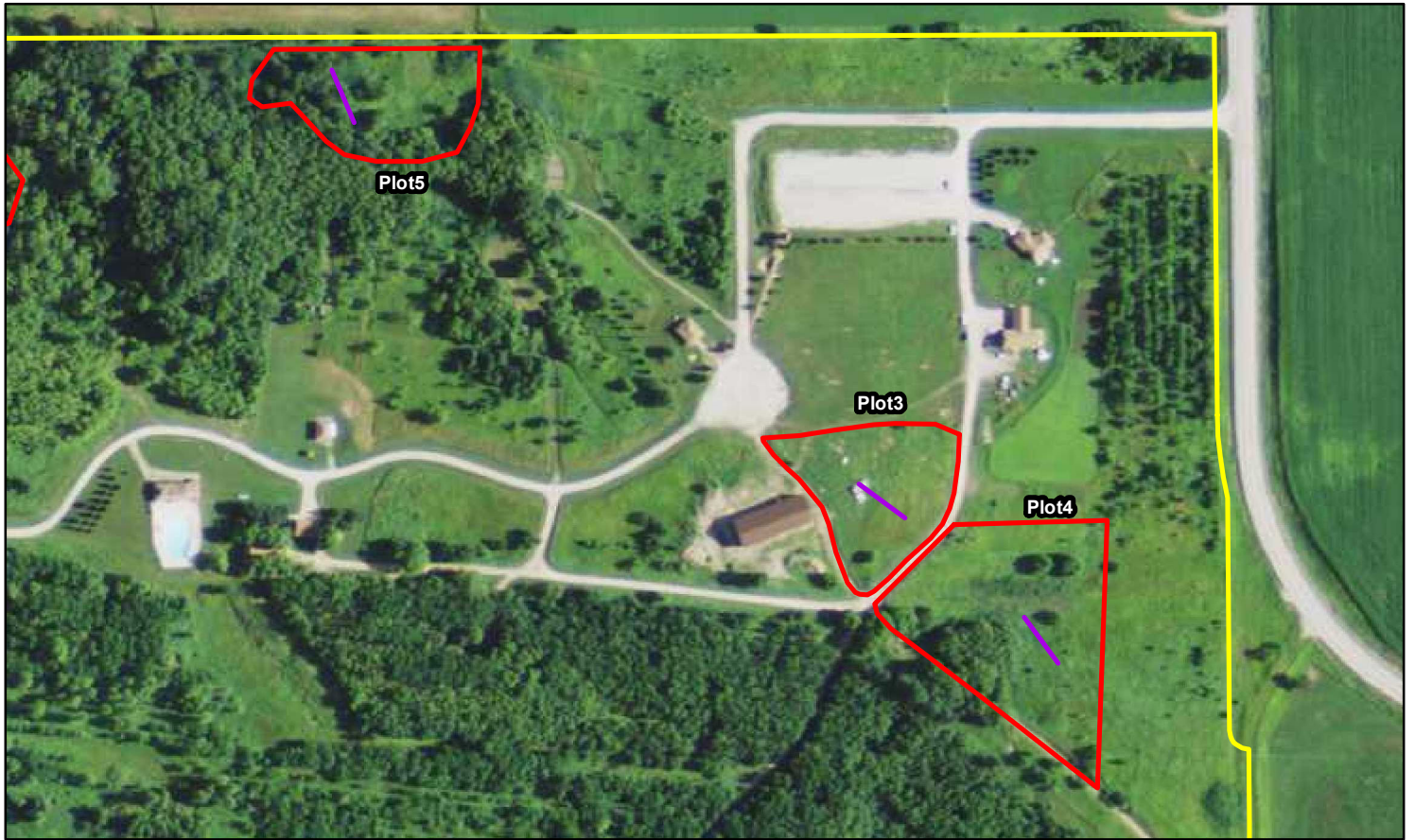


Figure 2: Original Transects

Gamehaven Scout Reservation
 5615 Simpson Rd SE
 Rochester, MN

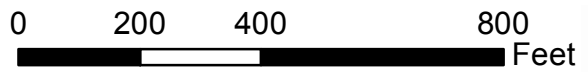




Figure 3: Plot 1 and Transects

Gamehaven Scout Reservation
5615 Simpson Rd SE
Rochester, MN



0 100 200 400 Feet



APPENDIX B
2015 Gamehaven Data Sheets

APPENDIX C
Photos

Transect 6-3 (May 2015)



Transect 6-2 (May 2015)



Transect 6-1 (May 2015)



Plot 1, Pre-Grazing (August 2011)



Plot 1, Post Grazing (September 2011)



Typical Goat Enclosure (September 2011)





Prescribed Grazing (Goat) Project

Final Report Covering Years 2014, 2015, and 2016

at Gamehaven, Eden Acres, and RiverBend Nature Center

June 5, 2017

Prepared For
Hiawatha Valley Resource Conservation and Development



Acknowledgement: Funding for this project was provided by the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative Citizen Commission on Minnesota Resources (LCCMR).



WSB Project No. 02791-00

**Prescribed Grazing (Goat) Project
Final Report Covering Years 2014, 2015, and 2016 at Gamehaven,
Eden Acres, and RiverBend Nature Center**

For:

Hiawatha Valley Resource Conservation and Development

June 5, 2017

Prepared By:

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Executive Summary

The Hiawatha Valley Resource Conservation and Development Council, Inc., (HVRCD) as part of its mission, began implementation of a program to control terrestrial invasive species using alternative biological control methods. The alternative biological control method used goats to graze undesirable vegetation rather than using herbicides or mechanical methods such as mowing, prescribed burning, cutting, etc.

HVRCD began a pilot project in 2011 with the help of the United States Department of Agriculture-Natural Resource Conservation Service (USDA-NRCS) to develop a baseline inventory of vegetative characteristics of selected sites and document the effects of grazing on terrestrial invasive species to determine the efficacy of grazing as a control technique.

In 2013 HVRCD received funding through the Environmental and Natural Resources Trust Fund (ENRTF) Legislative-Citizen Commission on Minnesota Resources (LCCMR). The project goals for ENTRF funds are:

(1) develop a cost effective and environmentally friendly alternative to chemical and mechanical control methods for these species, (2) demonstrate that multi-species grazing techniques can be used effectively to control invasive plants, (3) distribute results during field day demonstrations to connect livestock producers with landowners and (4) develop a Best Management Practice for invasive species control using grazing management as a component.

Three sites were selected as part of this project; Gamehaven Scout Reservation, approximately 10 miles southeast of the City of Rochester; River Bend Nature Center in the City of Faribault; and the property of the grazer, Eden Acres, roughly 5.4 miles southeast of the City of Faribault.

Results show little change in seasonal buckthorn sapling density, an increase in buckthorn seedlings, and variable results for adult buckthorn mortality. However, result show a change in the vertical composition or morphological stage of buckthorn within treatment areas as fewer live adult and large saplings were documented within the treatment sites.

Saplings are defined as individual buckthorn 3”-36” in height, seedlings are below 3” in height, and adults are all buckthorn taller than 36”.

Garlic mustard density was dramatically reduced in two growing seasons at the RiverBend site, showing a 94% decrease in density by 2016.

Site Description

The Gamehaven Boy Scout Ranch is a 262-acre parcel in Section 31, Township 106, Range 13 in Rochester, Minnesota. Twelve plots were originally identified as potential grazing sites. Of the 12 potential sites, six were chosen based on accessibility, proximity to a water supply, and the presence of invasive species. Out of the six plots chosen, Plots 1 through 5 received monitoring. The 7.6-acre Plot 1 was used for targeted grazing after 2011, where three transects (6-1, 6-2, and 6-3) were established.

Six plots were originally chosen in 2011 for monitoring buckthorn and wild parsnip at the Gamehaven Boy Scout Ranch. Following the first year of grazing, the scope of the project was limited to buckthorn monitoring in a single plot, which was completed on May 19, 2015. This concluded the monitoring at Gamehaven Boy Scout Ranch.

River Bend Nature Center consists of 731 acres of forest, prairie, wetlands, and the Straight River in Sections 31, 32, and 33 of Township 110N, Range 20W and Sections 4, 5, and 6, of Township 109N, Range 20W, in Faribault, Rice County, Minnesota. Three sites were identified for grazing purposes in 2014: a prairie sweet clover plot, a forested buckthorn plot, and a forested garlic mustard plot. The River Bend plots received grazing treatments in 2015. One transect was established for each plot in 2015 (**Figure 3, Appendix A**). In 2016 sweet clover did not return on this plot and no grazing occurred, so two (2) transects were established within the buckthorn grazing area and one (1) transect was established as a control in an area that was previously treated mechanically (prescribed burn). For garlic mustard, two (2) transects were established within a grazing area, and one (1) was left as a control.

Eden Acres consists of 10 acres of forested, wetland, and residential land in Sections 10 and 15, of Township 110N, Range 20W, in Faribault, Rice County, Minnesota. Seven plots were established for buckthorn grazing purposes in 2014 (**Figure 4, Appendix A**). Grazing efforts continued in 2015 and 2016, but in 2016, only six (6) transects were surveyed since grazing did not occur throughout the site as in previous years.

The Eden Acres site contains seven transects, which were established in early 2014. The transect locations were established to collect data on different goat grazing intensities within separate goat paddock areas. In 2016, only five (5) of the seven (7) transects were grazed (a prescribed burn was carried out in one transect) and six (6) of the seven (7) were surveyed for buckthorn density.

Species of Concern

The project area contains multiple terrestrial invasive species, but monitoring was limited to buckthorn, wild parsnip, sweet clover, and garlic mustard.

Table 1: Species of Concern

Site	Species
River Bend Nature Center	Buckthorn (<i>Rhamnus cathartica</i>), Garlic Mustard (<i>Alliaria petiolata</i>), Wild Parsnip (<i>Pastinaca sativa</i>), Sweet Clover (<i>Melilotus alba</i>)
Eden Acres	Buckthorn (<i>Rhamnus cathartica</i>)
Gamehaven	Buckthorn (<i>Rhamnus cathartica</i>), Wild Parsnip (<i>Pastinaca sativa</i>)



Buckthorn is known for having an extended growing season, often leafing out early in spring, and continuing to hold leaves until late autumn and being a prolific seeder. Once buckthorn plants reach three to four years of age, it begins to produce fruit. Seeds are dispersed through bird droppings and are viable in the soil for an average of six years, allowing buckthorn to quickly colonize an area with open canopy and few competitors. When heavily damaged or cut down, buckthorn readily sprouts from the base of the trunk, unless treated with herbicide.

Garlic mustard is a biennial herbaceous plant. It is often found invading high quality woodlands, upland, and floodplain forests. It appears as a single stemmed, one to three-foot-tall plant with scallop-edged leaves and numerous small white flowers.





Sweet Clover has the potential to invade high quality grasslands and reduce the ecological integrity by developing into a monotypic stand; reducing vegetative diversity. Sweet clover provides little ecological benefit and can displace other native herbaceous plants that have high coefficients of conservatism.

Wild Parsnip is a perennial invasive plant that is considered a prohibited noxious weed by the Minnesota Department of Agriculture. Skin contact can cause a rash and skin blistering similar to a burn.



Source: DR Blog

Methodology

Previous surveys to monitor grazing success used transect methodology to record data for buckthorn, sweet clover, and wild parsnip. The number of individual plants encountered were recorded and divided into two categories; above and below waist height. In 2014, six transects were completed on the Eden Acres site, one on the Riverbend site, and three at the Gamehaven site. Each of these transects recorded data on buckthorn. The Riverbend transect recorded data on both buckthorn and sweet clover.

To accomplish project goals, we established several transects within each of the study sites. Seven transects were established at Eden Acres and three transects were established at River Bend Nature Center. Transect locations were based on survey work completed in those locations in previous years; areas which had previously been divided up into paddocks where goats were rotated into and out of the plot areas. The seven transects located at Eden Acres are labeled 1-7, but transect 5 does not exist. This is a carryover from some of the original survey work completed here. Transects at Riverbend Nature Center were located based on cover types of buckthorn and garlic mustard. Transects were also located in areas that were representative of the project site and grazing areas.

Transects were 100 feet in length. Data was collected by first establishing a starting point for the transect, then measuring 100 feet using a 100-foot tape measure reel. These two points were demarcated with pink flagging and recorded using a sub-meter accuracy GPS unit. A photo was taken at the both the beginning and endpoint of each transect to document survey conditions and surrounding vegetative cover.

Once established, the transect was surveyed by walking the length and tallying the number of buckthorn stems that were alive or dead. In addition to plant condition, we recorded data on the height of the stems by dividing them into three categories: seedling, sapling, or adult. Individual buckthorn plants less than three inches were recorded as seedlings, buckthorn greater than three inches to less than three feet were identified as sapling, and buckthorn larger than three feet were recorded as adults. Using these two metrics, we could then calculate the total number of stems per transect. In 2016, alternate methodology was used to complete buckthorn counts within the grazing areas for transects #2 and #3 as there was an extremely high number of stems that had sprouted from adult buckthorn trees that had been flush cut at a height of 1-2 feet. For Transect #2, the seedlings and saplings were counted along a 50 foot length of the original 100-foot-long transect and total # of stems were calculated by multiplying the number of stems counted in the field by 2. Transect 3, included a larger number of sprouts from the cut adult buckthorn. Therefore, stems for saplings and seedling were counted along a 4-foot length of the transect, so field counts were multiplied by 25 to get the number of stems per 100 feet to compare to the previous year's survey. Adult buckthorn were counted along 20 feet of the transect, so field counts were multiplied by 5 to get the total number of stems along the 100 feet of transect #3.

Transect surveys are completed three times in 2016 for buckthorn at both River Bend Nature Center and Eden acres, once in the spring before heavy grazing commences once during mid-summer, and once during the fall when other plant species may be senescing making buckthorn easier to identify and to document the response of grazing intensity over the summer. Garlic mustard was surveyed twice in 2016 at River Bend Nature Center, once in early May and once in mid-July.

An alternate methodology that had been used previously proposed for the Eden Acres site is the establishment of a 0.1-acre plot. Live, dead, girdled, and sprouting/sprouting buckthorn stems were to be counted within each macroplot. As soon as full understory canopy emerged (spring period), all available browse was to be clipped starting at the maximum height that goats could browse down to the ground. The extent that goats could remove twigs was to be observed and replicated in the macroplot clippings. Each species was to be clipped separately, dried, and weighed to determine the amount of dry matter per acre each species contributed. While providing more quantitative data for analysis, we did not employ this method due to budgetary and time constraints. The proposed transect methodology provides sufficient data to achieve the two goals outline in the introduction of this document.

Results

GameHaven Boy Scout Ranch

HVRCD and its partners began collecting data both buckthorn and wild parsnip and implementing prescribed grazing on the Gamehaven site in 2011. Six (6) plots were delineated throughout the project area. Five (5) of the six plots contained one transect, while the sixth plot contained three separate transects. Methodology was similar to that described above for this project, except that “canopy hits” were counted along the 100 foot transect converted to a percentage. For wild parsnip, the canopy hits were segregated into both flowering and rosette stage. Data collected between 2011 and 2012 showed a little change in buckthorn canopy hits between the two years. In fact, buckthorn canopy hits increased by 5% across the three transects between 2011 and 2012.

In August 2014, WSB staff replicated transect counts for buckthorn along the three original transects established in 2011 for plot #6 and again in May 2015. Buckthorn density appears to have increased since the original baseline survey and grazing implemented in 2011. Data from 2011, 2012, 2014, and 2015 is displayed in tabular and graphical format below.

Table 2. Gamehaven Buckthorn Survey Results (Canopy Hits and stems/transect)

	Number of Occurrences			
Transect	6/23/2011	4/10/2012	8/15/2014	5/19/2015
6-1	76	99	75	73
6-2	37	37	33	88
6-3	37	29	50	86

Figure 1. Gamehaven Buckthorn Survey Results (Canopy Hits and stems/transect)

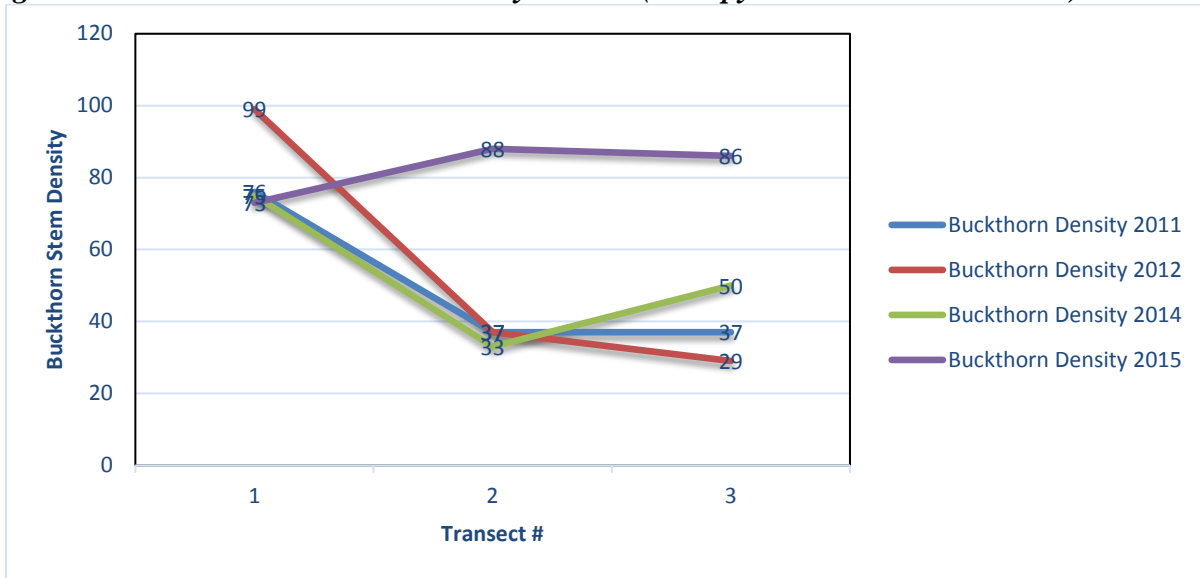
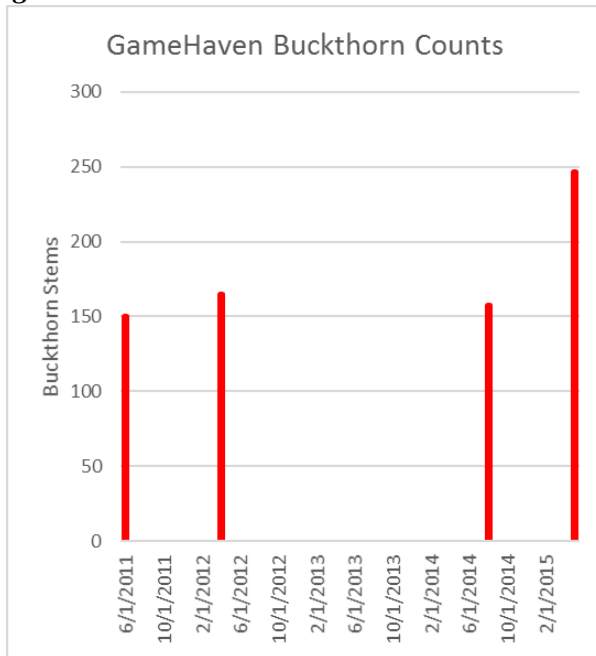


Figure 2. Gamehaven Total Buckthorn Counts Across all Three Transects



Previous reports indicate that grazing had been completed in 2011 and 2012. In 2011, 103 goats grazed plot 6, while in 2012 76 goats grazed. Grazing continued in 2013 and 2014, but no quantifiable data is available. The absence of goats in 2015 may have been the reason for a marked increase in total buckthorn density across all three transect as shown in Figure 2.

Wild parsnip appears to have responded to 2011 grazing as coverage decreased from 23.5% in plot 2 to 2.43% in 2012.

River Bend Nature Center

Transect surveys were completed for garlic mustard, sweet clover, and buckthorn in 2015 and garlic mustard and buckthorn in 2016. The sweet clover site was not grazed in 2016 and therefore not surveyed.

In 2015, one buckthorn transect was established and surveyed to establish a baseline density for buckthorn. The survey documented 199 individual buckthorn stems along the transect. No grazing was completed along this transect in 2015. In 2016, this transect was kept as a control (transect #1), and two (2) additional transect were established inside the goat grazing area. The area was grazed between June 23 and July 10, then again from July 30 to August 13. Three individual surveys were completed to document the effects of grazing on buckthorn density and distribution.



The control transects established in 2015, showed an initial increase in buckthorn stem density from 199 stems in 2015 to 438 stems during the May 4th survey. Stem density decreased over the growing season from 438 stems/100 foot transect to 197 stems by the October survey. This may be due to self-thinning as seedlings counted in the spring survey developed and outcompeted each other during the growing season.

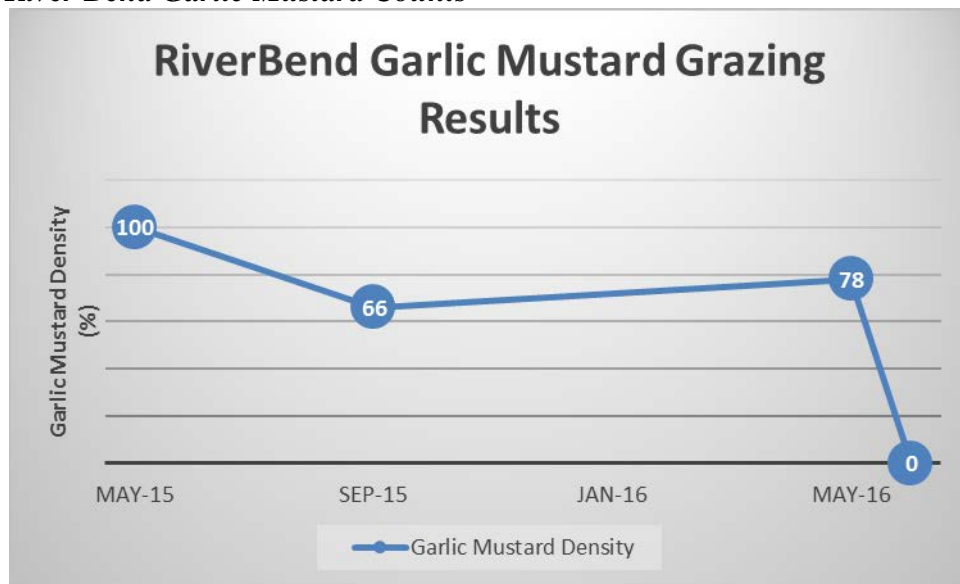
Buckthorn increased dramatically along transect 3 within the grazing area. The initial count along transect 3 resulted in 232 stems. By October this number had increased to 1,485; a 640% increase. Transect 2, initially decreased during the grazing period from 201 stems/100 foot transect to 181, but then increased by the end of the growing season in October to 244. The increase may be due to stump cutting the buckthorn. This resulted in a massive sprouting response by sapling and adult buckthorn. What would have been counted as one (1) sapling or adult before being cut, was counted as 20-50 stems per cut tree in the October survey. Based on this, survey results may not be reflective of the efficacy of the goat grazing.

Goat grazing intensity was 102 goat grazing days (6 goats x 17 grazing days) by the second survey period. Goat grazing intensity increased to 186 goat grazing days by the third period (6 goats x 31 goat grazing days). Goats did not graze beyond August 13, 2016 resulting in a 76-day period before the third survey where goats were not present. This may have allowed additional sprouting and growth by buckthorn within the paddock.

Grazing effects on garlic mustard were documented in one grazing area (paddock) on Riverbend Nature Center. In 2015 one (1) transect was established and surveyed twice, once on May 19, and again on September 30. Garlic mustard canopy coverage decreased from 100% coverage in May 2015 to 66% coverage by the September 30 survey; a 34% decline. In 2016, two transects were established in the same area as transect 1 from 2015, and a third transect was established as a control outside of the paddock from 2015. This transect was eventually grazed as well.

By spring 2016 garlic mustard density was documented at 78% and 64% along transect 1 and 2, which corresponded to transect 1 from 2015. It appears garlic mustard density had remained close to the same density as was surveyed in the September 2015 survey period. By the second survey on June 30, 2016, garlic mustard had decreased to 0% and 5% along transects 1 and 2; a 96% decrease on average. Similar results were recorded for transect 3 which decreased from 58% in the May 2016 survey to 5% by the June 30, 2016 survey. It should be noted that the area that transect #3 was located in was also grazed in 2015 which may have been responsible for the initially low garlic mustard density of 58%. Average reduction for garlic mustard over all transects in 2016 was 94%.

Figure 3. River Bend Garlic Mustard Counts



The reduction in garlic mustard was consistent even though grazing intensity was quite variable in 2016. For both transects 1 and 2, 23 goats grazed for 5 days (115 goat grazing days). Transect 3 was originally set up to be a control and not support any grazing activities; however, 23 goats grazed this site for 19 days (437 goat grazing days) in 2016.

Eden Acres

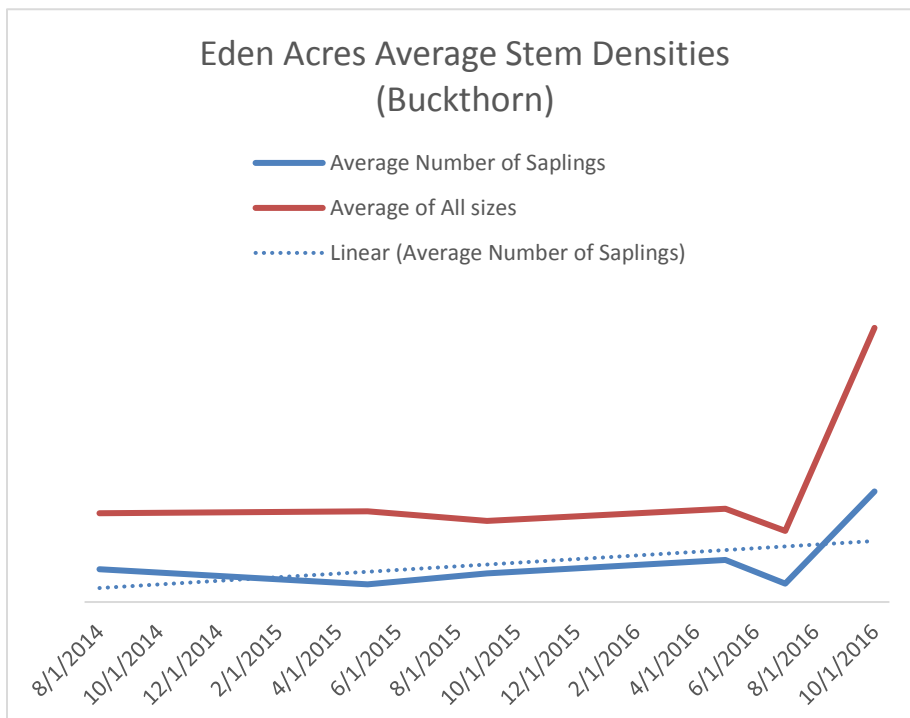
Field data was limited to buckthorn on the Eden Acres site; no data was collected on other invasive species at Eden Acres.

Buckthorn surveys were completed in 2014, 2015, and 2016 on Eden Acres. The 2014 data was collected using a slightly different methodology, but is useful for comparison. Only one survey was completed in 2014, so we will consider that a baseline year, since no other pre-grazing data is available for comparison.

In 2014, an average of 36 buckthorn stems were counted along the transect across all seven (7) transects. This includes seedling, saplings, and adults. When the data is filtered to look specifically at just saplings, the number drops to 13 stems/transect.

In 2015, an average of 35 stems were counted per transect and when filtered for saplings that number again drops to 9.5 stems/transect.

Figure 4. Eden Acres Buckthorn Stem Densities



By 2016 the average number of stems/transect increased to 59 stems/transect, and when filtered for saplings the number was 23 stems/transect. It should be noted that the October 2016 survey greatly increased the average number of stems for both saplings and seedlings. This may be reflective of grazing periods, as in 2014 and 2015 grazing was completed by early September, with the most intense grazing occurring in early to mid-summer.

Grazing intensity varied by year as well. To calculate grazing intensity, we multiplied the number of grazing days by the number of goats that were grazing to determine goat grazing days.

In 2014, the average number of days grazed across transects was 15 with 44 goats giving us 664 goat grazing days. In 2015, the number of grazing days and goat dropped as there were only 15 grazing days with 30 goats resulting in 412 grazing days. In 2016, most of Eden acres was considered one paddock as goats were pastured throughout the summer across the entire acreage. Also, the number of goats ranged from 2-23 with no specific corresponding grazing dates were kept. For this reason, we average the number of goats across the entire grazing period and considered the entire growing season the grazing period (6/12/16 to 10/26/16). This gave us an average of 12.5 goats grazing for 103 days or 920 grazing days. While this shows a higher intensity, the density of goats was not as high as in previous years as they were given most of the property to graze on.

Discussion

A review of the data shows that goat grazing may be most effective in controlling garlic mustard as transect counts showed a 94% decrease in coverage over the two-year monitoring period (2015 and 2016).

A review of buckthorn data from 2012-2016 across all three sites did show significant decrease in buckthorn density. Riverbend data from 2015 and 2016 may have been influenced by stump cutting and sprouting. Also, the density of goats within the paddocks may play a role in the frequency of buckthorn across the transects. The higher number of buckthorn stems is mainly attributed to seedlings. What may be effective is to combine grazing in the early to middle part of the growing season with a fall application of herbicide (such as glyphosate) to the seedlings or a prescribed burn, as the goats are not grazing plants lower than 12 inches (observed by herd owner).

Eden Acres displayed a slight increase in buckthorn stem density between 2014 and 2016. When the October 2016 survey data is not included, buckthorn density is relatively flat showing little change in density. However, as stated above, much of the buckthorn growth can be attributed to seedlings rather than large saplings or adult buckthorn.

In plots with increased buckthorn frequency, there were less buckthorn plants prior to or early on in grazing efforts in 2016. When visiting the site in October 2016, the majority of buckthorn plants in these plots were seedlings or saplings. It appears that goats were effective in removing the adult buckthorn plants, and the increase in buckthorn frequency may be attributed to sprouts in response to sudden canopy openings. The reduction in buckthorn frequency over time compared with the Gamehaven site's increase may be attributed to more frequent grazing by goats, as Eden Acres is home to both the goats and the grazer. This suggests that goat grazing may be more effective in removing buckthorn when frequent grazing is applied.

The project sites showed a shift in understory composition due to a decrease in adult and large sized sapling buckthorn since the project began in 2014. A decrease in canopy density may have allowed more sunlight to penetrate to the forest floor and support native grass, sedge, and forb growth. This growth and increase in diversity was not tracked as a part of this project, but would be beneficial to document as part of a future project involving prescribed grazing.

This shift in composition also provides easier access to the project sites for alternative control methods and data collection.

A follow up project to gather additional information on changes in floristic quality, overall biomass density, and grazing animal metrics (weight, health, etc.) would be very useful to resource managers and livestock producers to further develop a prescribed grazing program.

Additional data collection on grazing intensity (goat days) compared to vegetative biomass and a functional assessment of the vegetative community over a longer period of time and involving more sites would provide a robust dataset where resource managers and producers could develop specific programmatic guidance to use as part of an integrated pest management plan for multiple terrestrial invasive species.

APPENDIX A

Figure 1a: River Bend Site Location

Figure 1b: Eden Acres Site Location

Figure 2: River Bend Transects

Figure 3: Eden Acres Transects

APPENDIX B
Photos



Transect 3, Riverbend, May 2016



Transect 3, Riverbend, May 2015



Transect 3, Riverbend, October 2016



Garlic Mustard Transect 1 at Riverbend in May 2016



Eden Acres Transect 6, 2014



Eden Acres Transect 6, 2015



Eden Acres Transect 6, 2016



Gamehaven 2015, No grazing



Eden Acres Goats, 2015

Typical Goat Enclosure (September 2011)



Appendix C
Site Data

River Bend Garlic Mustard Data

Transect	Visit Date	Garlic Mustard %	Grazed or Control	Number of Goats	Days Grazed	Grazing Days	Dates Grazed
1	5/4/2016	78	Not Grazed	0	0	0	Grazing didn't start until 5-8-16
2	5/4/2016	64	Not Grazed	0	0	0	Grazing didn't start until 5-8-16
3	5/4/2016	58	Control	0	0	0	Grazing didn't start until 5-8-16
1	6/30/2016	0	Grazed	23	5	115	Grazing from 5-8 until 5-12-16
2	6/30/2016	5	Grazed	23	5	115	Grazing from 5-8 until 5-12-16
3	6/30/2016	5	Grazed	23	19	437	Grazing from 5-12-16 until 5-31-16

River Bend Buckthorn Data

Transect	Date Measured	Total Buckthorn			Seedlings			Sapling			Adult			Number of Goats	Duration of Grazing (days)	Grazing Intensity (goat days)	Date of Grazing
		Total	Living	Dead	Total	Living	Dead	Total	Living	Dead	Total	Living	Dead				
1	5/4/2016	438	418	20	231	231	0	186	176	10	21	11	10	0	0	0	No Grazing
2	5/4/2016	201	173	28	66	66	0	112	97	15	23	10	13	0	0	0	pre graze
3	5/4/2016	232	231	1	156	156	0	75	74	1	1	1	0	0	0	0	pre graze
1	7/15/2016	259	259	0	96	96	0	91	91	0	72	72	0	0	0	0	No Grazing
2	7/15/2016	181	177	4	94	94	0	69	69	0	18	14	4	6	17	102	6-23-16 to 7-10-16 and 7-30-16 to 8-13-16
3	7/15/2016	340	340	0	178	178	0	111	111	0	51	51	0	6	17	102	6-23-16 to 7-10-16 and 7-30-16 to 8-13-16
1	10/26/2016	197	181	16	51	51	0	145	130	15	1	0	1	0	0	0	No Grazing
2	10/26/2016	244	238	6	108	108	0	130	130	0	6	0	6	6	31	186	6-23-16 to 7-10-16 and 7-30-16 to 8-13-16
3	10/26/2016	1485	1475	10	1000	1,000	0	475	475	0	10	0	10	6	31	186	6-23-16 to 7-10-16 and 7-30-16 to 8-13-16

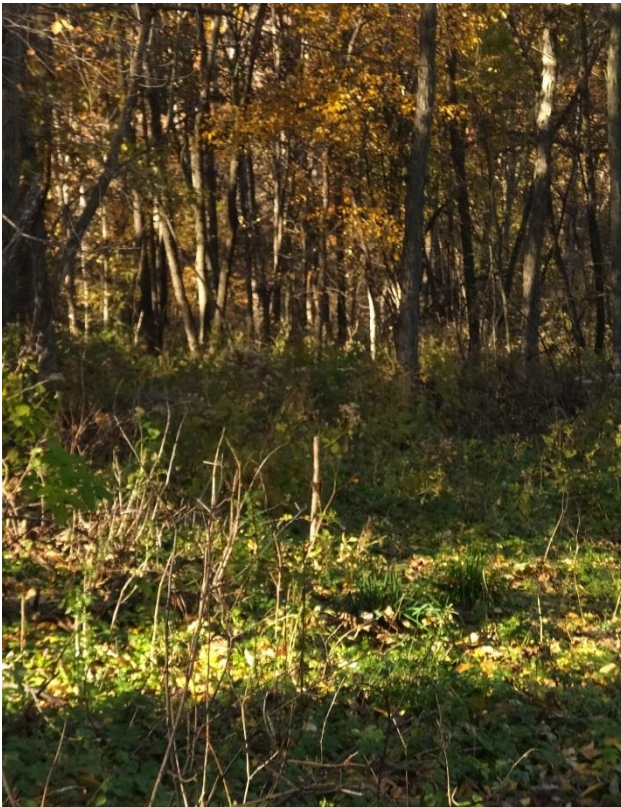
Eden Acres Buckthorn Data

Transect	Date Measured	Total Buckthorn			Seedlings			Sapling			Adult			Goat Area	Number of Goats	Duration of Grazing (days)	Grazing Intensity (goat days)	Date of Grazing
		Total	Living	Dead	Total	Living	Dead	Total	Living	Dead	Total	Living	Dead					
1	5/4/2015	7	7	0	5	5	0	2	2	0	0	0	0	10.4	0	0	0	N/A
2	5/4/2015													10.4	0	0	0	N/A
3	5/4/2015	94	87	7	45	45	0	38	38	0	11	4	7	10.4	0	0	0	N/A
4	5/4/2015	16	9	7	0	0	0	7	4	3	9	5	4	10.4	0	0	0	N/A
6	5/4/2015	64	62	2	22	22	0	36	36	0	6	4	2	10.4	0	0	0	N/A
7	5/4/2015	44	40	4	10	10	0	10	10	0	24	20	4	10.4	0	0	0	N/A
8	5/4/2015	22	22	0	9	9	0	12	12	0	1	1	0	10.4	0	0	0	N/A
	Total		227			91			102			34						
1	7/15/2016	0	0	0	0	0	0	0	0	0	0	0	0	10.4	2-23	34	68-782	6/12/16 to 7/15/17
2	7/15/2016	3	3	0	0	0	0	3	3	0	0	0	0	10.4	2-23	34	68-782	6/12/16 to 7/15/17
3	7/15/2016	71	69	2	35	35	0	19	19	0	15	15	2	10.4	2-23	34	68-782	6/12/16 to 7/15/17
4	7/15/2016	13	5	8	3	3	0	2	2	0	8	0	8	10.4	2-23	34	68-782	6/12/16 to 7/15/17
6	7/15/2016	57	57	0	41	41	0	13	13	0	3	3	0	10.4	2-23	34	68-782	6/12/16 to 7/15/17
7	7/15/2016	39	39	0	4	4	0	8	8	0	27	27	0	10.4	2-23	34	68-782	6/12/16 to 7/15/17
8	7/15/2016																	
			173			83			45			45						
1	10/26/2016	30	25	5	4	4	0	22	20	2	4	1	3	10.4	2-23	103	206-2,369	7/15/16 to 10/26/16
2														10.4	2-23	103	206-2,369	7/15/16 to 10/26/16
3	10/26/2016	301	282	24	164	164	0	130	117	13	7	1	6	10.4	2-23	103	206-2,369	7/15/16 to 10/26/16
4	10/26/2016	66	55	11	41	41	0	24	14	10	1	0	1	10.4	2-23	103	206-2,369	7/15/16 to 10/26/16
6	10/26/2016	165	155	10	112	112	0	48	43	5	5	0	5	10.4	2-23	103	206-2,369	7/15/16 to 10/26/16
7	10/26/2016	99	92	7	29	29	0	59	53	6	4	3	1	10.4	2-23	103	206-2,369	7/15/16 to 10/26/16
8	10/26/2016	63	58	5	32	32	0	26	22	4	4	3	1	10.4	2-23	103	206-2,369	7/15/16 to 10/26/16
	Total		667			382			269			8						

Minnesota Practice 528 Biological Brush Management Implementation Guide

Natural Resources Conservation Service (NRCS)
Minnesota

Practice Code 528
August 2016



Woodland understory more than 40% buckthorn. Photo taken in Rice County, MN. Kopp 2014



Woodland understory after goat grazing. Photo taken in Rice County, MN. Kopp 2014

Definition

Biological Brush Management is the reduction or removal of woody plants including those that are invasive and noxious, accomplished primarily by ruminant species browsing, trampling and stripping bark. For Biological removal of herbaceous plants see Herbaceous Weed Management.

Purposes

The practice is used to provide forage for livestock and manage unacceptable levels of brushy species (trees, shrubs and woody vines) in woodlands, forests, pastures, and rangeland to promote desirable plant growth. The practice may facilitate management of forests, pastures and rangeland, and improve wildlife habitat and can be used to manage unacceptable concentrations of invasive species such as buckthorn, honeysuckle or other plants listed in the Minnesota DNR invasive plants list.

Conditions Where Practice Applies

On forests, native and naturalized pastures, rangeland, wildlife lands, and other lands where trees and shrubs need to be removed to restore or create the desired plant community. Grazing and browsing animals will be used to defoliate the undesired trees and shrubs.

Criteria for Brush Management

Estimating Brush Canopy

Brush canopy estimates will be obtained by counting the number of brush clumps and their percent of area in plots. If the tree or shrub cover is uniform, a 66- by 66-foot plot of 0.1 acre is suitable. If vegetation is unevenly spaced, a more accurate sample can be obtained by using a 0.1-acre plot, 4,356 feet wide and 1,000 feet long. The NRCS National Range and Pasture Handbook, Chapter 4, provides details about monitoring brush composition, yield, and canopy. Identify target species for control and management and estimate concentration and location.

Beginning threshold:

The canopy of brush species will exceed 25% measured at or below seven feet, averaged throughout the targeted area. Brushy species with leaves above seven feet, and with stiff stems that goats cannot bend down to the ground, will not be accessible to livestock and require lopping or chain sawing to force the brush to leaf out within reach of the goats.

Minimum Defoliation:

For Control and Brush Eradication: all brush species will have at least 80% leaf removal and some twigs possibly eaten below seven feet in height throughout the treatment area by mid- August. For Sustainable Browse Management, limit defoliation to no more than 50% leaf removal.

Method/Implementation

Where there is less than 10% brush cover and the goal is invasive species control, use the herbaceous weed control standard and associated Jobsheet.

A Forage Balance Sheet will be developed to estimate the available feed and livestock intake.

Goats have variable daily Dry Matter Intake (DMI) based on their class and size. Class categories include Growing Kids, Nursing Does, Yearlings, Maintenance Goats (Open Does, Wethers, Bucks). DMI estimates are based on the weight of each goat, categorized by its class. According to Langston University meat goat data¹, growing kids consume 7.96% of their body weight in dry matter per day. Nursing does: 4.82%, Yearlings: 3.06%, Maintenance Goats: 2.04%. Adjust stocking rates based on composition of goat herd. Decrease stocking rate if nursing does and kids are used.

Growing calves, yearlings, late pregnancy and lactating beef cows not usually suited to Brush eradication because their nutrient requirements exceed the quality of the forage. Breeds of cattle most suited to brush management include Scottish Highlanders and Dexter. Expect total cattle intake of brush not to exceed 1% of body weight. Monitor body condition of cattle closely.

Brush Reduction or Eradication Strategies

Localized Infestations

Where the target species tend to be concentrated into smaller areas within a larger management unit, the total area will be subdivided into a minimum of three paddocks. Identify the paddock with the largest concentration of the target species and apply the most grazing pressure there. Defoliate to remove 80% of leaves and twigs of species targeted for removal. Estimate size of paddocks initially by stocking one goat per acre for each percent of browse cover. Adjust paddock sizes up or down by noting days it takes to achieve full defoliation. Move goats or other stock to the next paddock and repeat. **When the initial paddock leafs out again, regardless of where the goats are in the rotation, bring them back to the initial paddock to defoliate the brush again. Change stocking rates up or down to adjust for conditions.** Continue this until all paddocks have brush killed or suppressed to 80% defoliation. Killing brush may take 2 to 8 years of repeated browsing. Maintenance with goats should be applied in future years as needed. Browsing after August 15 does not result in control of brush species.

Target Species Evenly Distributed

Where the target species is distributed evenly across the control area a two paddock switchback system can be used. Start when leaves and twigs first emerge. Stock with enough goats to achieve at least 65% defoliation in 30 days. Move goats to the second paddock and defoliate to at least 65%. Repeat process until both paddocks have been defoliated to a minimum of 65%. Adjust stock density up or down as needed.

Browse Management Strategies

Where the goal is to maintain browse, reduce stocking rates. Subdivide area into multiple paddocks and set initial stocking densities. Where grasses and forbs predominate, graze cattle and/or sheep along with the goats and develop a forage balance table to estimate stocking rates.

Considerations

Goat Grazing Preferences

Preferred species:

Box elder, buckthorn, autumn olive, honeysuckle, multiflora rose, blackberry, greenbrier, raspberry, gooseberry, locust, , willow, mulberry, wild grape, , gooseberry, chicory, red clover, ragweed, lambs quarter, curly dock, sericea lespedeza, crown vetch, white clover, red clover, black medic, birdsfoot trefoil, poison ivy/oak/sumac, aspen , pigweed, oak, walnut, cherry, agrimony, burdock, growing tips of most grasses.

Intermediate preference:

Cedar, buck brush, barberry, hickory, sumac, ironweed, lupine, spiny amaranth, Siberian elm , burning bush, prickly ash, pokeweed, buttercup, , thistle, , ox-eye daisy, queen anne's lace, milkweed, upright parts of green garlic mustard, spotted knapweed, leafy spurge, yellow and white prairie clovers.

Not preferred:

Common mullein, velvetleaf, foxtail, reed canarygrass, any dry/stemmy grass, basal or dry parts of garlic mustard, the bulk dry matter component of most grasses

Undesirable or potentially poisonous:

Horse nettle (poisonous), perilla mint, wooly croton, buffalo burr, wild cherry (okay if fresh, poisonous if wilted in large quantity without other forages available), Switchgrass (may cause photosensitivity), alsike clover (may cause liver damage)

Fence:

Use the Minnesota Conservation Practice Standard Fence (382) to construct boundary fencing when permanent fences are desired. Perimeter fences need to be 6 or more wire high tensile electrified fence if goats are the primary species. Woven wire fences with an electric offset wire may also be used. Woven wire alone or high tensile fence with a minimum of three electrified wires are used for permanent interior fence. Voltages between 4000 and 7000 volts are recommended for electric fence to contain goats. Portable electric net fences can substitute for permanent fences and are commonly used, especially for contract grazing.

Watering:

Goats eating dry forages will need approximately 2 gallons of water per day per hundred pounds of body weight. Goats may need no supplemental water when fresh forage is abundant, as is the case early in the growing season in the first day that goats are placed in a paddock that is managed to be defoliated within 4 days. Water intake will increase as lush vegetation availability decreases. Lactating does will consume more water than other classes of goats. Cattle and sheep will have higher water requirements than goats. Plan to supply 2 gallons per hundred pounds body weight per day.

Supplemental Feed

If goats are browsing intermediate preference species they may need supplemental energy or protein or a supplement containing the antidote to the secondary plant compounds that make the plant less desirable for consumption, particularly if they are young, growing animals or lactating. Mature dry nannies or mature wethers may be able to cope short-term with intermediate preference browse without supplementation. The herder needs to monitor the body condition of the animals frequently (no less than once per week).

Sheep Grazing Preferences

. **Sheep alone will not control brush. They must be used in combination with goats.** Sheep brush intake is much less than goats, especially wool breeds. If given free choice, they may take in approximately 10% of their diet as brush. Sheep consume more broadleaf weeds than either goats or cattle, as much as 30% of their diet. The remaining 60% is grass. The planner should use dietary preferences based on the plant community to be controlled. Wool sheep are less suited for brush control and will need supplemental feed if brush is their only forage. Hair sheep would be a second preference to goats for brush control, and approximately equal to Scottish Highland cattle. Siberian elm has been identified as one brush species that hair sheep will consume

Cattle Grazing Preferences

Cattle alone will not control brush. They must be used in combination with goats. Cattle graze brush less aggressively than either goats or sheep and prefer grasses over either forbs or brush. Scottish Highland cattle will browse brush more than other breeds and prefer aspen. Cattle need grass in their forage-based diet to provide sufficient digestible carbohydrates.

Multi-species Browsing

Where the invasive plants are a mix of woody and forb species, a combination of goats and hair sheep, with the percentage of each livestock species by daily DMI being reflective of the percent cover of each type of invasive, can be successfully managed together, or in leader-follower browsing. Likewise, if the invasive community is a mix of invasive brush and grass, goats with hair sheep, or goats with cattle, or goats with horses would be an ideal mix for controlling the invasive plants. Sheep are susceptible to accumulated copper toxicity, thus treatment of sheep with Molybdenum following exposure to high-copper mineral designed for goats or cattle is recommended.

Guard Animals or Protection:

Goat herds need protection from predators such as bears, wolves, coyotes and domestic dogs. The extent of protection depends on the concentration of predators. Means of protection include multi-strand, high tensile electrified fence with sufficient wires located near the potential point of intrusion and a minimum charge of 5000 volts. Dogs, Llamas, and donkeys may be used to guard sheep and goats. A tightly enclosed predator proof area to place sheep and goats overnight may be required depending on location and predator concentration

Biological Brush Management Plan

Client:	Date:	Planner:
County:	Location:	Contract #:

Plan Objectives

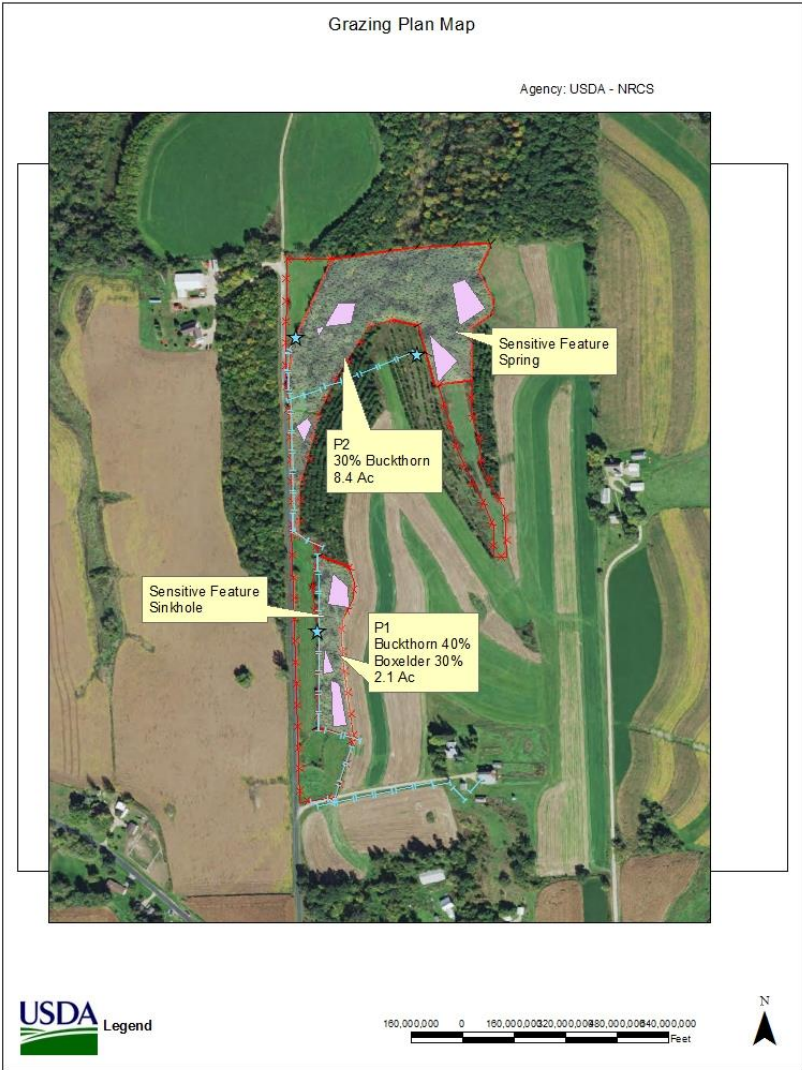
Determine whether the goal is to alter the plant community to provide sustainable browse or eradicate invasive species. Identify the desired species composition.

List Target Brush Species:

Brush Control Plan Details

Management Unit Name	Pasture/Management Goal	Acres	Target Species	Stocking Rate
Example 1	Brush Eradication	2.1	Buckthorn	60 goats
Example 2	Brush Eradication	8.4	Buckthorn	60 goats

Attach aerial photo labeled to show named management units. Management units will be defined by similar brush cover and concentration. On aerial photo show existing and planned fences, pipeline, watering facilities, and environmentally sensitive features (if applicable). Locate concentrations of invasive species. Identify desirable species. List target species for browsing. The sample map above shows the concentrations of Buckthorn in purple. Electric net fencing would be used to subdivide the area and concentrate grazing pressure.



Livestock Inventory

Kind/Class Animal	Number	Average Weight	Total Weight Group
Nanny Goats(example)	60	150	9000

Livestock Watering Plan

Estimate daily water use by animals and describe how water will be delivered. Formula for estimated daily water use is 2 gallon per hundred pounds of body weight. Example; 60, 150 pound goats weigh 9000 pounds as a group. $9000/100 = 90$. $90 \times 2 = 180$ gallons of water.

Kind/Class	Number	Ave. Body Wt.	Group Wt.	Est. Water Need
Wether goat	60	150	9000	180

Sensitive Features Plan

Describe the sensitive features (riparian areas, sinkholes, threatened and endangered species, steep areas, droughty soils, etc.) Locate them on the plan map and describe how they will be managed.

In sensitive areas containing desirable species, but areas with invasive shrubs, goat browsing in the dormant season can kill shrubs while avoiding negative impacts on the desirable plant species. Goats are capable of causing damage to thin-barked brush species after August and during the plant dormant season through girdling of bark. Species girdled by goats include: red cedar, buckthorn, autumn/Russian olive, sumac, small cherry, moderate box elders, moderate locust, small walnut, prickly ash. Species not readily girdled, but damaged by horn rubbing by goats include honeysuckle, barberry, buckbrush, and large grape vines.

Management Unit	Sensitive Feature Type	Management Recommendations

Management Considerations

When weather is colder than 40F and rain is predicted, goats need shelter. Describe in the plan how goats will be protected from cold, rainy conditions. Dry goats can handle up to -30F without wind or rain, but need shelter if temperatures are below 20F with wind. Goats cannot be overwintered with simple windbreaks like beef cattle or wool sheep. Describe in plan how goats and other livestock will be wintered on site if applicable. Describe how and where supplemental feed will be provided if applicable.

Monitoring Plan

Describe how the animal impact will be monitored and list criteria to move animals.

Management Unit	Management Objective	Action	Monitoring Frequency
Example 1	Remove 90% of leaves and new twig growth on all buckthorn as high as the animals can reach.	Remove animals once objective has been reached	Daily
Example 2	Remove 90% of leaves and new twig growth on all buckthorn as high as the animals can reach	Remove animals once objective has been reached.	Daily

Monitoring Report

The monitoring report describes the results of observations and measures progress implementing the plan. Monitor brush control daily. Observations will include the estimated percent of brush defoliation by species, bark stripping by species, any resource concerns in sensitive features, and any health issues in the grazing animals. The monitoring report will include data on species composition before the animals are turned out and when they are removed each year. See sample monitoring report below.

Date	Management Unit	Observations	Action
6/10	Example 1	Goats have removed around 50% of the buckthorn leaves up to the height they can reach	Keep goats in P1 until 90% of buckthorn leaves have been removed.
6/12	Example 1	90% removal achieved	Move to P2

Submit monitoring reports each year with monitoring results and a final monitoring report that describes the species composition and percent defoliation of each management unit.

Practice Specifications Approval and Completion Certification

NRCS Review Only

DESIGN INSTALLATION AND LAYOUT APPROVAL:

Designed By:	Date:	Job Approval Authority (JAA):
Checked By:	Date:	Job Approval Authority (JAA):
Approved By:	Date:	Job Approval Authority (JAA):

LANDOWNER/OPERATOR ACKNOWLEDGES:

- a. They have received a copy of the specifications and understand the contents including the scope and location of the practice.
- b. They have obtained all necessary permits and/or rights in advance of practice application, and will comply with all ordinances and laws pertaining to the application of this practice.
- c. No changes will be made in the installation of the job without prior concurrence of the NRCS.
- d. Maintenance of the installed work is necessary for proper performance during the life of the practice. The practice life is _____.

I have reviewed all specifications and agree to install as specified:

Landowner/operator name (type or print):		
Landowner/operator Signature:		Date:

RECORD OF COMPLETION AND CHECK OUT CERTIFICATION:

Treated Acres:	Date Completed by Client:	Date Certified:	Approver's Initials:

CERTIFICATION STATEMENT:

I certify that implementation of this conservation practice is complete, meets criteria for the stated purpose(s), and meets the NRCS conservation practice standard and specifications.

NRCS Signature:	Date:	Job Approval Authority (JAA):
Notes:		

References

National Range and Pasture Handbook: NRCS, Grazing Lands Technology Institute, 2003

Using Goats to Control Invasive Species ; Nolden, Cherrie; University of Wisconsin, Madison

Targeted Grazing Handbook; University of Idaho;

Prescribed Grazing with Goats; NRCS; Conservation Practice Information Sheet; IS-mo528-gg;2005



Minnesota Practice Implementation Guide Biological Herbaceous Weed Control 528

Natural Resources Conservation Service (NRCS)
Minnesota

Practice Code 528
May 2016

Definition

Biological Herbaceous Weed Control is the reduction or removal of broadleaf plants including those that are invasive, prohibited and noxious, accomplished primarily by ruminant species browsing and trampling. For Biological removal of woody plants see Biological Brush Management.

Purposes

The practice is used to manage unacceptable levels of invasive, prohibited, or noxious broadleaf plants in farmsteads, pastures, and rangeland to promote desirable plant growth and plant communities. In addition the practice may facilitate management of pastures and rangeland, provide forage for livestock, reduce erosion, increase water infiltration, and improve wildlife habitat. The practice can be used to manage unacceptable concentrations of invasive species such as garlic mustard, spotted knapweed or other plants listed in the Minnesota DNR invasive plants list.

Conditions Where Practice Applies

On native and naturalized pastures, rangeland, wildlife lands, and other lands where herbaceous broadleaf plants need to be removed to restore or create the desired plant community. Sheep and goats prefer browsing herbaceous species over other kinds of forages making them well suited to Biological Herbaceous Weed Management. Other species with some capacity to browse weeds are cattle and bison.

Criteria for Herbaceous Weed Management with Sheep

Estimating Herbaceous Weed Canopy

Herbaceous weed canopy estimates will be obtained by using the Line Transect Method and other methods in The NRCS National Range and Pasture Handbook, Chapter 4. Identify target species for control and management and estimate concentration and location. Use clipping and other methods to determine standing biomass for use with forage balance sheets.

Beginning threshold:

The canopy of herbaceous species will exceed 25%, averaged throughout the targeted area. Localized infestations that could negatively impact sensitive features such as unique native plant communities also constitute a threshold. If brush canopy exceeds 25% use the Biological Brush Management Jobsheet for guidance.

Minimum Defoliation:

For control: all target species will have at least 80% leaf removal.

Method/Implementation

Use weed canopy estimates to develop defoliation strategy. Identify concentrations of herbaceous weeds on an aerial photo. Develop a forage balance sheet to determine carrying capacity.

Recommended Method Table for Weed Control

%Forbs	%Grass	%Brush	Species
>25		>25	Use Brush Management Methods
	>75		Use Prescribed Grazing
>25		10-25	Goats and Sheep
25-40	60-75	0-10	Cattle, Sheep, Goats

Weed Reduction Strategies

General Guidelines

Start grazing early in the growing season to defoliate the target species multiple times. Don't allow target species to develop seed heads. Combine with other control methods (fire, mowing, herbicides) if needed. Concentrate livestock to maximize impact and regraze target species when new leaves develop to weaken the plants. Hair sheep consume more herbaceous weeds than wool sheep. Nursing ewes, nannies, and growing lambs and goats may need supplemental feed and their body condition will be monitored to detect loss or gain of body condition.

Localized Infestations

Where the target species tend to be concentrated into smaller areas within a larger management unit, identify the area with the largest species concentration of the target species and apply the most grazing pressure there using portable fence. Defoliate to remove a minimum 80% of leaves. **Estimate size of paddocks initially by stocking one mature sheep or goat per acre for each percent of herbaceous weed cover. Use forage balance sheet from Prescribed Grazing to determine stocking rates for other species.** Adjust paddock sizes up or down by noting days it takes to achieve full defoliation. Move animals to the next paddock and repeat. **When the initial paddock leafs out again, regardless of where the animals are in the rotation, bring them back to the initial paddock to defoliate again. Change stocking rates up or down to adjust for conditions.** Continue this until all paddocks have weeds killed or suppressed to 80% defoliation. Killing weeds will require repeated browsing. Maintenance should be applied in future years as needed.

Example:

Determine the recommended method to use on a pasture that has a 30% infestation of garlic mustard with 5% brush. From the Recommended Method Table above cattle, sheep and/or goats may be used. The initial stocking rate for sheep and goats, sheep alone or goats alone is 30 mature sheep per acre with an assumed average weight of 150 pounds.

Target Species Evenly Distributed

Where the target species is distributed evenly across the control area a two paddock switchback system can be used. Start when leaves first emerge. Stock with enough goats or sheep to achieve at least 65% defoliation in 30 days. Move goats to the second paddock and defoliate to at least 65%. Repeat process until both paddocks have been defoliated to a minimum of 65%. ***Use same starting stocking density as for localized concentrations of target species, one goat or sheep per acre per each percent of weed cover. Add cattle based on projected forage balance sheet.*** Adjust stock density up or down as needed to achieve defoliation goals.

Herbaceous Weed Management Strategies

Where the goal is to maintain herbaceous weeds as part of a grazing system, use the Prescribed Grazing Standard 528.

Considerations

Undesirable or potentially poisonous to all species:

Horse nettle (poisonous), perilla mint, wooly croton, buffalo burr, Switchgrass (may cause photosensitivity), alsike clover (may cause liver damage) Garden Iris, Holly, Morning Glory, Wild Cherry, Yew, Oaks, and Mountain Laurel.

Fence:

Use the Minnesota Conservation Practice Standard Fence (382) for construction specifications for goat and sheep boundary fencing options when permanent fences are desired. Perimeter fences need to be 6 or more wire high tensile electrified fence. Woven wire fences with an electric offset wire may also be used. Woven wire alone or high tensile fence with a minimum of three electrified wires are used for permanent interior fence. Voltages between 4000 and 7000 volts are recommended for electric fence to contain goats. Portable electric net fences can substitute for permanent fences and are commonly used, especially for contract grazing.

Watering:

Goats, sheep and cattle eating dry forages will need approximately 2 gallons of water per day per hundred pounds of body weight. Cattle will require this amount of water or more. Goats may need no supplemental water when fresh forage is abundant, as is the case early in the growing season in the first day that goats are placed in a paddock that is managed to be defoliated within 4 days. Water intake will increase as lush vegetation availability decreases. Lactating does and ewes will consume more water than other classes. Cattle and sheep will have higher water requirements than goats. Plan to supply 2 gallons per hundred pounds body weight per day.

Supplemental Feed

If goats and sheep are browsing intermediate preference species they may need supplemental energy or protein, particularly if they are young, growing animals or lactating. Mature dry nannies or mature

wethers may be able to cope short-term with intermediate preference browse without supplementation. The herder needs to monitor the body condition of the animals frequently (no less than once per week).

Multi-species Grazing

Where the invasive plants are a mix of woody and forb species, a combination of goats and hair sheep, with the percentage of each livestock species by daily DMI being reflective of the percent cover of each type of invasive, can be successfully managed together, or in leader-follower browsing. Likewise, if the invasive community is a mix of invasive herbaceous weeds and grass, goats with hair sheep, or goats with cattle, or goats with horses would be an ideal mix for controlling the invasive plants. Sheep are susceptible to accumulated copper toxicity, thus treatment of sheep with Molybdenum following exposure to high-copper mineral designed for goats or cattle is recommended.

Guard Animals or Protection:

Goat and sheep need protection from predators such as bears, wolves, coyotes and domestic dogs. The extent of protection depends on the concentration of predators. Means of protection include multi-strand, high tensile electrified fence with sufficient wires located near the potential point of intrusion and a minimum charge of 5000 volts. Dogs, Llamas, and donkeys may be used to guard sheep and goats. A tightly enclosed predator proof area to place sheep and goats overnight may be required depending on location and predator concentration

Biological Herbaceous Weed Management Plan

Client:	Date:	Planner:
County:	Location:	Contract #:

Plan Objectives

Determine whether the goal is to alter the plant community or eradicate invasive species. Identify the desired species composition.

List Target Herbaceous Weed Species:

Herbaceous Weed Control Plan Details

Management Unit Name	Pasture/Management Goal	Acres	Target Species	Percent Herbaceous Weed Cover	Stocking Density
Example	Weed Eradication	1.75	Garlic Mustard	30	20 sheep and 10 goats/acre

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Attach aerial photo labeled to show named management units. Management units will be defined by similar weed cover and concentration. On aerial photo show existing and planned fences, pipeline, watering facilities, and environmentally sensitive features (if applicable). Locate concentrations of invasive species. Identify desirable species. List target species and identify whether the goal is species eradication or changing the plant community.



Livestock Inventory

Example

Kind/Class Animal	Number	Average Weight	Total Weight Group
Ewes	20	150	3000
Lambs	30	50	1500

Planned Livestock

Kind/Class Animal	Number	Average Weight	Total Weight Group

Livestock Watering Plan

Estimate daily water use by animals and describe how water will be delivered. Formula for estimated daily water use is 2 gallon per hundred pounds of body weight.

Example

Kind/Class	Number	Ave. Body Wt.	Group Wt.	Est. Water Need
Ewes	20	150	3000	60
Lambs	30	50	1500	30

Kind/Class	Number	Ave. Body Wt.	Group Wt.	Est. Water Need

Sensitive Features Plan

Describe the sensitive features (riparian areas, sinkholes, threatened and endangered species, steep areas, droughty soils, etc.) Locate them on the plan map and describe how they will be managed.

Management Unit	Sensitive Feature Type	Management Recommendations

Management Considerations

When weather is colder than 40F and rain is predicted, goats need shelter. Describe in the plan how goats will be protected from cold, rainy conditions. Dry goats can handle up to -30F without wind or rain, but need shelter if temperatures are below 20F with wind. Goats cannot be overwintered with simple windbreaks like beef cattle or wool sheep. Describe in plan how goats and other livestock will be wintered on site if applicable. Describe how and where supplemental feed will be provided if applicable.

Monitoring Plan

Describe how the animal impact will be monitored and list criteria to move animals.

Management Unit	Management Objective	Action	Monitoring Frequency
Example	Remove 80% of leaves on all garlic mustard.	Remove animals once objective has been reached	Daily

Monitoring Report

The monitoring report describes the results of observations and measures progress implementing the plan. Monitor herbaceous weed grazing daily. Observations will include the estimated percent of weed defoliation by species, any resource concerns in sensitive features, and any health issues in the grazing animals. The monitoring report will include data on species composition before the animals are turned out and when they are removed each year. See sample monitoring report below.

Date	Management Unit	Observations	Action
6/15	P1	Animals have removed around 50% of the garlic mustard leaves from the concentrated area.	Keep animals in 1D until 80% of garlic mustard leaves have been removed.

Submit monitoring reports each year with monitoring results and a final monitoring report that describes the species composition and percent defoliation of each management unit.

Practice Specifications Approval and Completion Certification

NRCS Review Only

DESIGN INSTALLATION AND LAYOUT APPROVAL:

Designed By:	Date:	Job Approval Authority (JAA):
Checked By:	Date:	Job Approval Authority (JAA):
Approved By:	Date:	Job Approval Authority (JAA):

LANDOWNER/OPERATOR ACKNOWLEDGES:

- a. They have received a copy of the specifications and understand the contents including the scope and location of the practice.
- b. They have obtained all necessary permits and/or rights in advance of practice application, and will comply with all ordinances and laws pertaining to the application of this practice.
- c. No changes will be made in the installation of the job without prior concurrence of the NRCS.
- d. Maintenance of the installed work is necessary for proper performance during the life of the practice. The practice life is _____.

I have reviewed all specifications and agree to install as specified:

Landowner/operator name (type or print):		
Landowner/operator Signature:		Date:

RECORD OF COMPLETION AND CHECK OUT CERTIFICATION:

Treated Acres:	Date Completed by Client:	Date Certified:	Approver's Initials:

CERTIFICATION STATEMENT:

I certify that implementation of this conservation practice is complete, meets criteria for the stated purpose(s), and meets the NRCS conservation practice standard and specifications.

NRCS Signature:	Date:	Job Approval Authority (JAA):
Notes:		

References

National Range and Pasture Handbook: NRCS, Grazing Lands Technology Institute, 2003

Using Goats to Control Invasive Species ; Nolden, Cherrie; University of Wisconsin, Madison

Targeted Grazing Handbook; University of Idaho;

Prescribed Grazing with Goats; NRCS; Conservation Practice Information Sheet; IS-mo528-
gg;2005