Optimizing Native Prairie Seed Harvest and Replanting on State-owned Lands

Considerations for criteria, guidelines, and incentives that ensure the survival of native prairie remaining in Minnesota

A report to the Minnesota Legislature,
Environment and Natural Resource Finance Committees
(2007 Appropriation Language, Chapter 57, Article 1, Section 4, Subdivision 8)

Submitted by the
Minnesota Department of Natural Resources
a product of the
Prairie Seed Production and BioEnergy Project

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Executive Summary

The 2007 Minnesota Legislative Session appropriated the Minnesota Department of Natural Resources (MNDNR) $125,000 "to support a technical advisory committee and for land management units that manage grass lands in order to develop plans to optimize native prairie seed harvest and replanting on state-owned lands" (Chapter 57, Article 1, Sec.4, Subd.8). Furthermore, the Legislature directed the MNDNR to establish a Technical Advisory Committee, and submit a report by December 15, 2007, on its outcomes, including criteria, guidelines, and recommendations for incentives. This directive led the MNDNR to create the Prairie Seed Production and BioEnergy Project (PSPB).

MNDNR (in cooperation with the Minnesota Department of Agriculture and the Board of Water and Soil Resources) created the Technical Advisory Committee. The Technical Advisory Committee is comprised of non-government stakeholders and State agency personnel as mandated in statute. A Technical Team of plant ecologists and restoration practitioners representing MNDNR Divisions also aided in the PSPB project. The findings of the Technical Advisory Committee were presented to the NextGen Energy Board on November 29, 2007. This report marks the completion of Phase I of this project and meets the legislation's requirement to submit a report on outcomes from the technical committee to the legislative finance chairs on environment and natural resources by December 15, 2007.

Phase II of the project will create plans that explore and apply results from the Phase I report. Phase II of the project will begin in January; all project work will be completed by June 30, 2008.

This appropriation represents one element in the growing interest to find synergy between the need for grassland habitat and Clean Energy. New Clean Energy initiatives supporting large-scale reconstructing of prairie with local ecotype seed will likely necessitate harvesting from remnant native prairies. The report focuses on guiding prairie harvesting and reconstruction practices to ensure survival of the native prairie remaining in Minnesota.

Project Products:

1. **A set of Criteria** for identifying public and private lands that could produce local eco-type prairie seed, and for identifying lands that could be used to reconstruct prairie that could produce Clean Energy.
2. **A set of Guidelines** for producing prairie seed and reconstructing prairie that safeguard ecological values.
3. **A list of Incentives** that might encourage production of local eco-type prairie seed, and also reconstruct prairies that could serve Clean Energy needs.

The Technical Committee has learned:

- **Protection of Native Prairie –** All work related to prairie seed harvest and replanting must be in concert with the protection and survival of native prairie remaining in Minnesota. Broad spectrums of prairie management practices are being applied in the State; this effort should strive to increase the quality of such practices rather than lower expectations to a common denominator.
- **Seed Production –** Production of prairie seed from either native prairies or reconstructed prairies requires a unique set of criteria and guidelines. Remnant native prairie sites require

stringent production guidelines to safeguard ecological values. Current seed production capacities and needs across the prairie regions of the State are not well defined. It is unlikely all of Minnesota's reconstruction needs can be met with harvests from native prairies and first generation reconstructions. Seed supplies from second and third generation reconstructions may be needed in order to safeguard remnant native prairies from over harvesting seeds.

- **Seed Market –** MNDNR is an important but relatively small consumer of prairie seed for prairie reconstruction. Minnesota Department of Transportation is a larger consumer of private prairie seeds for its roadside reseeding projects, giving preference to source-identified seed. Federal Farm Bill programs may have substantial influence on demand for appropriate prairie seed.
- **Seed Certification –** It will be essential to develop and enforce seed certification standards for prairie seeds to meet the needs of consumers and producers, and safeguard ecological values.
- **Mandates and Statutory requirements** – State-owned lands are often subject to Federal requirements and State statutory mandates that impact those lands' ability to provide seed to the private marketplace.
- **Research needs –** Seed consumers, in general, are uncertain about what defines local ecotype seed, and what limits should be placed on origin of seed. Little is understood about growing monoculture production plots, and any genetic implications. More research may provide answers to these questions.
- **Clean Energy –** More information is needed to effectively promote reconstruction of prairie for Clean Energy. So far, the Project has explored reconstruction of prairies with ecological values as the primary motivation. The Board of Water and Soil Resources led Clean Energy discussions may provide additional incentives for reconstructing prairies when energy values are the primary motivation.

Recommendations for Phase II:

- **Testing and Improvements –** Test the report's criteria and guidelines using geographical information system (GIS) modeling; use these GIS models to analyze current seed production capacities on state-owned lands and the private market
- **Seed Market –** Outline long-term prairie reconstruction needs and clarify future demand for seed; develop a fair and equitable process for providing MNDNR local ecotype seed to the private market that integrates statutory limitations and protection of native prairie.
- **Outreach –** Summarize findings of this Project for distribution to prairie reconstruction practitioners.

Recommendations beyond Phase II:

- **Seed Production –** Partner with Minnesota Department of Agriculture to develop and possibly fund their Native Grasses and Wildflower Seed Production Incentive Loan Program.
- **Seed Certification –** Partner with the Minnesota Crop Improvement Association to further advance the Native Grass and Wildflower Certification Program, such as developing standards for monoculture seed production, and applying new technologies such as genetic profiling
- **Research and Development** – Support continued research into the implications of producing seed in monoculture stands and not using local origin seed; develop practical genetic profiling techniques.
- **Clean Energy –** Continue to work with other initiatives, such as those being led by the Board of Soil and Water Resources, linking findings of this report to prairie-based Clean Energy programs.

Contents

Abbreviations used in this report

BWSR – Board of Soil and Water Resources
ECS – Ecological Classification System
Gθ – Generation zero
G1 – Generation one
LGU – Local Government Unit
MCIA – Minnesota Crop Improvement Association
MDA – Minnesota Department of Agriculture
MNDNR – Minnesota Department of Natural Resources
MNDOT– Minnesota Department of Transportation
NPC – Native Plant Community
NRCS – Natural Resource Conservation Service
TNC – The Nature Conservancy
USDA – United States Department of Agriculture
USFWS – United States Fish and Wildlife Service

Estimation of Report costs (Phase I):

Project expense	Estimated cost
Agency staff (including project staff & facilitator, Technical Project Team, & other DNR personnel staff to develop, review & approve report)	$32,700
Citizen Advisors (including Technical Advisory Committee & members of the Commissioner's Advisory Committee)	$20,800
Direct Project Expenses (including meeting expenses & travel for lead project staff)	$1,400
Estimated Total	**$54,900**

Introduction

Minnesota's Prairie

Minnesota native prairie lands were part of the largest ecosystem in North America, which stretched from Canada to Mexico and from the Rockies to Indiana. Habitats ranged from sparsely vegetated sand dunes, to steep blufflands, to vast expanses of tallgrass prairie, to wet sedge meadows and marshes. Prior to European settlement 18 million acres of native prairie existed in Minnesota, most all of which has vanished. Flat and fertile prairies easily plowed have been converted to cropland and lost forever. Native prairies less suitable for row crops became pasturelands, many succumbing to overgrazing and broad herbicide usage. Other native prairies remained isolated from the conditions that shaped them and were lost to invasive species. As prairie habitats dwindle, populations of prairie dependant mammals, birds, and insects have also declined. Minnesota's Comprehensive Wildlife Conservation Strategy (CWCS) identifies 139 Species of Greatest Conservation Need (SGCN) in the Prairie Parkland Province. The CWCS problem assessment indicates habitat loss and degradation are the predominant challenges facing prairie SGCN's. Today, less than one percent (about 150,000 acres) of Minnesota's native prairie remains, and it continues to be lost.

Use of the terms "prairie" and "native prairie" can be variable, and are often applied inconsistently. In this report, "native prairie" means land that has never been plowed where native prairie vegetation originating from the site currently predominates or, if disturbed, is predominantly covered with native prairie vegetation that originated from the site. Unbroken pasture land used for livestock grazing can be considered native prairie if it has predominantly native vegetation originating from the site and conservation practices have maintained biological diversity. "Reconstructed prairie," means land that has been planted with native prairie species, completely converting it from a non-prairie land type such as row crop agriculture. Minnesota Statute 84.02 (2007) provides this definition for native prairie as well as a definition of ecotype regions (appendix A).

Native prairies store the species diversity and genetic adaptations preferred for high quality prairie reconstruction. Thus, native prairies become the initial seed sources for native prairie seed production and tomorrow's reconstructed prairies. This report addresses two practices in Minnesota's overall approach for protecting remaining native prairies, harvesting seed and reconstructing prairie. Not addressed is the continued loss of native prairie to degradation, conversion and invasive species, or strategies to deal with these losses.

Role of Prairie in meeting Clean Energy needs

Biomass energy crops are increasingly being viewed as a means to mitigate greenhouse gases, decrease dependence on foreign energy supplies, provide alternative crops for agriculture, and enhance rural development opportunities. When compared to traditional row crops, perennial biomass energy crops can provide improved soil quality and stability, improved water quality, habitat for wildlife, and lower inputs of energy, water, and agrochemicals. Planting low-input high-diversity mixtures of native prairie species to produce bioenergy feedstock is one approach being embraced. These reconstructed prairies are harvested for the energy fixed through photosynthesis. Large-scale conversion to intensively managed biomass plantings could dramatically impact Minnesota's natural resources. Benefits to natural resources from bioenergy plantings will depend on what is planted, where and how feedstocks are grown, and how the

bioenergy crop is managed and harvested. This report addresses "what is planted" by looking at production of local ecotype prairie seed for reconstructing diverse prairies that could serve Clean Energy needs.

Harvesting seed and reconstructing the Prairie

Minnesota is left with small isolated fragments of native prairie occurring on what is often considered difficult terrain, or marginal land. Many native prairies are found on steep slopes, areas with exposed rocks, or wet low lands. Physical characteristics that kept many native prairies from being destroyed can also make them difficult to harvest for any purpose. Few acres of native prairie remaining in Minnesota are feasible for the large-scale harvests needed for obtaining quantities of prairie seed. Combine the difficulties of collecting prairie seed with the sensitive nature of these lands, and it becomes obvious the process of producing quality prairie seed is not simple. Prairie communities are diverse and complex assembles of plants, making them far more challenging to harvest and propagate than single species crops.

The Minnesota Department of Natural Resources (MNDNR) has a long history of reconstructing prairies dating back to the late 1970's. The art and science of recreating a prairie have evolved greatly since that time. Initially seed sources were scarce in Minnesota; very early plantings imported seeds from southern States with greater seed supplies. Farm Programs, such as the Conservation Reserve Program (CRP), emerged in the 1980's leading to a market flooded with seeds of various origins. Over time MNDNR land administrators have developed restoration techniques utilizing diverse species from local native prairies as a foundation for new reconstructions. Today native prairies under MNDNR administration are commonly harvested to reconstruct other MNDNR lands around them, a practice that has yielded many impressive recreated prairies. A majority of MNDNR lands are reconstructed with seed from other State lands. Yet, MNDNR is an important, but small consumer of prairie seeds from the market.

While MNDNR does not purchase a large volume of seed, agencies such as the Minnesota Department of Transportation (MNDOT) purchase considerable quantities of prairie seed from the market. MNDOT, and others requiring source-identified seed, utilize seed standards set forth by the Minnesota Crop Improvement Association (MCIA). MCIA is a non-profit organization designated under Minnesota Seed Law as the official seed-certifying agent in the State. In 1998, MCIA developed the Native Grasses and Forbs Seed Certification Program. A committee of native seed producers and state agency personnel developed the current program standards. This voluntary certification program is designed to ensure the identity of native grass and forb reproductive material is preserved through all phases of production. MCIA verifies conformance to standards through inspections, testing, and review of required documentation. Seed meeting all standards is eligible to be sold with official certification markings including labels and/or certificates. In 2007, 14 native seed producers participated in the program enrolling 58 species of native plants.

How to use this report

The Legislature directed that this report should develop: 1) **criteria to identify** public and private marginal lands which could be used to produce native prairie seeds of a local eco-type or restore native prairies that could be used to produce Clean Energy, 2) **guidelines for production** that ensure high carbon sequestration, protection of wildlife and waters, and minimization of inputs and that do not compromise the survival of the native prairie remaining in

Minnesota, and 3) **recommendations for incentives** that will result in the production of native prairie seeds of a local eco-type or restore native prairies.

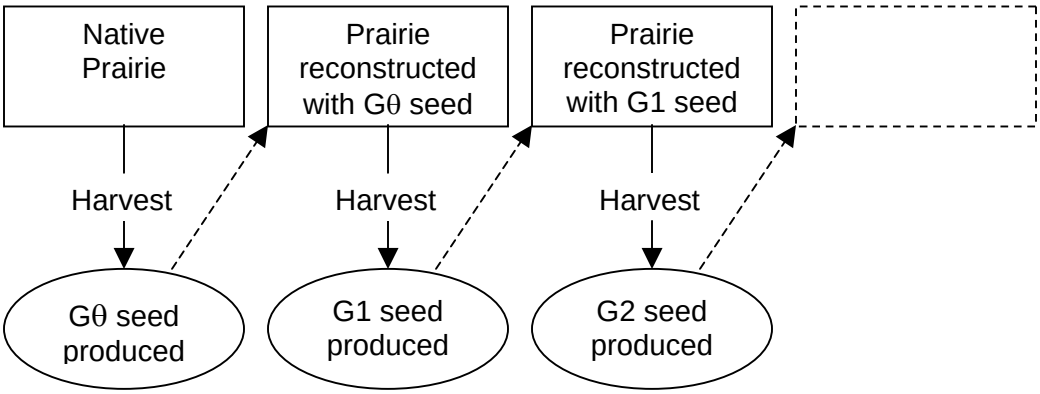
To ensure fitness and performance, future prairie reconstructions regardless of their purpose should use seed adapted to local environmental conditions. Efforts to increase the availability of locally adapted seeds will likely necessitate harvesting from remnant native prairies. The intent of this report is to guide the practices of prairie reconstruction while safeguarding the ecological values of Minnesota's native prairies. As current resources permit, land managers and native seed producers are implementing high quality prairie reconstructions with high species diversity in Minnesota. While it may not be feasible to replicate that quality at the scale and economies envisioned for Clean Energy purposes, diverse reconstructions need to continue to be encouraged and supported.

This report provides the required criteria, guidelines, and recommendations in each of three chapters. The first chapter deals with seed collected from native prairie (Generation θ seed), the second chapter looks at how that seed is used in reconstructed prairies to yield more seed (Generation 1 seed), and the third chapter addresses reconstruction of prairie to serve Clean Energy needs. In each case, the guidelines and criteria outline how to manage, not whether to manage. These criteria and guidelines focus on how to protect the functions and values of native and reconstructed prairie resources during seed and biomass harvesting activities. They generally do not provide advice on whether to manage or which management activities are needed. However, they do recommend avoiding negative impacts to sites of statewide ecological significance or ecological sensitivity. The criteria, guidelines, and recommendations provided in this report are intended to be a menu of suggested, voluntary actions, not a mandate.

Chapter 1.
Generation θ Seed Collection

Generation θ (Gθ) Seed Collection refers to the initial seed harvests from native prairie tracts that will be used to grow new plants (G1). This report assumes appropriate Gθ seed sources are genetically unaltered by human activity and the collection site is in a natural state. Gθ seed has not gone through an intentional selection process, and its origin is generally definable by a geographic location from which the germplasm is collected. Harvesting Gθ prairie seed occurs on remnant native prairies and requires a unique set of guidelines. Many native prairies could be considered "marginal" by many definitions and not conducive to high volume seed harvesting. Safeguarding the ecological value of a Gθ collection site must be maintained as the highest priority. The criteria and guidelines below are designed to help prairie managers through the process of selecting native prairie lands for Gθ seed harvest, and cautions required for managing this rare and unique resource.

Table 1. Illustration of seed generations



Criteria for identifying lands that could produce Generation θ prairie seed

This section of the report addresses the Legislature's requirement to develop **criteria to identify** public and private marginal lands that could be used to produce native prairie seeds of a local eco-type. Specifically, the criteria in this Chapter are for identifying **native prairie** suitable for seed harvest.

Land administrator goals and mandates – In the process of identifying possible Gθ harvest lands one must consider the land administrator's management goals, particularly for agency-owned lands. Federal and State laws guide many land administrators, bounding the permissible activities on those lands. Other public land managers may also have program policies directed at protecting the public benefits of those lands. Examples of the native prairie values associated with different management goals are:

- Wildlife habitat
- Rare or Endangered element protection
- Public recreation
- Cultural resource protection
- Water quality

- Ecological resource value
- Perennial or permanent vegetative cover

Often Gθ seed collections and a land administrator's goals can be mutually beneficial, but consistency with these goals should be confirmed if seed collection is to occur.

Geography, soil, and Native Plant Community considerations – The Ecotype Region in which a Gθ seed collection falls should be consistent with the Ecotype Region of the reconstruction site (Appendix A). Also, the soil characteristics of a seed collection site should match those of the desired reconstruction(s) to help ensure successful establishment and sustainability of a prairie seeding. The desired Native Plant Community (NPC) classification being reconstructed with Gθ seed will need to be determined. With the desired NPC identified, reconstructionists should seek Gθ harvest sites that match the reconstruction. Using the *"Field Guide to the Native Plant Communities of Minnesota -The Prairie Parkland and Tallgrass Aspen Parklands Provinces"* will help determine the NPC class of the Gθ harvest site, and if it is equivalent to the desired reconstruction. (http://www.dnr.state.mn.us/npc/index.html).

Scale of harvest site – Feasibility of a potential Gθ harvest site will depend on harvest goals and techniques used. Operational costs can be high for large-scale harvests, so harvest sites will need to supply enough seed to justify those costs. On the other hand, small-scale collections, particularly hand picking, will not require substantial acreage. Collection sites and subsequent plant populations should also be large enough to reduce risks of genetic in-breeding. Determining if a small plant population has been subject to in-breeding may be difficult, but needs to be considered in harvest site selection.

Operational criteria – Suitable Gθ harvest sites should lend themselves to the operational practices necessary to collect seed without impacting the native prairie values.

Stimulating seed production – Techniques such as prescribed burning or grazing are common accepted practices for stimulating prairie seed production. Ideal seed harvest sites should be feasible to be prescribed burned, or grazed according to a management plan designed to protect native prairie values.

Seed collection – Accessibility with equipment is necessary for larger volume harvests. Ideal Gθ harvest sites should have minimal prohibitive characteristics such as rocks, slope, wet or sensitive soils.

Seed handling and processing – It is critical to dry recently harvested seed to prevent excessive heating or rotting. Harvest sites need to be within a reasonable proximity to seed processing infrastructure for drying, cleaning, and bagging.

Isolation and land requirements – To ensure that Gθ seed harvest sites have not been influenced by surrounding biological contaminants, isolation standards should be applied. If intending to certify seed origin, potential harvest sites must meet the MN Crop Improvement Association's (MCIA) isolation standards (http://www.mncia.org/doc/pub/nativegrass/NGF_Standards.doc). Knowledge of past land use is necessary to determine if non-natives, weeds, cultivars, or species of unknown origin have ever been introduced to the harvest site. Past introduction of undesirable

species may preclude a site as a Gθ harvest location. For instance, if Big Bluestem *(Andropogon gerardii)* seed of unknown origin has been introduced, that field cannot produce certifiable Big Bluestem seed. Although it is possible that same field may produce certifiable seed of another species.

Guidelines for producing Generation θ prairie seed

This section of the report addresses the Legislature's requirement to develop **guidelines for production** to achieve multiple values that do not compromise the **survival of the native prairie** remaining in Minnesota. Specifically, the guidelines in this Chapter are for producing seed from native prairie.

Documentation – Documentation is critical for maintaining the high standards associated with quality Gθ seed production.

Permitting – Any required special use permits must be secured from the land administrator prior to harvest if applicable. Agencies are encouraged to use standardized permit requirements for Gθ harvests. Standardizing permit requirements for Gθ harvests would ensure that all native prairie lands are receiving the same protective measures. Permit requirements should be tailored to the specific harvest techniques being proposed, such as, mechanical vs. hand harvest, and well as the site's goals and mandates, its conditions, and proposed timing.

Seed analysis – Following harvest, a uniform and representative seed sample should be analyzed for germination, purity, and weed presence. Guidelines for collecting a representative sample can be found in the MCIA Seed Certification Handbook (www.mncia.org). One option for obtaining seed analysis is the Minnesota Department of Agriculture (MDA) Laboratory Services Division (http://www.mda.state.mn.us/about/divisions/lab.htm). Guidelines for labeling native prairie seed for resale can be found the Minnesota Seed Laws and Rules (http://www.mda.state.mn.us/news/publications/licensing/grain&seed/seedlaw.pdf). When feasible a genetic profile of harvested seed should be collected and recorded. Several examples of techniques include:

- Diversity Arrays Technology
- Amplified fragment length polymorphism analysis
- Restriction fragment length polymorphism analysis

Record keeping – Accurate harvest records for the following should be kept:

- Technique(s) used
- GPS coordinates of harvest
- Date
- Conditions
- Collection results and yield
- Soil type of harvest field

Operational practices – Harvest practices applied to a Gθ site need to assure that sensitive high quality native prairie is not degraded.

Stimulating seed production – When using prescribed burning to stimulate seed production, use frequencies no greater than 3-5 years on a given field. Randomize the seasonal timing of burns, and avoid successive late spring burning. Excessive fire use can lead to changes in species composition, diversity of a native prairie, and adversely impact invertebrate populations. Grazing techniques to stimulate seed production should be short duration, seasonally randomized, and allow plants to rebound in order to protect native plant diversity. More information on conservation grazing can be found at www.mda.state.mn.us/protecting/conservation/grazing.htm.
Prescribed haying to stimulate seed production should occur at frequencies no greater than every 3 years on a given field. No artificial or commercial fertilizing should take place on Gθ seed production areas.

Seed collection protocols – Collecting seed from a diverse prairie system requires plant identification skills and knowledge of proper harvest procedures. For example, harvest equipment with wide cutting heads should be kept well above the ground surface to avoid "scalping." Harvest personal must also analyze recent precipitation's impacts to ground conditions, assuring that no rutting will take place. Ensure seed collectors and handlers are qualified and have the necessary competencies to cautiously operate on a native prairie. Plans for Gθ harvests should include a refuge component that leaves a portion of the prairie undisturbed. A good rule of thumb is to take no more than 75% of the seed of a perennial species or 50% of the seed of an annual species. Reducing large mechanized harvests to a frequency no greater than every 3 years will help minimize exploitation of conservative-seed producing and disturbance sensitive species. Harvests should also be staggered within a growing season to obtain the broadest spectrum of species possible. Staggering the collection of a single species across a 2-week period may also be helpful in capturing more genetic variation. Making collections from the center of a field when possible will help avoid contamination from adjoining lands.

Weed management on Gθ harvest sites – No broad herbicide applications of non-selective herbicides should occur on Gθ (native prairie) sites. If needed weeds should be spot treated, avoiding any application to non-target species.

Managing invasive species risks – Design and implement seed harvesting activities to reduce pathways for the introduction or spread of invasive species. Movement of equipment, organisms, and organic and inorganic material, are all potential pathways. Each of these pathways must be considered and addressed to reduce risk associated with invasive species movement. Seed collections should not take place in locations with known invasive plant populations. Practitioners should ensure that invasive species, particularly those that are noxious weeds, are not making their way into seed collections. Complete listings of prohibited and noxious weeds can be found at http://files.dnr.state.mn.us/eco/invasives/weedlist.pdf. Further guidance is provided in MN DNR Operational Order 113 - Invasive Species http://files.dnr.state.mn.us/assistance/grants/habitat/heritage/oporder_113.pdf

Common Prairie invasives – The following is a partial list of invasives to avoid in a prairie seed harvest. More information on terrestrial invasive species can be found at http://www.dnr.state.mn.us/invasives/terrestrialplants/index.html.

- Birdsfoot trefoil
- Canada thistle
- Purple crown vetch
- Leafy spurge
- Queen Ann's lace
- Reed canary grass
- Smooth brome grass
- Wild parsnip
- Spotted knapweed
- White & yellow sweet clover

MN seed Laws and Rules – Reconstruction practitioners harvesting seed should obtain a seed analysis. One option for obtaining seed analysis is the MDA Laboratory Services Division (http://www.mda.state.mn.us/about/divisions/lab.htm). All prairie reconstruction practitioners should follow Minnesota Seed and Noxious Weed Laws.

- Minnesota Seed Law – MN Statutes, Sections 21.80 – 21.92
  http://www.revisor.leg.state.mn.us/bin/getpub.php?pubtype=STAT_CHAP&year=2007&section=21#stat.21.80.0
  Minnesota seed law forbids selling seed containing the following "prohibited noxious weeds":
  - Bull thistle
  - Canada thistle
  - Musk thistle
  - Perennial sow thistle
  - Plumeless thistle
  - Field bindweed
  - Hemp
  - Leafy spurge
  - Perennial peppergrass
  - Russian knapweed

- Minnesota Noxious Weed Law – Minnesota Statutes, sections 18.75 to 18.88 and Minnesota Rules, parts 1505.0730 to 1505.0760
  http://www.revisor.leg.state.mn.us/bin/getpub.php?pubtype=STAT_CHAP&year=2007&section=18#stat.18.75.0

Sanitation protocols – Before arriving and leaving a harvest site, inspect for and remove all visible plants, seeds, mud, soil, and animals from equipment, animals, and persons.

- Combines and mechanized machinery
  - Before leaving harvest site: remove or open heads and clean, open any trap doors and run machine until the loose material is removed.
  - Before entering new harvest site: select an area with access to water and a surface where material can be swept up and disposed of properly. Open all access doors, traps, and elevators and run the machine until loose material is all removed. Use high-pressure water to dislodge remaining debris.
- Seed processing equipment
  - Between drying, cleaning, and bagging different lots of seed, disassemble equipment and sweep out or vacuum any remaining material.
- Dispose of unwanted seeds and debris in a manner that prevents contamination of other seed sources, or introduction to unintended sites.
- If livestock are entering site, "flush" them with clean material by feeding livestock weed free forage in an offsite location for two weeks prior to entering a potential Gθ harvest site.

Natural and cultural resource protection – Avoid public native prairie sites established for natural and cultural resource protection and recreation that are not conducive to high volume seed harvesting. Safeguarding the ecological value of a Gθ must be maintained as the highest priority.

Natural resource protection – Applying the operational guidelines above will help minimize harvesting disturbance to plant communities and wildlife species on Gθ harvest sites with occurrences of rare plants and animals. Reference the Wisconsin DNR protocols for reducing incidental taking of rare plants and animals. More information on Wisconsin DNR taking protocols are at http://dnr.wi.gov/org/land/er/take/Grassland Savanna Protocol.htm
The following features should be buffered from concentrated harvest activities:

- Known listed plant species occurrences
- Areas providing critical habitat for Species in Greatest Conservation Need, where harvest activities jeopardize the species
- Sensitive riparian zones

Cultural resource protection – Harvest activities should minimize conflicts with cultural resources, historical features, and related recreation opportunities and buffer them from concentrated collection activities. This includes such resources within State Parks or Trails, Wildlife Management Areas, and historic Native American sites.

Recommendations for incentives resulting in the production of Generation θ prairie seed

This section of the report addresses the Legislature's requirement to develop **recommendations for incentives** that will result in the production of native prairie seeds of a local eco-type. Specifically, this Chapter provides a list of potential recommendations for incentives for producing seed from native prairie and pertinent information related to these incentives.

MNDNR initiatives –

- The Minnesota DNR can influence the demand for Gθ seed by becoming a consistent and reliable customer for high quality prairie seed. When purchasing prairie seed the MNDNR could demand source-identified seed from appropriate Ecotype Regions.
- Through mapping exercises the MNDNR could identify the appropriate Gθ sites on public or private land.
- An interdisciplinary task force could develop a harvest framework, protocols, and schedule based on departmental prairie reconstruction priorities.
- Private seed producers may be allowed to collect seed from MNDNR lands (if site-specific mandates so allow) and keep a portion of the seed as compensation for supplying equipment and labor. Private producers may also be allowed to collect seed from MNDNR lands and in exchange for performing site stewardship activities.

Compensation to private landowners –

- Private landowners with identified Gθ harvest sites could receive direct payment for allowing seed to be harvest from their lands (following the Gθ harvest guidelines). These

payments could come in the form of one-time payments, lease agreements, or cooperative agreements.

- Currently, the MNDNR Prairie Tax-Exemption Program provides incentive to protect native prairie by exempting eligible lands from property taxes. Lands enrolled in Prairie Tax-Exemption can be harvested for seed. Landowners who wish to manage their lands for Gθ seed may receive tax exemption from this program. (http://www.dnr.state.mn.us/prairierestoration/taxexemption.html)
- The MNDNR Native Prairie Bank program allows landowners to protect native prairie on their property through a conservation easement. Prairie Bank easements can include provisions that can allow seed harvesting under a management plan by the landowner and/or the MNDNR. (http://www.dnr.state.mn.us/prairierestoration/prairiebank.html)
- The MNDNR also offers technical guidance to private landowners with native prairie. Technical assistance is offered through state prairie specialists or the Prairie Stewardship Planning Assistance Program (PSPA). Through the PSPA, program professional consultants provide landowners with a comprehensive Prairie Stewardship Plan. These plans can include sustainable seed harvesting if the landowner desires that.

Educational materials – Currently, very few tools are available for guiding production of Gθ prairie seed. Providing educational materials to potential seed producers may help encourage sustainable seed harvest, ensuring survival of native prairies being harvested. Educational materials could be tailored for audiences such as Federal and State agencies, LGU's, NGO's, private landowners, and private seed producers.

Minnesota Crop Improvement Association – MCIA administrates the "Native Grasses and Forbs Pre-Variety Germplasm Standards" for assuring native prairie seed identity is maintained through all phases of production. MCIA could be assisted with a review process of current isolation standards and criteria for identifying Gθ sites. A process of reviewing and testing the current seed certification standards would improve customer confidence.

Chapter 2.
Generation 1 Seed Production

Generation 1 (G1) Seed Production refers to harvesting seed from fields reconstructed with source-identified Gθ seed (refer to Table. 1). Thus, the parent seed source for G1 seed production area is a Gθ native prairie collection. G1 harvest sites are likely to be former croplands or other previously altered lands. Production stands for G1 seed can be either monoculture plots or diverse polyculture fields. Private industry growers commonly produce G1 seed in single species stands. Growing monoculture production stands is often necessary to meet demands for large volumes of seed. The criteria and guidelines below are designed to help prairie managers through the process of selecting and managing lands for G1 seed production in polyculture settings.

Criteria for identifying lands that could produce Generation 1 prairie seed

This section of the report addresses the Legislature's requirement to develop **criteria to identify** public and private marginal lands that could be used to produce native prairie seeds of a local eco-type. Specifically, the criteria in this Chapter are for identifying **reconstructed prairies** suitable for harvest of Generation 1 seed.

Land administrator goals and mandates – In the process of identifying possible G1 harvest lands one must consider the land administrator's management goals, particularly agency owned lands. Federal and State laws guide many land administrators, bounding the permissible activities on those lands. Other public land managers may have program policies directed at protecting the public benefits of those lands. Examples of the reconstructed prairie values associated with different management goals are:

- Wildlife habitat
- Rare or Endangered element protection
- Public recreation
- Cultural resource protection
- Water quality
- Ecological resource value
- Perennial or permanent vegetative cover
- Production of prairie seed
- Erosion control or living snow fences

Often there can be mutual benefits between G1 seed collections and a land administrator's goals, but consistency with these goals should be confirmed if seed collection is to occur.

Native prairie – G1 production sites should not be native prairie, or negatively impact a native prairie. This is to say, native prairies should not be converted or modified for the purpose of G1 seed production.

Geography, soil, and Native Plant Community considerations – The Ecotype Region in which a potential G1 production site falls should match the natural distribution range of the species and/or Native Plant Community (NPC) class being propagated. Also the soil characteristics of a G1 production site should match those of the NPC class being propagated. Matching soil

characteristics will reduce the chance of making a genetic selection for small set of plants adapted to alternate soil conditions. Using the *"Field Guide to the Native Plant Communities of Minnesota -The Prairie Parkland and Tallgrass Aspen Parklands Provinces"* will help determine if the soil characteristics of a potential G1 production site are similar to those of the NPC class being propagated (http://www.dnr.state.mn.us/npc/index.html). Sites with highly erosive soils may not sustain high volume mechanical harvesting equipment and may not be ideal for large-scale production. Knowledge of past land usage will also be useful in determining site suitability for G1 seed production. For instance, former agricultural lands with herbicide carryover may impact a site's ability to grow certain plants. Examples of these herbicides are Alachlor (Lasso), Atrazine, and Imazethapyr (Pursuit).

Need or justification – Depending on Ecotype Region, acceptable production sites may be already in operation. Prairie reconstruction practitioners should determine what source-identified prairie seed is readily available before developing new sources.

Opportunities for multiple environmental benefits – Criteria for selecting G1 seed production lands should include opportunity for other values, such as buffering native prairies, terrestrial carbon sequestration, protection of wildlife and water, and improved soil management.

Operational criteria – Suitable G1 harvest sites should lend themselves to the operational practices necessary to collect seed.

> *Stimulating seed production* – Techniques such as prescribed burning or grazing are common accepted practices for stimulating prairie seed production. Ideal seed harvest sites should be feasible to be prescribed burned, or grazed in a timely manner according to a management plan designed to protect native prairie values.
>
> *Seed collection* – Accessibility with equipment will be critical with larger mechanized harvests. Ideal G1 harvest sites should have minimal prohibitive characteristics such as rocks, slope, wet or sensitive soils.
>
> *Seed handling and processing* – It is critical to dry recently harvested seed to prevent excessive heating or rotting. Harvest sites need to be within a reasonable proximity to seed processing infrastructure for drying, cleaning, and bagging.

Isolation and land requirements – To ensure G1 seed harvest sites have not been influenced by surrounding biological contaminants, isolation standards should be applied. If intending to certify seed origin, potential harvest sites must meet the MN Crop Improvement Association's (MCIA) isolation standards (http://www.mncia.org/doc/pub/nativegrass/NGF_Standards.doc). Knowledge of past land use is necessary to determine if non-natives, weeds, cultivars, or species of unknown origin have ever been introduced to the harvest site. Past introduction of undesirable species may preclude a site as a harvest location. For instance, if Big Bluestem *(Andropogon gerardii)* seed of unknown origin has been introduced, that field cannot produce certifiable Big Bluestem seed. Although it is possible that same field may produce certifiable seed of another species.

Guidelines for producing Generation 1 prairie seed

This section of the report addresses the Legislature's requirement to develop **guidelines for production** that ensure high carbon sequestration, protection of wildlife and waters, and minimization of inputs and that do not compromise the survival of the native prairie remaining in Minnesota. Specifically, the guidelines in this Chapter are for producing Generation 1 seed from reconstructed prairie.

Documentation – Documentation is critical for maintaining the high standards associated with quality G1 seed production.

Permitting – Any required special use permits must be secured from the land administrator prior to harvest if applicable. Agencies are encouraged to use standardized permit requirements for G1 harvests. Standardizing permit requirements for G1 harvests would ensure that a fair and equitable process is followed. Permit requirements should be tailored to the specific harvest techniques being proposed, such as, mechanical vs. hand harvest, and well as the site's goals and mandates, its conditions, and proposed timing.

Seed analysis – Following harvest, a uniform and representative seed sample should be analyzed for germination, purity, and weed presence. Guidelines for collecting a representative sample can be found in the MCIA Seed Certification Handbook (www.mncia.org). One option for obtaining seed analysis is the MDA Laboratory Services Division (http://www.mda.state.mn.us/about/divisions/lab.htm). Guidelines for labeling native prairie seed for resale can be found the Minnesota Seed Laws and Rules (http://www.mda.state.mn.us/news/publications/licensing/grain&seed/seedlaw.pdf). When feasible a genetic profile of harvested seed should be collected and recorded. Several examples of techniques include:

- Diversity Arrays Technology
- Amplified fragment length polymorphism analysis
- Restriction fragment length polymorphism analysis

Record keeping – Accurate harvest records for the following should be kept:

- Land use history
- Seed used to establish site
- Technique(s) used
- GPS coordinates of harvest
- Date
- Conditions
- Collection results and yield
- Soil type of harvest field

Operational practices – Collecting G1 prairie seed involves activities with potential to degrade natural resources. While the risks of degrading prairie resources are lower than Gθ sites, harvest practices should minimize possible impacts. The following operational guidelines apply to polyculture plantings that serve multiple resource benefits.

Stimulating seed production – When using prescribed burning to stimulate seed production, avoid frequencies greater then every 3-5 years on a given field. Randomize the seasonal timing of burns, and avoid successive late spring burning. Excessive fire use can lead to

changes in species composition, diversity of a native prairie, and adversely impact invertebrate populations. Grazing techniques to stimulate seed production should be short duration, seasonally randomized, and allow plants to rebound in order to protect native plant diversity. More information on conservation grazing can be found at www.mda.state.mn.us/protecting/conservation/grazing.htm. Avoid prescribed haying to stimulate seed production at frequencies greater than every 3 years on a given field. Artificial or commercial fertilizing should be avoided on G1 seed production areas. Fertilizer may shift which plants express themselves and thereby alter genetics being selected. Artificial fertilizer may also add to nutrient runoff. Consider using native legumes and inoculating with appropriate rhizobia if necessary.

Seed collection protocols – Collecting seed from a diverse polyculture planting requires plant identification skills and knowledge of proper harvest procedures. For example, harvest equipment with wide cutting heads should be kept well above the ground surface to avoid "scalping." Harvest personal must also analyze recent precipitation's impacts to ground conditions, assuring that no rutting will take place. Ensure seed collectors and handlers are qualified and have the necessary competencies to carryout harvest operations. Reducing frequency of large mechanized harvests will help minimize impacts to conservative seed producing and disturbance sensitive species. Harvests should also be staggered within a growing season to obtain the broadest spectrum of species possible. Staggering the collection of a single species across a 2-week period may also be helpfully in capturing more genetic variation. Making collections from the center of a field when possible will help avoid contamination from adjoining lands.

Weed management on G1 harvest sites – Minimize broad herbicide application techniques, or use of non-selective herbicides. Use weed free mulch and cover crops (if necessary) during establishment of G1 production sites to alleviate future weed problems.

Managing invasive species risks – Design and implement seed harvesting activities to reduce pathways for the introduction or spread of invasive species. Movement of equipment, organisms, and organic and inorganic material, are all potential pathways. Each of these pathways must be considered and addressed to reduce risk associated with invasive species movement. Seed collections should not take place in locations with known invasive plant populations. Practitioners should ensure that invasive species, particularly those that are noxious weeds, are not making their way into seed collections. Complete listings of prohibited and noxious weeds can be found at http://files.dnr.state.mn.us/eco/invasives/weedlist.pdf. Further guidance is provided in MNDNR Operational Order 113 - Invasive Species http://files.dnr.state.mn.us/assistance/grants/habitat/heritage/oporder_113.pdf

Common Prairie invasives – The following is a partial list of invasives to avoid in a prairie seed harvest. More information on terrestrial invasive species can be found at http://www.dnr.state.mn.us/invasives/terrestrialplants/index.html.

- Birdsfoot trefoil
- Canada thistle
- Purple crown vetch
- Leafy spurge
- Queen Ann's lace
- Reed canary grass

- Smooth brome grass
- Wild parsnip
- Spotted knapweed
- White & yellow sweet clover

MN seed Laws and Rules – Practitioners harvesting their own seed should obtain a seed analysis. One option for obtaining seed analysis is the MDA Laboratory Services Division (http://www.mda.state.mn.us/about/divisions/lab.htm). All prairie reconstruction practitioners should follow Minnesota Seed and Noxious Weed Laws.

- Minnesota Seed Law – MN Statutes, Sections 21.80 – 21.92 http://www.revisor.leg.state.mn.us/bin/getpub.php?pubtype=STAT_CHAP&year=2007&section=21#stat.21.80.0

  Minnesota seed law forbids selling seed containing the following "prohibited noxious weeds":
  - Bull thistle
  - Canada thistle
  - Musk thistle
  - Perennial sow thistle
  - Plumeless thistle
  - Field bindweed
  - Hemp
  - Leafy spurge
  - Perennial peppergrass
  - Russian knapweed

- Minnesota Noxious Weed Law – Minnesota Statutes, sections 18.75 to 18.88 and Minnesota Rules, parts 1505.0730 to 1505.0760 http://www.revisor.leg.state.mn.us/bin/getpub.php?pubtype=STAT_CHAP&year=2007&section=18#stat.18.75.0

Sanitation protocols – Before arriving and leaving a harvest site, inspect for and remove all visible plants, seeds, mud, soil, and animals from equipment, animals, and persons.

- Combines and mechanized machinery:
  - Before leaving harvest site: remove or open heads and clean, open any trap doors and run machine until the loose material is removed.
  - Before entering new harvest site: select an area with access to water and a surface where material can be swept up and disposed of properly. Open all access doors, traps, and elevators and run the machine until loose material is all removed. Use high-pressure water to dislodge remaining debris.
- Seed processing equipment:
  - Between drying, cleaning, and bagging different lots of seed, disassemble equipment and sweep out or vacuum any remaining material.
- Dispose of unwanted seeds and debris in a manner that prevents contamination of other seed sources, or introduction to unintended sites.
- If livestock are entering site, "flush" them with clean material by feeding livestock weed free forage in an offsite location for two weeks prior to entering a potential Gθ harvest site.

Natural and cultural resource protection – Public G1 harvest sites may also serve other natural and cultural resource functions. Avoid public sites established for natural and cultural resource

protection and recreation that are not conducive to high volume seed harvesting. The following guidelines apply to polyculture plantings that serve multiple resource benefits.

Natural resource protection – Applying the operational guidelines above will help minimize harvesting disturbance to plant communities and wildlife species on G1 harvest sites with occurrences of rare plants and animals. Reference the Wisconsin DNR protocols for reducing incidental taking of rare plants and animals. For more information on Wisconsin DNR taking protocols see http://dnr.wi.gov/org/land/er/take/Grassland Savanna Protocol.htm. The following features should be buffered from concentrated harvest activities:

- Known listed plant species occurrences
- Areas providing critical habitat for Species in Greatest Conservation Need, where harvest activities jeopardize the species
- Sensitive riparian zones
- Native prairies

Cultural resource protection – G1 harvest activities should minimize conflicts with cultural resources, historical features, and related recreation opportunities and buffer them from concentrated collection activities. This includes such resources within State Parks or Trails, Wildlife Management Areas, and historic Native American sites.

Recommended incentives resulting in the production of Generation 1 prairie seed

This section of the report addresses the Legislature's requirement to develop **recommendations for incentives** that will result in the production of native prairie seeds of a local eco-type. Specifically, this Chapter provides a list of potential recommendations for incentives for producing Generation 1 seed from reconstructed prairie and pertinent information related to these incentives.

Research – Support research related to genetics and prairie restoration and reconstruction. An example would be exploring G1 seed production as a monoculture; what are the long-term implications for management and genetics.

MNDNR initiatives – Private seed producers may be allowed to collect seed from MNDNR lands (if site-specific mandates so allow) and keep a portion of the seed as compensation for supplying equipment and labor. Private producers may also be allowed to collect seed from MNDNR lands and in exchange for performing site stewardship activities. These collections would have to be consistent with the land administers goals and mandates.

Influence demand by agencies –

MNDNR – The Minnesota DNR can influence the demand for G1 seed by becoming a consistent and reliable customer for high quality prairie seed. When purchasing prairie seed the MNDNR could demand source-identified seed from appropriate Ecotype Regions. Through an interdisciplinary reconstruction plan the MNDNR could outline long term

reconstruction needs, clarifying future demand for seed. MNDNR would need to have clear expectations for quality of purchased seed, monitor and enforce those expectations, and develop funds for premium seed. The MNDNR might also develop a purpose driven seed selection matrix to guide decisions on when and where to use Gθ, G1, or later generations.

USDA/NRCS – Farm Bill programs administered through the U.S. Department of Agriculture (USDA) and its Natural Resource Conservation Service (NRCS) are the largest consumers of prairie seed. The volume of seed purchased for Farm Bill programs substantially impacts the market. Modifying USDA seed purchase policies, procedures, and practices to promote local ecotype seed would greatly influence demand for quality prairie seed. The NRCS Plant Material Center in Bismarck, ND has currently released 40 varieties of conservation plants. A paper on the NRCS view toward native grass varieties is found in appendix D.

BWSR – Along with assistance to Farm Bill program implementation, BWSR administers State programs requiring prairie seed for reconstructions. Enhancing BWSR seed purchase policies, procedures, and practices to promote local ecotype seed could influence demand for quality prairie seed. For example, BWSR is currently working to develop educational materials to promote the use of local seed sources and is promoting an increased use of yellow-tag certified seed for their programs. BWSR's new Native Buffer and Cooperative Weed Management Area grant programs will also require the use of local sources of seed and will work within the framework of the guidelines recommended in this document.

MN DOT – Modifying MN DOT seed purchase policies, procedures, and practices to promote local ecotype seed would greatly influence demand for quality prairie seed. An example would be separating prairie reconstruction contracts from general road construction in highway projects, similar to Iowa DOT. Currently MN DOT is the largest user and promoter of source-identified seed in Minnesota.

USFWS – Modifying U.S. Fish and Wildlife Service (USFWS) seed purchase policies, procedures, and practices to promote local ecotype seed would greatly influence demand for quality prairie seed.

Influence supply – The current capacity to supply prairie seeds from each Ecotype Region is not known. Anticipating an increased demand for source-identified local seed, correspondingly supply will also need to increase. One method may be to direct compensation to potential growers for reconstructing prairie that will produce prairie seed. An example would be MDA's Native Grasses and Wildflower Seed Production Incentive Loan Program for startup seed producers (MN Statute 17.231 http://ros.leg.mn/bin/getpub.php?pubtype=STAT_CHAP&year=2007&section=17#stat.17.231.0). This MDA program is not currently funded. Another obstacle limiting the supply of source-identified local seed is the profitability of certified seed, or "yellow tag" seed. With limited demand for certified seed, many producers cannot justify the added cost. Reducing the producer costs for participating in the "yellow tag program" may help with initial supply issues.

Influencing market exchange – Reconstructing a prairie for G1 seed production also has terrestrial carbon sequestration benefits. Capturing this dual benefit with carbon credits may provide an additional incentive for establishing and producing G1 prairie seed. Eliminating possible fraud in the seed market would also improve consumer confidence in purchasing seed. An example would be developing and providing MCIA genetic profiling tools to enhance monitoring and enforcement of seed production regulations. The market can also supply seeds at a lower cost if there is consistency in species being demanded. If purchasers of prairie seed mixes agreed upon lists of species commonly used by all buyers, it becomes more economical feasible for producers to answer those demands.

Educational materials – Currently, very few tools are available for guiding production of G1 prairie seed. Providing educational materials to potential seed producers could help ensure sustainable seed harvest while encouraging multiple resource benefits. Educational materials could be tailored for audiences such as Federal and State agencies, LGU's, NGO's, and private seed producers. Educational outreach could also include improving awareness of prairie reconstruction guidelines among the general public. An example would be developing lists of appropriate species and communities for prairie reconstructions by each Ecotype Region.

Chapter 3.
Reconstructing Prairie that could serve Clean Energy needs

Prior to European settlement, more than 18 million acres of prairie covered Minnesota. Our prairie lands were part of the largest ecosystem in North America, which stretched from Canada to Mexico and from the Rockies to Indiana. With its fertile soil, nutritious grasses and aura of possibility, prairie became the basis for an agricultural empire. Today, less than one percent of Minnesota's native prairie remains. The near elimination of native prairie has inspired many efforts to protect remaining parcels and to reconstruct prairies with native species for multiple conservation values. With a growing need to find renewable energy sources, an eye has been turned toward the sustainable and productive nature of prairie systems. Using native prairie species for Clean Energy production may provide an opportunity to link conserving natural resources, providing outdoor recreation, and promoting sustainable commercial use of natural resources. The criteria and guidelines below are designed to help prairie managers through the process of reconstructing prairie that could one day serve Clean Energy needs.

Criteria for identifying lands for Reconstructing Prairie that could serve Clean Energy needs

This section of the report addresses the Legislature's requirement to develop **criteria to identify** public and private marginal lands for restored prairies that could be used to produce Clean Energy. Specifically, the criteria in this Chapter are for identifying lands for **reconstructing prairies** that could serve multiple purposes, including production of biomass **for Clean Energy needs**.

Land administrator goals and mandates – In the process of identifying lands for prairie reconstruction that could serve Clean Energy needs one must consider the land administrator's management goals, particularly agency owned lands. Federal and State laws guide many land administrators, bounding the permissible activities on those lands. Other public land managers may have program policies directed at protecting the public benefits of those lands. Examples of prairie values associated with different management goals are:

- Wildlife habitat
- Rare or Endangered element protection
- Public recreation
- Cultural resource protection
- Water quality
- Ecological resource value
- Perennial or permanent vegetative cover
- Production of prairie seed

Prairie reconstruction practitioners should strive to find mutual benefits between prairie reconstruction for Clean Energy and a land administrator's goals.

Native prairie – Sites for prairie reconstruction that could serve Clean Energy needs should not be native prairie, or negatively impact a native prairie.

Opportunity for multiple environmental benefits – If strategically planned, reconstructed prairies can provide a multitude of environmental services, including Clean Energy functions.

Reconstruction sites should be selected to include opportunity for buffering native prairies, terrestrial carbon sequestration, protection of wildlife and water, and improved soil management.

Flexibility and feasibility – Ideally located prairie reconstructions should lend themselves to a variety of utilities and functions.

Alternative functions – Locations with opportunities for sustainable haying or grazing could add valuable utility and possible management options to a reconstructed prairie. Reconstructions established with Gθ seed sources could also serve as future G1 production areas.

Feasibility – Reconstructions may need to meet a minimum threshold for acreage before being considered feasible for some Clean Energy needs. Proximity to potential Clean Energy outlets must be considered. For example, a 5-acre site greater than 50 miles from a Clean Energy facility may not meet cost/benefit ratios established by the industry. While the industry and regulatory authorities may dictate placement of Clean Energy facilities, industrial volume water supply should be considered. It may be impractical to locate substantial Clean Energy reconstructions in areas lacking sufficient and sustainable water supply.

Geography, soil, and Native Plant Community considerations –

Ecotype Regions – The Ecotype Region for a potential reconstruction and the natural distribution range of the species being propagated should match. Soil characteristics of a reconstruction site should also match those of the species being propagated. Matching soil characteristics will help ensure successful establishment and long-term survival of restored prairies. Using the "Field Guide to the Native Plant Communities of Minnesota -The Prairie Parkland and Tallgrass Aspen Parklands Provinces" will help determine if the soil characteristics of a potential reconstruction site are similar to those of the NPC class or species being propagated (http://www.dnr.state.mn.us/npc/index.html). If possible projects should be delayed until appropriate seed sources are available. Erosive sites can be seeded with an annual cover crop until seed can be obtained.

Soils – Sites with highly erosive soils may not sustain heavy mechanical harvesting equipment and therefore are not ideal for large-scale production. For biomass production, determine soil fertility (nutrient rich or poor) to indicate productivity of potential prairie reconstructions. Use knowledge of past land usage to help determine site suitability for prairie reconstruction. For instance, former agricultural lands with herbicide carryover may impact a site's ability to grow certain plants. Examples of these herbicides are Alachlor (Lasso), Atrazine, and Imazethapyr (Pursuit).

Operational criteria –

Stimulating seed production – Techniques such as prescribed burning or grazing are common accepted practices for stimulating production and maintaining restored prairies. Ideal reconstruction sites should be feasible to prescribe burned, or grazed in a timely manner.

Accessibility – Accessibility with equipment will be critical for operational uses that utilize typical farm machinery. Ideal reconstructions, that could serve Clean Energy uses, should have minimal prohibitive characteristics such as rocks, slope, wet or sensitive soils.

Guidelines for Reconstructing Prairie that could serve Clean Energy needs

This section of the report addresses the Legislature's requirement to develop **guidelines for production** that ensure high carbon sequestration, protection of wildlife and waters, and minimization of inputs and that do not compromise the survival of the native prairie remaining in Minnesota. Specifically, the guidelines in this Chapter are for **reconstructing prairies** that could serve multiple purposes, including production of biomass **for Clean Energy needs**.

Documentation – Documentation is critical for long-term maintenance and management of a prairie reconstruction. For instance, a Clean Energy reconstruction could never later convert to G1 seed production without adequate records related to seed sources and historical land use.

Permitting – Any special use permits should be secured from the land administrator prior to harvesting reconstructed prairies if applicable. Agencies are encouraged to use standardized permit requirements for Clean Energy harvests. Standardizing permit requirements for Clean Energy harvests will ensure a fair and equitable process. Permit requirements should be tailored to the specific harvest type being proposed.

Record keeping – Accurate seeding records for the following should be kept:

- Land use history
- Seed used to establish site
- Seeding methods used
- GPS coordinates of harvest
- Date of seeding
- Conditions during seeding
- Soil type of harvest field

Operational practices – Guidelines below offer considerations for establishing and assisting a reconstructed prairie through its juvenile years. A good reference produced by the MNDNR is http://files.dnr.state.mn.us/assistance/backyard/prairierestoration/goingnative.pdf.

Establishment – Establishing diverse prairie reconstruction starts with a good seed source. Seed sources for reconstructions should originate from within the same Ecotype Region as the planting. Using seed certified by MCIA for purchases made off the market will assure origin and quality are known. Use the following the guidelines below to help ensure successful prairie establishment.

- Control weeds on-site prior to seeding, it is much easier to control weeds beforehand.
- Seeds should also match the soil properties of the reconstruction site. Reconstructions may have varying soil types and require application of different seed mixes to the different soil types, often called a "sculptured" seeding.
- Whenever practical, prairie reconstruction practitioners should strive for the highest diversity of native species possible.

- Use a seed rate that applies approximately 10 pounds pure live seed per acre.
- Regardless of seeding techniques use (drilling or broadcasting), make sure to have good soil to seed contact. Broadcasting may require mechanical seed incorporation such as harrowing or using a roller. A good rule of thumb for planting depth is to plant seeds as deep as the seed's thickness itself.
- Use weed free mulch if required, and if cover crops are needed avoid those that are considered invasive.
- Do not fertilize new reconstructions, native species do not require fertilizer, only weed species will benefit from additional nutrients. Using legumes and inoculating soils with appropriate rhizobia will provide sufficient nitrogen to system.

Post-seeding management – Although an established prairie is low-maintenance, that does not mean *no* maintenance. Especially in the first three to five years, as the prairie is becoming established, some careful attention is required. Timely mowing and spot treatments of competitive plants may be required in these early establishment years. Once established, the long-term strategy should be to maintain or enhance the diversity of a reconstruction over time. Maintaining diversity over time requires an Integrated Pest Management plan that incorporates biological, mechanical, and chemical control options. Minimize broad herbicide application techniques and use of non-selective herbicides. Haying and grazing can be useful management tools; well-planned harvests for Clean Energy could provide the same management benefits.

Harvest – The following guidelines are a summary of recommendations found in "*MNDNR Recommendations for Best Management Practices [BMPs] for RIM Clean Energy Production and Harvest"*. These guidelines assume that using reconstructed prairies for Clean Energy will involve harvesting plants as a biomass feedstock.

- To reduce impacts to wildlife species, harvest bioenergy feedstock outside of nesting and brood-rearing seasons (defined as April 15-August 1). Harvesting in late fall, winter, or early spring also allows translocation of nutrients back into roots and less moisture in the feedstock
- A minimum of 4-inch stubble height should be maintained. Taller stubble can provide greater habitat value, however, leaving unharvested areas can mitigate this. Taller stubble heights can also improve soil moisture by catching snow, and provide shading to reduce evaporative loss of spring rains.
- Leaving portions of fields unharvested can provide winter habitat for wildlife such as resident game birds and prairie invertebrates, and spring nesting for a variety of game birds, waterfowl, and grassland songbirds. Leaving portion of fields unharvested each year can also serve as a biomass reserve in times of drought or other emergencies.
- Fields should be harvested in blocks, rather than strips. Blocks are more efficient for harvesting and transporting and reduce the wildlife predation found with strips.
- In rough terrain, mowing height adjustments should be made to reduce scalping.
- Fields should be harvested when conditions prevent or minimize rutting and soil erosion (harvest on frozen ground or under dry field conditions).
- Harvested biomass should be stored off the reconstructed prairie on areas where desirable vegetation will not be smothered.

- No more than one biomass harvest per year should be done, not including seed harvest.

Managing invasive species risks – Many seed harvesting activities are potential pathways for the introduction or spread of invasive species. Movement of equipment, organisms, and organic and inorganic material, are all potential pathways. Each of these pathways must be considered and addressed to reduce risk associated with invasive species movement. The harvesting and transport of biomass has strong potential to be a vector for invasive species movement if precautions are not taken. Information on terrestrial invasive species can be found at http://www.dnr.state.mn.us/invasives/terrestrialplants/index.html. Reconstruction and bioenergy practitioners should ensure that invasive species, particularly those that are noxious weeds, are not making their way into reconstruction and harvest activities.. Complete listings of prohibited and noxious weeds can be found at http://files.dnr.state.mn.us/eco/invasives/weedlist.pdf. Further guidance on managing invasive risks is provided in MNDNR Operational Order 113 - Invasive Species (http://files.dnr.state.mn.us/assistance/grants/habitat/heritage/oporder_113.pdf).

MN seed Laws and Rules – Purchasing seed certified by the MCIA will ensure that Minnesota Weed and Seed laws are being adhered to. Practitioners harvesting their own seed should obtain a seed analysis. One option for obtaining seed analysis is the MDA Laboratory Services Division (http://www.mda.state.mn.us/about/divisions/lab.htm). All prairie reconstruction practitioners should follow Minnesota Seed and Noxious Weed Laws

- Minnesota Seed Law – MN Statutes, Sections 21.80 – 21.92 http://www.revisor.leg.state.mn.us/bin/getpub.php?pubtype=STAT_CHAP&year=2007&section=21#stat.21.80.0

  Minnesota seed law forbids selling seed containing the following “prohibited noxious weeds”:
  - Bull thistle
  - Canada thistle
  - Musk thistle
  - Perennial sow thistle
  - Plumeless thistle
  - Field bindweed
  - Hemp
  - Leafy spurge
  - Perennial peppergrass
  - Russian knapweed

- Minnesota Noxious Weed Law – Minnesota Statutes, sections 18.75 to 18.88 and Minnesota Rules, parts 1505.0730 to 1505.0760 http://www.revisor.leg.state.mn.us/bin/getpub.php?pubtype=STAT_CHAP&year=2007&section=18#stat.18.75.0

Sanitation protocols – Before arriving and leaving a site, inspect for and remove all visible plants, seeds, mud, soil, and animals from equipment, animals, and persons.

- Equipment / machinery:
  - Before leaving harvest site: remove heads or attachments and clean, open any trap doors and run machine until the loose material is removed.

    - Before entering new harvest site: select an area with access to water and a surface where material can be swept up and disposed of properly. Open all access doors, traps, and elevators and run the machine until loose material is all removed. Use high-pressure water to dislodge remaining debris.
- Dispose of unwanted seeds and debris in a manner that prevents contamination of other seed sources, or introduction to unintended sites.
- If livestock are entering site, "flush" them with clean material by feeding livestock weed free forage in an offsite location for two weeks prior to entering a potential harvest site.

Cultural resource protection – Reconstructed prairies used for Clean Energy may also provide historical feature protection and recreational opportunities. The following guidelines apply to polyculture plantings that serve multiple resource benefits.

Natural resource protection – Well-designed and managed prairie reconstructions for Clean Energy are likely to attract grassland wildlife species. Applying the operational guidelines above will help minimize harvesting disturbance to plant communities and wildlife species. Reference the Wisconsin DNR protocols for reducing incidental taking of rare plants and animals. More information on Wisconsin DNR taking protocols see http://dnr.wi.gov/org/land/er/take/Grassland Savanna Protocol.htm. The following features should be buffered from concentrated harvest activities:

- Known Federal and State listed species occurrences
- Known occurrences of Species in Greatest Conservation Need
- Riparian zones
- Native prairies

Cultural resource protection – Reconstructions for Clean Energy should minimize conflicts with cultural resources, historical features, and related recreation opportunities and buffer them from concentrated collection activities. Examples of these resources are State Parks or Trails, Wildlife Management Areas, and historic Native American sites.

Recommended incentives resulting in Reconstructed Prairie that could serve Clean Energy needs

This section of the report addresses the Legislature's requirement to develop **recommendations for incentives** that will result in the restoration of prairie. Specifically, this Chapter provides a preliminary list of types of potential recommendations for incentives for **reconstructing prairies** that could serve multiple purposes, including production of biomass **for Clean Energy needs**.

Enhance the economics of Prairie-based Clean Energy -

- Increase consumer demand for biomass-based Clean Energy
- Increase available biomass to the Clean Energy industry
- Increase profitability of biomass-based Clean Energy
- Reduce subsidies for competitive energy sources
- Support research to improve biomass-based Clean Energy systems and efficiency

Reduce costs for reconstructed prairie establishment -

- Conservation group can cost-share programs that demonstrate innovative ways to combine conservation and Clean Energy.
- Roadsides for Wildlife assistance provides cost-share for prairie establishment, and can assist with costs.
- Reduce property tax classification for reconstructed prairies serving Clean Energy needs.
- Emerging carbon credit programs can offer supplemental funds for prairie seed reconstruction.

Conclusion

This report marks the end of Phase I of the Prairie Seed Production and BioEnergy Project. It fulfills direction of the 2007 Minnesota Legislature for the outcomes from the Technical Advisory Committee to be reported by December 15, 2007, to the Legislative Finance Chairs on Environment and Natural Resources. Specifically, in response to the Legislation, this report provides a series of criteria to identify lands for prairie seed production and prairie reconstruction, guidelines for achieving multiple benefits while providing for the native prairie seed production, and recommendations for incentives for prairie seed production and prairie reconstruction.

Phase II of this project will utilize the remaining funds appropriated to create plans that explore and test results from Phase I. Testing the results of Phase I will determine feasibility of implementing the criteria, guidelines, and incentives. Applying the criteria and guidelines to a geographical information system (GIS) model may also reveal current and needed seed production capacities in Minnesota. Phase II will work to engage additional partners, such as the University of Minnesota and Federal agencies, actively harvesting or reconstructing prairie. All Prairie Seed Production and BioEnergy project work will be completed by June 30, 2008.

Phase II of this project will continue to focus on guiding prairie harvesting and reconstruction practices to ensure survival of the native prairie remaining in Minnesota. All work related to prairie seed harvest and replanting must be in concert with the protection and survival of native prairie remaining in Minnesota.

Appendix A
Prairie Definitions
MS 84.02, Minnesota Statutes 2007

84.02 DEFINITIONS.

Subdivision 1. **Definitions.** For purposes of this chapter, the terms defined in this section shall have the meanings given them.

Subd. 2. **Best management practice for native prairie restoration.** "Best management practice for native prairie restoration" means using seeds collected from a native prairie within the same county or within 25 miles of the county's border, but not across the boundary of an ecotype region.

Subd. 3. **Created grassland.** "Created grassland" means a restoration using seeds or plants with origins outside of the state of Minnesota.

Subd. 4. **Ecotype region.** "Ecotype region" means the following ecological subsections and counties based on the Department of Natural Resources map, "County Landscape Groupings Based on Ecological Subsections," dated February 15, 2007.

Ecotype Region	Counties or portions thereof:
Rochester Plateau, Blufflands, and Oak Savanna	Houston, Winona, Fillmore, Wabasha, Goodhue, Mower, Freeborn, Steele, Olmsted, Rice, Waseca, Dakota, Dodge
Anoka Sand Plain, Big Woods, and St. Paul Baldwin Plains and Moraines	Anoka, Hennepin, Ramsey, Washington, Chisago, Scott, Carver, McLeod, Wright, Benton, Isanti, Le Sueur, Sherburne
Inner Coteau and Coteau Moraines	Lincoln, Lyon, Pipestone, Rock, Murray, Nobles, Jackson, Cottonwood
Red River Prairie (South)	Traverse, Wilkin, Clay, Becker
Red River Prairie (North) and Aspen Parklands	Kittson, Roseau, Red Lake, Pennington, Marshall, Clearwater, Mahnomen, Polk, Norman
Minnesota River Prairie (North)	Big Stone, Pope, Stevens, Grant, Swift, Chippewa, Meeker, Kandiyohi, Renville, Lac qui Parle, Yellow Medicine
Minnesota River Prairie (South)	Nicollet, Redwood, Brown, Watonwan, Martin, Faribault, Blue Earth, Sibley
Hardwood Hills	Douglas, Morrison, Otter Tail, Stearns, Todd

Subd. 5. **Native prairie.** "Native prairie" means land that has never been plowed where native prairie vegetation originating from the site currently predominates or, if disturbed, is

predominantly covered with native prairie vegetation that originated from the site. Unbroken pasture land used for livestock grazing can be considered native prairie if it has predominantly native vegetation originating from the site and conservation practices have maintained biological diversity.

Subd. 6. **Native prairie species of a local ecotype.** "Native prairie species of a local ecotype" means a genetically differentiated population of a species that has at least one trait (morphological, biochemical, fitness, or phenological) that is evolutionarily adapted to local environmental conditions, notably plant competitors, pathogens, pollinators, soil microorganisms, growing season length, climate, hydrology, and soil.

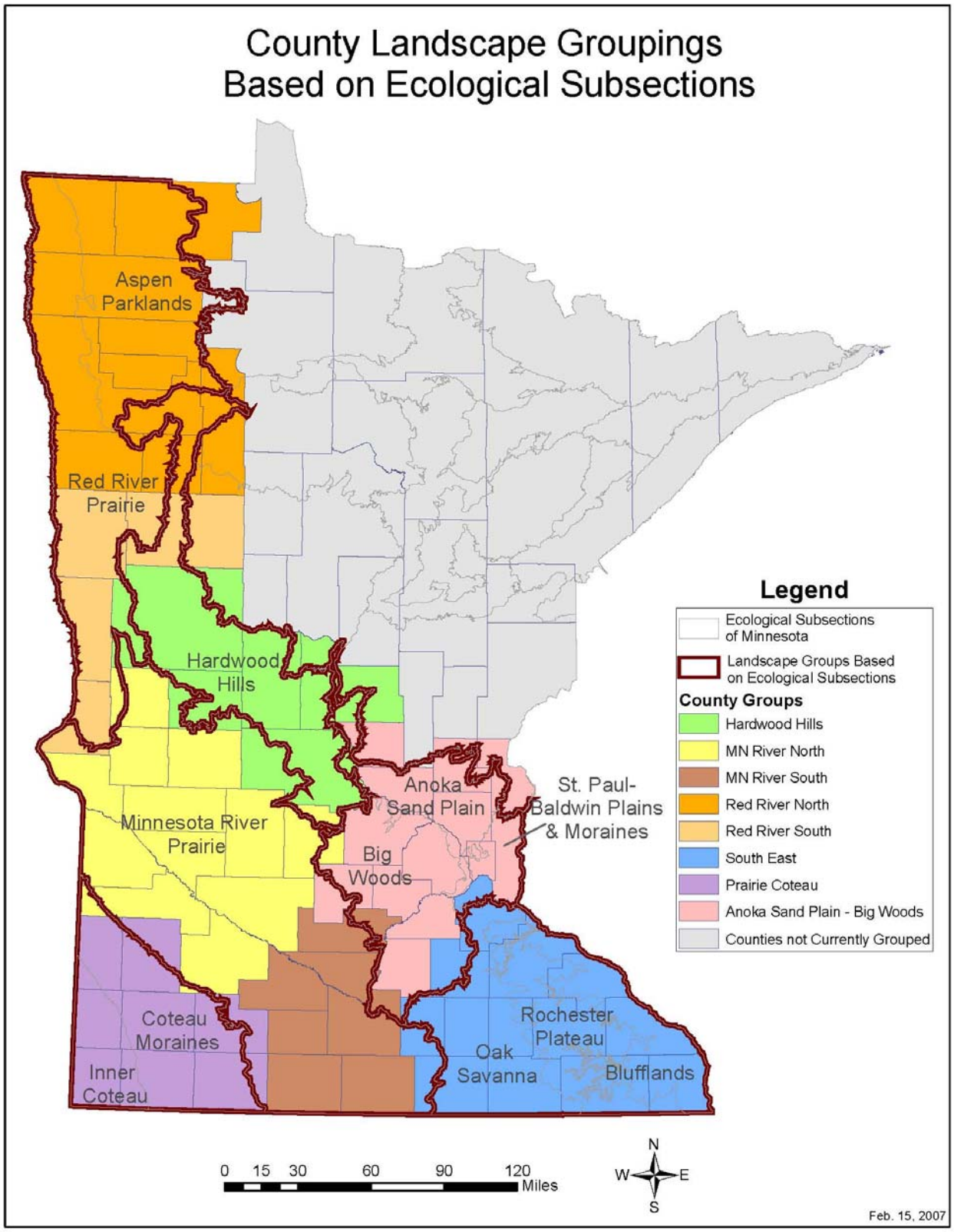
Subd. 7. **Restored native prairie.** "Restored native prairie" means a restoration using at least 25 representative and biologically diverse native prairie plant species of a local ecotype originating in the same county as the restoration site or within 25 miles of the county's border, but not across the boundary of an ecotype region.

Subd. 8. **Restored prairie.** "Restored prairie" means a restoration using at least 25 representative and biologically diverse native prairie plant species originating from the same ecotype region in which the restoration occurs.

History: *2007 c 57 art 1 s 17*

Appendix B

Minnesota Ecotype Regions map



Appendix C
2007 legislative appropriation language

Appropriation Language: Chapter 57, Article 1, Sec.4, Subd.8

$125,000 the first year is to support a technical advisory committee and for land management units that manage grasslands in order to develop plans to optimize native prairie seed harvest and replanting on state-owned lands. The work must use best management practices with an outcome of ensuring the survival of the native prairie remaining in Minnesota and to estimate the value of the seeds. Maximizing seed harvest may include allowing seed producers to keep a portion of the seed as compensation for supplying equipment and labor.

The Department of Natural Resources in cooperation with the Department of Agriculture and the Board of Water and Soil Resources shall establish the technical advisory committee which has the expertise to develop
(1) criteria to identify public and private marginal lands which could be used to produce native prairie seeds of a local eco-type or restore native prairies that could be used to produce Clean Energy,
(2) guidelines for production that ensure high carbon sequestration, protection of wildlife and waters, and minimization of inputs and that do not compromise the survival of the native prairie remaining in Minnesota, and
(3) recommendations for incentives that will result in the production of native prairie seeds of a local eco-type or restore native prairies.

In addition to agency members, the advisory committee shall have one member from each of two statewide farm organizations, one member from a statewide sustainable farmer organization, one member each from three statewide rural economic development organizations, one member each from three statewide environmental organizations, and one member each from three statewide wildlife or conservation organizations. No person registered as a lobbyist under Minnesota Statutes, section 10A.03, may serve on the technical advisory committee.

The technical committee shall work with the NextGen Energy Board to develop a Clean Energy program.

A report on outcomes from the technical committee is due December 15, 2007, to the legislative finance chairs on environment and natural resources.

Appendix D

USDA Natural Resource Conservation Service - comments on seed varieties

FIVE MYTHS CONCERNING NATIVE GRASS VARIETIES – June 2007
Dwight Tober, Plant Materials Specialist
Bismark Plant Material Center
USDA Natural Resources Conservation Service

What seed source is better for native grass seedings; local populations, or varieties, or something in-between? One answer that I believe most people would agree with is that it depends on the objective(s) of the planting. Multiple objectives may cloud the issue, but providing clear and definitive objectives generally will lead you to the best answer. For example, germplasm preservation may be a primary objective for planting seed from remnant local populations; and wildlife cover may be a primary objective for planting a variety proven to provide good biomass and a minimum amount of lodging over winter. Varieties or Natural Germplasms are sometimes not used because of misinformation associated with the development and release of native plant materials. Natural Germplasm is plant materials that has not been manipulated or significantly altered from the original collection. Some of this misinformation is presented in the following five myths regarding native grass releases.

1. Varieties of native grass are too aggressive and do not perform well in mixtures.
Certain species are aggressive on specific sites and can become dominant. For example, Rodan western wheatgrass, planted as part of a mixture, may dominate a clayey site after several years. However, it is the strong adaptation of the species to that site that may be undesirable and not the performance of the variety Rodan. Switchgrass, especially the lowland types, can become overly competitive on some wet sites. This is generally more of a species/site issue rather than a seed source issue. Seeding a balanced mixture of species suited to the site is a good start. Species dynamics over time is highly correlated to environmental conditions and management schemes.

2. Varieties of native grass will not produce seed because they are too competitive and will remain vegetative.
This misunderstanding probably got started years ago when more southern (Nebraska, Kansas) varieties of warm-season grasses were being used in the Dakota's and Minnesota because of the unavailability of more northern sources. These southern sources were late maturing, and often remained vegetative and did not produce seed, especially during dry conditions. Northern source varieties and Natural Germplasms are now available. These northern sources are early maturing and produce excellent seed crops.

3. Varieties of native grass are Genetically Modified Organisms (GMOs).
I am not aware of any native grass varieties that are GMOs. Although the extent of selection varies, all of the native grass releases being produced at the Bismarck PMC originate from natural populations. New releases are more genetically diverse than previously and are no longer called varieties. Native grasses are now generally being released as Natural Germplasms. Itasca Natural Germplasm little bluestem is a regional collection with 72 different sources (site collections) of parent material comprising its genetic background. Bad River Ecotype blue grama originates from native seed harvest and has had no intentional selection or purposeful genetic manipulation.

4. Varieties of native grass do not perform as well as sources from local populations and will not persist.

Proven varieties generally perform better than local populations in terms of ease of establishment, seedling vigor, disease resistance, biomass yield, seed production, and reduced lodging because of initial selection and extensive field testing. These are all very important plant traits which benefit wildlife habitat and conservation cover. Varieties must be field-tested and have their performance documented prior to formal release. Persistence or life span of adapted varieties is no less than sources from local populations.

5. Genetic diversity of the species is decreased when using native grass varieties or Natural Germplasms.

A single variety or Natural Germplasm release will not completely represent the genetic diversity present in the species, but a small population of plants that trace to a single site or a limited number of sites (local populations) may have an extremely narrow gene base and high genetic vulnerability. It is also true that some varieties were developed primarily for forage benefits and may have been selected for a relatively narrow range of traits. However, current procedures used by most PMCs for release of native grasses or other species guard against low genetic diversity. Plants used in a new release are collected over a fairly wide range of environments. New regional releases from the Bismarck PMC contain more genetic diversity than would sources from a limited number of isolated local populations. Release categories for Natural Germplasms that are eligible for seed certification include “source identified”, “selected”, and “tested”. The “selected” category refers to limited phenotypic selection and does not encompass intensive recurrent selection. In nature, plant selection is an ongoing ecological process and whenever seed is harvested from any source, plant selection is occurring. Finally, developed seed sources will occupy only a very small proportion of the total plant population that exists for the species. As such, any outcrossing with plants of the same species that are indigenous to a local area would have low impact on genetic diversity of that species in most instances. Local populations where inbreeding depression is a concern would benefit from outcrossing of these genetically diverse Natural Germplasms.

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http://www.mncia.org/doc/pub/nativegrass/NGF_Standards.doc

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http://www.dnr.state.mn.us/npc/index.html

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http://files.dnr.state.mn.us/assistance/grants/habitat/heritage/oporder_113.pdf

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http://www.dnr.state.mn.us/invasives/terrestrialplants/index.html

Minnesota DNR – Going Native, A prairie restoration handbook for MN landowners
http://files.dnr.state.mn.us/assistance/backyard/prairierestoration/goingnative.pdf

Minnesota DNR – Species of Greatest Conservation Need
http://www.dnr.state.mn.us/cwcs/need.html

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http://www.mda.state.mn.us/about/divisions/lab.htm

Minnesota Department of Agriculture - Native Grasses and Wildflower Seed Production Incentive Loan Program http://ros.leg.mn/bin/getpub.php?pubtype=STAT_CHAP&year=2007&section=17#stat.17.231.0

Minnesota Seed Laws and Rules
http://www.mda.state.mn.us/news/publications/licensing/grain&seed/seedlaw.pdf

Minnesota Department of Agriculture – Controlled Grazing
www.mda.state.mn.us/protecting/conservation/grazing.htm

Minnesota Noxious Weed Law
http://www.revisor.leg.state.mn.us/bin/getpub.php?pubtype=STAT_CHAP&year=2007&section=18#stat.18.75.0

Federal and State listed Species information
http://www.dnr.state.mn.us/ets/index.html

Iowa Ecotype Project
http://www.uni.edu/ecotype/index.html

Iowa DNR – Prairie Resource Center
http://www.iowadnr.com/wildlife/files/seedharvest.html

Wisconsin DNR – Grassland Incidental Taking Protocols
http://dnr.wi.gov/org/land/er/take/Grassland Savanna Protocol.htm