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The Minnesota Department of Transportation's Integrated Roadside Vegetation Management Program to Establish Native Vegetation along Minnesota Roadways

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Introduction

The Integrated Roadside Vegetation Management (IRVM) Program of the Minnesota Department of Transportation (MnDOT) is a program whereby vegetation managers within MnDOT seek to maintain roadside vegetation for numerous benefits to the Minnesota public such as safety, environmental, appearance and public relations (IRVM Website). The program allows vegetation managers to manage the vegetation along the state highways of Minnesota. The IRVM Program consists of Best Management Practices for the establishment of vegetation after construction has been completed. Some of the choices vegetation managers can choose in regard to vegetation are the use of sod or the use of native vegetation. The use of native vegetation is increasing within MnDOT and is becoming a common option for vegetation managers. Using native vegetation along roadways has faced many obstacles and setbacks. However, research and experience are making the transition from using standard vegetation along roadsides to using native vegetation an easier choice for vegetation managers.

During highway and bridge construction, entire MnDOT construction sites are often completely stripped of vegetation for the construction process. The topsoil is stripped and either hauled to other construction sites or is stockpiled on site. Heavy clay soils are frequently brought on site and used for regrading because of the high degree of cohesiveness and compactibility of the clay soil.

Highway construction causes great changes in the landforms of the site, which drastically alters the hydrology and vegetation of the site. The roadside can also be a very difficult place to establish vegetation because of the high degree of disturbance (e. g. snowplowing, vehicular breakdowns and traffic accidents). Roadsides also have high inputs of chemicals (e. g. salt application and petroleum products from vehicles). Roadsides also experience high degrees of soil compaction and very low soil fertility. The highly disturbed conditions along most roadsides causes the establishment of vegetation to be a tedious task that is also confounded through infestation of noxious weeds. Reclamation of roadsides within Minnesota has begun with the implementation of the Integrated Roadside Vegetation Management program. The goal of this program is not to restore Minnesota's roadsides to a pristine prairie condition. Rather, the goal is to reclaim the roadsides with perennial vegetation so they are environmentally sound.

Roadways within Minnesota are controlled at the local, county, state and federal level. The interstate highway system allows the American public to enjoy speedy transit across the United States. It was established in the 1950's and the majority of the interstate system was completed in the late 1970's and early 1980's. Presently there are construction projects aimed at the expansion of the interstate highway system and other projects that have the goal of updating the system to allow for increases in current and future demand. The control of the interstate

highways within each state is under the jurisdiction the respective state's department of transportation ("State" DOT's). The completion of the interstate system in Minnesota doubled the total acreage under the control of MnDOT. There are now approximately 260,000 acres of highway right-of-way in Minnesota (Jacobson, Personal communication). The maintenance responsibility for the highways also doubled after completion of the interstate system. MnDOT routinely mows the highway right-of-ways twice a year. Mowing nearly 260,000 acres twice a year is both labor and resource intensive. MnDOT started to look for alternative practices in hope of reducing the maintenance of the highway system. In the late 1970's, MnDOT started leaving the backslopes of the roadways unmowed in order to reduce some costs. At the same time, MnDOT started looking for grass species that required lower maintenance.

Need for Native Vegetation

In the late 1970's, technical staff of the Office of Environmental Services within MnDOT began looking for and experimenting with lower maintenance forbs and grasses. Leo. Holm, in monitoring roadside vegetation, began to monitor the seed mixes used in MnDOT's construction projects. At this time, most of the seed mixes used were forage based species mixes. These mixes were developed in the midwestern and western states for grazing of animals, which could be loosely equated with frequent mowing conditions. The main species components of these mixes were predominantly brome grasses (mainly *Bromus inermis*) with alfalfa, timothy (*Phleum pratensis*), and bird's foot trefoil (*Lotus corniculatus*). Mr. Holm began noticing that the brome grass began to lose vigor after awhile. In many instances where brome grass dominated, there would be large dead or weak patches. Invasive species and noxious weeds invaded these openings and became dominant. Mr. Holm also noticed that where native grasses, mostly sand dropseed (*Sporobolus cryptandrus*) and switchgrass (*Panicum virgatum*) had been included in the seed mix, they increased their numbers and expanded into these patches before the invasive species could. Native grasses seemed to perform better on soils with low fertility such as roadways within the Anoka Sand Plain of central Minnesota (Jacobson, Personal communication). It was for these reasons that MnDOT began to look at the possibility of using native grasses and forbs in their seed mixes.

Legislative mandates were not the initiative for MnDOT to begin using native vegetation along Minnesota roadways. Rather, the decision to begin using native vegetation was entirely internal to MnDOT. Legislation has been proposed related to the use of native vegetation by MnDOT, but nothing has ever passed. Since MnDOT already uses native vegetation and intends to continue its use, legislation will not likely increase restoration and reclamation activity. In the mid-1980's, the Minnesota Department of Natural Resources developed a "Roadsides for Wildlife" program aimed at increasing the wildlife habitat along Minnesota roadways primarily for pheasants, songbirds, and small mammals and was an opportunity for MnDOT to begin using and showcasing native vegetation. This program led to the Minnesota Mowing Law, which restricted when and where MnDOT mows along roadsides. It restricted general mowing in rural Minnesota but not in urban settings. Along rural roadways, MnDOT can only mow during the month of August. MnDOT cannot mow prior to the month of August because of the pheasant nesting time periods. MnDOT still mows shoulder cuts, intersections, and other safety areas along roadsides, but does not mow from the toe of the inslope back away from the road.

MnDOT started to develop a native vegetation program because of the need to reduce maintenance and to increase roadside habitat and ecology. Research in the 1970's and early 1980's pointed out that most of the problem plant species along roadsides are exotic species and noxious weeds such as Canada thistle (*Cirsium arvense)* and leafy spurge (*Euphorbia esula)* (Jacobson, Personal communication). MnDOT started experimenting with native vegetation during the 1980's. At first, MnDOT used native vegetation on small portions of construction projects in order to evaluate their performance. Native vegetation could not be used on entire projects because little was known about their engineering properties. It was not known at the time whether native vegetation could withstand the highly erosive conditions found along most roadways. The germination and establishment rates of native vegetation were also not known. Without knowing the germination success of the native vegetation, vegetation managers could not predict the potential for native vegetation to establish along roadways. Poor initial availability and limited quantity of native seed from producers also would not have met the demand of MnDOT. Because of the doubts in performance, native vegetation was initially used only on flat slopes (4:1 and gentler) to minimize the possibility of erosion. Since one of the main goals MnDOT had for native vegetation were reductions in mowing and maintenance, most of the native vegetation used on roadways would have been typified as being of a tallgrass prairie community. As such, tallgrass prairie species are infrequently mowed and therefore the maintenance of these stands would decrease. Because native vegetation was not mowed (and tended to look unkempt), there was little acceptance of the use of native vegetation in urban areas by the general public, who preferred roadways to be mowed and manicured at the time (Jacobson, Personal communication).

MnDOT determined that the use of native vegetation is a viable option for a roadside vegetation management program. MnDOT based this decision on the results of research conducted by MnDOT and published in the scientific literature (Jacobson, Personal communication). In the early 1990's, MnDOT began specifying and designing seed mixes that had native vegetation as the primary component of the seed mixes. In designing seed mixes, vegetation managers at MnDOT needed to account for the wide range of possible plant communities along Minnesota's roadsides. The designers also had to include the physiology of the native vegetation into the design of the seed mixes. For instance, research showed that native vegetation establishes very slowly (Jacobson, Personal communication). Therefore MnDOT needed to include a cover crop in all of the seed mixes in order to control erosion until the native vegetation was vigorous enough to control erosion.

Ecology of Native Roadside Vegetation

The ecology of a native stand of vegetation is very important when designing seed mixes. Grass species can be generally divided into two types of species based on seasonal growth patterns. Cool season grasses exhibit a bimodal growth pattern where they can germinate and establish very early in the spring, they then slow their growth during the summer and begin to grow in the fall. Cool season grasses have a temperature optimum of 60 – 75 °F (Beard, 1973). Warm season grasses exhibit a unimodal growth pattern. They germinate and establish during the summer months. Warm season grasses have a temperature optimum of 80 – 90 °F (Beard, 1973). Cool season grasses are often non-native in tallgrass prairies, but there are native cool season grasses.

In the same respect, there are non-native warm season grasses (e. g. the Bermuda grasses) but many are native to Minnesota prairies.

There are differences in resource allocation of warm and cool season grasses that allow them to work in concert to be very effective in controlling soil erosion. Cool season grasses allocate their carbon and nutrients towards vegetative (green) growth and maintain shallow root systems. As such, they typically have luxuriant green growth very early on and very late in the season. However, cool season grasses do not have extensive root systems that are often very shallow in the soil profile and not extensive (Bennett & Doss, 1960). Warm season grasses allocate most of their carbon and nutrients to the development of an extensive root system. The root system of warm season grasses typically reaches from several feet to several yards into the soil profile depending on species. The root system also forms an extensive network of highly branched roots with an abundance of root hairs. Cool season grasses can withstand more frequent mowing because they allocate more nutrients to vegetative growth than warm season grasses. Warm season grasses do not tolerate intense mowing. Cool season and warm season grasses work together to control erosion, increase slope stability, improve wildlife habitat and provide a high aesthetic appeal to motorists.

Opposition to the Use of Native Vegetation

There was opposition to the use of native vegetation within MnDOT. Most of the older seed mixes (typically the forage-based seed mixes) seemed to perform up to specifications under a wide variety of conditions, so many vegetation managers did not see a need to change the seed mixes (Jacobson, Personal communication). In 1971, MnDOT switched from primarily using forage-based mixes to "Mix 500." This seed mix still contained some of the forage species (e. g. smooth brome grass and alfalfa) but added a higher concentration of warm season native grasses (e. g. little bluestem and switchgrass). Project administrators, engineers, inspectors, and seeders did not like Mix 500. Although no research was conducted, they perceived that it did not perform as well as the older mixes (Jacobson, Personal communication). In the early 1990's MnDOT started to leave out the forage species and have mixes that were solely native species. The new group of administrators, engineers, inspectors and seeders had the same reservations about the native seed mixes as their predecessors had about Mix 500. They also claimed that the native mixes did not perform as well as Mix 500 even though there was no research to corroborate this feeling (Jacobson, Personal communication).

An explanation of why this bias against natives exists is that initially very little was known about native grasses and their ecology and physiology. Most of the native vegetation initially used were warm season grasses that were seeded in April and early May. These seeding times occurred when the soil temperatures were well below the 65 °F required for germination and establishment. The early seeding times caused many projects to fail because there was an insufficient amount of established vegetation during the spring rainstorms that caused slope failures and massive erosive events. These failures could have been averted had there been sufficient knowledge about the use and application of native grasses.

There has been opposition to the use of natives because of their higher costs. Native seed mixes typically cost twice as much as Mix 500. Not only do the native seed mixes cost more, but the

installation costs are also more expensive (Jacobson, Personal communication). The forage-based seed mixes were broadcast seeded and did not require specialized and expensive seeding equipment. The native seed mixes need to be incorporated into the soil via a seed drill. Using a seed drill increases the costs of a native seed mix installation. The added cost of planting native vegetation needs to be offset by the benefits of using native vegetation. If the benefits of native vegetation were not enough to justify their use, then MnDOT would not use them. MnDOT has published several brochures and papers that discuss the benefits of using native vegetation. One brochure, "Native Vegetation: Why all the fuss?" outlines how deeply penetrating and extensive the root system of warm season natives compares to that of the cool season grasses (MnDOT, 1992). Information such as this has convinced design engineers of the usefulness of native vegetation in controlling soil erosion (Jacobson, Personal communication).

Transition to the Use of Native Vegetation

In the 1990's, production of both warm and cool season native grasses increased their availability on the market dramatically. The increased production of cool season native grasses allowed them to be used on projects and in areas where previously there would have been no chance for native vegetation. MnDOT had a transition period from 1985 to 1995 where there was a gradual phase-out of the older seed mixes and an increasing phase-in of native seed mixes. This transition encouraged the seed producers to not only grow more quantity of native seed but also grow a wider species variety of seed. MnDOT could not have accomplished their native vegetation program if the seed producers had not increased native seed production.

The native vegetation program has received a very good overall reception within MnDOT. As previously mentioned most of the opposition to the use of native vegetation stems from the inexperience of using native vegetation. There are still some people within MnDOT who prefer the use of sod to that of seed and also prefer forage seed to native seed. MnDOT has set up a series of Best Management Practices in regards to vegetation. Sod is used when the adjacent land use calls for its use. For example, a prairie would not be planted in the vicinity of a manicured lawn. Sod is typically used in residential and industrial areas as well as areas that require high maintenance (frequent mowing, fertilization and watering are part of the maintenance of a sodded area) and have high traffic flows. The forage grasses are used when there are less maintenance requirements than in sodded areas but the area is still maintained to some degree (e. g. mowing every other year). MnDOT uses native vegetation in areas where very little or no maintenance conditions are required. The MnDOT Seeding Manual (MnDOT, 1996) identifies where native seed mixes are to be used on MnDOT construction sites. Some of the potential areas for the use of native vegetation are:

- Rural roadways where minimal mowing is desired
- Urban roadsides, interchanges, etc. where minimal mowing is desired
- Adjacent to National & State parks, Federal & State management areas, and Scientific and Natural Areas
- Adjacent to private nature preserves (e. g. The Nature Conservancy preserves)
- Wetland mitigation and other restoration sites
- Rest areas, state entrances and truck stations that are non-turfed areas

- Areas with informal or naturalized landscaping
- Rehabilitating weed infested areas

Technical staff at MnDOT are showing that projects do not fail because of the use of native grasses. They have shown that if a project fails, it is because of some underlying factor that was not taken into account in the design stage (such as slope seepage contributing to a failed slope or improperly graded sites). The technical staff is also identifying improper procedures in seeding native grasses. They have found that in some instances native grasses were seeded in a manner similar to Kentucky bluegrass (a non-native grass). Bluegrasses are typically broadcast seeded whereas native grasses need to be incorporated into the soil with a seed drill. The improper seeding of natives may have led to project failures.

Some independent contractors object to the use of native mixes and wish to continue using the older seed mixes with current construction projects. They believe that native grasses are difficult to establish. Seeding with native seeds is quite labor intensive because native seeds need to have good site preparation and good incorporation into the soil. Other independent contractors like the use of native vegetation because of the broader time span of seeding. With both cool and warm season mixes, contractors can continually seed throughout the construction season (spring through fall) and do not have an inactive time period. Thus projects do not have to be completed at a specific time in order to be seeded. In spring and fall they plant cool season mixes; in the summer they plant warm season mixes.

Public Perception of Native Vegetation

The use of native vegetation, in the eyes of the public is mixed. In general, based on calls to MnDOT, 50% of the public likes the natural look and concepts associated with the use of native vegetation and 50% of the public likes the manicured, golf course-like appearance of Minnesota's roadways (Jacobson, Personal communication). However, public perception of the use of native vegetation may be changing. Recently MnDOT discontinued mowing along sections of I-94 in the metropolitan area. Generally these sections would be mowed twice a year to maintain the manicured appearance. There were several calls to MnDOT praising and thanking MnDOT for planting the beautiful purple wildflowers along these urban roadways. MnDOT had not planted any wildflowers as the public had thought. The "prairie" flowers were actually Canada thistle (*Cirsium arvense*) and spotted knapweed (*Centaurea maculosa*), two of the most common noxious weeds along roadways. Normally these plants were not allowed to flower because of the frequent mowing conditions in the metropolitan area. Once the mowing had stopped, the flowers were allowed to bolt and flower. Based on the number of calls, MnDOT felt that the urban population was ready for the use of native vegetation along urban highways. MnDOT has learned that an abundance of flowers and a showy vegetative stand is a good thing in the public's eye.

Regulation of Native Vegetation

MnDOT regulates the use of native vegetation on highway construction sites. MnDOT approves seed growers who produce wild ecotype plant materials that are regional in origin. After completing the certification process, seed producers are given seed bag labels to identify that the

seed source has been certified for use. Acceptance of seed without the MnDOT label is prohibited on construction sites. In the future, MnDOT will use the Minnesota Crop Improvement Association (MCIA) Origin certification program to certify seed sources. This certification program details how seed suppliers can label the origin of their seed stock. The growth and collection of the seed is regulated by this program (MCIA's website).

In order for any material to be used on a construction project, it needs to be specified is the designs of the project by the design engineers. The use of native vegetation and seed mixes are listed in MnDOT's Specifications for Construction book. This specification book details all of the design specifications that highway projects must follow. Thus the use of native vegetation is now fully specified to be used on MnDOT construction projects. As a further aid to design engineers and vegetation managers, MnDOT publishes a Seeding Manual that details all of the seed mixes that can be used on MnDOT projects. MnDOT also publishes several design guides that are used by design and construction engineers to put together the turf establishment recommendations and designs. The construction designs are reviewed by technical staff for compliance with the use of native vegetation and overall turf establishment procedures (including erosion control practices) and need to be signed off before construction can begin. MnDOT tightly controls modification of seed mixes. Changes to specified seed mixes (such as the addition or deletion of a species) needs to be documented in the design of the project. The reasons for the changes need to be documented as well. Typically MnDOT's vegetation specialists modify seed mixes to be more conducive to a particular site (Jacobson, Personal communication).

The scientific basis for using and establishing native vegetation is still in its infancy, but is progressing very rapidly. There is new research looking at mycorhizzal associations and how these associations lead to a healthier stand of native vegetation (Jacobson, Personal communication). There is also research aimed at identifying and deliminating the native source of seed and vegetation (Jacobson, Personal communication). Using native vegetation has an advantage that they have evolved and are adapted to Minnesota's soils and climate. Therefore, once established, native vegetation will be able to favorably respond to fluctuations in Minnesota's environment. The engineering properties of native vegetation are also superior to non-native vegetation; native vegetation has a more extensive root systems to stabilize slopes; they also can produce enough aboveground biomass to act as mulches to prevent surface soil erosion; and they can survive extreme roadside temperatures (which can reach well over 120 °F and whither non-native vegetation). Current research is also showing that native vegetation is also physiologically superior to non-native vegetation. Native vegetation may be more salt tolerant than non-native vegetation, which is a very important factor along Minnesota roadways (Biesboer et al., 1998). Native vegetation may also be better adapted to low soil nutrient conditions than non-natives (Risser, 1985).

Engineers and technical staff at MnDOT are being educated on the benefits of using native vegetation. There is also a "grass roots" movement within MnDOT to change the old stereotypes and biases against the use and management of native vegetation. Some of the educational material are specifications on using native vegetation, design books to aid design engineers, and the most important educational tool: successful projects. The use of native vegetation within MnDOT has undergone a lot of changes, alterations and difficulties. The acceptance of native

vegetation is becoming more common. Aiding the acceptance are positive results, new, cutting edge research, new technologies, and new outlooks. MnDOT has not accomplished this goal alone; seed producers took a chance on the difficult task of growing native vegetation, independent contractors took the risk of using native vegetation on construction sites, and most importantly the public has accepted the use of native vegetation along Minnesota's roadsides.

One of the main shortcomings of this program is the lack of long-term monitoring. Sites where native vegetation is used is monitored in a cursory manner for the first four to five years after intial seeding. When monitoring and evaluating a site, MnDOT personnel frequently do a "walk through" evaluation that is purely subjective in nature (Jacobson, Personal communication). MnDOT does not employ a rigorous method, such as a releve, for determining the success of a specific project. The diminutive monitoring program MnDOT has for its roadsides is an outgrowth of the shear size of MnDOT's revegetation opportunities. There are approximately 7000 acres of roadsides revegetated by MnDOT every year. This amount of acreage could not be rigorously monitored within reason and with the available human resources MnDOT has under its control. MnDOT has construction sites that are separated into reclamations (a healthy majority of the 7000 acres per year) and restorations (a minority of the 7000 acres). The reclaimed sites that are revegetated suffer the most from a lack of monitoring. The restorations receive most of the monitoring time and effort. Restorations that are a part of a wetland mitigation or are done in conjunction with other restoration groups are monitored to a higher degree than the reclamations, but still would not be rigorously monitored (Jacobson, Personal communication). In other words, a releve would not be performed on each of the restorations.

The goals of the Integrated Roadside Vegetation Management program are not to restore a roadside to a native prairie condition. Roadways are constantly disturbed sites that may benefit from the use of native vegetation, but should not rely on native vegetation. The ultimate goal of MnDOT (or any state DOT for that matter) is the safety of the American public travelling on the interstate highway within its state. To this end, MnDOT needs to use vegetation that is going to prevent unsafe roadside conditions; such as massive erosion, landslides, flooding and general road instability. It has been shown that native vegetation, through its physiological and ecological nature, may be the ideal choice in some situations. Native vegetation may also have an aesthetic affect on the motoring public via beautiful, colorful prairie flowers that may enhance the traveling experience. However, MnDOT does not rely completely on the use of native vegetation.

The physiology and ecology of a plant are going to dictate when and where it is to be used. If a non-native plant has engineering and economic properties that outweigh the properties of a native plant, then the non-native plants are to be used. However, the properties of the non-native plant should be directly compared to native vegetation. MnDOT does use native vegetation whenever and wherever possible, but not on all construction sites (Jacobson, Personal communication). In order for native vegetation to be used on more construction projects, researchers need to identify the engineering and economic properties that will enable design engineers to justify their use on a project.

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