Demicks Lake Pipeline Project

REVEGETATION PLAN

ISSUED FOR CONSTRUCTION

Prepared by:

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Revegetation Plan
ONEOK Bakken Pipeline, L.L.C.
Casey Furey, Crowley Fleck PLLP

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1.0 INTRODUCTION

This *Revegetation Plan* (Plan) was created to provide procedures to be followed during the revegetation of areas disturbed as a result of constructing the ONEOK Bakken Pipeline, L.L.C. (ONEOK) Demicks Lake Pipeline Project (Project). This Plan incorporates comments from the Natural Resource Conservation Service (NRCS) and/or county conservation offices in McKenzie County, North Dakota, and Richland County, Montana; applicable agency permit conditions; the contractor's ONEOK-approved Revegetation Plan, and ONEOK's *Construction and Mitigation Restoration Plan (CMRP)*. Permit conditions, environmental and civil, or landowner agreements will take precedence over the requirements of this Plan.

1.1 Revegetation

This Plan applies to all areas of perennial vegetation disturbed by construction. ONEOK will not seed active or rotated croplands unless specifically requested to do so by the landowner or land management agency. Seeding which occurs on US Forest Service (USFS)-administered lands will be conducted in accordance with the conditions of ONEOK's Special Use Permit. ONEOK will coordinate with landowners to discourage livestock grazing of the construction right-of-way (ROW) during the first growing season by utilization of temporary fencing, deferred grazing (see Section 1.4), or increased grazing rotation frequency, especially in critical areas, such as sandy sites with blow-out potential.

1.1.1 Wetlands and Stream Banks

Temporary Revegetation

ONEOK's contractor will seed wetlands, excluding those inundated or farmed, and stream banks with an appropriate cover crop where necessary to prevent erosion (see Appendix A – Contractor Revegetation Plan). No fertilizer, lime, or mulch will be applied in wetlands.

Permanent Restoration

Stream banks will be seeded with the same seed mix as the adjacent upland area, except where a specific streambank seed mix was requested by a county NRCS or conservation district (see Appendix B, NRCS Herbaceous Vegetation Establishment Guide). Seeding which occurs on USFS lands will be conducted in accordance with the conditions of ONEOK's Special Use Permit. ONEOK does not propose permanent planting or seeding in wetlands. In wetlands, the root mat/vegetative layer should be left in place during construction, except directly over the trench line. By leaving the root mat/vegetative layer intact, revegetation of the wetland to its pre-construction composition will occur naturally through native recruitment.

1.1.2 Uplands

Temporary Revegetation and Stabilization

If final grading and installation of permanent erosion control measures will not be completed in an area within 10 days after the trench is backfilled, then temporary stabilization measures will be employed. Temporary stabilization measures will also be employed where construction activity is interupted for extended periods and when seeding cannot be completed, e.g. due to seeding period restrictions.

Temporary stabilization measures consist of surface roughening (e.g. plowing or discing to achieve a rough surface), temporary seeding, or temporary mulching. Surface roughening will predominantly be used for temporary stabilization of the soils until soil conditions permit seedbed preparation and seed germination. Surface roughening may include equipment tracking, scarifying, imprinting, or tilling a

disturbed area. These techniques are only adequate when the soils have a significant organic component. If the soils are sandy the surface roughening technique will be ineffective and will contribute to fugitive dust emissions. ONEOK's Enivironmental Inspection Team and Construction Management team must approve the use of surface roughening.

Temporary seeding and/or mulching will be employed where erosion is likely to occur, including locations such as stream banks, road ditches, steep slopes, and areas subject to storm water flow, as described in the *Storm Water Pollution Prevention Plan (SWPPP).* ONEOK's specification for installation of mulch and temporary stabilization is discussed in Section 1.7.5 of the *CMRP*. The contractor will consult with ONEOK and the Lead Environmental Inspector (EI) if there is a need for temporary stabiliation measures.

Permanent Revegetation

All upland areas disturbed by construction activities, excluding active and rotated cropland, will be seeded within 10 days of completion of final clean up. Ideally, seeding will be done before the ground freezes. Fertilizer and pH modifying agents (e.g., lime) may be used and will be based on local soil moisture conditions, germination requirements of selected species, and adaptation of seed soil temperature.

1.1.3 Seedbed Preparation

Seeding will follow cleanup and topsoil replacement as closely as practicable. The contractor will scarify, till, disk, or harrow the seedbed as needed in order to enhance seed germination. Soil compact treatment will be applicable as described in the *CMRP*. Sites where this method is not practical (e.g., steep slopes, rocky areas, etc.) will be dozer-tracked perpendicular to the slope or otherwise left with adequate roughness, following topsoil placement, to provide micro-sites for seed germination and to reduce soil movement. If mulch was applied prior to seeding for temporary erosion control, the contractor will remove and dispose of the mulch prior to seedbed preparation to ensure that seedbed preparation equipment and seed drills do not become plugged with excess mulch; to support an adequate seedbed; and to ensure that seed incorporation or soil packing equipment can operate without becoming plugged with mulch.

1.1.4 Seeding Method

Based on site-specific conditions, seeding will be accomplished by drilling or broadcasting. A range-type drill, or similar device, will be employed on level to gently sloping areas where rock fragment content allows drilling operations. The seeder will be followed with a drag packer or roller to ensure uniform coverage of the seed and adequate compaction. Drill seeding will be done along contour lines where practical, not up and down the slope. The drill seeder will apply seed mixes with mechanisms such as seed box agitators to allow even distribution of all species in each seed mix, with an adjustable metering mechanism to accurately deliver the specified seeding rate, and with a mechanism such as depth bands to accurately place the seed at the specified depth. Planting depth will not exceed local and regional agriculture practices. Seeders will be calibrated and operated at an appropriate speed so that the specified seeding rate is planted. The row spacing on drill seeders will not exceed 8 inches, unless otherwise recommended due to growth characteristics of a certain species.

Broadcast seeding will be employed on steep (> 15 % slope) and/or rocky areas where drill seeding is not practical. Seed will be broadcast using manually-operated, cyclone-type bucket spreaders, mechanical seed spreaders or blowers, or hydroseeders. Broadcast seeding will be performed at 2 times the rate for drill seeding. Seeds will be mixed frequently in spreader hoppers to discourage

settling. Broadcast seeding may be delayed during high wind conditions if even distribution of seed is impeded.

Where possible, broadcast areas will be chained or harrowed to cover seed. On small or inaccessible areas, hand raking will be used to cover seed. On steeper slopes where tilling or harrowing are not feasible, the areas will be dozer-tracked perpendicular to the slope prior to seeding, or-otherwise left in a roughened state, to provide micro-sites for seed germination.

Hydro seeding may be used, on a limited basis, where the slope is too steep, or soil conditions do not warrant conventional seeding methods. Fertilizer, where specified, may be included in the seed, virgin wood fiber, tackifier, and water mixture. When hydro-seeding, virgin wood fiber will be applied at the rate of approximately 3,000 pounds per acre on an air-dry weight basis as necessary to provide at least seventy-five (75) percent ground cover. Tackifier will consist of biodegradable, vegetable-based material and will be applied at the rate recommended by the manufacturer. The seed, mulch, and tackifier slurry will be applied so that it forms a uniform, mat-like covering of the ground.

1.1.5 Revegetation Mixtures and Rates

In cooperation with the applicable agencies and private landowners, seed mixtures have been developed for the soil types within the Project area (see Appendices A and B). Disturbed areas (with the exception of cultivated fields and wetlands) will be seeded in accordance with written recommendations for seed species, rates, techniques, and planting dates from the NRCS or county conservation districts (unless otherwise specified in landowner agreements) as outlined in the contractors revegetation plan (Appendix A) or the NRCS Herbaceous Vegetation Establishment Guide (Appendix B). Seed included in mixtures developed in collaboration with agencies assume use of local strains or cultivars to assure seeds. Seed will be acquired from local sources that can verify appropriate cultivars are used.

Conservation Reserve Program (CRP) seed mixture will be applied to CRP lands. The property owner is responsible for identifying CRP lands crossed by the Project. All disturbed areas will be re-seeded in accordance with the specifications outlined below. The ROW will be re-seeded at the end of construction.

In some instances, seed mixtures may need to be modified as a result of limited species availability, poor seed quality, or site differences. With ONEOK approval, these modifications will be made based on site-specific conditions and requirements.

1.1.6 Seed Installation Timing

Seeding of permanent native seed mixes should not occur outside of the dormant seeding windows listed in Table 1.1.7-1. to prevent premature germination of vunerable native seedlings during the hottest and driest time of the year. Temporary stablization measures should be utilized during the summer period and prior to the winter dormant seeding date for each respective state. These dates are subject to annual and local variability across the project, but should be used as a general rule of thumb and deviation of more than a week from these dates should only be considered on a case by case basis, with the EI team’s recommendations and ONEOK’s approval. Replanting of alfalfa fields requires two growing season and communciation with the landowner will take place during this timeframe.

1.1.7 Dormant Seeding

Dormant seeding is most effective in restoration of disturbed areas because early spring is the most reliable period for moist soil conditions. Low temperatures and dormant vegetation during the winter

months help soils retain beneficial amounts of moisture into the spring (WYRRC, 2010). Dormant seeding is conducted after soil temperatures are cool enough to prevent seed germination; generally when soil temperature at two inches below the soil surface is 40 degrees or less for a minimum of five consecutive days (NRCS, 2018). The dormant seeding timeframe in North Dakota and Montana occurs after November 1. Dormant seeding is only practicable if the soil is not frozen and snow is not present. Procedures for applying soil amendments, seedbed preparation, seeding, and mulching are the same as outlined for permanent revegetation in this Plan.

Where dormant seeding is conducted, one or more of the following temporary erosion and sediment controls will be put in place over the freshly seeded area unless the local soil conservation authority, landowner, or land managing agency specifies otherwise. The temporary measures are as follows:

- Straw mulch, at 4,000 lbs/acre, anchored;
- Hydromulch, at 1,500 to 2,000 lbs/acre;
- Erosion control blanket, 1 layer on soil surface

Additional erosion control measures will be applied as outlined in ONEOK's *CMRP*.

1.2 Weed Control

Weed control practices will be implemented to limit the growth and spread of weeds and to ensure that revegetation is successful with the proposed seed mixtures in accordance with ONEOK's project-specific *Weed Management Plan*.

1.3 Seed Inspection

Seed Tag Inspection

Restoration contractors will collect tags from the seed used to document compliance with agency and landowner seeding requirements and provide the tags and associated records to the appropriate EI. The restoration contractor will be responsible for inspecting seed and seed tags to ensure compliance with the above requirements. Seed purchased by the contractor will be on a "Pure Live Seed" (PLS) basis. The restoration contractor will inspect seed prior to use. Seed tags will identify:

- Purity;
- Germination;
- Date tested;
- Total weight and PLS weight;
- Weed seed content; and
- Suppliers name and business information.

Seed Purity

The germination and purity tests conducted by the vendor will be completed within 12 months of seed utilization. The seed tags on the seed sacks will also certify that the seed is "Noxious Weed Free". Seed rates used on the Project will be based on PLS rate, not actual weight basis.

1.4 Grazing Deferment

Excessive livestock grazing is detrimental to the germination of permanent vegetative cover over the ROW. In order to ensure that the ROW is properly restored with sufficient vegetative cover, ONEOK will develop grazing deferment plans with landowners, tenants, or other grazing permit holders that address construction timing, fence cutting and bracing, temporary fencing, cattle guard locations, and water requirements for livestock.

The NRCS recommends all range plantings are not grazed until the stand is fully established, which is a minimum of one full growing season. If, after one full growing season, the stand has not adequately established, or seedlings do not have well-developed root systems with adventitious roots above the sown seed, grazing should be deferred for a second growing season (NRCS, 2018; Appendix B).

1.5 Revegetation Monitoring

Monitoring will be conducted in compliance with the *SWPPP* during the construction phase as well as the post construction phase of the Project to verify adequate vegetation establishment to stabilize the soil and satisfy permit conditions.

2.0 REFERENCES

U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS). April 2018. Herbaceous Vegetation Establishment Guide. Available online at: https://efotg.sc.egov.usda.gov/references/Public/ND/Herbaceous_Veg_Est_Guide.pdf. Accessed December 20, 2018.

Wyoming Reclamation and Restoration Center (WYRRC). 2010. Successful Restoration of Severely Disturbed Lands: Seeding Essentials for Reclaiming Disturbed Lands

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APPENDIX A

Contractor Revegetation Plan

Ecozone Reclamation Plans

Demicks Lake Pipeline

Prepared for:
ONEOK, Inc.

Prepared by:
Duraroot, LLC

Date:
December 20, 2018

Reclamation Guidelines for the Demicks Lake Pipeline

The Demicks Lake Pipeline (DLP) is a pipeline project in McKenzie County, North Dakota and Richland County, Montana. Land use along the DLP right-of-way (ROW) includes cultivated cropland, hay/tame pasture, and native range/grassland. Vegetation consists predominantly of cereal grain crops, alfalfa/grass hay, and native/introduced grasses. Soils vary in chemical and physical composition, depth, drainage capability, and reclamation potential. Ecozone delineations along the DLP ROW considered dominant soil types, soil chemical characteristics, dominant vegetation, land use, and topography.

The ecozones present along the DLP are: Cultivated Crop Ecozone, Saline Ecozone, Badlands Ecozone, Loamy Ecozone, and Sandy Ecozone. Characteristics of each ecozone, along with associated reclamation techniques and recommendations, are detailed in each ecozone report. Fertility recommendations and seed mixes were developed based on soil sample analytical data and vegetation field surveys performed during the fall of 2018 and from data collected as part of the Garden Creek Loop project for ONEOK. Soil sample analytical data were used to make amendment recommendations based on the soil chemistry for most of the ROW. Recommendations are based on sample data analysis and Duraroot's interpretation of the soils along the alignment. All soil samples were collected by or under the supervision of a Certified Professional Soil Scientist (CPSS). A summary of all soil fertility data for DLP can be found in Attachment A.

Due to the nature and scale of the project, these reclamation guidelines have been developed using a broad-based approach to address reclamation across the project disturbance and to facilitate construction activities. Site-specific plans are recommended in areas with soil characteristics that could negatively impact revegetation, such as shallow soil resources or high/low pH and elevated salt concentrations (Attachment A). Soil sample data indicate that potentially challenging sites, in terms of reclamation success, are present along the pipeline route. It is likely that additional areas are present, but further sampling would be needed to more accurately delineate boundaries. Duraroot can provide site-specific reclamation plans for these locations at a small additional cost of $500 per plan.

RECLAMATION PLAN
CULTIVATED CROP ECOZONE SITES

SITE DESCRIPTION

The Cultivated Crop Ecozone is comprised of managed row crops, hayfields, and tame pastures. The Cultivated Crop Ecozone makes up approximately forty-four (43.5) percent of the land use on Demicks Lake Pipeline. Following construction, the land will be returned to productive cropland. The Cultivated Crop Ecozone contains primarily medium textured loam soils, with grades less than 10 percent. Soil pH is predominately slightly alkaline (pH 7.4 to 7.8) to moderately alkaline (pH 7.9 to 8.4). One key factor in reclaiming the Cultivated Crop Ecozone sites will be the preservation of topsoil, which has the soil properties necessary for agricultural production. This ecozone should present minimal challenges for reclamation due to desirable ecozone characteristics.

Due to reclamation timing, a cover crop seed mix for the Cultivated Crop Ecozone is provided in Table 1. A cover crop should be seeded on all cultivated cropland when establishment of the crop will not occur within 45 days or less of reclamation activities. A cover crop will protect the soil from wind and water erosion, increase soil stabilization, improve soil structure, suppress weed establishment, and improve overall reclamation success. The cover crop seed mix below was developed to provide quick cover due to a rapid germination rate and to aid in accelerated soil stabilization by helping to prevent the migration of topsoil during periods of freeze/thaw and rain events. A cover crop seed mix recommendation for immediate vegetation cover is provided in Table 1. Landowner preferences should be identified prior to seeding to develop appropriate seed mixes for hayfields and tame pastures. The reclamation plan is provided on Page 2.

Table 1. Demicks Lake Pipeline Cultivated Crop Ecozone Site Cover Crop Seed Mix Recommendation.

Common Name	Scientific Name	# PLS/acre	PLS/sq ft	% of Mix
Quickguard-Sterile Triticale	*Triticum aestivum x Secale cereal*	60	18	90%
Nitro Radish	*Raphanus sativus*	3.5	2.0	10%
Total	**--**	**64**	**20**	**100%**

RECLAMATION PLAN
CULTIVATED CROP ECOZONE SITES

(1) SOIL AMENDMENTS

Soil and nutrient amendments within cultivated areas should be based on surface owner requests. If the surface owner does not have any tract specific requests, it is recommended that approximately 20 pounds of nitrogen and 50 pounds of phosphorus per acre be applied.

(2) SEEDBED PREPARATION

These recommended seedbed preparation steps will aid in successful reclamation. Steps may be omitted, conducted in different order, or changed to optimize success and efficiency depending on field conditions, sub-soil properties, and local terrain.

- Rip subsurface soil, prior to topsoil spreading, to a minimum depth of 16 inches to reduce soil compaction and improve drainage. Ripping should be conducted using a double pass with a straight-shank agricultural ripper or parabolic ripper. The shanks on the back of a grader or dozer should NOT be used to alleviate soil compaction. Do not smooth the ROW with a dozer once ripped. It is beneficial to have an irregular surface to help tie the topsoil and subsoil horizons together. Tillage can be used to break soil clods apart prior to topsoil application.
- Apply topsoil and requested soil amendments, discussed above, to improve the soil's physical and chemical characteristics and to supplement soil nutrients.
- Finally, till the site to a depth of 4.0 to 6.0 inches to incorporate applied soil amendments and to create a seedbed conducive to seedling establishment (disk and harrow, field cultivator, vibra-shank, or other alternative suitable to site conditions).

(3) OPTIONAL COVER CROP SEEDING

Cover crop seeding should be conducted using a drill seeder suitable for the location's soils and capable of direct seed placement. Drill seeding should occur on the contour using a drill equipped with a double disc opener, wheel press, and depth bands to ensure proper seeding depth. Seed should be planted to the depth specified by the vendor to ensure proper germination and emergence. It is recommended that grain seed be placed 0.5 to 1.0 inches deep. The Cultivated Crop Ecozone recommended cover crop seed mix and rate is provided in Table 1.

(4) STRAW MULCHING

Application of straw mulch is recommended to reduce potential water and wind erosion when establishment of the crop will not occur within 45 days of reclamation activities and a cover crop will not be planted. Recommended straw mulch application rates are between 1.5 to 2.0 tons per acre. This will provide ground coverage of approximately 80 to 90 percent of the ground surface prior to crimping. Once applied the straw mulch should be crimped into the soil using a straight disc crimper with approximate 8.0-inch spaced tines. Upon successful crimping the straw mulch should be standing vertically with approximately 40 to 60 percent of the ground surface covered. Straw mulch should be at least 6.0 inches in length. Straw mulch should be crimped sufficiently to cause vertical cover that will not be dislodged by light breezes. Straw mulch should be applied based on surface owner preference in crop areas.

(5) WEED MANAGEMENT

A site-specific Integrated Weed Management Plan (IWMP) should be developed once weedy species can be identified and regular crop rotation has begun. Sites could be mowed prior to flowering and seed head production of weedy species. Mowing will reduce competition with desirable species and allow greater opportunity for reclamation success. In addition to mowing, herbicides appropriate for the identified weedy species could be implemented into the weed management plan to eradicate any problematic species. If herbicides are intended to be used, they should be applied in consultation with the surface owner to ensure that the application of herbicides is appropriate for the subsequent agricultural crop. Application timing and rates should follow the manufacturer's recommendations.

RECLAMATION PLAN
BADLANDS ECOZONE SITES

SITE DESCRIPTION

The Badlands Ecozone occurs in uplands on barren shoulders and backslopes of ridges and bluffs, as well as topographically low areas including alluvial fans and stream terraces. This ecozone covers approximately four (3.9) percent of the Demicks Lake Pipeline. The Badlands Ecozone typically consists of moderately steep to steep slopes greater than 25 percent and can contain a restrictive layer in soil depths less than 10 inches. Soil formation is minimal with variable soil texture and high erosion potential. The Badlands Ecozone includes rocky outcrops with three percent or more of the ground surface covered by rock and contains little to no vegetative cover. Additionally, this ecozone can include fine textured soils (clay loams and clays) with characteristically elevated soil electrical conductivity (EC) and soil sodium adsorption ratio (SAR). These sites will be returned to similar pre-disturbance land use following construction.

A recommended seed mix is provided for the Badlands Ecozone in Table 1. The Badlands seed mix was developed using 80 pure live seeds (PLS) per square foot. This seed mix considers seed availability, original site composition, and desirable species for quick stabilization in erosive, shallow soils.

Key obstacles for reclamation in the Badlands Ecozone are steep slopes with high potential for erosion and shallow soils with potentially elevated soil salinity and soil attributes associated with sodic soils (soil dispersion, poor soil structure, hard surface crust formation, and reduced infiltration) and low water holding potential. Ecozone appropriate erosion control measures, seedbed preparation methods, suitable seed mixes, seeding practices, and a site specific Integrated Weed Management Plan (IWMP) should help expedite reclamation success. The Badlands Ecozone reclamation plan is provided on Page 2.

Table 1. Demicks Lake Pipeline Badlands Ecozone Sites Seed Mix Recommendation.

Common Name	Scientific Name	# PLS/acre	PLS/sq ft	% of Mix
Blue Grama	*Bouteloua gracilis*	0.42	8.0	10%
Green Needlegrass	*Nassella viridula*	2.9	12	15%
Little Bluestem	*Schizachyrium scoparium*	2.0	12	15%
Western Wheatgrass	*Pascopyrum smithii*	6.3	16	20%
Bluebunch Wheatgrass	*Pseudoroegneria spicata*	3.7	12	15%
Inland Saltgrass	*Distichlis spicata*	1.0	12	15%
Slender Wheatgrass	*Elymus trachycaulus*	2.2	8.0	10%
Total	**--**	**19**	**80**	**100%**

Notes:
1. Seed mix was developed for badlands soil conditions based on vegetation data. Seed mix may be adjusted based on landowner preferences.

(1) SOIL AMENDMENTS

Soil amendment recommendations are based on recent soil chemical analysis. It is recommended that the following fertilizer amounts be applied to areas within the Badlands Ecozone:

- Nitrogen – 20 pounds per acre
- P_2O_5 – 50 pounds per acre
- K_2O – 0 pounds per acre

(2) SEEDBED PREPARATION

These recommended seedbed preparation steps will aid in successful reclamation. Steps may be omitted, conducted in different order, or changed to optimize success and efficiency depending on field conditions, sub-soil properties, and local terrain.

- When topographical slope allows, shallow rip subsurface soil prior to topsoil application to the maximum depth allowed to reduce soil compaction and improve drainage.
- Apply topsoil and soil amendments, discussed above, to supplement soil nutrients.
- Finally, till the site to a depth of 4.0 to 6.0 inches to create a seedbed conducive to seedling establishment (disk and harrow, field cultivator, vibra-shank, or other alternative suitable to site conditions). Tillage is dependent on topographical slope. If slopes are too sleep, implement minimal till practices.

(3) SEEDING

Seeding should be conducted on the contour using either an imprint seeder or a drill seeder, depending on slope limitations for safe equipment operation. Drill seeders should be equipped with an agitator, double disc opener, wheel press, and depth bands to mix seed and ensure proper seeding depths. Seeds should be planted to the depth specified by the vendor to ensure proper germination and emergence. It is recommended that the seed be placed no deeper than ½ inch. The Badlands Ecozone seed mix and rate are provided in Table 1.

(4) EROSION CONTROL

Because of steep slope gradients and high erosion potential, all disturbances in the Badlands Ecozone should be hydro-mulched using a bonded fiber matrix (BFM) or flexible growth medium (FGM). Hydro-mulch application will stabilize slopes during reclamation and protect seed until vegetation can successfully establish. A synthetic polymer product, such as polyacrylamide (PAM), could be added to the hydro-mulch solution to encourage soil aggregation and further reduce erosion potential. In areas with limited available soil material a Biotic Soil Media (BSM) can be used to improve grass establishment.

Additional erosion control devices (ECDs) appropriate for specific site conditions should be installed and maintained during all construction and reclamation activities through final site stabilization. Implementing ECDs will minimize erosion of disturbed soils and prevent the transportation of sediment outside the construction ROW and into environmentally sensitive areas such as wetlands, waterbodies, and agricultural lands. Erosion control devices should be employed as needed.

(5) WEED MANAGEMENT

A site specific IWMP should be developed once weedy species can be identified. Locations could be mowed, slope permitting, prior to flowering and seed head production of weedy species. Mowing will reduce competition with desirable species and allow greater opportunity for reclamation success. In addition to mowing, herbicides appropriate for the identified weedy species could be applied to eradicate any problematic species. Application timing and rates should follow the manufacturer's recommendations. Herbicide applications should be selective and avoid desirable native grass, forb, and shrub species.

RECLAMATION PLAN
LOAMY ECOZONE SITES

SITE DESCRIPTION

The Loamy Ecozone consists primarily of grassland used for livestock grazing, forage production, and wildlife. This ecozone covers approximately thirty-two (32.4) percent of the Demicks Lake Pipeline. The Loamy Ecozone is composed of tall and short/mid grasslands. Fine to medium soil textures characterize the Loamy Ecozone, which consists predominantly of clay loams, loams, silt loams, and silty clay loams over varying topography. Vegetation within this ecozone consists of diverse herbaceous plant communities where the dominant vegetation is grass. Pastures consist primarily of an alfalfa/grass mix and native range is primarily native and introduced grasses and forbs. These sites will be returned to a similar pre-disturbance land use following construction.

A recommended seed mix is provided for the Loamy Ecozone sites in Table 1. The native grass seed mix was developed using 60 pure live seed (PLS) per square foot, respectively. The Loamy Ecozone seed mix considers seed availability, original site composition, and the ability of species to thrive in this specific ecozone.

The Loamy Ecozone should present minimal challenges for reclamation due to desirable ecozone characteristics. Appropriate seedbed preparation methods, seeding practices, a suitable seed mix, and a site specific Integrated Weed Management Plan (IWMP) should help expedite reclamation success. The reclamation plan is provided on Page 2.

Table 1. Demicks Lake Pipeline Loamy Ecozone Site Seed Mix Recommendation.

Common Name	Scientific Name	# PLS/acre	PLS/sq ft	% of Mix
Western Wheatgrass	*Pascopyrum smithii*	4.8	12	20%
Needle-and-Thread	*Hesperostipa comata*	3.4	9.0	15%
Blue Grama	*Bouteloua gracilis*	0.48	9.0	15%
Green Needlegrass	*Nassella viridula*	2.2	9.0	15%
Sideoats Grama	*Bouteloua curtipendula*	2.1	9.0	15%
Little Bluestem	*Schizachyrium scoparium*	1.0	6.0	10%
Slender Wheatgrass	*Elymus trachycaulus*	1.6	6.0	10%
Total	**--**	**16**	**60**	**100%**

Notes:
1. Seed mix was developed for loamy soil conditions and fine to medium soil textures based on vegetation data. Seed mix may be adjusted based landowner preferences.

RECLAMATION PLAN
LOAMY ECOZONE SITES

(1) SOIL AMENDMENTS

Soil amendment recommendations are based on recent soil chemical analysis. It is recommended that the following fertilizer amounts be applied to areas within the Loamy Ecozone:

- Nitrogen – 20 pounds per acre
- P_2O_5 – 50 pounds per acre
- K_2O – 0 pounds per acre

(2) SEEDBED PREPARATION

These recommended seedbed preparation steps will aid in successful reclamation. Steps may be omitted, conducted in different order, or changed to optimize success and efficiency depending on field conditions, sub-soil properties, and local terrain.

- Rip subsurface soil, prior to topsoil application, to a minimum of 16 inches to reduce soil compaction and improve drainage. Ripping should be conducted using a double pass with a straight-shank agricultural ripper or parabolic ripper. The shanks on the back of a grader or dozer should NOT be used to alleviate soil compaction. Do not smooth the ROW with a dozer once ripped it is beneficial to have an irregular surface to help tie the topsoil and subsoil horizons together. Tillage can be used to break soil clods apart prior to topsoil application.
- Apply topsoil and soil amendments, discussed above, to improve the soil chemical characteristics and to supplement soil nutrients.
- Finally, till the site to a depth of 4.0 to 6.0 inches to incorporate soil amendments and to create a seedbed conducive to seedling establishment (disk and harrow, field cultivator, vibra-shank, or other alternative suitable to site conditions).

(3) SEEDING

Seeding should be conducted using a drill seeder suitable for the location's soils and capable of direct seed placement. Drill seeding should occur on the contour using a drill equipped with an agitator, double disc opener, wheel press, and depth bands to mix seed and ensure proper seeding depths. Seeds should be planted to the depth specified by the vendor to ensure proper germination and emergence. It is recommended that the seed be placed ⅛ to ½ inch deep. The Loamy Ecozone seed mix and rate are provided in Table 1.

(4) STRAW MULCHING

Application of straw mulch is recommended to reduce potential water and wind erosion. Recommended straw mulch application rates are between 1.5 to 2.0 tons per acre. This will provide ground coverage of approximately 80 to 90 percent of the ground surface prior to crimping. Once applied the straw mulch should be crimped into the soil using a straight disc crimper with approximate 8.0-inch spaced tines. Upon successful crimping the straw mulch should be standing vertically with approximately 40 to 60 percent of the ground surface covered. Straw mulch should be at least 6.0 inches in length. Straw mulch should be crimped sufficiently to cause vertical cover that will not be dislodged by light breezes.

(5) WEED MANAGEMENT

A site-specific IWMP should be developed once weedy species can be identified. Sites could be mowed prior to flowering and seed head production of weedy species. Mowing will reduce competition with desirable species and allow greater opportunity for reclamation success. In addition to mowing, herbicides appropriate for the identified weedy species should be implemented into the weed management plan to eradicate any problematic species. Application timing and rates should follow the manufacturer's recommendations. Herbicide applications should be selective and avoid desirable native grass, forb, and shrub species. It is recommended to avoid overgrazing during the establishment period to minimize competitive weedy species establishment.

RECLAMATION PLAN
SALINE ECOZONE SITES

SITE DESCRIPTION

The Saline Ecozone consists of land used primarily for forage production and grazing. The Saline Ecozone makes up approximately fourteen (13.8) percent of the Demicks Lake Pipeline. This ecozone occurs in topographically low areas, including alluvial fans and stream terraces, as well as on hillsides. This ecozone consists of fine textured soils (clay loams and clays) with characteristically elevated soil electrical conductivity (EC) and soil sodium adsorption ratio (SAR). Soils are moderately deep to deep (> 20 inches) and slope typically ranges from 0 to 8 percent. Vegetation of the Saline Ecozone is predominantly native/introduced rangeland grasses. These sites will be returned to a similar pre-disturbance land use following construction.

A recommended seed mix is provided for the Saline Ecozone in Table 1. The seed mix was developed using 80 pure live seeds (PLS) per square foot. This seed mix considers inherent soil properties and includes saline tolerant grass species to improve reclamation success.

One key obstacle in reclaiming the Saline Ecozone sites will be the elevated soil salinity and potential soil attributes associated with sodic soils (soil dispersion, poor soil structure, hard surface crust formation, and reduced infiltration). Additionally, fine textured soils with elevated soil clay contents can contribute to greater potential soil erosion and deteriorated soil structure. Deteriorated soil structure may result in hard, compacted soils that will limit infiltration and root growth. Ecozone appropriate soil amendments, seedbed preparation methods, seeding practices, a suitable seed mix, and a site specific Integrated Weed Management Plan (IWMP) should help expedite reclamation success. The reclamation plan is provided on Page 2.

Table 1. Demicks Lake Pipeline Saline Ecozone Sites Seed Mix Recommendation.

Common Name	Scientific Name	# PLS/acre	PLS/sq ft	% of Mix
Beardless Wildrye	*Leymus triticoides*	3.4	12	15%
Inland Saltgrass	*Distichlis spicata*	1.3	16	20%
Western Wheatgrass	*Pascopyrum smithii*	6.3	16	20%
Nuttall's Alkaligrass	*Puccinellia nuttalliana*	0.33	16	20%
Green Needlegrass	*Nassella viridula*	2.0	8.0	10%
Slender Wheatgrass	*Elymus trachycaulus*	3.3	12	15%
Total	**--**	**17**	**80**	**100%**

Notes:
1. Seed mix was developed for saline and fine textured soil conditions based on vegetation data. Seed mix may be adjusted based on landowner preferences.

RECLAMATION PLAN
SALINE ECOZONE SITES

(1) SOIL AMENDMENTS

Soil amendments are recommended to expedite reclamation success and create conditions that can better support seed germination and plant growth. Gypsum ($CaSO_4 \cdot 2H_2O$) is recommended to improve potential saline/sodic soil conditions within the Saline Ecozone and to reduce potential soil dispersion. It is recommended that 1.5 tons per acre gypsum be applied to soils within the Saline Ecozone. In addition, 5.0 tons per acre of cornstalks should be applied to the Saline Ecozone sites to improve soil structure and reduce potential soil dispersion of saline/sodic soils. To offset nitrogen immobilization due to the organic carbon additions, it is recommended that 75 pounds per acre of nitrogen be applied. Soil amendments should be incorporated post topsoil application to a depth of 4.0 to 6.0 inches.

- Gypsum – 1.5 tons per acre
- Cornstalks – 5.0 tons per acre
- Nitrogen – 75 pounds per acre
- P_2O_5 – 50 pounds per acre

(2) SEEDBED PREPARATION

These recommended seedbed preparation steps will aid in successful reclamation. Steps may be omitted, conducted in different order, or changed to optimize success and efficiency depending on field conditions, sub-soil properties, and local terrain.

- Rip subsurface soil, prior to topsoil application, to a minimum of 16 inches to reduce soil compaction and improve drainage. Ripping should be conducted using a double pass with a straight-shank agricultural ripper or parabolic ripper. The shanks on the back of a grader or dozer should NOT be used to alleviate soil compaction. Do not smooth the ROW with a dozer once ripped. It is beneficial to have an irregular surface to help tie the topsoil and subsoil horizons together. Tillage can be used to break soil clods apart prior to topsoil application.
- Apply topsoil and soil amendments, discussed above, to improve the soil physical and chemical characteristics and to supplement soil nutrients.
- Finally, till the site to a depth of 4.0 to 6.0 inches to incorporate soil amendments and to create a seedbed conducive to seedling establishment (disk and harrow, field cultivator, vibra-shank, or other alternative suitable to site conditions).

(3) SEEDING

Seeding should be conducted using a drill seeder suitable for the location's soils and capable of direct seed placement into fine textured soils. Drill seeding should occur on the contour using a drill equipped with an agitator, double disc opener, wheel press, and depth bands to mix seed and ensure proper seeding depths. Seeds should be planted to the depth specified by the vendor to ensure proper germination and emergence. It is recommended that the seed be placed ⅛ to ½ inch deep. The Saline Ecozone seed mix and rate are provided in Table 1.

(4) STRAW MULCHING

Application of straw mulch is recommended to reduce potential water and wind erosion. Recommended straw mulch application rates are between 1.5 to 2.0 tons per acre. This will provide ground coverage of approximately 80 to 90 percent of the ground surface prior to crimping. Once applied the straw mulch should be crimped into the soil using a straight disc crimper with approximate 8.0-inch spaced tines. Upon successful crimping, the straw mulch should be standing vertically with approximately 40 to 60 percent of the ground surface covered. Straw mulch should be at least 6.0 inches in length. Straw mulch should be crimped sufficiently to cause vertical cover that will not be dislodged by light breezes.

(5) WEED MANAGEMENT

A site-specific IWMP should be developed once weedy species can be identified. Sites could be mowed prior to flowering and seed head production of weedy species. Mowing will reduce competition with desirable species and allow greater opportunity for reclamation success. In addition to mowing, herbicides appropriate for the identified weedy species should be implemented into the weed management plan to eradicate any problematic species. Application timing and rates should follow the manufacturer's recommendations. Herbicide applications should be selective and avoid desirable native grass, forb, and shrub species. It is recommended to avoid overgrazing during the establishment period to minimize competitive weedy species establishment.

RECLAMATION PLAN
SANDY ECOZONE SITES

SITE DESCRIPTION

The dominant characteristic of the Sandy Ecozone is coarse soil textures consisting primarily of sandy loams. The Sandy Ecozone covers approximately six (6.3) percent of Demicks Lake Pipeline. These soils can be found on slopes ranging from 0 to 30 percent and tend to be well- to excessively drained. Vegetation and land use within the Sandy Ecozone includes pasture and native range consisting of both native and introduced grasses and forbs. These sites will be returned to a similar pre-disturbance land use following construction.

A recommended seed mix is provided for the Sandy Ecozone in Table 1. The seed mix was developed using 60 pure live seeds (PLS) per square foot and considers seed availability, original site composition, and the ability of species to thrive in this specific ecozone.

One key obstacle in reclaiming the Sandy Ecozone sites will be elevated sand contents and coarse soil textures, which will contribute to lower soil water holding capacity and moisture availability for seed germination and seedling establishment. Ecozone appropriate soil amendments, seedbed preparation methods, suitable seed mixes, seeding practices, and a site specific Integrated Weed Management Plan (IWMP) should help expedite reclamation success. The reclamation plan is provided on Page 2.

Table 1. Demicks Lake Pipeline Sandy Ecozone Sites Seed Mix Recommendation.

Common Name	Scientific Name	# PLS/acre	PLS/sq ft	% of Mix
Western Wheatgrass	*Pascopyrum smithii*	4.8	12	20%
Sideoats Grama	*Bouteloua curtipendula*	2.1	9.0	15%
Canada Wildrye	*Elymus canadensis*	2.3	6.0	10%
Needle-and-Thread	*Hesperostipa comata*	3.4	9.0	15%
Sand Dropseed	*Sporobolus cryptandrus*	0.10	12	20%
Little Bluestem	*Schizachyrium scoparium*	1.0	6.0	10%
Slender Wheatgrass	*Elymus trachycaulus*	1.6	6.0	10%
Total	**--**	**15**	**60**	**100%**

Notes:
1. Seed mix was developed for sandy soil conditions and coarse soil textures based on vegetation data. Seed mix may be adjusted based on landowner preferences.

RECLAMATION PLAN
SANDY ECOZONE SITES

(1) SOIL AMENDMENTS

Soil amendments are recommended to expedite reclamation success and create conditions that can better support seed germination and plant growth. To improve soil structure and organic matter content it is recommended that 5.0 tons per acre of cornstalks be applied to sandy sites. Improved soil structure and organic matter content in coarse textured soils will increase the soil's water holding capacity and nutrient retention. The use of corn stalk mulch can be omitted in some areas of the Sandy Ecozone if it is determined that sand content does not warrant the use. To offset nitrogen immobilization due to the organic carbon additions, it is recommended that 75 pounds per acre of nitrogen be applied. The cornstalks and nitrogen should be applied and incorporated post topsoil application to a depth of 4.0 to 6.0 inches.

- Nitrogen – 75 pounds per acre or 20 pounds per acre without cornstalks
- P_2O_5 – 50 pounds per acre
- K_2O – 0 pounds per acre

(2) SEEDBED PREPARATION

These recommended seedbed preparation steps will aid in successful reclamation. Steps may be omitted, conducted in different order, or changed to optimize success and efficiency depending on field conditions, sub-soil properties, and local terrain.

- Rip subsurface soil, prior to topsoil application, to a minimum depth of 16 inches to reduce soil compaction and improve drainage. Ripping should be conducted using a double pass with a straight-shank agricultural ripper or parabolic ripper. The shanks on the back of a grader or dozer should NOT be used to reduce soil compaction. Do not smooth the ROW with a dozer once ripped it is beneficial to have an irregular surface to help tie the topsoil and subsoil horizons together. Tillage can be used to break soil clods apart prior to topsoil application.
- Apply topsoil and soil amendments, discussed above, to improve soil structure and to supplement soil nutrients.
- Finally, till the site to a depth of 4.0 to 6.0 inches to incorporate soil amendments and to create a seedbed conducive to seedling establishment (disk and harrow, field cultivator, vibra-shank, or other alternative suitable to site conditions).

(3) SEEDING

Seeding should be conducted using equipment appropriate for soil conditions. On coarse textured soils of moderate slope an imprint seeder could be used to establish microclimates for seed placement and water retention. Any method that would encourage water retention will benefit seedling establishment in coarse textured soils. Imprint seeding will also help protect young newly emerged plants from wind damage and moving sand particles. If imprint seeding is not an option, seeding should be conducted using a drill seeder capable of direct seed placement in coarse soil textures. Drill seeding should occur on the contour using a drill equipped with an agitator, double disc opener, wheel press, and depth bands to mix seed and ensure proper seeding depths. Seeds should be planted to the depth specified by the vendor to ensure proper germination and emergence. It is recommended that the seed be placed no deeper than ½ inch. The Sandy Ecozone seed mix and rate are provided in Table 1.

(4) STRAW MULCHING

Application of straw mulch is recommended to reduce potential water and wind erosion and to stabilize soils. Recommended straw mulch application rates are between 1.5 to 2.0 tons per acre. This will provide ground coverage of approximately 80 to 90 percent of the ground surface prior to crimping. Once applied the straw mulch should be crimped into the soil using a straight disc crimper with approximate 8.0-inch spaced tines. Upon successful crimping the straw mulch should be standing vertically with approximately 40 to 60 percent of the ground surface covered. Straw mulch should be at least 6.0 inches in length. Straw mulch should be crimped sufficiently to cause vertical cover that will not be dislodged by light breezes. Straw mulch should not be used in areas where seed is imprinted.

(5) WEED MANAGEMENT

A site specific IWMP should be developed once weedy species can be identified. Problematic locations could be mowed prior to flowering and seed head production of weedy species. Mowing will reduce competition with desirable species and allow greater opportunity for reclamation success. In addition to mowing, herbicides appropriate for the identified weedy species could be applied to eradicate any problematic species. Application timing and rates should follow the manufacturer's recommendations. Herbicide applications should be selective and avoid desirable native grass, forb, and shrub species.

ATTACHMENT A

Soil Data Demicks Lake Pipeline

Sample ID	pH	Ec_e	SAR	N	P	K	OM
		dS/m		lb/acre	ppm		%
0001	8.0	0.71	0.03	5	2	174	3.7
0007	8.1	0.58	0.52	8	2	181	3.9
0014	7.3	0.61	0.03	10	3	452	4.9
0021	8.0	0.64	0	4	2	221	3.9
0029	7.6	0.52	0	6	4	229	3.8
0035	8.0	1.0	0	16	13	361	4.8
0042	7.9	0.86	0	10	2	257	3.9
0049	8.9	1.2	8.3	3	2	159	1.5
0056	7.2	0.64	0	12	11	335	5.3
0063	7.7	1.01	0	17	6	403	7.9
0070	7.9	0.95	0	17	5	286	3.1
0077	7.1	0.61	0.03	16	6	266	7.6
0084	7.8	0.74	0	12	4	280	5.3
0091	7.9	0.77	0	8	4	175	3.8
0098	7.7	0.58	0	4	4	141	4.7
0099	8.0	0.83	0	8	3	240	4
0104	8.2	0.89	0	6	3	187	3.3
0113	8.5	0.61	4.0	13	4	186	2.3
0121	9.0	5.5	22	9	4	157	2.2
0126	6.9	0.64	0.03	11	5	281	4.3
0133	7.6	0.77	0	8	4	228	4.7
0140	7.2	0.58	0.03	3	3	219	3.8
0147	7.8	1.0	0.65	5	3	223	3.1
0161	7.8	0.8	0	7	4	222	4.5
0168	7.8	0.89	1.6	10	3	277	3.9
0175	8.6	1.1	9.1	7	2	162	1.8
0298	5.9	0.15	0	9	16	309	2.8
0364	7.5	0.80	0	13	3	217	3.2
0371	7.4	0.31	0.03	8	4	193	2.4
0378	7.3	0.22	0.03	4	3	152	1.5
0392	8.4	0.89	5.0	6	3	212	2.2
0399	7.9	0.64	0	11	3	131	2.2
0406	7.7	0.12	0.65	3	4	49	0.5
0413	7.6	0.64	3.6	18	43	326	3.9
0420	7.0	0.09	0.28	3	2	207	1.7
0427	7.9	0.52	0	14	3	56	1.4
0434	6.9	0.64	0.65	31	6	206	2.6
0438	6.4	0.58	1.5	30	9	218	2.5
0448	6.3	0.37	0	10	5	192	2

Sample ID	pH	Ec_e	SAR	N	P	K	OM
		dS/m		lb/acre	ppm		%
0455	5.7	0.64	0.03	56	8	476	4.3
0469	7.8	1.3	0	40	4	306	3.5
0470	8.0	1.0	0.15	22	5	291	3.9
0483	8.0	1.2	0.40	63	31	899	3.1
0490	6.7	0.71	0	34	3	316	3.2
0512	8.0	0.61	0	4	22	173	2.1
0518	7.7	1.4	0	83	14	331	3.1
0525	7.7	1.3	0	52	19	292	3.1
0532	8.0	0.77	0	14	5	180	2.7
0539	5.6	0.58	0.15	32	30	293	5
0541	7.7	11	25	4	16	227	4.3

Notes:
1. Soil sample analytical results from soil samples collected during the fall of 2018.
2. Red highlighted cells could potentially impair reclamation success.

Soil Data Demicks Lake Pipeline

Sample ID	pH	Ec_e	SAR	N	P	K
		dS/m		lb/acre	ppm	
BEISIGL-FLASHER-TELFER	7.8	0.63	0.60	16	13	185
BELFIELD-SAVAGE -DAGLUM	7.8	0.66	0.60	29	15	331
BRANDENBURG-CABBA-DOGTOOTH	7.4	0.74	0.50	26	9	329
CABBA-BADLAND	8.3	6.2	19	4	3	101
CABBA-CHAMA-SEN	7.7	0.83	0.70	44	10	279
CABBA-CHAMA-SHAMBO	7.8	1.1	0.90	35	7	211
CHAMA-SEN-CABBA	7.7	0.85	0.80	43	7	229
DAGLUM-BELFIED	7.8	1.2	1.6	8	7	229
DOGTOOTH-JANESBURG	7.8	1.4	3.8	10	7	255
DOGTOOTH-JANESBURG-CABBA	7.8	1.1	2.1	22	9	254
FARNUF	7.7	0.56	0.40	15	15	340
KORCHEA	7.7	0.90	0.60	30	14	477
LAWTHER	7.8	0.68	1.4	19	18	433
REEDER-FARNUF	7.8	0.63	1.0	13	11	239
REGENT-JANESBURG	7.8	1.3	1.7	12	6	174
RHOADES-DAGLUM	7.5	0.91	1.5	8	9	290
SAVAGE	7.7	0.90	0.60	32	15	348
VEBAR-COHAGEN	7.4	1.4	0.80	91	15	506
ZAHL-CABBA-WILLIAMS	7.2	0.94	0.30	17	6	310

Notes:

1. Soil sample analytical results from soil samples collected during the fall of 2015. Soil samples were collected as part of the Garden Creek Loop project for ONEOK.
2. Red highlighted cells could potentially impair reclamation success.

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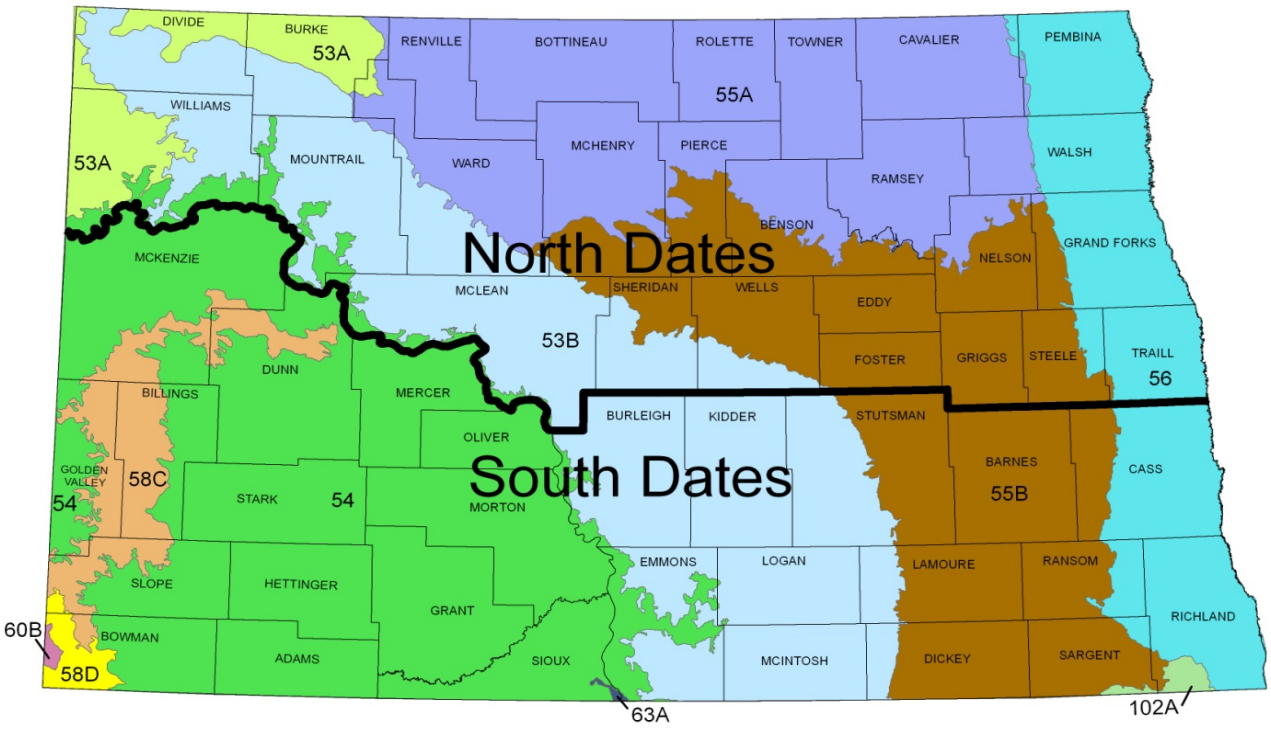
APPENDIX B

NRCS Herbaceous Vegetation Establishment Guide

Herbaceous Vegetation Establishment Guide

Seeding Dates:

Seeding dates are based on climatic records, research, and experience; and represent optimum periods for grass and legume establishment. These dates should provide for adequate development of adventitious roots prior to stressful periods, such as hot, dry summers and cold, open winters. The following table shows recommended seeding dates by Major Land Resource Areas (MLRAs). Variation from these dates plus or minus 5 days may be made if justified by moisture and temperature conditions.



Seeding Dates		
Species Type and Season of Planting	**NORTH** (53A, N.1/2 53B, 55A, N. ½ 56, N. 1/3 55B)	**SOUTH** (58C, 58D, 54, S. ½ 53B, S. 2/3 55B, S. 56)
Cool Season Species		
Spring[3]	Prior to May 20	Prior to May 10
Late summer [1]	August 10 to September 1	August 10 to September 15
Late fall (dormant) [2, 3]	See footnote [2]	See footnote [2]
Warm Season Species		
Spring	May 10 to June 25	May 10 to June 25
Warm/Cool Season Mix		
Spring	May 1 to June 15	April 20 to June 1

[1] If legumes are part of a mixture, seed by August 25th. For winter survival, it is essential that alfalfa plants reach the 6-leaf stage prior to fall dormancy. Alfalfa requires 6-8 weeks growth after emergence to develop the 6-leaf stage.

[2] Seeding may occur once soil temperatures drop to 40º Fahrenheit for a minimum of 5 consecutive days (usually after November 1) based upon North Dakota Agriculture Weather Network http://ndawn.ndsu.nodak.edu/index.html or actual field measurements at a depth of 2 inches.

[3] Pollinator plantings consisting of forbs only (no grasses) will be seeded during the spring or dormant seeding windows. Pollinator plantings consisting of forbs and grass mixtures will be seeded during the appropriate seeding window for the grass component of the mixture.

Seedbed Preparation:

A seedbed will be prepared that is free of competing vegetation and is not subject to excessive erosion. A firm seedbed will be provided so the seed is placed at the designed depth. **IT SHOULD BE FIRM ENOUGH SO THAT ADULT FOOTPRINTS ARE HARDLY VISIBLE**.

The presence or absence of weed populations, especially noxious weeds, will impact seedbed preparations. Each field should be evaluated for weed pressure. Seeding on fields with significant weed populations will be delayed until weeds are controlled. This may mean a protective cover crop may need to be planted.

When planning a seeding, the previous two years of herbicide application should be considered. Any potential carryover problems should be addressed by delaying seeding, establishing a cover crop, and/or changing species to be planted. If a cover crop is necessary, refer to part 6 of this tech note.

Seedbed alternatives:

No-Till Method - Seeding into standing stubble of a previous crop without further seedbed preparation. Excess straw or chaff should be removed prior to seeding. Use of harvest equipment, which spreads straw along a minimum of 80 percent of the header width, will prevent excess chaff problems. If weeds or excessive volunteering of previous crop is present, control with appropriate herbicide(s) in accordance with product label directions and current recommendations from North Dakota State University Cooperative Extension Service, ND Weed Control Guide, Cir. W-253 Rev.

Rye produces an allelopathic agent that may inhibit germination in many grass species. If possible, avoid seeding into rye stubble or heavy rye residue. Other commonly grown crops provide good cover and do not inhibit germination.

Cover Crop Method - Plant a cover crop (high residue producing crop) of oats, barley, flax, grain sorghum, millet, or sudangrass during the growing season before seeding perennial forages if existing cover is insufficient to control erosion. If the cover crop method is to be used, see part 7.

Clean-Till Method - Seed into a new, clean tilled, firmly packed seedbed. If erosion or potential climatic factors are a potential concern, a cover crop may be used. See part 6 if a cover crop is to be used.

Seeding Equipment:

Seeding equipment that ensures proper seed placement and good seed-soil contact will be used. Modern grass seeding attachments that allow for proper seed flow, seed placement and soil packing are needed to ensure a successful seeding.

Slower seeding speeds should be used for fluffy or rough-coated seed species. Three to five miles per hour should be the seeding speed for most types of grass drills. Seeding speeds in excess of 6 miles per hour may result in uneven or inconsistent grass and legume stands.

If a carrier is needed to help feed seed through the drill cracked corn or rolled oats may be added to the mixture.

Grass Drill

Grass drills are specifically designed and equipped to properly meter and place various grass, legume and/or forb seed and share the following design characteristics:

- Different seed boxes are normally required to handle the three types of grass seed commonly used. This includes the relatively clean, smooth seed characteristic of many cool-season grasses, the chaffy or trashy seed characteristic of many warm-season grasses, and fine, smooth seed, characteristic of legumes or grasses such as switchgrass, hard fescue, or reed canarygrass. Seed boxes having the capability of seeding chaffy or awned grasses (i.e. blue grama, bluestems, and indiangrass) are needed, only if such species are planned in the seeding mixture; likewise, fine-seed or legume seed boxes are needed, only if such species are to be seeded.
- Agitators or similar mechanisms that prevent bridging of chaffy or trashy seed and ensure a constant flow of seed at the desired rate with uniform mixing of the species in the mixture.
- Feeder mechanism (picker wheels, fluted feed, etc.) that ensures uniform flow of all types of grass seed either separately or in a mixture.
- Oversized feeder tubes that allow constant flow of chaffy or trashy type seed from boxes to placement point (if such seed is used).
- Individually mounted, adjustable, spring loaded, double-disc openers.
- Depth bands or other depth-control systems that provide positive seed placement for final planting depth of one-fourth to one inch over varying degrees of seedbed firmness.
- Press/packer wheels that provide adequate covering and firming of soil over and around the seed for necessary seed/soil contact after proper seed placement. They should be mounted individually on each furrow opener or independently to follow behind each opener. Press/packer wheels are not intended to provide the basic "firm seedbed." The firm seedbed must exist before the drilling operation begins.
- Drill calibration should be completed for both grass and grain drills prior to seeding. Refer to item 4 for guidance in completing drill calibration.

Small Grain Drill

Free-flowing grass seed (i.e., wheatgrasses) and legume seed can be successfully planted with a small grain drill provided proper seeding depth can be maintained throughout the field. Seeding depth is the most limiting factor to seeding success and contributes to most of the seeding failures when using a grain drill. It is extremely important to have a firm seedbed when using a grain drill. Periodic inspections should be done to check seeding depth especially when seeding across different soil types. Seeding depth will vary under actual planting conditions.

Checking the drill frequently and hand mixing the seed is essential to achieving a properly blended seed mix and helps ensure that seeds of different sizes are seeded evenly across the field. Periodic feeder

mechanism adjustments are usually necessary to ensure proper seeding rates. A separate legume box is desirable for seeding small seeded species. (i.e. switchgrass, hard fescue, reed canarygrass, and alfalfa). Ensure that the grain drill's drop tubes are placed in front of the packer wheels to allow for proper seed-soil contact.

Chaffy or awned seeds (i.e. bluestems, indiangrass, and blue grama) are extremely difficult to plant with a grain drill. It is recommended that a grass drill be used for these types of grasses. Proper agitation is needed to prevent "bridging" of seed in the seedbox, and the feeder mechanism must be capable of metering a uniform flow of seed at the desired rate. Very few grain drills have this capability. Use of debearded seeds is strongly recommended when considering seeding chaffy or awned seeds in a grain drill.

Broadcast Seeder

Broadcasting may only be used when one or more of the following conditions apply to the planting area:

- Slope makes use of a drill impractical;
- Soil conditions prohibit effective use of a drill;
- Area is 5 acres or less;
- Seeding pure stands of alfalfa.

Broadcast plantings exceeding 5 acres require a variance approved by the State Resource Conservationist. All areas to be broadcast will have properly prepared seedbed (minimal residue cover with a smooth, firmly packed surface). Following the broadcast operation, an additional operation will incorporate the seed into the soil at the proper depth. This can include use of a drag or harrow, culti-packer, roller packer, or other suitable implement to cover and press the seed into the soil surface, to attain the goal of good seed to soil contact. All broadcast plantings will utilize 150% of full seeding rates listed in Table 1. Forbs planned for pollinator plantings which normally exceed 100% rates, will not exceed 150% of the full seeding rate.

Air-seeders

Some air-seeders and similar types of equipment may be used to seed free flowing grass seed (i.e., wheatgrasses) and legume seed if proper seeding depth can be obtained (as specified in part 6). However, seeding mixtures containing varying seed sizes may require an inert carrier to work properly in air-seeders. The shallow planting depths for grasses and legumes can be difficult to maintain with this type equipment. The equipment must be able to provide a uniform flow of seed at the desired rate. Use packer wheels or other suitable packing implement to press soil firmly around the seeds.

Drill Calibration:

Grass or grain drills may be calibrated using the following methods.

Bulk Weight Method:

Raise the drill's drive wheel and measure its circumference in **feet**. Next, measure the distance between seed spouts or disc openers. Use Table A to determine the number of revolutions (R) to turn the drive wheel for the row spacing and wheel circumference in feet (C) for your drill.

Table A

Row spacing in inches	No. of seed spouts to use	Turns of drive wheel	Row spacing in inches	No. of seed spouts to use	Turns of drive wheel
6	4	96/C = R	24	1	96/C = R
7	4	82/C = R	30	1	77/C = R
8	3	96/C = R	36	1	64/C = R
10	3	77/C = R	42	1	55/C = R
12	2	96/C = R	48	1	48/C = R

Place enough seed in the box to cover spouts from which you will collect seed. Turn the drive wheel until all spouts are feeding. Place a container under the correct number of seed spouts (as determined from the Table A) and turn the drive wheel the number of revolutions previously determined. Weigh the sample in grams. Multiply this weight by 0.5. The result is the pounds per acre at that setting. Make adjustments in the drill setting and continue trials until the desired seeding rate is obtained.

Remember: Seeding rates as determined by this method are in terms of **bulk seed**. You need to convert your seeding rate from pure live seed per acre to bulk seed per acre when using this calibration method.

Example:

Row spacing = 7 inches
Number of seed spouts = 4
Circumference of drive wheel = 6.8 ft
Revolutions of drive wheel (R) = 82/C
R = 82/6.8 = 12 revolutions
Bulk seeding rate is 15.1 lbs/ac. The drill is properly set when the 4 seed spouts yield 30 grams of seed after 12 revolutions of the drive wheel.
30 grams x 0.5 = 15 lbs/ac

Seeds Per Row Foot Method:

This method of determining the amount of seed being distributed by the seeding equipment is to count the number of seeds per foot of drill row while the machine is in operation.

Fill the drill with seed, make setting, and drive equipment over a hard ground surface or canvas. Count the number of seeds per foot of row and adjust until proper seeding rate is attained. Use Table B to determine the linear foot of row necessary to equal one square foot planted.

Table B

Row spacing in inches	Linear foot of row to equal one square foot
6	2.0 feet
7	1.8 feet
8	1.5 feet
10	1.2 feet
12	1.0 foot

To determine the proper number of seeds per foot of drill row for a specific seeding mixture; you will first need to calculate the bulk seeding rate for each species in the mix. From Table 1, calculate the number of seeds per square foot (ft^2) for each pound seeded (seeds per pound divided by 43,560ft^2/acre). Multiply the number of seeds per square foot for each pound seeded by the bulk seeding rate for each species. Total the resulting numbers to determine the number of seeds per square foot for the mixture.

For example: If you want to calibrate a drill for a mixture of 4.5 lbs. PLS/ac green needlegrass (80% purity and 70% germination) and 4.0 lbs. PLS/ac western wheatgrass (92% purity and 85% germination), we would calculate the bulk seeding rate for each species. Bulk seeding rate would be 8 lbs/ac for the green needlegrass and 5.1 lbs/ac for the western wheatgrass. Table 1 shows one pound of green needlegrass seed contains,

180,000 or 4.1 seeds/ft^2 for each pound seeded (180,000/43,560 ft^2/acre). Western wheatgrass has 112,000 seeds per pound or about 2.6 seeds/ft^2 for each pound seeded.

8 lbs/ac x 4.1 seeds/ft^2/lb. = 32.8 seeds/ft^2
5.1 lbs/ac x 2.6 seeds/ft^2/lb. = 13.3 seeds/ft^2

The total seeds per square foot for the mix would be 46. If the drill we are calibrating has 7-inch row spacing, the drill calibration would be 46 seeds per 1.8 feet of row length.

Seed Requirements:

A. All seed must meet the requirements of North Dakota State Seed Laws and Regulations. Information on State seed law is available at Chapter 4.1-53 of the ND Century Code or ND Seed Labeling Requirements. All seed, including homegrown seed, must be officially tested for purity and germination to enable pure live seed (PLS) calculations for determining the proper seeding rate. Tests must be made within a 12-month period, exclusive of the test month, prior to seeding. Recommend re-testing of seed within the 12-month period if stored improperly (high humidity and/or high temperature).

B. Use certified seed when available.

C. Approved Varieties and Seed Selection:

   a. Origin of non-varietal ('common') grass seed (and for those varieties not listed in table 2) of both native and introduced species for Forage and Biomass Planting is limited to ND, SD, NE, MT, MN, WY, and the Canadian provinces of Alberta, Manitoba and Saskatchewan.

   b. Origin of non-varietal ('common') native forbs and legumes (and for those varieties not listed in table 2) will originate or be grown in ND, SD, NE, MT, WY, ID, WA, OR, MN, WI, IA, CO, and the Canadian provinces of Alberta, Manitoba and Saskatchewan.

   c. Approved named varieties are located in Table 2. All approved seed varieties must originate from the contiguous United States or Canada. If the origin is from someplace other than the contiguous United States or the Canadian provinces of Alberta, Manitoba and Saskatchewan the producer or vendor must provide a DNA analysis that proves the variety is bona fide.

   d. Alfalfa named varieties must have a Winter Survival Index (WSI) of 2 or less to meet specifications. The term winter hardiness rating is sometimes used synonymously with winter survival index, a number of 2 or less is acceptable. If the winter hardiness rating uses letters (e.g. EH, extremely hardy) those will not be acceptable, only a number of 2 or less will be accepted. Origin of **non-varietal** ('common') alfalfa types and introduced legumes is limited to ND, SD, MN, MT, and the Canadian provinces of Alberta, Manitoba and Saskatchewan.

   e. Organic grass seed. Grass seed produced in a manner which meets the requirements of the National Organic Program is presently limited by availability and species. If organic grass seed which meets the requirements of Section 5 of this document is not available for the species identified on the ND-CPA-9, substitution of non-organically raised grass seed of the same species is permitted under Section 205.204(a) of the Code of Federal Regulations – National Organic Program.

   f. Legume seed should be inoculated with the proper culture just prior to seeding in order to increase the potential for nitrogen fixation by the plant.

D. No noxious weed amounts are allowed on any seed tags.

E. All seeding rates will be based on pure live seed (PLS). PLS can be calculated from information on the seed tag. PLS is derived by multiplying percent pure seed by percent germination (plus

percent hard and dormant seed, if present) and dividing by 100. See ND Extension Service Publication A-353 "Farmer's Guide for Seed Buying".

F. Additional information on seed tag interpretation can be found at:
http://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/ndpmcnl11797.pdf

G. Seed coating is considered inert matter which is reflected in the purity and inert percentages on the seed tag. The extra weight of the coating reduces the number of pure live seeds per pound, resulting in need to use higher seeding rates to achieve a full stand. Seed coating is considered inert matter which is reflected in the purity and inert percentages on the seed tag. The extra weight of the coating reduces the number of pure live seeds per pound, resulting in need to use higher seeding rates to achieve a full stand.
http://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/ndpmcnl12597.pdf

H. Total PLS pounds seeded must be within 10% of the planned design.

Seeding Depth:

Proper seeding depth is extremely important in successfully establishing native and introduced vegetation from seed. Native grasses, forbs, and shrubs need to be seeded at a shallow depth, as light plays a key role in the germination of many native species. Optimum seeding depths are ¼ to ¾ inch.

Cover and Companion Crops:

Cover Crops

A cover crop is an annual residue-producing crop, planted during the growing season(s) before seeding the perennial cover. Its purpose is to provide cover and residues to reduce evaporation, maintain cool soil temperatures, smother or reduce weeds, improve soil structure, enhance soil biology, trap snow, protect seedlings from extreme climatic conditions and control wind and water erosion.

See Practice 340 *Cover Crop* for guidance on selecting and managing cover crops. See Table 1: *Cover Crop – Common Species and Properties* for cover crop species characteristics, seeding rates, mycorrhizal association, etc.

Companion Crops

A companion crop is an annual that is planted with the perennial species. Seeding rates for companion crops are lower than normal seeding rates for those crops to reduce competition with the seeded perennial species.

Barley	10 lbs/acre
Oats	10 lbs/acre
Spring wheat	15 lbs/acre
Flax	7 lbs/acre

If used, the companion crop should be clipped above the new perennial seedlings and removed before it becomes competitive with the perennial species.

Management and Protection During Establishment:

Grazing

Do not graze until stand is fully established. This period will be a minimum of one full growing season. If an adequate stand has not established during the first growing season, or if seedlings do not have well-developed root systems with adventitious roots above the sown seed, then deferment should be extended through the second growing season. Grazing during the deferment period for weed control will be handled on a case-by-case basis provided no damage will be done to the seeded species.

Weed Control

During the establishment period, excessive amounts of competitive weeds will be controlled. Control weeds that compete with seedlings for sunlight and/or moisture during the growing season of the species planted. The first weed control operation will be needed as recommended or prior to weed seed maturity. Repeated weed control operations may be needed. Competitive weeds can be controlled either mechanically or chemically, or by a combination of these methods.

Mechanical - When controlling competitive weeds by clipping or mowing, adjust the equipment to cut above the new seedlings, and clip before the weeds set seed or mature. If the clippings are dense enough to smother the new seedlings, promptly remove clippings from the field.

Mowing Height – Eight to ten inches is the preferred stubble height. This will be over the top of most 1- to 2-year old forb and legumes species in early summer. Certain species are especially sensitive to clipping height and removal of the basal leaves may result in death of the plant. Some grass species such as switchgrass have high growing points, and once established should not be mowed at a height less than 10 inches until after the growing season.

Equipment – Swathers generally work best because of operator visibility, maneuverability, and ease of height adjustment. The operator can quickly raise or lower the platform. If the windrows are heavy enough to smother new seedlings they should be promptly removed. Sickle bar mowers are good if an adequate, consistent stubble height can be maintained. Rotary mowers can work well if they are set at the highest wheel setting. This will usually result in about an 8-inch clipping height. A level mowing height should be maintained and travel speed as appropriate to disperse the clippings. A sharp blade is essential.

Timing – Mowing must be done early enough in the season before most of the weed seed become viable and so the seeded species can still benefit from the "opened canopy" and put on new growth before fall. Multiple mowings in a season may be necessary with high density/biomass weed competition. Mowing in late summer or early fall provides little benefit to the seeded species and probably causes more harm than good. Check local/state regulations of individual conservation practices for the earliest allowable mowing dates.

Whenever new seedings are mowed some injury occurs to the seeded species. Young forb and legume seedlings are especially vulnerable and may be killed by driving over them. If weeds are a competition problem to the new seeding, then mowing is probably justified. Spot mowing is encouraged whenever possbile. This eliminates damage to the seeded species in areas where you don't have to mow, and maintains the taller wildlife cover. Spot mowing also creates "edge" structure which enhances landscape diversity within the field and may provide additional wildlife benefits.

Chemical - To control competitive weeds with herbicides use the appropriate herbicide(s) applied according to the manufacturer's label. The best control will generally be obtained when weeds are in the early stages of growth. Precautions should be taken to ensure that grass or legume seedlings are not

injured by the selected herbicide(s). Refer to North Dakota State University, ND Weed Control Guide (Cir. W-253 Rev.) for specific herbicide recommendations on forage crops in North Dakota. Noxious weeds must be controlled in accordance with State law.

Insect Control
Insects can be a threat to seedlings. Contact the County Extension Service for recommendations on control of specific insects affecting seeded species.

Cautions when using pesticides:
Some herbicides have residual activity that can adversely impact stand establishment of sensitive species or may have haying or grazing restrictions. Use of pesticides must be consistent with the manufacturer's label requirements and in accordance with State and Federal laws and regulations.

Guidelines for Stand Evaluation:
To determine adequacy of stands and to determine if reseeding or reinforcement seeding is required, use ND-CPA-9a, Stand Evaluation Worksheet, and the following guidelines:

It should be recognized that environmental factors, such as climate, insects, soils, and fertility affect time required for establishment of stands. Timeliness of precipitation, drought, extreme temperatures, severe winds, or late soil thaw can delay seedling emergence and/or development.

Seedling emergence should be relatively uniform over the area. The density of established plants required for an adequate stand will depend upon the planned purpose of the seeding and may vary from program-to-program. Consult program specific guidelines for additional information.

If specific practice or program guidelines are not available, stand counts should indicate a density of at least 3 to 5 seedlings per square foot of area. If at least 3 of the seedlings are rhizomatous species, the lower limit of 3 seedlings per square foot is adequate. The upper limit of 5 seedlings per square foot is necessary when all are bunch-type species or a mixture of rhizomatous and bunch-type species.

The adequacy of a stand will be based on density of established plants and stage of morphological development needed to ensure perenniality. To be considered established, a grass plant must have a well-developed adventitious root system and should exhibit signs of tillering or rhizome development. See Figure 1. An alfalfa plant must have a well-developed taproot with secondary and tertiary roots and a well-developed crown set below the soil surface and/or branch rhizome.

For more information on alfalfa seedling development, see these online publications:

University of Wisconsin, Alfalfa Germination & Growth, A-3681

NDSU, Time of Seeding for New Alfalfa Establishment, R648

Preliminary stand evaluation can be made 4 to 8 weeks after germination; evaluate for progress and management problems (i.e. weeds, insects, etc.) - not for final establishment.

All stands must go through at least one winter before making final stand evaluation.

Stands resulting from late fall (dormant) or spring seedings must go through the first growing season and subsequent winter; evaluation for final establishment can be made any time during the second growing season.

Stands resulting from late summer seeding cannot be evaluated for final establishment until the end of subsequent, full growing season.

Most stands will require 2 growing seasons to become established; warm-season species may require 3 growing seasons for establishment.

Stand counts may either be done using a 1-square foot frame or the row count method. If a frame count is used, all plants rooted within the frame should be counted. If the row count method is used, 2 side-by-side rows should be counted, the length to be determined by the row spacing. 6-inch row spacing would require the observer to count all plants in 2 rows for a length of 12 inches; a 7-inch row spacing would require a 10.3-inch length of 2 rows; and an 8-inch row spacing would require a 9-inch length.

A predetermined number of steps should be taken diagonal or perpendicular to the drill rows and the frame dropped at the toe of the foot on the final step. The frame should be dropped in a consistent alignment to the drill rows. The same procedure would be used when making a row count. Instead of dropping the frame at the toe of the foot, this point would then mark the beginning of the row count.

The number of samples required depends on factors such as stand uniformity and the number of species to be counted. Generally, a minimum of 10 counts (or frames) per 10 acres or less of field size would result in a representative sample. End rows, turn around areas or other areas that may have been double seeded should be avoided. Ten counts per 10 acres of field size should only be used as a starting point. For example, a 70 to 80 acre pasture planting with a uniform stand may be sampled accurately using 40 counts or less. Whatever the situation, enough counts must be taken so that a representative sample is obtained.

ND-CPA-9A, Stand Evaluation Worksheet, may be used to document the stand counts.

If evaluation reveals a marginal stand, consideration should be given to allowing a second growing season for establishment. Seedings that contain a high percentage of "hard seed" are more likely to produce new seedlings during the second growing season.

The alternative of a partial reinforcement seeding, in lieu of the full seeding rate, should be considered during the evaluations.

"Spot" seeding weak areas may be a logical alternative in the case of spotty or intermittent stands, in lieu of whole field reseeding. Grazing deferment should follow spot seedings.

Table 1. Full Seeding Rates [1,2]					
Species	**Seeds/Pound**	**MLRA 55 A/B & 56 [4]**		**MLRA 53 A/B, 54 & 58 C/D [4]**	
		Seed/SqFt	**#PLS/Ac**	**Seed/SqFt**	**#PLS/Ac**
Introduced Cool-Season Grasses					
Bromegrass					
Meadow (BRBI2)	80,000	30	16.5	25	13.5
Smooth (BRIN2)	135,000	25	8	20	6.5
Creeping foxtail (ALAR)	750,000	60	3.5	60	3.5
Hard fescue (FEBR7)	565,000	50	4	35	3
Timothy (PHPR3)	1,300,000	30	1	NR	NR
Wheatgrass					
Green (ELHO3)	135,000	46	14	33	10
Crested (AGCR)	175,000	28	7	25	6
Intermediate (THIN6)	88,000	20	10	17	8.5
Pubescent (THIN6)	88,000	20	10	17	8.5
Siberian (AGFR)	175,000	30	7.5	25	6
Tall (THPO7)	79,000	23	13.5	20	11
Wildrye					
Altai (LEAN3)	68,000	30	19	25	16
Dahurian (ELDA3)	86,000	20	10	17	8.5
Mammoth (LERA5)	55,000	30	24	25	20
Manystem (LEMU11)	150,000	30	8.5	25	7.5
Russian (PSJU3)	175,000	30	7.5	25	6
Native Cool-Season Grasses					
Bluejoint (CACA4)	4,480,000	50	0.5	50	0.5
Fowl bluegrass (POPA2)	2,080,000	48	1	48	1
Green needlegrass (NAVI4)	180,000	30	7.5	25	6
Mannagrass					
American (GLGR)	1,280,000	45	1.5	45	1.5
Fowl (GLST)	1,440,000	37	1	37	1
Needle and thread (HECO26)	115,000	25	9.5	25	9.5
Nutall alkaligrass (PUNU2)	2,108,000	50	1	50	1

Table 1. Full Seeding Rates [1,2]					
Species	**Seeds/Pound**	**MLRA 55 A/B & 56 [4]**		**MLRA 53 A/B, 54 & 58 C/D [4]**	
		Seed/SqFt	**#PLS/Ac**	**Seed/SqFt**	**#PLS/Ac**
Native Cool-Season Grasses (cont.)					
Porcupine grass (HESP11)	57,000	25	19	25	19
Prairie junegrass (KOMA)	2,315,000	50	1	50	1
Reed canarygrass (PHAR3)	530,000	40	3.5	40	3.5
Wheatgrass					
Bluebunch (PSSP6)	140,000	NR	NR	25	8
Slender, awned & bearded (ELTR7)	155,000	25	5.5	17	5
Streambank/Thickspike (ELLAL)	155,000	NR	NR	25	7
Western (PASM)	112,000	25	10	20	8
Whitetop (Sprangletop) (SCFE)	191,000	11	2.4	NR	NR
Wildrye					
Basin (LECI4)	140,000	NR	NR	25	8
Beardless (LETR5)	150000	30	8.5	25	7.5
Canada (ELCA4)	115,000	20	7.5	17	6.5
Virginia (ELSU)	96,000	20	10	NR	NR
Native Warm-Season Grasses					
Alkali sacaton (SPAI)	1,758,000	NR	NR	40	6
American sloughgrass (BESY)	1,150,000	25	0.9	25	0.9
Bluestem					
Big (ANGE)	176,000	30	7.5	25	6
Little (SCSC)	286,000	30	4.5	25	4
Sand (ANHA)	113,000	30	12	25	9.5
Buffalograss (BODA2)	50,000	30	26	25	23
Grama					
Blue (BOGR2)	750,000	40	2.5	30	2
Sideoats (BOCU)	180,000	30	7.5	25	6
Inland saltgrass (DISP)	520,000	35	5.5	35	5.5
Indian ricegrass (ACHY)	235,000	30	5.5	25	4.5
Indiangrass (SONU2)	193,000	30	7	25	5.5
Prairie cordgrass (SPPE)	183,000	30	7	30	7

Table 1. Full Seeding Rates [1,2]					
Species	**Seeds/Pound**	**MLRA 55 A/B & 56 [4]**		**MLRA 53 A/B, 54 & 58 C/D [4]**	
		Seed/SqFt	**#PLS/Ac**	**Seed/SqFt**	**#PLS/Ac**
Native Warm-Season Grasses (cont.)					
Prairie dropseed (SPHE)	224,000	25	5	25	5
Prairie sandreed (CALO)	275,000	30	5	25	4
Sand dropseed (SPCR)	5,680,000	70	0.5	70	0.5
Switchgrass (PAVI)	390,000	40	4.5	30	3.5
Native Grass-likes					
Fox sedge (CAVU2)	1,600,000	37	1	37	1
Slough sedge (CAAT2)	230,490	25	4.7	25	4.7
Native Forbs and Legumes					
American vetch (VIAM)	30,000	25	36	25	36
Aster					
Blue (SYLAL3)	880,000	30	1.5	30	1.5
Heath (SYER)	3,200,000	30	0.4	30	0.4
New England (SYNO2)	1,300,000	25	0.8	NR	NR
Black-eyed Susan (RUHI2)[3]	1,450,000	25	0.8	25	0.8
Black samson (ECAN2)	120,000	25	9	25	9
Blanket flower (GAAR)	157,000	25	7	25	7
Blue vervain (VEHA2)	1,488,000	34	1	34	1
Canada anemone (ANCA8)	128,000	29	10	29	10
Canada milkvetch (ASCAC6)	266,000	25	4	25	4
Canada tickclover (DECA7)	88,000	25	12.3	25	12.3
Columbine (AQCA)	362,000	25	3	25	3
Coneflower					
Grayhead (RAPI)	625,000	25	1.7	NR	NR
Prairie (Yellow) (RACO3)[3]	737,000	25	1.5	25	1.5
Cudweed sagewort (ARLU)[3]	4,000,000	25	0.3	25	0.3
Culver's root (VEVI4)	12,800,000	30	0.1	NR	NR
Cup plant (SIPE2)	22,400	10	9	NR	NR

Table 1. Full Seeding Rates [1,2]					
Species	**Seeds/Pound**	**MLRA 55 A/B & 56 [4]**		**MLRA 53 A/B, 54 & 58 C/D [4]**	
		Seed/SqFt	**#PLS/Ac**	**Seed/SqFt**	**#PLS/Ac**
Native Forbs and Legumes (cont.)					
Evening primrose (OEBI)	1,376,000	25.3	0.8	25.3	0.8
Gayfeather					
Dotted (LIPU)	136,000	25	8	25	8
Thickspike (LIPY)	136,000	25	8	NR	NR
False boneset (EUPE3)	2,560,000	25	0.4	25	0.4
Giant blue hyssop (AGFO)	1,440,000	25	0.8	25	0.8
Golden Alexander (ZIAU)	176,000	25	6.2	25	6.2
Goldenrod					
Canada (SOCA6)	4,600,000	25	0.2	25	0.2
Missouri (SOMI2)	1,998,000	25	0.5	25	0.5
Stiff (SORI2)	772,000	25	1.4	25	1.4
Tall smooth (SOGI)	700,000	25	0.5	25	0.5
Hoary vervain (VEST)	450,000	25	2.4	25	2.4
Illinois bundleflower (DEIL)	60,000	25	18	25	18
Ironweed (VEFA2)	385,000	25	2.8	25	2.8
Joe Pye weed (EUMAB)	1,520,000	25	0.7	25	0.7
Lewis flax (LILE3)	287,000	25	3.8	25	3.8
Milkweed					
Butterfly (ASTU)	67,000	25	16.2	25	16.2
Showy (ASSP)	85,000	25	13	25	13
Swamp (ASIN)	72,000	25	15	25	15
Partridge pea (CHFAF)	43,000	10	10	10	10
Plains coreopsis (COTI3)	1,650,000	25	0.7	25	0.7
Prairieclover					
Purple (DAPU5)	290,000	25	3.8	25	3.8
White (DAAL)	278,000	25	3.9	25	3.9
Prairie onion (ALST)	176,000	25	6.2	25	6.2
Prairie phlox (PHAN4)	304,000	28	4	28	4

Table 1. Full Seeding Rates [1,2]					
Species	**Seeds/Pound**	**MLRA 55 A/B & 56 [4]**		**MLRA 53 A/B, 54 & 58 C/D [4]**	
		Seed/SqFt	**#PLS/Ac**	**Seed/SqFt**	**#PLS/Ac**
Native Forbs and Legumes (cont.)					
Purple meadow rue (THDA)	176,000	25	6.2	25	6.2
Rocky Mountain Bee plant (CLSE)	64,000	29.6	20	29.6	20
Scarlet globemallow (SPCO)	500,000	25	2	25	2
Silvery lupine (LUAR3)	126,000	NR	NR	25	8
Shell-leaf penstemon (PEGR7)	273,000	25	4	25	4
Sneezeweed (HEAU)	2,100,000	25	0.4	25	0.4
Spiderwort					
Long bract (TRBR)	166,000	25	7	25	7
Prairie (TROC)	166,000	25	7	25	7
Sunflower					
False (HEHES)	60,000	25	18	25	18
Maximilian (HEMA2)	250,000	6	1	6	1
Sawtooth (HEGR)	630,000	25	1.7	NR	NR
Stiff (HEPAS)[3]	85,000	5	2.5	5	2.5
Western yarrow (ACMIO)[3]	2,800,000	25	0.4	25	0.4
Wild bergamot (MOFI)	1,200,000	25	0.9	25	0.9
Introduced Legumes					
Alfalfa (MESA)	210,000	30	6.5	25	5.5
Birdsfoot trefoil (LOCO6)	418,000	50	5	NR	NR
Cicer milkvetch (ASCI4)	134,000	30	10	25	8
Clover					
Alsike (TRHY)	680,000	50	3	50	3
Red (TRPR2)	275,000	30	5	NR	NR
Strawberry (TRFR2)	300,000	25	3.5	25	3.5
Sweet (MEOF)	260,000	25	4	20	3
White / Ladino (TRRE3)	800,000	25	1.5	25	1.5
Sainfoin (ONVI)	18,500	15	35 (hull)	15	35 (hull)

Table 1. Full Seeding Rates [1,2]					
Species	**Seeds/Pound**	**MLRA 55 A/B & 56 [4]**		**MLRA 53 A/B, 54 & 58 C/D [4]**	
		Seed/SqFt	**#PLS/Ac**	**Seed/SqFt**	**#PLS/Ac**
Native Shrubs					
Buffaloberry (SHAR)	41,000	4	4.2	4	4.2
Chokecherry (PRVIV)	5,000	3	26	3	26
False indigo (AMNA)	52,000	30	25	25	21
Golden currant (RIAU)	240,000	30	5.5	25	4.5
Juneberry (AMAL2)	82,000	30	16	25	13
Leadplant (AMCA6)	200,000	30	6.5	25	5.4
Prairie rose (ROAR3)	45,000	30	29	25	24
Saltbush					
Fourwing (dewinged) (ATCA2)	52,000	7	6	7	6
Gardner (ATGA)	110,000	30	12	25	10
Western snowberry (SYOC)	74,400	30	17.5	25	14.6
Winterfat (KRLA2)	150,000	30	8.5	25	7
WY big sagebrush (ARTRW8)	2,466,000	NR	NR	28	0.5

Footnotes for Table 1.

[1] See individual practice specifications (e.g. 550 Range Planting) for planning and application details and requirements.

[2] For additional information see http://plants.usda.gov/.

[3] These species are limited to no more than 2% of the seeding mix.

[4] See map on page 1 or Major Land Resource Areas (MLRA) of North Dakota in FOTG - Section I - Maps.

Table 2. Approved Named Varieties [1]		
Species	**Recommended Varieties for North Dakota**	
Introduced Cool-Season Grasses		
Bromegrass	Meadow	Fleet, Paddock, Regar, Montana, MacBeth, Cache
	Smooth[1]	Carlton, Signal, Magna, Manchar, Badger, Radisson, Rebound, Beacon, Barton, Baylor, Saratoga, Lincoln, AC Rocket, Bravo, Polar, Jubilee, Alpha, Cottonwood, York
Creeping foxtail		Retain, Garrison
Hard fescue		Discovery, Aurora, Reliant, Durar
Timothy		Climax, Itasca, Winmor, Comtal, Goliath, Timfor, Toro
Wheatgrass	Crested	
	Type: Standard	Nordan, RoadCrest, Summit
	Fairway	Ephraim, Ruff, Parkway, Fairway, Douglas
	Hybrid	HyCrest II, HyCrest, NU-ARS AC2
	Green	NewHy, AC Saltlander
	Intermediate	Reliant, Clarke, Slate, Chief, Oahe, Haymaker, Beefmaker, Manifest, Rush [4]
	Pubescent	Manska, Greenleaf, Luna
	Siberian	Vavilov, P-27
	Tall	Orbit, Platte, Jose, Alkar
Wildrye	Altai	Pearl, Eejay, Prairieland, Mustang
	Beardless	Shoshone
	Dahurian	Arthur, James
	Mammoth	Volga
	Manystem	Shoshone
	Russian	Mankota, Tetracan, Bozoisky Select, Swift, Bozoisky II, Cabree, Mayak
Native Cool-Season Grasses		
Bluejoint		Common
Fowl bluegrass		Common
Green needlegrass		Lodorm, AC Mallard, Fowler
Mannagrass	American	Common
	Fowl	Common
Needle and thread		Common, AC Sharptail
Nutall's alkaligrass		Common
Porcupine grass		Common
Prairie junegrass		Common
Reed canarygrass		Palaton, Venture, Vantage, Rise, Rival, Chiefton, Marathon
Wheatgrass	Bluebunch	Goldar, Secar, Anatone, P-7, Whitmax
	Slender awned, bearded	Adanac, Pryor, Revenue, Primar, Firststrike
	Streambank/ Thickspike	Bannock, Critana, Sodar, AC Polar, Elbee
	Western	Rodan, Walsh, Flintlock, Rosana, W.R.Poole, Recovery
Whitetop (Sprangletop)		Common
Wildrye	Basin	Trailhead, Magnar, Continental, Washoe
	Canada	Mandan
	Virginia	Omaha

Table 2. Approved Named Varieties [1]		
Species	**Recommended Varieties for North Dakota**	
Native Warm-Season Grasses		
Alkali sacaton		Common
American sloughgrass		Common
Bluestem	Big	Sunnyview, Bison, Bonilla, Bounty, Champ
	Little	Badlands, Itasca
	Sand	Goldstrike, Garden
Buffalograss		Bowie, Cody
Grama	Blue	Bad Rivean
	Sideoats	Killdeer, Pierre, Butte
Inland saltgrass		Common
Indian ricegrass		Rimrock, Nezpar
Indiangrass		Tomahawk
Prairie cordgrass		Red River
Prairie sandreed		Goshen, Bowman, Koch
Prairie dropseed		Common
Sand dropseed		Common
Switchgrass		Dacotah, Forestburg, Sunburst, Summer
Native Grass-likes		
Fox sedge (*Carex vulpinoidea*)		Common
Slough sedge (*Carex atherodes*)		Common
Native Legumes and Forbs		
American vetch		Common
Aster	Blue	Common
	Heath	Common
	New England	Common
Black-eyed Susan		Common
Black Samson		Bismarck
Blanket flower		Meriwether
Blue vervain		Common
Canada anemone		Common
Canada milkvetch		Sunrise
Canada tickclover		Common
Columbine		Common
Coneflower	Grayhead	Common
	Prairie (yellow)	Stillwater
Cudweed sagewort		Summit
Culver’s root		Common
Cup plant		Common
Evening primrose		Common
False boneset		Common
Giant blue hyssop		Common
Gayfeather	Dotted	Common
	Thickspike	Common

Table 2. Approved Named Varieties [1]		
Species	**Recommended Varieties for North Dakota**	
Native Legumes and Forbs (cont.)		
Golden Alexander		Common
Goldenrod	Canada	Common
	Missouri	Common
	Stiff	Common
Hoary vervain		Common
Illinois bundleflower		Common
Ironweed		Common
Joe Pye weed		Common
Lewis flax		Appar, Maple Grove
Milkweed	Butterfly	Common
	Showy	Common
	Swamp	Common
	Tall smooth	Common
Partridge pea		Common
Plains coreopsis		Common
Prairie onion		Common
Prairie phlox		Common
Purple meadow rue		Common
Prairieclover	Purple	Bismarck
	White	Antelope
Rocky Mountain Bee plant		Common
Scarlet globemallow		Common
Shell-leaf penstemon		Common
Silvery lupine		Common
Sneezeweed		Common
Spiderwort	Long bract	Common
	Prairie	Common
False sunflower	False	Common
	Maximilian	Medicine Creek
	Sawtooth	Common
	Stiff	Bismarck
Western yarrow		Great Northern, Eagle
Wild bergamot (Monarda)		Common
Introduced Legumes		
Alfalfa [2]		Winter Survival Index (WSI) of 2 or less [3]
Birdsfoot trefoil		Leo, Empire, Viking
Cicer milkvetch		Lutana, Monarch, Windsor
Clover	Alsike	Common
	Red	Common
	Strawberry	Common
	Sweet	Common
	White / Ladino	Common
Sainfoin		Eski

Table 2. Approved Named Varieties [1]		
Species	**Recommended Varieties for North Dakota**	
Native Shrubs		
Buffaloberry		Sakakawea
Chokecherry		Common
Currant	Golden	Common
False indigo		Survivor
Fourwing saltbush	Dewinged	Wytana, Snake River
Gardner saltbush		Common
Juneberry		Common
Leadplant		Common
Prairie rose		Common
Western snowberry		Trapper
Winterfat		Open Range
WY big sagebrush		Common

Footnotes for Table 2.

[1] See individual practice specification (e.g. 512 – Forage and Biomass Planting) for planning and application details and requirements.

[2] A partial list of grazable type alfalfas can be found in the NDSU report, "Developing Alfalfa Adapted to Grazing in the Northern Great Plains".

[3] The following web sites are approved for use in determining alfalfa varieties that are acceptable and planners are strongly encouraged to use these web sites for selecting acceptable varieties: http://www.alfalfa.org/ or http://www.extension.umn.edu/agriculture/forages/variety-selection-and-genetics/#legumes . Alfalfa named varieties must have a Winter Survival Index (WSI) of 2 or less to meet specifications. The term winter hardiness rating is sometimes used synonymously with winter survival index, a number of 2 or less is acceptable. If the winter hardiness rating uses letters (e.g. EH, extremely hardy) those will not be acceptable, only a number of 2 or less will be accepted.

Generally, the higher the fall dormancy score, the greater the production potential of the alfalfa variety. However, the higher FDS, the shorter the life span/persistence of the alfalfa variety. Origin of non-varietal ('common') alfalfa types is limited to ND, SD, MN, MT, and the Canadian provinces of Alberta, Manitoba and Saskatchewan.

NOTE: Approved varieties which may not be shown on these web sites include Alogonquin, Anik, Blazer, Champ, Drylander, Grim, Ladak, Ladak 65, Prowler, Rambler, Rangelander, Ramsey, Ranger, Spredor 2, Teton, Travois, Vernal, and Wrangler. Alfalfa varieties not listed here or shown on these web sites will require documentation from the distributor or developer to determine suitability. Consult the appropriate area or state office specialist for assistance as needed.

[4] Limited ND production trials indicate Rush intermediate wheatgrass is less productive than other approved intermediate varieties; therefore, Rush will be used for conservation cover plantings only. In addition, Rush is a Protected Plant Variety (PPV) and should only be available as commercial certified seed as designated by blue seed tag.

Table 3. Grass and Grass-like Species Characteristics									
Species	**Growth Characteristics [1,10]**	**Drought Tolerance [2]**	**Flood Tolerance [3]**	**Saline Tolerance (dS/m) [4]**	**Recovery After Harvest**	**Season Of Use [6]**	**Longevity [7]**	**Grazing Preference [8]**	**Stand Establishment [9]**
Introduced Grasses									
Bromegrass									
Meadow (BRBR14)	B/M	Fair	Fair	5-10	Good	Sp, F	Medium	High	Medium
Smooth (BRIN2)	R/M	Fair	Good	5-10	Good	Sp, F	Long	High	Rapid
Creeping foxtail (ALAR)	R/M	Poor	Good	10-15	Good	Sp, Su, F	Long	High	Medium
Hard fescue (FEBR7)	B/S	Good	Fair	NR	Good	Sp, F	Medium	Medium	Medium
Timothy (PHPR3)	B/M	Poor	Good	NR	Good	Sp, F	Short	Medium	Rapid
Wheatgrass									
Green (ELHO3)	B/M	Fair	Good	15-25	Good	Sp	Long	High	Medium
Crested (AGCR)	B/M	Good	Poor	10-15	Fair	Sp, F	Long	Medium	Rapid
Intermediate (THIN6)	R/M	Fair	Fair	10-15	Fair	Sp	Long	High	Medium
Pubescent (THIN6)	R/M	Fair	Fair	10-15	Fair	Sp	Long	High	Medium
Siberian (AGFR)	R/M	Good	Poor	NR	Fair	Sp, F	Long	Medium	Rapid
Tall (THPO7)	B/T	Fair	Good	15-25	Fair	Sp, F, W	Medium	Low	Medium
Wildrye									
Altai (LEAN3)	B/M	Fair	Good	15-25	Poor	Sp, F, W	Medium	Medium	Slow
Dahurian (ELDA3)	B/M	Fair	Fair	NR	Good	Sp	Short	Medium	Rapid
Mammoth (LERA5)	R/T	Good	Poor	NR	Fair	Sp	Long	Low	Slow
Manystem (LEMU11)	R/M	Fair	Fair	15-25	Poor	Su, F	Long	Medium	Slow
Russian (PSJU3)	B/M	Good	Fair	15-25	Good	Sp, F, W	Medium	High	Medium
Native Cool-Season Grasses									
Bluejoint fowlgrass (CACA4)	R/M	Poor	Good	NR	Fair	Sp,Su	Long	Medium	Medium
Fowl bluegrass(POPA2)	B/M	Poor	Good	Poor	Poor	Sp, F	Med	Low	Medium
Green needlegrass (NAVI4)	B/M	Good	Fair	NR	Good	Sp, F	Long	High	Medium
Mannagrass									
American (GLGR)	R/T	Poor	Good	NR	NR	NR	NR	NR	NR
Fowl (GLST)	R/T	Poor	Good	NR	Poor	NR	Short	High	Medium
Needle and thread (HECO26)	B/M	Good	Fair	NR	Fair	Sp	Long	Medium	Slow
Nutall's Alkaligrass (PUNU2)	B/S	Poor	Good	15-25	Fair	Sp	Long	High	Slow
Porcupinegrass (HESP11)	B/M	Good	Fair	NR	Good	Sp	Long	Medium	Slow
Prairie junegrass (KOMA)	B/S	Good	Poor	NR	Poor	Sp	Long	High	Slow
Reed canarygrass (PHAR3)	R/T	Fair	Good	5-10	Good	Sp, Su	Long	High	Medium
Wheatgrass									
Bluebunch (PSSP6)	B/M	Good	Poor	NR	Poor	Sp, Su, F	Long	High	Medium

Table 3. Grass and Grass-like Species Characteristics									
Species	**Growth Characteristics [1,10]**	**Drought Tolerance [2]**	**Flood Tolerance [3]**	**Saline Tolerance (dS/m) [4]**	**Recovery After Harvest**	**Season Of Use [6]**	**Longevity [7]**	**Grazing Preference [8]**	**Stand Establishment [9]**
Native Cool-Season Grasses (cont.)									
Wheatgrass (cont.)									
Slender/Awned/Bearded (ELTR7)	B/M	Good	Good	15-25	Fair	Sp, Su, F	Short	Medium	Rapid
Streambank/Thickspike (ELLAL)	R/M	Good	Fair	10-15	Fair	Sp. F	Long	Medium	Medium
Western (PASM)	R/M	Good	Good	15-25	Fair	Sp, Su, F	Long	Medium	Medium
Whitetop (Sprangletop) (SCFE)	R/T	Poor	Good	NR	NR	NR	Medium	NR	NR
Wildrye									
Basin (LECI4)	B/T	Good	Fair	NR	Fair	Sp, F	Long	High	Slow
Beardless (LETR5)	R/M	Fair	Fair	15-25	Poor	Su, F	Long	Medium	Slow
Canada (ELCA4)	B/M	Fair	Good	10-15	Fair	Sp, F	Short	Medium	Rapid
Virginia (ELSU)	B/M	Fair	Good	Poor	Poor	Sp	Short	Medium	Rapid
Native Warm-Season Grasses									
Alkali sacaton									
American sloughgrass (BESY)	St/S	Poor	Good	NR	Poor	NR	NR	NR	NR
Bluestem									
Big (ANGE)	R/T	Fair	Good	NR	Good	Su	Long	High	Slow
Little (SCSC)	B/M	Good	Poor	NR	Fair	Su, F	Long	Medium	Medium
Sand (ANHA)	R/T	Good	Fair	NR	Fair	Su, F	Long	High	Slow
Buffalograss (BODA2)	St/S	Good	Poor	10-15	Fair	Su	Long	High	Medium
Grama									
Blue (BOGR2)	B/S	Good	Poor	NR	Poor	Su	Long	High	Medium
Sideoats (BOCU)	R/S	Good	Poor	NR	Fair	Su, F	Long	High	Medium
Inland saltgrass (DISP)									
Indian ricegrass (ACHY)	B/M	Good	Poor	NR	Fair	Su	Long	High	Slow
Indiangrass (SONU2)	R/T	Fair	Good	NR	Good	Su, F	Long	High	Medium
Prairie cordgrass (SPPE)	R/T	Poor	Good	10-15	Fair	Sp	Long	Medium	Slow
Prairie sandreed (CALO)	R/T	Good	Poor	NR	Fair	Su, F	Long	Medium	Slow
Prairie dropseed (SPHE)	B/M	Fair	Good	NR	Fair	Su	Long	Medium	Slow
Sand dropseed (SPCR)	B/M	Good	Poor	NR	Poor	Su	Short	Low	Rapid
Switchgrass (PAVI)	R/T	Fair	Good	5-10	Fair	Su, F	Long	Medium	Medium
Native Grass-likes									
Fox sedge (CAVU2)	B/S	Poor	Good	None	Poor	Sp	Long	Medium	Medium
Slough sedge (CAAT2)	R/M	Poor	Good	None	Poor	Sp, Su	Long	Low	Low

NR = Not Rated

Table 4. Pollinator / Forb Species Characteristics											
Species	**Growth Character-istics[1,10]**	**Establish-ment List[12]**	**Drought Tolerance [2]**	**Flood Tolerance [3]**	**Saline Tolerance (dS/m) [4]**	**Recovery After Harvest**	**Season of Use [6]**	**Longevity[7]**	**Grazing Preference[8]**	**Stand Establish-ment[9]**	**Bloom Period[11]**
Native Forbs/Legumes											
American vetch (VIAM)	Pr/P	B	Good	Poor	Poor	NR	NR	Medium	NR	Medium	Er / Mi
Aster											
Blue (SYLAL3)	E/P	B	Fair	Poor	None	Poor	NR	Short	NR	NR	Mi / L
Heath (SYER)	E/P	B	Good	Fair	NR	NR	Su	Long	Low	NR	Mi / L
New England (SYNO2)	E/P/R	B	Poor	Good	NR	NR	NR	Long	NR	Medium	Mi / L
Black samson (ECAN2)	E/P	A	Good	Poor	Poor	NR	NR	Long	NR	Slow	Mi / L
Black-eyed susan (RUHI2)	E/P	A	Good	Good	Poor	NR	NR	Short	NR	Rapid	Mi / L
Blanketflower (GAAR)	E/P	A	Good	Fair	2-6	NR	NR	Medium	NR	Medium	Mi
Blue vervain (VEHA2)	E/P	B	NR	NR	NR	NR	NR	NR	NR	NR	Mi / L
Canada anemone (ANCA8)	P/R/M	B	Fair	NR	NR	Poor	NR	Medium	NR	NR	Er / Mi
Canada milkvetch (ASCAC6)	E/P	A	Fair	Good	2-6	NR	NR	Short	NR	Medium	Mi
Canada tickclover (DECA7)	E/P	B	Fair	Fair	NR	NR	Sp, Su	Medium	Medium	NR	Mi
Columbine (AQCA)	P/M	B	Fair	NR	NR	NR	NR	Medium	NR	Rapid	Er / Mi
Coneflower											
Grayhead (RAPI)	E/P/T	B	Good	Fair	NR	Poor	Sp, Su	Medium	Medium	Medium	L
Prairie (Yellow) (RACO3)	E/P	A	Good	Fair	2-6	NR	NR	Long	NR	Medium	Mi
Cudweed sagewort (ARLU)	E/P	B	Good	Poor	NR	NR	NR	Long	NR	Medium	L
Culver's root (VEVI4)	E/P	B	Fair	Fair	NR	NR	NR	Long	NR	NR	Mi
Cup plant (SIPE2)	E/P/T	B	Poor	Good	Poor	NR	NR	Long	NR	Medium	L
Evening primrose (OEBI)	Bi/M	B	Medium	NR	None	Slow	NR	Short	NR	Rapid	Mi / L
False boneset (EUPE3)	E/P	A	NR	NR	NR	NR	NR	NR	NR	NR	Mi /L
Gayfeather											
Dotted (LIPU)	E/P	A	Good	Poor	Poor	NR	NR	Long	NR	Slow	Mi / L
Thickspike (LIPY)	E/P	B	Poor	Fair	Poor	Poor	Su	Medium	NR	Medium	Mi / L
Giant blue hyssop (AGFO)	E/P/R	A	Poor	Fair	NR	NR	NR	Medium	NR	Rapid	Mi / L
Golden Alexander (ZIAU)	E/P	B	Poor	Fair	NR	NR	Sp, Su	Medium	NR	Medium	Er
Goldenrod											
Canada (SOCA6)	E/P	B	Fair	NR	NR	Fair	NR	Long	NR	NR	Mi / L
Missouri (SOMI2)	E/P	B	Good	NR	NR	Poor	NR	Short	NR	NR	Mi / L
Stiff (SORI2)	E/P/B	A	Good	NR	NR	Fair	NR	Medium	NR	NR	Er / Mi / L
Tall smooth (SOGI)	E/P/B	B	Medium	NR	NR	NR	NR	Medium	NR	NR	L
Hoary vervain (VEST)	E/P	B	NR	NR	NR	NR	NR	NR	NR	NR	Mi / L

Table 4. Pollinator / Forb Species Characteristics											
Species	**Growth Character-istics[1,10]**	**Establish-ment List[12]**	**Drought Tolerance [2]**	**Flood Tolerance [3]**	**Saline Tolerance (dS/m) [4]**	**Recovery After Harvest**	**Season of Use [6]**	**Longevity[7]**	**Grazing Preference[8]**	**Stand Establish-ment[9]**	**Bloom Period[11]**
Native Forbs/Legumes (cont.)											
Illinois bundleflower (DEIL)	E/P	A	Fair	Good	Poor	Fair	Sp, Su	Short	High	Rapid	Mi / L
Ironweed (VEFA2)	E/P	B	Fair	Good	NR	Fair	Sp, Su	Short	High	Rapid	Mi / L
Joe Pye weed (EUMAB)	E/P	B	Fair	Good	NR	NR	NR	Medium	NR	NR	Mi / L
Lewis flax (LILE3)	E/P	A	Good	Fair	2-6	NR	NR	Medium	NR	Rapid	Er
Milkweed											
Butterfly (ASTU)	E/P	A	Good	Poor	None	Poor	Sp, Su	Medium	NR	NR	Er / Mi / L
Showy (ASSP)	E/P	B	Low	NR	NR	Poor	NR	Long	NR	NR	Er / Mi
Swamp (ASIN)	E/P	B	Poor	NR	NR	Poor	NR	Medium	NR	NR	Mi / L
Partridge pea (CHFAF)	E/P	B	NR	NR	NR	NR	NR	NR	NR	NR	L
Plains coreopsis (COTI3)	E/A	A	Good	Good	NR	NR	NR	Short	NR	Rapid	Er / Mi
Prairieclover											
Purple (DAPU5)	E/P	A	Good	Fair	2-6	NR	NR	Medium	NR	Medium	Mi
White (DAAL)	E/P	B	Good	Fair	NR	NR	NR	Medium	NR	Medium	Mi
Prairie onion (ALST)	E/P	B	Good	Poor	NR	NR	NR	NR	NR	NR	Mi
Prairie phlox (PHAN4)	P/R/M	B	NR	NR	NR	NR	Sp, Su	Long	Fair	Slow	Mi
Purple meadow rue (THDA)	E/P	B	Poor	Good	NR	NR	NR	NR	NR	NR	Mi
Rocky Mountain Bee plant (CLSE)	A/L/T	B	Low	NR	NR	Slow	NR	Short	Low	Rapid	Er
Scarlet globemallow (SPCO)	E/P	A	Good	Poor	NR	Good	NR	Short	Fair	NR	Mi
Shell-leaf penstemon (PEGR7)	E/P	A	Good	Poor	NR	NR	NR	Short	NR	Medium	Er
Silvery lupine (LUAR3)	E/P	B	Fair	NR	NR	Good	NR	Short	NR	NR	Er / Mi
Sneezeweed (HEAU)	E/P	B	Poor	NR	NR	Poor	Sp, Su	Medium	NR	NR	L
Spiderwort											
Long bract (TRBR)	E/P/R	B	NR	NR	NR	NR	NR	NR	NR	NR	Er / Mi
Prairie (TROCO)	E/P	B	Good	Good	NR	NR	NR	NR	NR	NR	Er / Mi / L
Sunflower											
False sunflower (HEHES)	E/R	B	Good	NR	None	Poor	NR	Short	NR	NR	Mi / L
Maximilian (HEMA2)	E/P/R	A	Poor	Good	2-6	NR	NR	Long	NR	Medium	Mi /L
Sawtooth (HEGR4)	E/P/R	B	Fair	NR	NR	Poor	NR	Medium	NR	NR	Mi / L
Stiff (HEPAS)	E/P/R	B	Fair	NR	NR	Poor	NR	Long	High	Slow	Mi / L
Western yarrow (ACMIO)	E/P	A	Good	Good	2-6	NR	NR	Long	NR	Medium	Er / Mi
Wild bergamot (MOFI)	R/P	A	Poor	Good	NR	Poor	Sp	Medium	Medium	Medium	Mi / L
Introduced Legumes											
Alfalfa (MESA)	E/P	A	Good	Poor	5-10	Good	Sp, Su	Medium	High	Rapid	Er / Mi

Table 4. Pollinator / Forb Species Characteristics											
Species	**Growth Character-istics[1,10]**	**Establish-ment List[12]**	**Drought Tolerance [2]**	**Flood Tolerance [3]**	**Saline Tolerance (dS/m) [4]**	**Recovery After Harvest**	**Season of Use [6]**	**Longevity[7]**	**Grazing Preference[8]**	**Stand Establish-ment[9]**	**Bloom Period[11]**
Introduced Legumes (cont.)											
Birdsfoot trefoil (LOCO6)	Pr/P	A	Fair	Fair	5-10	Good	Sp, Su	Medium	High	Rapid	Er
Cicer milkvetch (ASCI4)	Pr/P	A	Good	Fair	5-10	Good	Sp	Long	High	Medium	Mi
Clover											
Alsike (TRHY)	Pr/P	A	Poor	Good	5-10	Good	Sp, Su	Short	High	Medium	Mi
Red (TRPR2)	Pr/P	A	Fair	Fair	5-10	Fair	Sp, Su	Short	High	Medium	Er / Mi
Strawberry (TRFR2)	E/P	A	Fair	Good	15-25	Fair	Sp, Su	Medium	Medium	Rapid	Er / Mi
Sweet (MEOF)	E/Bi	A	Good	Fair	5-10	Poor	Sp, Su	Medium	Medium	Rapid	Mi
White / Ladino (TRRE3)	Pr/P	A	Poor	Good	5-10	Fair	Sp, Su	Short	High	Medium	Er / Mi / L
Sainfoin (ONVI)	E/P	A	Good	Poor	NR	Fair	Sp, Su	Medium	High	Slow	Er
Native Shrubs											
Buffaloberry (SHAR)	E/P/R	A	Good	Poor	8-15	NR	NR	Long	NR	Slow	Er
Chokecherry (PRVIV)	E/P/R	A	Fair	Fair	4-8	NR	NR	Long	NR	Slow	Er
False indigo (AMFR)	E/P	A	Poor	Good	NR	NR	NR	Medium	NR	Slow	Mi
Golden currant (RIAU)	E/P	A	Good	Fair	8-15	NR	NR	Medium	NR	Slow	Er
Juneberry (AMAL2)	E/P/R	A	Poor	Good	4-8	NR	NR	Long	NR	Slow	Er
Leadplant (AMCA6)	E/P	A	Good	Poor	NR	NR	NR	Long	NR	Slow	Mi / L
Prairie rose (ROAR3)	E/P/R	A	Good	Fair	NR	NR	NR	Long	NR	Slow	Er / Mi
Saltbush											
Fourwing, dewinged (ATCA2)	E/P	A	Good	Poor	8-15	NR	NR	Long	NR	Slow	Mi
Gardner (ATGA)	E/P	A	Good	Poor	8-15	NR	NR	Long	NR	Slow	Mi
Western snowberry (SYOC)	E/P/R	A	Fair	Fair	NR	NR	NR	Long	NR	Slow	Er / Mi
Winterfat (KRLA2)	E/P	A	Good	Poor	NR	NR	NR	Long	NR	Slow	Er
WY big sagebrush (ARTRW8)	E/P	A	Good	NR	NR	NR	NR	Long	NR	NR	L

NR = Not Rated

Footnotes for Table 3 and Table 4.

[1]For additional information refer to the USDA Plants Database at: http://plants.usda.gov/.
[2]**Drought Tolerance**: Based on species being on an adapted site.
[3]**Flood Tolerance**: Good = 28-42 days; Fair = 14-28 days; Poor = less than 14 days. Creeping foxtail and reed canarygrass can tolerate up to 60 days.
[4]**Plant salinity tolerance** ratings are based upon saturated paste measurements in decisiemens per meter (dS/m). USDA-NRCS March 2007. Plant Materials for Salt-Affected Sites in the Northern Great Plains. Soil surface layer salinity measurements may be taken in the field using a 1:1 solution and a handheld EC Meter. To convert EC Meter readings to dS/m, multiply meter reading by 0.5.
[5]**Recovery after Harvest**: Based on adequate soil moisture.
[6]**Season of Use**: Sp – spring; Su – summer; F – fall; W – winter.
[7]**Longevity**: Short 1-4 years; Medium 5-10 years; Long – longer than 10 years with proper management.
[8]**Grazing Preference**: Based on season of rapid growth. Palatability is relative, depending on quantity, quality, and availability of other species. Grazing preference shown is for cattle and will vary for other species of domestic livestock or wildlife.
[9]**Stand Establishment**: Rapid – usually 1 growing season after planting; Medium – usually 1-2 growing seasons after planting; Slow usually 2-3 growing seasons after planting.

10.

Growth Characteristics	
A	Annual
B	Bunch
Bi	Biennial
E	Erect
M	Mid 18" - 36"
P	Perennial
Pr	Prostrate
R	Rhizomatous
S	Short < 18"
St	Stoloniferous
T	Tall > 36"

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11.

Bloom Period		
Er	Early bloom period	April - May
Mi	Mid-bloom period	May - July
L	Late bloom period	July - September

[12]**Establishment List:** Pollinator species listed as “A” have demonstrated consistent establishment and persistence on various sites state-wide, based on field reviews of pollinator plantings. At least 75% of native forbs must be “A” Establishment list species. Additional species to consider for pollinator plantings are noted as “B”. Grass species do not have a rating.