

# Evaluation of Ecological Site Classes and Community Classes for Regional Scale Modeling of Conservation Effects on Grazing Lands: MLRA 60A

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## INTRODUCTION

The Grazing Lands Component of the Conservation Effects Assessment Project (CEAP-GL) is evaluating the development and use of Ecological Site Classes and Community Classes within Major Land Resource Areas for regional and national scale modeling of conservation effects. National Resources Inventory (NRI) data is correlated to proposed Ecological Site Classes to provide data for the Agricultural Policy/Environmental eXtender (APEX) model and other models. The Rangeland Hydrology and Erosion Model (RHEM) is used to assess runoff and erosion differences between Community Classes.

## CLASSIFICATION HIERARCHY AND DEFINITIONS

### Ecological Site Class

Ecological Site Classes are proposed subdivisions of a Major Land Resource Area (MLRA) or Land Resource Unit (LRU). They are similar in concept to a general soil survey map unit – a general grouping of ecological sites by major landforms and vegetation types. An Ecological Site Class differs from other kinds of land in the kinds and amounts of vegetation produced, in the responses to disturbances, in recovery mechanisms, and management responses.

### Plant Functional Groups

The Plant Functional/Structural Group indicator is defined in [Interpreting Indicators of Rangeland Health](#) (version 4) as, *“A suite or group of species that because of similar shoot or root structure, photosynthetic pathways, nitrogen fixing ability, life cycle, etc., are grouped together on an ecological site basis.”*

The presence, dominance and relative proportions of plant functional groups affect soil, hydrologic and biotic variables including:

- the kinds and amounts of canopy and foliar cover
- amount and arrangement of bare ground and litter cover
- plant spacing and amount of basal cover
- runoff and erosion rates
- structure and arrangement of vegetation which then influences the potential to carry fire and regulate fire intensity
- grazing preferences and distribution
- wildlife habitat values

The change in presence, dominance and/or proportion of plant functional groups is the primary attribute used to characterize States and Community Phases within an Ecological Site Description. Standardized plant functional groups were developed based on growth forms and flowering period. All plant species found in the MLRA were assigned to a plant functional groups. Non-native species were assigned to functional groups designated with (I) -

for introduced. Production by functional group was then calculated for each NRI Primary Sampling Unit (PSU) community in the MLRA. Refer to [Appendix E](#) for a list of common species and their assigned functional groups used for this project.

## Community Class

A Community Class is a proposed plant community classification for an Ecological Site Class. The name of the Community Class is derived using the seven (7) dominant plant functional groups, listed in descending order by annual aboveground production on a dry weight basis. A Community Class is differentiated from other Community Classes by the presence and relative dominance of plant functional groups, and/or by significant differences in annual production.

## Plant Community

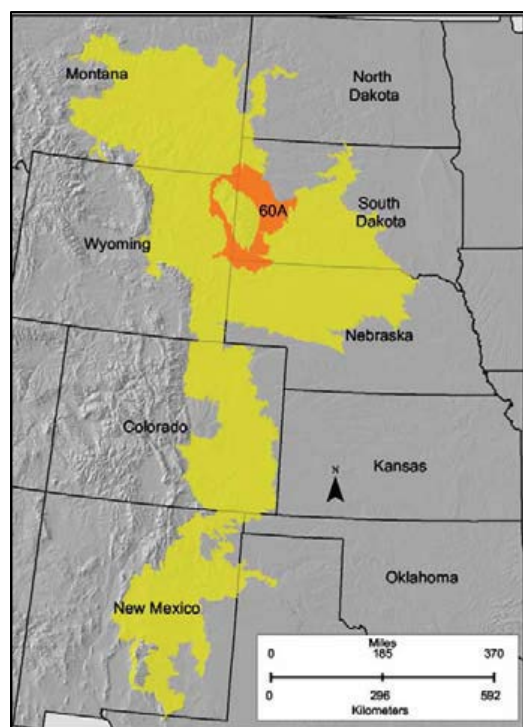
An actual plant community found at a given location, at a point in time.

## MAJOR LAND RESOURCE AREA 60A – PIERRE SHALE PLAINS

Major Land Resource Area 60A occurs in the west-central and southwestern corner of South Dakota, extending into northeast Wyoming and northwest Nebraska around the base of the Black Hills and Dakota Hogback. This area is part of the Western Great Plains Range and Irrigated Region - Land Resource Region (LRR G). MLRA 60A is just under 6.5 million acres in size (26,295 square kilometers). Elevations range from 2620 feet (800 meters) above mean sea level to 4260 feet (1,300 meters). The area is an unglaciated portion of the Missouri Plateau. The MLRA is characterized by eroded plateaus and terraces of cretaceous Pierre shale with layers of smectitic clay formed from volcanic ash. The Cheyenne and Belle Fourche Rivers are the major drainages in the MLRA.

This Major Land Resource Area is dominated by grassland vegetation with trees and shrubs along the drainages. Important perennial grasses include western wheatgrass, blue grama, needleandthread, buffalograss, green needlegrass and little bluestem. Common native shrubs include sand sagebrush leadplant, and western snowberry. Trees include boxelder, plains cottonwood and green ash with some ponderosa pine and eastern redcedar. Refer to [Appendix E](#) for scientific plant names and additional plant classification data used throughout the report.

Important wildlife includes pronghorn antelope, white-tailed deer, mule deer, ring-necked pheasant, sharp-tailed grouse, ducks, coyotes, badgers and beaver. The black-footed ferret and sage grouse are important species of concern in the MLRA.



**Figure 1.** LRR G and MLRA 60A map. Source: Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296 (2006).

## CLIMATE

The following climate information is excerpted from the Loamy 16-18" P.Z. Ecological Site Description and characterizes the climate in MLRA 60A.

"The climate in this MLRA is typical of the drier portions of the Northern Great Plains where sagebrush steppes to the west yield to grassland steppes to the east. Annual precipitation ranges from 16 to 18 inches per year, with most occurring during the growing season. Temperatures show a wide range between summer and winter and between daily maximums and minimums, due to the high elevation and dry air, which permits rapid incoming and outgoing radiation. Cold air masses from Canada in winter move rapidly from northwest to southeast and account for extreme minimum temperatures. Chinook winds may occur in winter and bring rapid rises in temperature. Extreme storms may occur during the winter, but most severely affect ranch operations during late winter and spring. The normal average annual temperature is about 47°F. January is the coldest month with average temperatures ranging from about 18°F (Newell, SD), to about 23°F (Oelrichs, SD). July is the warmest month with average temperatures ranging from about 72°F (Newell, SD), to about 74°F (Oelrichs, SD). The range of normal average monthly temperatures between the coldest and warmest months is about 53°F. Hourly winds are estimated to average about 11 miles per hour annually, ranging from about 13 miles per hour during the spring to about 10 miles per hour during the summer. Daytime winds are generally stronger than nighttime and occasional strong storms may bring brief periods of high winds with gusts to more than 50 miles per hour.

Growth of cool season plants begins in early to mid-March, slowing or ceasing in late June. Warm season plants begin growth about mid-May and can continue to early or mid-September. Green up of cool season plants may occur in September and October when adequate soil moisture is present."

### Averages

|                                     |      |
|-------------------------------------|------|
| Frost-free period (days):           | 130  |
| Freeze-free period (days):          | 148  |
| Mean annual precipitation (inches): | 19.0 |

**Table 1.** Monthly Precipitation (Inches)

|        | Jan  | Feb  | Mar  | Apr  | May  | Jun  | Jul  | Aug  | Sep  | Oct  | Nov  | Dec  |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|
| High   | 0.43 | 0.57 | 0.94 | 1.78 | 3.19 | 3.38 | 2.78 | 1.76 | 1.50 | 1.32 | 0.61 | 0.49 |
| Medium | 0.40 | 0.51 | 0.89 | 1.72 | 2.97 | 3.21 | 2.33 | 1.56 | 1.38 | 1.20 | 0.59 | 0.48 |
| Low    | 0.37 | 0.45 | 0.85 | 1.66 | 2.74 | 3.05 | 1.87 | 1.37 | 1.26 | 1.07 | 0.57 | 0.48 |

**Table 2.** Monthly Temperature (°F)

|      | Jan  | Feb  | Mar  | Apr  | May  | Jun  | Jul  | Aug  | Sep  | Oct  | Nov  | Dec  |
|------|------|------|------|------|------|------|------|------|------|------|------|------|
| High | 34.6 | 40.9 | 48.8 | 60.9 | 71.1 | 81.5 | 90.3 | 89.7 | 79.2 | 65.5 | 47.9 | 37.5 |
| Low  | 6.00 | 11.4 | 19.5 | 31.4 | 42.6 | 52.2 | 57.8 | 55.9 | 44.8 | 32.9 | 20.3 | 10.0 |

The soil temperature regime is mesic and the soil moisture regime is ustic.

### Representative Climate Stations

- (1) SD0236, Ardmore 2 N. Period of record 1948-1999
- (2) SD8911, Wasta. Period of record 1949 – 1999\*
- (3) SD6054 Newell. Period of Record 1948-1999

\*This climate station was used for the Rangeland Hydrology and Erosion Model (RHEM) evaluations.

## AGRICULTURAL OPERATIONS

Cropland covers about 11 percent of the acres in this MLRA, while rangeland covers about 82 percent. Twenty three percent (23%) of the MLRA is federal land. The kind and size of livestock operations are variable, but a typical livestock operation is cow-calf, about 8000 acres in size, with about 200 mother cows. Stocking rates average 0.2-0.3 AUMs/Ac. Most calves are born from January through early April in barns or lots where livestock are fed during the winter. Cattle graze on rangelands starting from mid-April through May and typically come off the rangeland from late October to early November. Calves are kept about a month after weaning, and then shipped in mid to late October. If the operation includes crop or hay land, livestock may graze those areas through November. During the winter, cattle are typically fed grass-alfalfa hay with protein cake or distillers grain.

Crops grown in this MLRA include small grains (wheat, barley) that are planted in mid to late May and harvested from then the end of July through August. Most of the small grain cropland is highly erodible land, so it is not grazed. Corn, sunflower, and alfalfa are other common crops. Canola is grown in the northern portion of the MLRA. Potatoes and specialty crops are grown in a few areas. Intermediate wheatgrass is grown for grass hay. There is very little irrigation used in the MLRA.

## RESOURCE MANAGEMENT SYSTEMS

### Conservation Practices Applied

Table 3 shows the kinds and amounts of conservation practices that the landowners in MLRA 60A are investing in on grazing lands. The table shows the most common conservation practices applied with NRCS assistance on grazed rangeland during fiscal years 2006-2011.

**Table 3.** Common conservation practices applied on grazed rangeland in MLRA 60A from 2006-2011 (NRCS).

| Practice Code | Practice Name (Units)                    | Practice Count | Amount Applied | Acres Benefitted |
|---------------|------------------------------------------|----------------|----------------|------------------|
| 516           | Pipeline (ft)                            | 1,092          | 4,063,840      | 765,390          |
| 614           | Watering Facility (no)                   | 1,016          | 3,103          | 708,865          |
| 528           | Prescribed Grazing (ac)                  | 475            | 201,687        | 241,441          |
| 595           | Integrated Pest Management (IPM) (ac)    | 349            | 111,139        | 114,388          |
| 382           | Fence (ft)                               | 260            | 895,245        | 110,519          |
| 533           | Pumping Plant (no)                       | 122            | 2,556          | 69,917           |
| 645           | Upland Wildlife Habitat Management (ac)  | 99             | 100,577        | 106,738          |
| 642           | Water Well (no)                          | 98             | 98             | 54,263           |
| 472           | Access Control (ft)                      | 54             | 24,190         | 36,818           |
| 314           | Brush Management (ac)                    | 46             | 325            | 10,835           |
| 380           | Windbreak/Shelterbelt Establishment (ac) | 40             | 34,131         | 11,673           |
| 378           | Pond (no)                                | 26             | 26             | 22,234           |
| 561           | Heavy Use Area Protection (ac)           | 24             | 3,960          | 7,297            |
| 484           | Mulching (ac)                            | 24             | 40             | 4,270            |
| 548           | Grazing Land Mechanical Treatment (ac)   | 14             | 723            | 8,197            |
| 574           | Spring Development (no)                  | 8              | 8              | 9,075            |
| 327           | Conservation Cover (ac)                  | 7              | 32             | 20               |
| 512           | Forage and Biomass Planting (ac)         | 7              | 312            | 1,829            |
| 550           | Range Planting (ac)                      | 6              | 721            | 736              |

## **Prescribed Grazing**

Prescribed grazing is a common conservation practice applied to address resource concerns on rangelands in this MLRA. A typical livestock operation has 2-3 pastures used primarily for herd management. Season long grazing is common. Prescribed grazing focuses on maintaining proper stocking rates and encouraging producers to change the period of use in the rangeland pastures each year to help maintain desirable species composition.

## **Watering Facilities**

On the eastern side of the MLRA, livestock water is mostly provided through rural water supply systems. There are some artesian wells (1500 ft. deep) but water quality is typically poor. On the western side of the MLRA, water is mostly provided by ponds and wells (150 – 200 ft. deep), livestock pipeline, and watering facilities. Water quality in dams is poor (sulfates).

## **Brush Management**

This practice is rarely applied in this MLRA primarily because of sage grouse concerns. There is some brush management applied on rocky mountain juniper, eastern red cedar and ponderosa pine using mechanical methods (nippers and chain saws). Russian olive and salt cedar in riparian areas are also being controlled using chemical and mechanical methods.

## **Range Planting**

Range planting is not common in this MLRA. There is typically a sufficient seed source for the desirable species to become re-established with good grazing management.

## **Prescribed Burning**

Prescribed Burning is not commonly used in this MLRA, but it plays an important role the ecology of many of the plant communities. The natural fire frequency in this MLRA is 75-100 years on the west side with Wyoming big sagebrush. The shallow clay soils with big sagebrush will not carry a fire. The rest of the MLRA has a 10-15 year natural fire frequency.

## **Fencing**

Standard barbed wire fencing using 3-4 wires is the typical fencing used for livestock control. More 2-wire electric fence is being installed in the last 10 years.

## **Herbaceous Weed Control**

Herbaceous weed control is being used to control noxious weeds such as leafy spurge, and Canada thistle. Biological control of leafy spurge with flea beetles or moths is successful. Leafy spurge is also controlled using 2,4-D, picloram and imazapic. Aminopyralid is used on Canada thistle as well. Ground spraying using trucks is the most common application method. On the western side of the MLRA, cheatgrass is more of a problem than the non-native perennial species such as Kentucky bluegrass and smooth brome.

## **Upland Wildlife Habitat Management**

Most conservation plans manage grazing to benefit wildlife. Some operations diversify income with fee hunting for whitetail deer and waterfowl. Sage grouse occur in the northern portion of the MLRA.

## **ECOLOGICAL SITE CLASSES AND COMMUNITY CLASSES**

As of January 2017, there were 27 ecological sites correlated to soil map unit components in MLRA 60A. Those were grouped into eight (8) ecological site classes by working with the state and local NRCS soil and rangeland management scientists in MLRA 60A. The ecological site classes are based on landscape position, soil characteristics, plant community composition, plant production and the response to climate, disturbance, use, and management.

## ECOLOGICAL SITE CLASSES FOR MAJOR LAND RESOURCE AREA 60A

### Loamy Terrace Ecological Site Class

- Clayey Overflow R060AY021SD
- Loamy Overflow R060AY020SD
- Loamy Terrace R060AY022SD
- Lowland R060AY042SD

### Loamy Upland Ecological Site Class

- Clayey 13-16" PZ R060AY011SD
- Clayey 16-18" PZ R060AY040SD
- Loamy 13-16" PZ R060AY010SD
- Loamy 16-18" PZ R060AY041SD

### Saline Bottomland Ecological Site Class

- Closed Depression R060AY019SD
- Saline Lowland R060AY007SD
- Saline Subirrigated R060AY036SD

### Sandy Upland Ecological Site Class

- Sands R060AY008SD
- Sandy R060AY009SD

### Shallow Porous Clay Upland Ecological Site Class

- Porous Clay R060AY030SD
- Shallow Clay R060AY017SD
- Shallow Porous Clay R060AY043SD

### Shallow Upland Ecological Site Class

- Claypan R060AY013SD
- Dense Clay R060AY018SD
- Saline Upland R060AY026SD
- Shallow Dense Clay R060AY025SD
- Shallow Loamy R060AY024SD
- Thin Claypan R060AY015SD
- Thin Upland R060AY012SD

### Very Shallow Upland Ecological Site Class

- Very Shallow R060XY016SD
- Shallow Sandy R060AY044SD

### Wet Bottomland Ecological Site Class

- Subirrigated R060AY003SD
- Wetland R060AY002SD

Each NRI Primary Sampling Unit (PSU) in the MLRA was correlated to a Community Class where possible. PSU data were not used when the species present or vegetation production was questionable. Additional Community Classes that are not currently represented in the ecological site descriptions were added when present in the NRI data. Community Class names are derived using the top seven (7) plant functional groups, listed in descending order of annual aboveground air-dry production.

All species and plant community production values shown as pounds per acre (lbs/ac) in the following ecological site class descriptions, refers to annual aboveground production air-dried production. The dominant functional groups and average production for the plant functional groups are calculated from the NRI PSUs that are correlated to each Community Class. Refer to [Appendix E](#) for plant taxonomy.

The following sections describe the eight ecological site classes in MLRA 60A.

## LOAMY TERRACE ECOLOGICAL SITE CLASS

### General Description

The Loamy Terrace ecological site class occurs on nearly level to gently sloping low-lying areas of the landscape that benefit from run-on moisture from adjacent sites and/or rare to occasional flooding. The soils are formed from mixed alluvium.

### Geomorphic Features

Landscape Positions: Alluvial Fan, Flood Plain, Plain, Stream Terrace  
Slope (percent): 0 - 9

### Representative Soil Features

Soil Depth: Moderately Deep to Deep  
Parent Material Kind: Alluvium  
Parent Material Origin: Mixed  
Surface Texture: Loam, Silt Loam, Silty Clay Loam, Fine Sandy Loam, Sandy Clay Loam, Clay, Sandy Clay, Sandy Loam, Clay Loam,  
Surface Texture Modifier: Gravelly, Cobbly  
Subsurface Texture Group: Loamy to Clayey  
Drainage Class: Moderately Well to Well  
Permeability Class: Very Slow to Rapid  
Chemistry: None to Slightly Saline  
Available Water Capacity: 3 – 8 inches

### Vegetation Dynamics

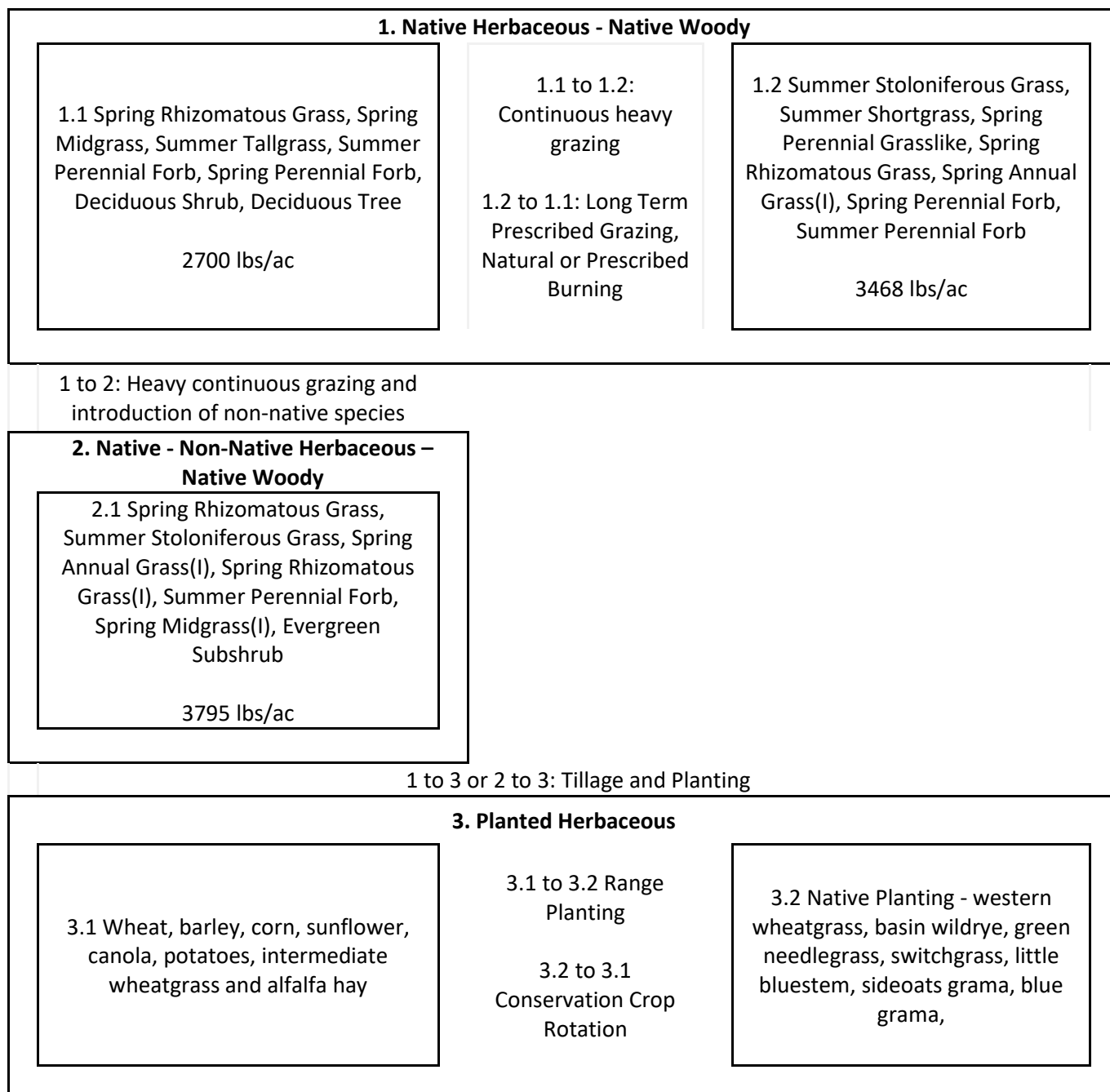
Community Class 1.1 in the State and Transition Model (Figure 2) was derived from functional group production for the reference communities in the ecological sites correlated to this ecological site class. This community class produces about 2700 lbs/ac/yr dominated by western wheatgrass, green needlegrass, big bluestem, slender wheatgrass, thickspike wheatgrass, switchgrass, sedges, and blue grama. With continuous season long heavy grazing, the plant community is likely to transition to a shortgrass dominated community class with increases in buffalograss and blue grama. Long term prescribed grazing and a return of the natural fire frequency may return the site to the Community Class 1.1.

With heavy continuous grazing and the introduction of non-native species, the site will transition to a Native – Non-Native Herbaceous - Native Woody State with Japanese brome, cheatgrass, field brome and crested wheatgrass becoming part of the plant community. The site will not transition from this state back to the Native Herbaceous state.

Plowing and tillage convert the site to a “Planted Herbaceous State”. Cropping and harvesting of annual and perennial crops maintain a cropland community class (Community Class 3.1). When seeded to native perennial grasses, the site transitions to a native planted community class (Community Class 3.2). Native planting species shown are some of the species recommended in the NRCS South Dakota Technical Note Number 4 for the sites correlated to this Site Class. Once the site is tilled and planted, it does not return to States 1 or 2.



## State and Transition Model



**Figure 2.** State and Transition Model, MLRA 60A Loamy Terrace ecological site class.

NRI Primary Sampling Units (PSUs) were correlated to these community classes where possible. Community class production, functional group dominance, and dominant species based on available NRI data are shown in Table 4. Ground and canopy cover from the NRI PSUs was used to estimate average annual erosion and percent runoff using the Rangeland Hydrology and Erosion Model (RHEM). No data is shown if the NRI data indicated that the ecological site description did not match the soil characteristics at the PSU.

**Table 4.** NRI Community Class Data and RHEM Results - MLRA 60A Loamy Terrace ecological site class.

| Comm Class ID | Community Class Name                                                                                                                                                                                          | Dominant Species (Symbol)(Lbs/Ac)                                                                                                                                                                                                           | Production Lbs/Ac | Soil Loss T/Ac/Yr | % Runoff | # PSUs |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-------------------|----------|--------|
| 060A.3.1.1    | Spring Rhizomatous Grass(1166), Spring Midgrass(717), Spring Perennial Forb(194), Evergreen Subshrub(150), Herbaceous Vine(126), Summer Stoloniferous Grass(76), Summer Perennial Forb(50)                    | western wheatgrass(PASM)(1166), slender wheatgrass(ELTR7)(552), green needlegrass(NAVI4)(165), Gardner's saltbush(ATGA)(150), American vetch(VIAM)(126), common dandelion(TAOF)(114), Buffalograss(BODA2)(76), desert biscuitroot(LOFO)(68) | 2545              |                   |          | 1      |
| 060A.3.1.2    | Summer Stoloniferous Grass(1316), Summer Shortgrass(630), Spring Perennial Grasslike(555), Spring Rhizomatous Grass(287), Spring Annual Grass(I)(245), Spring Perennial Forb(138), Summer Perennial Forb(116) | Buffalograss(BODA2)(1316), blue grama(BOGR2)(630), sedge(CAREX)(313), western wheatgrass(PASM)(287), threadleaf sedge(CAFI)(242), cheatgrass(BRTE)(214), aster(ASTER)(126), goldenrod(SOLID)(108)                                           | 3468              | 0.28              | 8.11%    | 2      |
| 060A.3.2.1    | Spring Rhizomatous Grass(1174), Summer Stoloniferous Grass(1124), Spring Annual Grass(I)(538), Spring Rhizomatous Grass(I)(279), Summer Perennial Forb(166), Spring Midgrass(I)(158), Evergreen Subshrub(96)  | western wheatgrass(PASM)(1174), Buffalograss(BODA2)(1124), cheatgrass(BRTE)(476), smooth brome(BRIN2)(249), crested wheatgrass(AGCR)(158), white prairie aster(SYFA)(135), broom snakeweed(GUSA2)(96), Japanese brome(BRAR5)(62)            | 3795              | 0.10              | 6.40%    | 5      |

### Supporting Information

The following publications support the STM. The first publication reiterates the statement of the STM, that varieties of wheatgrass will thrive in environments of no-till land management. The second publication describes

fire effects in an overflow site. This publication examines vegetation within reference state, as described in the STM.

**Engle, D.M. and P.M. Bultsma. 1984. Burning of Northern Mixed Prairie During Drought. Journal of Range Management 37(5): 398-401.**

This study took place in north-central South Dakota and examined burn effects on Northern mixed prairie during drought. Burning was timed at the latter part of the active growth season of Kentucky bluegrass. Comparisons were made between two burning dates and two different sites with below average precipitation. The first site was a silty range site and the second was an overflow range site. The first site was in excellent range condition and dominated by western wheatgrass, needleandthread and green needlegrass. The overflow site was also in excellent condition with big bluestem exhibiting dominance. Both sites were progressively exhibiting Kentucky bluegrass as a major component.

A randomized block design was utilized with three replications. The treatments were two burning dates, one early during the emergence of warm-season grasses, and the other later once the warm-season grasses were approximately 5-10 cm tall. Ten quadrats were established on each treatment plot and herbage was clipped. Standing litter and mulch were also evaluated. Additionally, two plants of each species (Kentucky bluegrass, green needlegrass, western wheatgrass, and big bluestem) were randomly selected to evaluate fire effects. Leaf length and basal area were also measured.

The results found that the leaf length, number of inflorescences, and basal area of cool-season grasses were reduced with burning and more pronounced with the later burn. Leaf length of big bluestem was reduced by burning on the overflow sites, but inflorescence was increased. Standing crop of big bluestem on overflow sites increased on plots burned earlier, but not on those burned later. However, green needlegrass decreased on burned, compared to unburned. Kentucky bluegrass standing crop decreased with burning on both sites. Burning did not reduce standing crop on any other species. On the second year, the growth on overflow sites was higher on burned plots than on control plots. Silty sites did not have a higher standing crop with burning.

**Perryman, B.L., W.A. Laycock and D.W. Kock. 2000. Investigation of herbaceous species adapted to snowfence areas. Journal of Range Management 53(4): 371-375.**

This study took place in Albany county, Wyoming, with the objective of determining which cultural practices and herbaceous species could be best suited for revegetating snowdrift areas. The species evaluated at the site included mountain brome, altai wildrye, basin wildrye, Russian wildrye, tall fescue, pubescent wheatgrass, western wheatgrass, thickspike wheatgrass, crested wheatgrass, slender wheatgrass, big bluegrass and tufted hairgrass. There were two sites, one shallow upland, and one deep lowland. Snow drift depth was measured for all fences at the time of maximum drift accumulation each year of the study.

The study on the two sites was a randomized complete block factory design, with three replicate blocks. Species performance was based on foliar cover at the end of the first growing season, and aboveground biomass at the end of the second growing season. Seeding operations were conducted as were herbicide treatments.

On the shallow soil site, the results found that foliar cover and aboveground biomass indicated benefits to tillage and moisture supply. The tilled plot cover was three times that of the no-till. Drift area produced more cover than the non-drift area. Unexpectedly, the non-drift area-till produced 20% more aboveground biomass than the drift area-till. Pubescent wheatgrass, thickspike wheatgrass, and slender wheatgrass produced the most cover and aboveground biomass. The deep soil site showed improved foliar coverage on tilled sites. Non-drift areas produced twice as much foliar cover. Slender wheatgrass was the best performer for both cover and biomass production. These results indicate that seedbed preparation is superior to no-till. Additionally, slender wheatgrass varieties, pubescent wheatgrass, and thickspike wheatgrass do well in no-till situations.

## LOAMY UPLAND ECOLOGICAL SITE CLASS

### General Description

The Loamy Upland ecological site class occurs on nearly level to moderately steep uplands. The soils are well drained and formed in alluvium, residuum derived from silty or clayey material or from shale.

### Geomorphic Features

Landscape Positions: Fan, Hill, Plain  
Slope (percent): 0 – 30

### Representative Soil Features

Soil Depth: Moderately Deep to Deep  
Parent Material Kind: Alluvium, Residuum  
Parent Material Origin: Mixed  
Surface Texture: Loam, Silt Loam, Silty Clay Loam, Silty Clay  
Surface Texture Modifier: None  
Subsurface Texture Group: Clayey to Loamy  
Drainage Class: Well  
Permeability Class: Very Slow to Moderate  
Chemistry: None  
Available Water Capacity: 3 – 8 inches

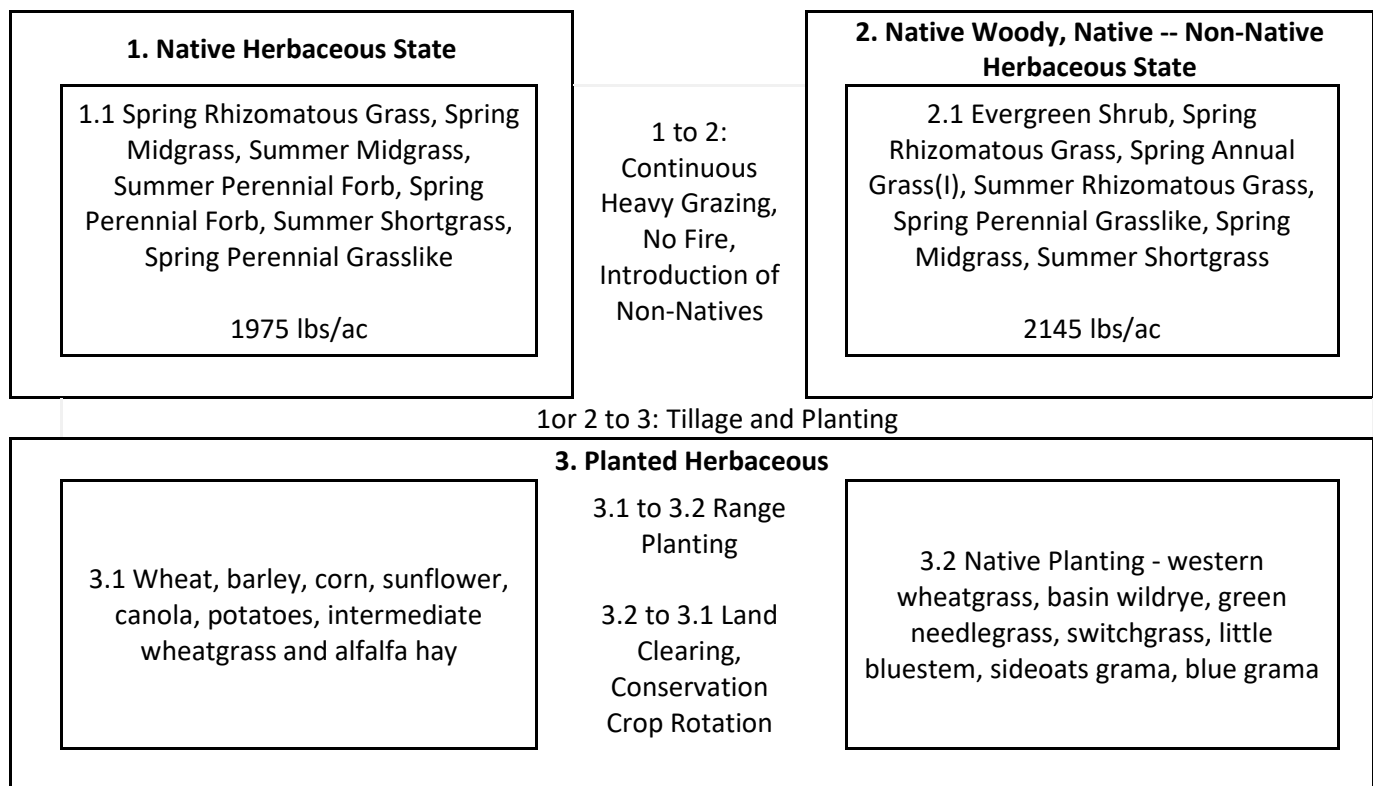
### Vegetation Dynamics

Community Class 1.1 in the State and Transition Model (Figure 3) was derived from functional group production for the reference communities in the ecological sites correlated to this ecological site class. The reference communities have an average annual production of 1975 lbs/ac/yr dominated by western wheatgrass, green needlegrass, thickspike wheatgrass, sideoats grama, needleandthread, blue grama, sedges, and big bluestem.

With heavy continuous grazing, no fire, and the introduction of non-native species, the site will transition to a Native Woody, Native -- Non-Native Herbaceous State (State 2) dominated by crested wheatgrass and big sagebrush. In the southeast portion of this MLRA, in the highest and wettest portion of the MLRA, this site class includes a juniper – ponderosa pine forest community (30% canopy cover). There is no NRI data for the juniper – pine community class.

Plowing and tillage convert the site to a “Planted Herbaceous State”. Cropping and harvesting of annual and perennial crops maintain a cropland community class (Community Class 3.1). When seeded to native perennial grasses, the site transitions to a native planted community class (Community Class 3.2). Native planting species shown are some of the species recommended in the NRCS South Dakota Technical Note Number 4 for the sites correlated to this Site Class. Once the site is tilled and planted, it does not return to States 1 or 2.

## State and Transition Model



**Figure 3.** State and Transition Model, MLRA 60A Loamy Upland ecological site class.

NRI Primary Sampling Units (PSUs) were correlated to these community classes where possible. Community class production, functional group dominance, and dominant species based on available NRI data are shown in Table 5. Ground and canopy cover from the NRI PSUs was used to estimate average annual erosion and percent runoff using the Rangeland Hydrology and Erosion Model (RHEM).

**Table 5.** NRI Community Class Data and RHEM Results - MLRA 60A Loamy Upland ecological site class.

| Comm Class ID | Community Class Name                                                                                                                                                                   | Dominant Species (Symbol)(Lbs/Ac)                                                                                                                                                                                                                         | Production Lbs/Ac | Soil Loss T/Ac/Yr | % Runoff | # PSUs |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-------------------|----------|--------|
| 060A.6.1.1    | Spring Rhizomatous Grass(969), Summer Stoloniferous Grass(672), Spring Midgrass(104), Summer Shortgrass(97), Spring Perennial Forb(67), Summer Perennial Forb(40), Herbaceous Vine(38) | western wheatgrass(PASM)(957), Buffalograss(BODA2)(672), blue grama(BOGR2)(97), green needlegrass(NAVI4)(59), American vetch(VIAM)(38), sedge(CAREX)(27), prairie Junegrass(KOMA)(26), scarlet globemallow(SPCO)(22)                                      | 2125              | 0.56              | 7.21%    | 20     |
| 060A.6.2.1    | Evergreen Shrub(810), Spring Midgrass(I)(748), Summer Stoloniferous Grass(300), Spring Rhizomatous Grass(216), Spring Annual Grass(I)(133), Summer Shortgrass(68)                      | crested wheatgrass(AGCR)(748), big sagebrush(ARTR2)(660), Buffalograss(BODA2)(300), western wheatgrass(PASM)(216), rubber rabbitbrush(ERNA10)(150), Japanese brome(BRAR5)(133), blue grama(BOGR2)(68), woolly plantain(PLPA2)(30), field brome(BRAR5)(24) | 2401              | 0.12              | 3.18%    | 3      |

### Supporting Information

The following publications support the STM. The first publication illustrates the vegetation changes that will occur with varying grazing management systems after fire. The study found the same conclusions to that of the STM, in terms of increases and decreases in herbage production. Although the second publication did not see a significant decrease of western wheatgrass with continuous grazing, the study did find that once utilization exceeded 80% there would be a decrease. This corresponds with the STM, as season-long heavy continuous grazing would likely produce this amount of utilization.

**Stroud, D.O., R.H. Hart, M.J. Samuel, and J.D. Rodgers. 1985. Western Wheatgrass Responses to Simulated Grazing. *Journal of Range Management* 38(2): 103-108.**

The objective of this study, which took place in Cheyenne, Wyoming, was to develop improved guides for grazing management than those from conventional clipping. The major grass species that were present included blue grama, western wheatgrass and needleandthread.

Twenty-four plots were established on native range. Four replications of six treatments were implemented in a randomized block design. The six treatments included unclipped control, clipping western wheatgrass to 2.5 to 4 times, and 4 clipping treatments simulating 4 levels of continuous grazing. All western wheatgrass tillers were individually labeled with bird leg bands. Aboveground and belowground production was analyzed with covariance procedures.

The results found that second heaviest simulated grazing treatment increased the production of western wheatgrass the most. No significant differences in forage production were witnessed with the ungrazed and three lighter simulated continuous grazing treatments. There was a significant negative correlation between western wheatgrass herbage production and the herbage production of other species. In the two years of the study, simulated continuous grazing resulted in no significant decrease of production of western wheatgrass, until utilization exceeded 80%.

**Watts, C.R., L.C. Eichhorn, and R.J. Mackie. 1987. Vegetation Trends within Rest-Rotation and Season-long Grazing Systems in the Missouri River Breaks, Montana. *Journal of Range Management* 40 (5): 393-396.**

This study took place northwest of Petroleum County, Montana, with the objective of reporting the results of two 10-year studies of vegetation trends on rough "breaks-type" rangeland. One study was designed to help evaluate the potential application of rest-rotation grazing in diverse vegetation and topography. The other study was designed to evaluate season-long grazing under proper stocking rates. The sites were highly dissected uplands, with coulees and creek bottoms interspersed. Soils in the breaks are moderately saline and alkaline clays and heavy clay loams were predominant throughout. On ridgetops, big sagebrush and wheatgrasses dominate, with ponderosa pine, Douglas fir, and Rocky Mountain juniper common on side slopes and drainages. Common grasses included bluebunch wheatgrass, western wheatgrass, green needlegrass, Sandberg's bluegrass and prairie junegrass. Other dominant vegetation included a variety of sedges, American vetch, snowberry, fragrant sumac, rabbitbrush and chokecherry.

Vegetation trends associated with rest-rotation grazing were measured in 1 of 3 pastures of fair to good range condition with 3,482 AUMs (utilizing an average of 2,700 annually), using the formula: early use (May to August), late use (August to November), total rest. The season-long system was 4,963 ha of poor to fair range condition with 1,876 AUMs and was grazed annually from May to October. The studies were conducted on recent wildfire burns in both pastures. Vegetation trends were assessed using exclosures, paired with line-transects.

The results found that grass coverage trends were similar between the exclosures and transects. However, the trends on a temporal scale varied greatly among the 3 types, mostly as a result of site characteristics. The greatest variation was seen on the ponderosa pine-bluebunch wheatgrass (Pipo-Agsp) and rough cocklebur (Xast) types, on which grass coverage increased sharply for 2-4 years post-burn, then declined variably to year 10, when it differed little from year one. Conversely, grass coverage on the ponderosa pine-Rocky Mountain (Pipo-Jusc) juniper type, on which grass was very sparse until burning eliminated competing woody vegetation, remained low for 3-4 years, then increased through year 10. Grass coverage invariably decreased the year following late season grazing. Bare ground decreased within exclosures and increased outside through year 5. The vegetation trends under season-long grazing varied somewhat for the 3 types over the 10 years, however, grass coverage generally increased on transects inside the exclosure. Trends on grazed transects were more varied. For the big sagebrush-western wheatgrass type (Artr-Agsm), grass coverage changed little outside the exclosure. For Pipo-Jusc, grass coverage sharply increased 2-4 years into the study, but changed little thereafter. In Douglas fir- Rocky Mountain juniper (Psme-Jusc) type, which was on a steeper slope and deeper soil, grass increased through year 6, then decreased to year 10. By the sixth year, grass coverage was significantly greater on Artr-Agsm and Pipo-Jusc types and was significantly greater on all types by year 10. Forbs were relatively similar both inside and outside the exclosures. Prior burning eliminated big sagebrush, which did not return during the study. Trends in shrub coverage were generally similar both inside and outside the exclosure. Ultimately, the results found that rest-rotation grazing may maintain vegetation cover.

## SALINE BOTTOMLAND ECOLOGICAL SITE CLASS

### General Description

The Saline Bottomland ecological site class occurs on nearly level to gently floodplains, terraces, and alluvial fans. This group is very deep poorly drained soils formed in alluvium overlying clay shale, soft sandstone or stratified alluvium. High soluble salt concentrations occur in the subsoils.

### Geomorphic Features

Landscape Positions: Alluvial Fan, Basin Floor, Depression, Flood Plain, Stream Terrace  
Slope (percent) 0 – 6

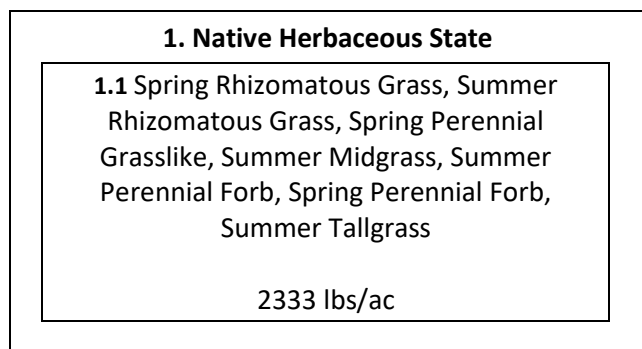
### Representative Soil Features

Soil Depth: Deep  
Parent Material Kind: Alluvium  
Parent Material Origin: Mixed  
Surface Texture: Silty Clay Loam, Silty Clay, Clay, Slay Loam, Loam, Very Fine Sandy Loam  
Surface Texture Modifier: None  
Subsurface Texture Group: Clayey  
Drainage Class: Poorly to Somewhat Poorly  
Permeability Class: Very Slow to Moderately Rapid  
Chemistry: Saline  
Available Water Capacity: 1 – 7 inches

### Vegetation Dynamics

Community Class 1.1 in the State and Transition Model (Figure 4) was derived from functional group production for the reference communities in the ecological sites correlated to this ecological site group. The Reference Community produces about 2333 lbs/ac/yr dominated by western wheatgrass, alkali sacaton, thickspike wheatgrass, inland saltgrass, alkali cordgrass, Nuttall's alkaligrass, sedges, and prairie cordgrass. There is no NRI data for this ecological site class.

### State and Transition Model



**Figure 4.** State and Transition Model, MLRA 60A Saline Bottomland ecological site class.

### Supporting Information

No literature was found that dealt with this ecological site class.



## SANDY UPLAND ECOLOGICAL SITE CLASS

### General Description

The Sandy Upland ecological site class occurs mainly on nearly level to undulating slopes on uplands, dune fields and river valleys. Sites in this class formed in eolian sand or sandy alluvium.

### Geomorphic Features

Landscape Positions: Dune, Interdune, Flood Plain, Stream Terrace, Valley  
Slope (percent): 0 - 24

### Representative Soil Features

Soil Depth: Moderately Deep to Deep  
Parent Material Kind: Alluvium or Eolian  
Parent Material Origin: Mixed  
Surface Texture: Fine Sand, Loamy Fine sand, Sandy Loam, Fine Sandy Loam  
Surface Texture Modifier: None  
Subsurface Texture Group: Sandy  
Drainage Class: Well to Excessively Drained  
Permeability Class: Moderate to Moderately Rapid  
Chemistry: None  
Available Water Capacity: 2 – 5 inches

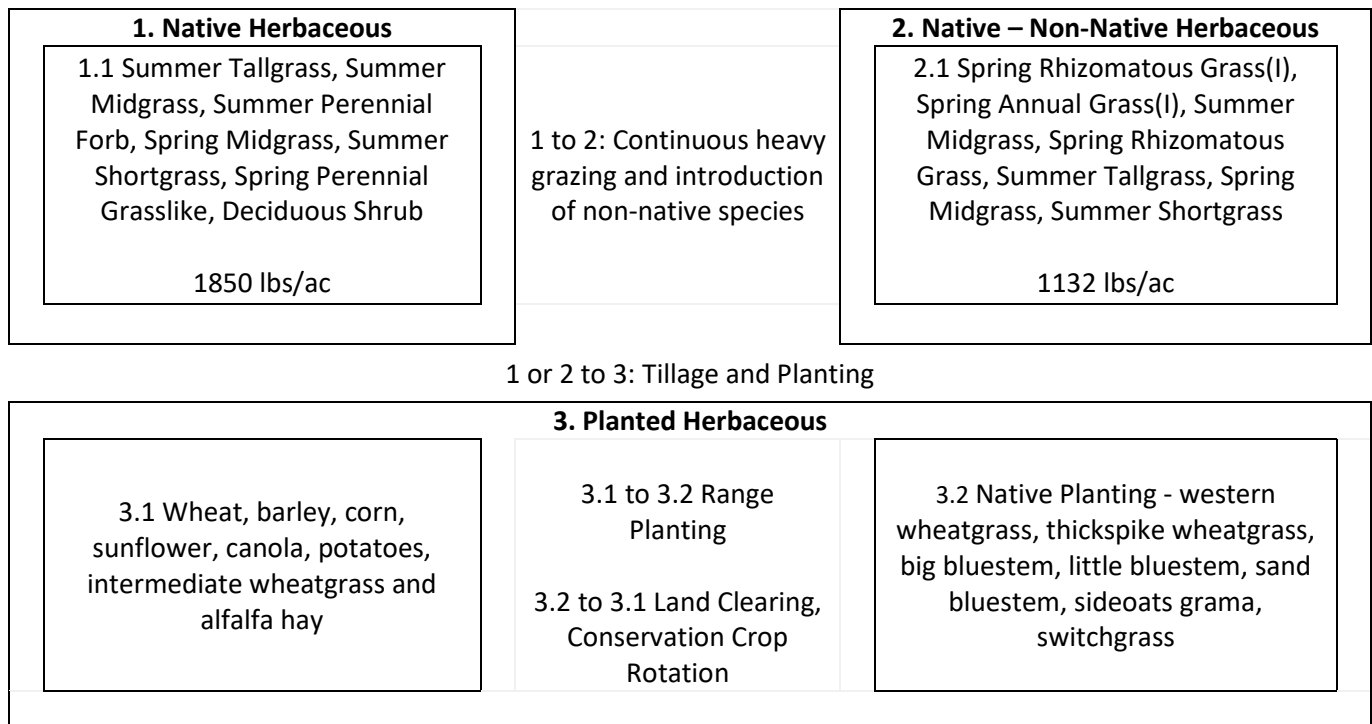
### Vegetation Dynamics

Community Class 1.1 in the State and Transition Model (Figure 5) was derived from functional group production for the reference communities in the ecological site descriptions for sites correlated to this ecological site class. This community class has an average annual production of about 1850 lbs/ac, dominated by prairie sandreed, sand bluestem, little bluestem, needleandthread, blue grama, western wheatgrass, sedges, and wild rose.

With the introduction of non-native species, the site will transition to a Native -- Non-Native Herbaceous state (State 2) with lower production from native grasses and a portion of the production coming from of Japanese brome, cheatgrass and crested wheatgrass.

Plowing and tillage converts the site to a Planted Herbaceous State (State 3). Cropping and harvesting of annual and perennial crops maintain a cropland community class (Community Class 3.1). When seeded to native perennial grasses, the site transitions to a native planted community class (Community Class 3.2). Native planting species shown are some of the species recommended in the NRCS South Dakota Technical Note Number 4 for the sites correlated to this Site Class. Once the site is plowed and planted, it does not return to State 1 or 2.

## State and Transition Model



**Figure 5.** State and Transition Model, MLRA 60A Sandy Upland ecological site class.

NRI Primary Sampling Units (PSUs) were correlated to these community classes where possible. Community class production, functional group dominance, and dominant species based on available NRI data are shown in Table 6. Ground and canopy cover from the NRI PSUs was used to estimate average annual erosion and percent runoff using the Rangeland Hydrology and Erosion Model (RHEM).

**Table 6.** NRI Community Class Data and RHEM Results - MLRA 60A Sandy Upland ecological site class.

| Comm Class ID | Community Class Name                                                                                                                                                                   | Dominant Species (Symbol)(Lbs/Ac)                                                                                                                                                                                                      | Production Lbs/Ac | Soil Loss T/Ac/Yr | % Runoff | # PSUs |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-------------------|----------|--------|
| 060A.29.2.1   | Spring Rhizomatous Grass(l)(191), Spring Annual Grass(l)(146), Summer Midgrass(137), Spring Rhizomatous Grass(111), Summer Tallgrass(110), Spring Midgrass(105), Summer Shortgrass(57) | intermediate wheatgrass(THIN6)(187), western wheatgrass(PASM)(111), prairie sandreed(CALO)(110), needleandthread(HECO26)(105), alkali sacaton(SPAI)(88), cheatgrass(BRTE)(87), Japanese brome(BRAR5)(58), crested wheatgrass(AGCR)(57) | 1132              | 0.02              | 1.55%    | 4      |

## Supporting Information

The following publication supports the STM. The study results are in accordance with many of the vegetation species the STM suggests would be present in this ecological site group.

**Strong, D.J., L.T. Vermeire, A.C. Ganguli. 2013. Fire and Nitrogen Effects on Purple Threeawn (*Aristida purpurea*) Abundance in Northern Mixed-Prairie Old Fields. *Rangeland Ecology & Management* 66(5): 553-560.**

This study in Terry, Montana, maintained three objectives: 1) determine the efficacy of nitrogen and fire during different seasons to reduce purple threeawn, 2) assess nontarget plant responses after nitrogen and fire. The study sites were on abandoned cropland seeded to crested wheatgrass. Two similar sites were selected and treated on variable years. Both sites were sandy ecological sites with purple threeawn, crested wheatgrass, sand dropseed, blue grama, buffalograss, tumblegrass, needleandthread, Sandberg bluegrass, intermediate wheatgrass, sixweeks fescue, field brome, cheatgrass and some shrubs and forbs.

The experimental design included randomly assigning three replications of the three fire treatments (no fire, summer fire, fall fire) and three different levels of nitrogen application. Standing crop, current-year biomass, basal cover, bare ground, litter and relative biomass were measured to assess vegetation response. Measurements were done with line-point intercept and clipping of quadrats with statistical analysis being performed following.

The results found summer and fall fires reduced standing crop relative to non-burned sites. The addition of nitrogen increased current-year biomass. Summer and fall fires reduced biomass, except for no effect being measured with a dry spring. Purple threeawn biomass was reduced by fire, but nitrogen had no effect. Forb biomass more than doubled on non-burned plots at which nitrogen was applied. In terms of ground cover, basal cover was greater in all plots following a dry spring, then a wet spring. Fall fire reduced purple threeawn regardless of the weather. Needleandthread was reduced by fire also. Crested wheatgrass showed a significant increase with fire. Litter cover was increased with nitrogen application on non-burned plots, had no effect on summer burned plots and little effect on fall burned. Summer fire decreased purple threeawn relative composition, but caused a doubling of crested wheatgrass.

## SHALLOW POROUS CLAY UPLAND ECOLOGICAL SITE CLASS

### General Description

The Shallow Porous Clay Upland ecological site class occurs on gently to moderately rolling to steeply sloping uplands. Soils are generally shallow and are formed from acid material weathered from shale and contain many small shale fragments.

### Geomorphic Features

Landscape Positions: Hill, Plain, Ridge  
Slope (percent): 2 - 60

### Representative Soil Features

Soil Depth: Shallow to Deep  
Parent Material Kind: Residuum  
Parent Material Origin: Shale  
Surface Texture: Clay, Silty Clay Loam, Silty Clay  
Surface Texture Modifier: Channery  
Subsurface Texture Group: Clayey  
Drainage Class: Well  
Permeability Class: Very Slow to Moderately Rapid  
Chemistry: None  
Available Water Capacity: 2 – 5 inches

### Vegetation Dynamics

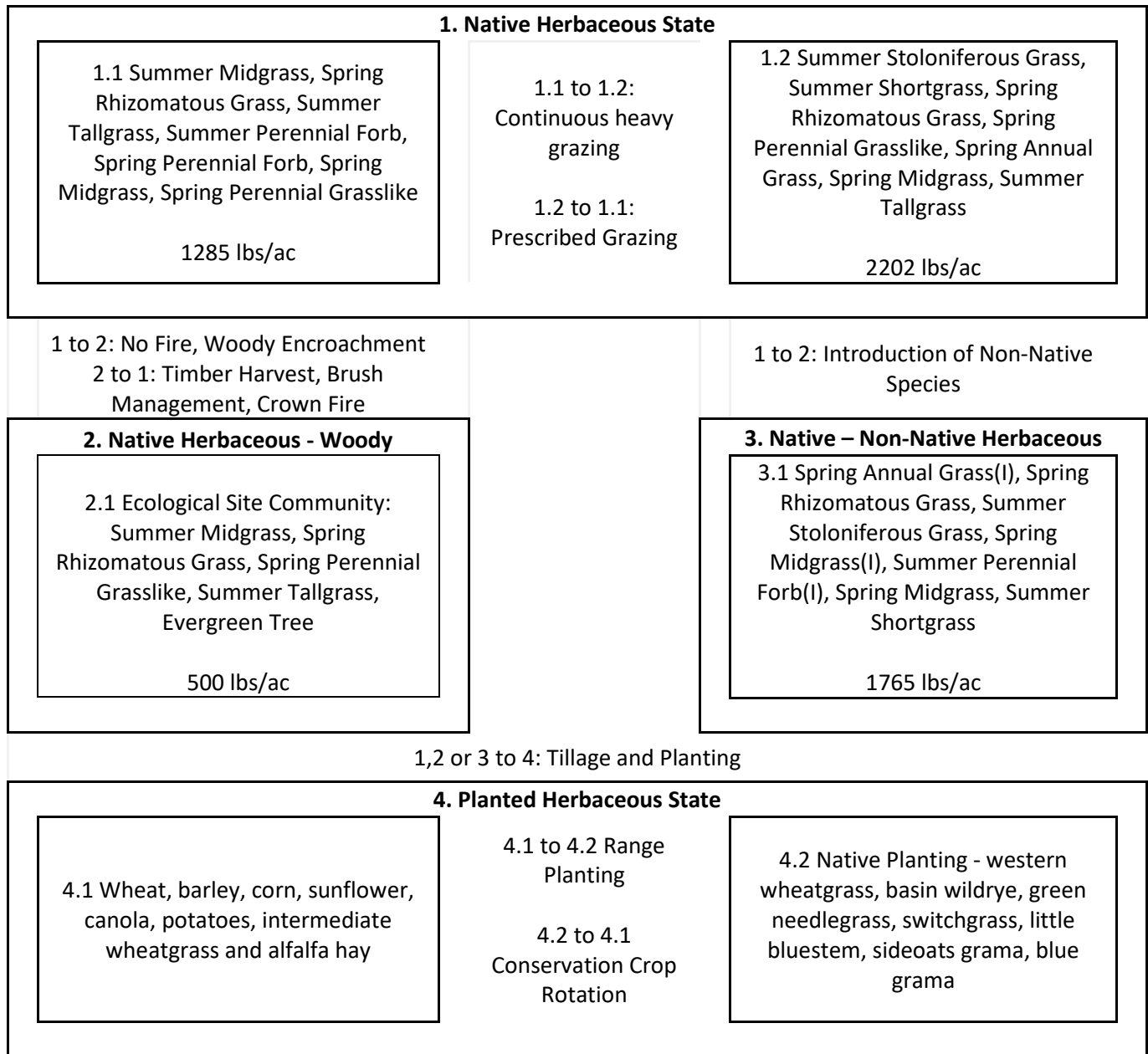
Community Class 1.1 in the State and Transition Model (Figure 6) was derived from functional group production for the reference communities in the ecological sites correlated to this ecological site group. This community class produces about 1285 lbs/ac/yr. dominated by little bluestem, western wheatgrass, sideoats grama, prairie sandreed, thickspike wheatgrass, big bluestem, sun sedge, and green needlegrass. With continuous heavy grazing, the site may transition to a shortgrass dominated community class dominated by buffalograss and blue grama. With long term prescribed grazing the site may transition back to Community 1.1.

With lack of fire, woody species such as juniper and ponderosa pine will increase on the site and transition the site to State 2. Timber harvest, brush management, and stand replacing crown fires can return the site to the reference state. There are no NRI points representing this state.

With the introduction of non-natives such as cheatgrass, crested wheatgrass, and sweetclover, the site will transition to a Native – Non-Native Herbaceous state (State 3). Once non-natives have become established, the site will not transition back to State 1 or 2.

Plowing and tillage converts the site to a Planted Herbaceous State (State 4). Cropping and harvesting of annual and perennial crops maintain a cropland community class (Community Class 4.1). When seeded to native perennial grasses, the site transitions to a native planted community class (Community Class 4.2). Native planting species shown are some of the species recommended in the NRCS South Dakota Technical Note Number 4 for the sites correlated to this Site Class. Once the site is plowed and planted, it does not return to State 1, 2 or 3.

## State and Transition Model



**Figure 6.** State and Transition Model, MLRA 60A Shallow Porous Clay Upland ecological site class.

NRI Primary Sampling Units (PSUs) were correlated to these community classes where possible. Community class production, functional group dominance, and dominant species based on available NRI data are shown in Table 7. Ground and canopy cover from the NRI PSUs was used to estimate average annual erosion and percent runoff using the Rangeland Hydrology and Erosion Model (RHEM).

**Table 7.** NRI Community Class Data and RHEM Results - MLRA 60A Shallow Porous Clay Upland ecological site class.

| Comm Class ID | Community Class Name                                                                                                                                                                             | Dominant Species (Symbol)(Lbs/Ac)                                                                                                                                                                                                                    | Production Lbs/Ac | Soil Loss T/Ac/Yr | % Runoff | # PSUs |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-------------------|----------|--------|
| 060A.33.1.1   | Spring Rhizomatous Grass(708), Summer Midgrass(259), Spring Midgrass(113), Summer Perennial Forb(91), Coniferous Tree(65), Spring Perennial Forb(19), Summer Shortgrass(11)                      | western wheatgrass(PASM)(708), green needlegrass(NAVI4)(106), sideoats grama(BOCU)(105), little bluestem(SCSC)(95), Rocky Mountain juniper(JUSC2)(65), prairie dropseed(SPHE)(58), white sagebrush(ARLU)(47), silverleaf Indian breadroot(PEAR6)(28) | 1288              |                   |          | 3      |
| 060A.33.1.2   | Summer Stoloniferous Grass(1128), Summer Shortgrass(432), Spring Rhizomatous Grass(296), Spring Perennial Grasslike(169), Spring Annual Grass(I)(91), Spring Midgrass(45), Summer Tallgrass(17)  | Buffalograss(BODA2)(1128), blue grama(BOGR2)(432), western wheatgrass(PASM)(296), threadleaf sedge(CAFI)(169), Japanese brome(BRAR5)(91), green needlegrass(NAVI4)(45), big bluestem(ANGE)(17), crested wheatgrass(AGCR)(9)                          | 2202              |                   |          | 2      |
| 060A.33.2.1   | Spring Annual Grass(I)(375), Spring Rhizomatous Grass(338), Summer Stoloniferous Grass(280), Spring Midgrass(I)(176), Summer Perennial Forb(I)(141), Spring Midgrass(101), Summer Shortgrass(54) | cheatgrass(BRTE)(352), western wheatgrass(PASM)(338), buffalograss(BODA2)(280), crested wheatgrass(AGCR)(176), sweetclover(MEOF)(141), needleandthread(HECO26)(66), blue grama(BOGR2)(50), sedge(CAREX)(37)                                          | 1765              | 0.90              | 19.71%   | 9      |

## Supporting Information

The following publications supports the STM. This study takes place in an adjacent MLRA, but demonstrates many of the same vegetation dynamics that would be present in this ecological site class. The second study examines herbage production under a ponderosa pine stand. As the STM suggests, with a lack of disturbance, the ponderosa pine crown cover will increase, causing the herbage production to decrease. The publication suggests thinning to increase forage supply.

**Karn, J.F., R.E. Ries and L. Hofmann. 1999. Season-long grazing of seeded cool-season pastures in the Northern Great Plains. *Journal of Range Management* 52(3): 235-240.**

Grazing studies were implemented for 140 days each summer for two years near Mandan, North Dakota. The species that were seeded included western wheatgrass, crested wheatgrass and smooth brome grass. Native pastures were located adjacent on loam, silt loam and silty clay soils. Both seeded and native pastures underwent 2 replications of moderate and heavy stocking rates. Flat native pastures were fine-silty soils and consisted of blue grama, green needlegrass, needleandthread, western wheatgrass, sedges, threeawn and Kentucky bluegrass. Rolling native pastures consisted of the same, with the addition of little bluestem and some patches of western snowberry and buffaloberry.

Standing crop was measured by hand clipping forage at a 5mm stubble height from 36 plots randomly located in cages. These cages were randomly placed in each seeded pasture and each of the flat and rolling native pastures. Steers were weighed and observed during the study.

Results found that western wheatgrass had the highest average end of season standing crop and the greatest amount of grazed residue. Smooth brome grass has the lowest end of season standing crop and grazed residue. End of season standing crop averaged over all cool-season and native pastures was greater at the moderate versus the heavy stocking rate.

**Pase, Charles P. 1958. Herbage Production and Composition under Immature Ponderosa Pine Stands in the Black Hills. *Journal of Range Management* 11(5): 238-243.**

This study in southwestern South Dakota, took place on soils that range from sandy loams to clay loams. The study purpose was to determine the herbage production and composition under immature ponderosa pine stands of the Black Hills. Vegetation in the area consists of ponderosa pine, juniper, bearberry, chokecherry, snowberry, eastern hornbeam, hazelnut, Pennsylvania sedge, Kentucky bluegrass, roughleaf ricegrass, poverty oatgrass, pussytoes and goldenrod. The study design included thirty-one sample areas on timber sites of even-aged, second-growth ponderosa pine. Herbage production was determined by the weight estimate method. Twenty circular plots were established at each sample area and transects were spaced 10 feet apart. Crown density was gathered by the "moosehorn" estimator and basal area by Bitterlich stick.

The results found that herbage production decreased as crown cover increased. All groups of vegetation (grasses, forbs, shrubs) increased as crown cover decreased. Herbage production decreased as pine litter increased. Various species related differently to crown canopy. For instance, Pennsylvania sedge and roughleaf ricegrass persisted under a dense canopy. However, Kentucky bluegrass and fuzzyspike wildrye virtually disappeared under dense stands. Little bluestem was generally most abundant under open stands of southerly exposure. Few of the 63 forbs persisted under even moderately dense canopies. Bearberry, common juniper, and snowberry were the abundant of the 19 species of shrubs, but each decreased with an increase in canopy.

## SHALLOW UPLAND ECOLOGICAL SITE CLASS

### General Description

The Shallow Upland ecological site class occurs on nearly level to steeply sloping uplands. These sites have formed in residuum weathered from clay shale, siltstone or silty and clayey alluvium.

### Geomorphic Features

Landscape Positions: Fan, Flat, Hill, Plain, Ridge, Terrace  
Slope (percent): 0 – 50

### Representative Soil Features

Soil Depth: Very Shallow to Deep  
Parent Material Kind: Alluvium, Residuum  
Parent Material Origin: Mixed  
Surface Texture: Loam, Silty Loam, Fine Sandy Loam, Clay  
Surface Texture Modifier: None  
Subsurface Texture Group: Clayey  
Drainage Class: Moderately Well to Well  
Permeability Class: Slow to Very Slow  
Chemistry: Sodic  
Available Water Capacity: 1 – 5 inches

### Vegetation Dynamics

Community Class 1.1 in the State and Transition Model (Figure 7) was derived from functional group production in the reference communities for the ecological sites correlated to this ecological site class. This site class produces about 1083 lbs/ac/yr dominated by western wheatgrass, thickspike wheatgrass, Montana wheatgrass, blue grama, green needlegrass, needleandthread, sideoats grama, and little bluestem. With continuous heavy grazing the site will likely transition to a shortgrass community (1.2) dominated by buffalograss and blue grama.

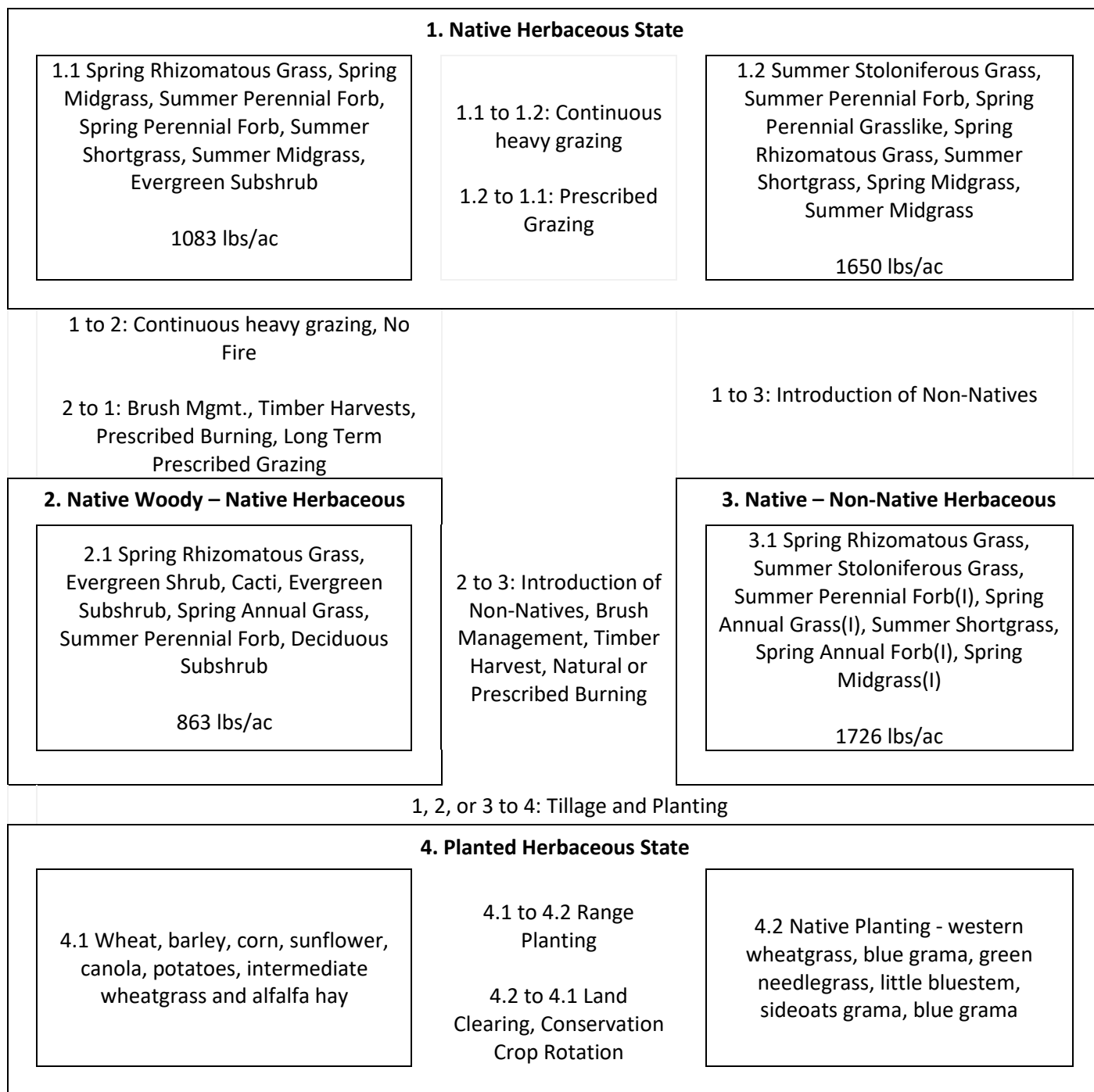
With continuous heavy grazing and a lack of fire, the site will transition to a Native Woody – Native Herbaceous state with a decrease of grasses and the invasion of woody species including big sagebrush, and ponderosa pine and juniper in the higher rainfall areas. With timber harvest, brush management, regular natural or Prescribed Burning and long term Prescribed Grazing, the site may return to the Native Herbaceous State.

With the introduction of non-natives such as cheatgrass, Japanese brome, crested wheatgrass, and sweetclover, the site will transition to a Native – Non-Native Herbaceous state. Once non-natives have become established, the site will not transition back to State 1 or 2.

Plowing and tillage converts the site to a Planted Herbaceous State (State 4). Cropping and harvesting of annual and perennial crops maintain a cropland community class (Community Class 4.1). When seeded to native perennial grasses, the site transitions to a native planted community class (Community Class 4.2). Native planting species shown are some of the species recommended in the NRCS South Dakota Technical Note Number 4 for the sites correlated to this Site Class. Once the site is plowed and planted, it does not return to State 1, 2 or 3.



## State and Transition Model



**Figure 7.** State and Transition Model, MLRA 60A Shallow Upland ecological site class.

NRI Primary Sampling Units (PSUs) were correlated to these community classes where possible. Community class production, functional group dominance, and dominant species based on available NRI data are shown in Table 8. Ground and canopy cover from the NRI PSUs was used to estimate average annual erosion and percent runoff using the Rangeland Hydrology and Erosion Model (RHEM).

**Table 8.** NRI Community Class Data and RHEM Results - MLRA 60A Shallow Upland ecological site class.

| Comm Class ID | Community Class Name                                                                                                                                                                                 | Dominant Species (Symbol)(Lbs/Ac)                                                                                                                                                                                                     | Production Lbs/Ac | Soil Loss T/Ac/Yr | % Runoff | # PSUs |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-------------------|----------|--------|
| 060A.18.1.1   | Spring Rhizomatous Grass(537), Summer Stoloniferous Grass(228), Summer Midgrass(97), Spring Midgrass(88), Spring Perennial Forb(67), Summer Perennial Forb(57), Spring Perennial Grasslike(37)       | western wheatgrass(PASM)(505), buffalograss(BODA2)(228), sideoats grama(BOCU)(61), needleandthread(HECO26)(32), sedge(CAREX)(32), little bluestem(SCSC)(32), Montana wheatgrass(ELAL7)(31), green needlegrass(NAVI4)(27)              | 1278              | 2.19              | 24.60%   | 20     |
| 060A.18.1.2   | Summer Stoloniferous Grass(341), Summer Perennial Forb(291), Spring Perennial Grasslike(221), Spring Rhizomatous Grass(184), Summer Shortgrass(156), Spring Midgrass(109), Summer Midgrass(97)       | Buffalograss(BODA2)(341), sedge(CAREX)(162), western wheatgrass(PASM)(157), blue grama(BOGR2)(155), slimflower scurfpea(PSTE5)(150), dotted blazing star(LIPU)(99), sideoats grama(BOCU)(69), threadleaf sedge(CAFI)(58)              | 1650              | 2.30              | 19.21%   | 8      |
| 060A.18.2.1   | Spring Rhizomatous Grass(340), Evergreen Shrub(326), Cacti(75), Evergreen Subshrub(52), Spring Annual Grass(I)(25), Summer Perennial Forb(14), Deciduous Subshrub(13)                                | big sagebrush(ARTR2)(308), western wheatgrass(PASM)(251), Montana wheatgrass(ELAL7)(88), Opuntia spp.(OPUNT)(75), Nuttall's saltbush(ATNU2)(46), Japanese brome(BRAR5)(25), branched false goldenweed(OOMU)(13), knotweed(POLYG4)(8)  | 863               | 0.67              | 27.15%   | 3      |
| 060A.18.3.1   | Spring Rhizomatous Grass(686), Summer Stoloniferous Grass(206), Summer Perennial Forb(I)(132), Spring Annual Grass(I)(108), Summer Shortgrass(93), Spring Annual Forb(I)(80), Spring Midgrass(I)(62) | western wheatgrass(PASM)(685), Buffalograss(BODA2)(206), sweetclover(MEOF)(132), blue grama(BOGR2)(93), crested wheatgrass(AGCR)(62), Japanese brome(BRAR5)(58), sweetclover(MELIL)(53), cheatgrass(BRTE)(50), field brome(BRAR5)(11) | 1726              | 1.18              | 13.53%   | 23     |

## Supporting Information

The following publication supports the STM. The first publication delves into herbage production in response to canopy cover. The publication supports the STM in the finding that as canopy cover increases, herbage production decreases. The second publication, though it is farther west than the STM, demonstrates similar dynamics to MLRA 60A. As described in the STM, this study shows similar responses to disturbance in terms of how fire alters vegetation states.

**Bennett, D.L., G.D. Lemme and P.D. Evenson. 1987. Understory Herbage Production of Major Soils within the Black Hills of South Dakota. *Journal of Range Management* 40(2): 166-170.**

The objective of this study was to develop models to predict understory herbage production potential of predominant forest soils of the Black Hills. The study was conducted on a variety of soil temperature regimes and varying soil classifications; however, all classifications were of loamy or fine.

A total of twelve sites were selected within each of the 7 soil types, each were large homogeneous areas on slopes that had been utilized by cattle following thinning. Transects were placed across each study area. Canopy cover was measured with a spherical densiometer and basal area with a cruising prism. Percent slope and aspect were also calculated. Understory vegetation was oven-dried and determined with the double-sampling method from quadrats.

The results found that canopy cover was the most important independent variable in the prediction of yield components. Basal area was not as predictive in determining understory herbage yield. It was found that higher yielding soils had a more negative interaction with cover, resulting in a faster yield reduction as canopy cover increased. However, the general trend indicated, with an increase in canopy cover, herbage production and forage potential decreased.

**MacNeil, M.D., M.R. Haferkamp, L.T. Vermeire and J.M. Muscha. 2008. Prescribed fire and grazing effects on carbon dynamics in a northern mixed-grass prairie. *Agriculture, Ecosystems and Environment* 127: 66-72.**

The objective of this study was to determine the effects of fire and grazing on CO<sub>2</sub> fluxes and other measures of biotic and abiotic states. The study took place in at Fort Keogh Livestock and Range Research Laboratory near Miles City, MT on fine loam soils.

The experimental design included four replicate plots, which were randomly assigned undisturbed, burned, or grazed treatments. Burned plots were treated during the dormant season and grazed were stocked with yearling ewes with the intent of harvesting 50%. For measurement of CO<sub>2</sub> flux, an open-chamber gas exchange system was utilized. Above-ground biomass was clipped to the soil surface and sorted into vegetation components. Soil cores were also taken to determine soil C, and soil respiration measurements were also done. Statistical analyses of all measurements were completed to determine biotic and abiotic variables.

In terms of abiotic variables, temperatures and photosynthetically active radiation were unaffected by treatments. Treatments did temporally alter soil water content in seasonal changes. Burned plots had less soil water content than grazed or undisturbed. Seasonal dynamics of primary production were noted and temporal changes in green biomass were affected by treatment. In May-June, green biomass was greater on burned plots than on either grazed or undisturbed and decreased greatly in July on grazed plots. CO<sub>2</sub> fluxes in the study were relatively small, but were mainly altered by soil water availability. CO<sub>2</sub> flux over burned and unburned plots was very similar, but green biomass was increased on the burned plots. Grazing removed green biomass and reduced the amount of currently senesced biomass.

**Dix, R.L. 1958. Some Slope-Plant Relationships in the Grasslands of the Little Missouri Badlands of North Dakota. *Journal of Range Management* 11(2): 88-92.**

This study, located in Billings County, North Dakota focused on describing the vegetational characteristics of four grassland sites that differed in slope and exposure to determine the similarities and differences.

The soils of the sites were well-drained clay loam series. The native vegetation on moderate slopes included blue grama, western wheatgrass, thread-leaf sedge, and needleandthread. On steeper slopes vegetation included little bluestem, plains muhly, sideoats grama, and little club-moss. Sandy soils were dominated by prairie sandgrass. Grazing by livestock had been limited only to stray cattle for the past 20 years.

The vegetation was sampled with 40 quadrats per stand at 20 pace intervals, measuring the frequency index for each species. Results found that blue grama and western wheatgrass decrease, while little bluestem and plains muhly will increase. Stands highest in sedges and blue grama were found on steep slopes of which erosion was evident, as well as stands of plains muhly, little bluestem and sedges, which are topped with sandstone concretions. Stands high in blue grama and western wheatgrass were found on gentler slopes areas of deposition and erosion. Successional relationships were not evident between the stands, but disturbances by erodibility caused a lack of vegetal stability. Overall, the study found that the most critical factor in determining kinds and numbers of plants on sites is the soil moisture, and in conjunction, the exposure, slope and topography.

## VERY SHALLOW UPLAND ECOLOGICAL SITE CLASS

### General Description

The Very Shallow Upland ecological site class occurs on gently sloping to very steep uplands. It was derived from soft siltstone, sandstone, porcellanite, alluvium or loess deposits.

### Geomorphic Features

Landscape Positions: Escarpment, Hill, Knoll, Ridge, Terrace  
Slope (percent) 0 – 45

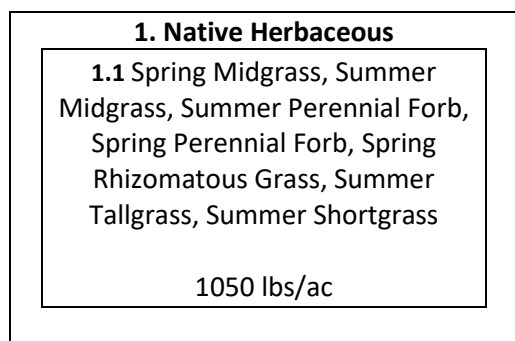
### Representative Soil Features

Soil Depth: Very Shallow to Shallow  
Parent Material Kind: Alluvium, Eolian, Residuum  
Parent Material Origin: Mixed  
Surface Texture: Fine Sandy Loam, Sandy Loam, Loamy Fine Sand, Silty Loam, Silty Clay Loam, Clay Loam,  
Surface Texture Modifier: Gravelly  
Subsurface Texture Group: Loamy to Sandy  
Drainage Class: Well to Excessively Well  
Permeability Class: Slow to Very Rapid  
Chemistry: None  
Available Water Capacity: 1 – 6 inches

### Vegetation Dynamics

Community Class 1.1 in the State and Transition Model (Figure 8) was derived from functional group production for the reference communities in the ecological sites correlated to this ecological site group. The reference state of this ecological site group has an annual production of 1050 lbs/ac/yr dominated by needleandthread, sideoats grama, little bluestem, prairie sandreed, western wheatgrass, blue grama, bluebunch wheatgrass, and thickspike wheatgrass. There are no NRI PSUs representing this site class.

### State and Transition Model



**Figure 8.** State and Transition Model, MLRA 60A Very Shallow Upland ecological site class.

### Supporting Information

The following publication supports the STM. Although this study takes place in a nearby MLRA, the vegetation dynamics are similar to that of this MLRA. This study reiterates the STM findings in regard to vegetation that would be found in similar ecological site groups.

**Dix, R.L. 1958. Some Slope-Plant Relationships in the Grasslands of the Little Missouri Badlands of North Dakota. *Journal of Range Management* 11(2): 88-92.**

This study, located in Billings County, North Dakota focused on describing the vegetational characteristics of four grassland sites that differed in slope and exposure to determine the similarities and differences.

The soils of the sites were well-drained clay loam series. The native vegetation on moderate slopes included blue grama, western wheatgrass, thread-leaf sedge, and needleandthread. On steeper slopes vegetation included little bluestem, plains muhly, sideoats grama, and little club-moss. Sandy soils were dominated by prairie sandgrass. Grazing by livestock had been limited only to stray cattle for the past 20 years.

The vegetation was sampled with 40 quadrats per stand at 20 pace intervals, measuring the frequency index for each species. Results found that blue grama and western wheatgrass decrease, while little bluestem and plains muhly will increase. Stands highest in sedges and blue grama were found on steep slopes of which erosion was evident, as well as stands of plains muhly, little bluestem and sedges, which are topped with sandstone concretions. Stands high in blue grama and western wheatgrass were found on gentler slopes areas of deposition and erosion. Successional relationships were not evident between the stands, but disturbances by erodibility caused a lack of vegetal stability. Overall, the study found that the most critical factor in determining kinds and numbers of plants on sites is the soil moisture, and in conjunction, the exposure, slope and topography.

## WET BOTTOMLAND ECOLOGICAL SITE CLASS

### General Description

The Wet Bottomland ecological site class occurs on level to nearly level river valleys and uplands and are formed in loamy, silty or clayey alluvium. Water tables on this site class range from 1 foot above to 2 feet below the surface several weeks during the growing season. The site also receives additional water from surface runoff and/or underground seepage.

### Geomorphic Features

Landscape Positions: Depression, Flood Plain, Oxbow, Slough, Stream Terrace  
Slope (percent): 0 - 3

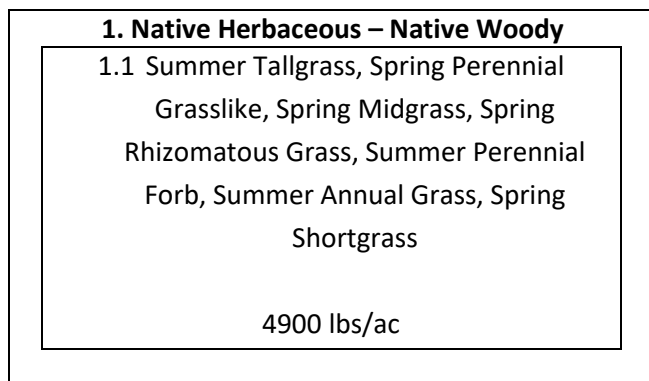
### Representative Soil Features

Soil Depth: Deep  
Parent Material Kind: Alluvium  
Parent Material Origin: Mixed  
Surface Texture: Silt Loam, Silty Clay Loam, Silty Clay, Loamy Fine Sand  
Surface Texture Modifier: None  
Subsurface Texture Group: Clayey to Loamy  
Drainage Class: Poorly to Moderately Well Drained  
Permeability Class: Very Slow to Rapid  
Chemistry: None  
Available Water Capacity: 4 – 8 inches

### Vegetation Dynamics

Community Class 1.1 in the State and Transition Model (Figure 9) was derived from functional group production for the reference communities in the ecological site descriptions that were correlated to this ecological site class. This community class has an average annual production of 4900lbs/ac/yr dominated by prairie cordgrass, big bluestem, bluejoint, sedges, switchgrass, rough barnyardgrass, Nebraska sedge), and wheat sedge.

### State and Transition Model



**Figure 9.** State and Transition Model, MLRA 60A Wet Bottomland ecological site class.

Only one NRI Primary Sampling Units (PSUs) occurs in this community class. REHM was not used to estimate erosion or runoff, because the model was not designed for use on saturated soils, and flooding has the most significant impact on runoff and erosion for this site class.

**Table 9.** NRI Community Class Data and RHEM Results - MLRA 60A Wet Bottomland ecological site class.

| Comm Class ID | Community Class Name                                                                                                  | Dominant Species (Symbol)(Lbs/Ac)                                                                                                                                                               | Production Lbs/Ac | Soil Loss T/Ac/Yr | % Runoff | # PSUs |
|---------------|-----------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-------------------|----------|--------|
| 060A.22.1.1   | Summer Tallgrass(1782), Deciduous Shrub(1440), Summer Perennial Forb(507), Spring Rhizomatous Grass(l)(300), Lichen() | prairie cordgrass(SPPE)(1782), western snowberry(SYOC)(1386), Canada goldenrod(SOCA6)(507), smooth brome(BRIN2)(300), smooth sumac(RHGL)(47), Woods' rose(ROWO)(7), biological crust(SDH_BIO)() | 4029              |                   |          | 1      |

### Supporting Information

The following publication supports the STM. Although the first study is focused on cattle performance and is slightly further east than this MLRA, the vegetation that is stated as predominant in the STM is agreed upon in this study. The second study took place slightly further east of MLRA 60A, the similarities of vegetation are consistent with the STM. Additionally, the study is in accordance with the estimated vegetation that would be present in a wetland ecological site group.

**Lamb, J.B., D.C. Adams, T.J. Klopfenstein, W.W. Stroup, and G.P. Lardy. 1997. Range or meadow regrowth and weaning effects on 2-year old cows. Journal of Range Management 50 (1): 16-19.**

This study took place near Whitman, NE and determine time of grazing to improve body condition score and to evaluate nutrient intake on range and subirrigated meadow. The range site was classified as sands in excellent condition. Dominant vegetation included little bluestem, prairie sandreed, sand bluestem, switchgrass, sand lovegrass, blue grama, and leadplant. The subirrigated meadow common vegetation was smooth brome, redtop, timothy, slender wheatgrass, quackgrass, Kentucky bluegrass, prairie cordgrass and several sedges and rushes. Less common vegetation included big bluestem, indiagrass, and switchgrass.

Individual cows and calves were weighed and evaluated for body condition score (BCS) after 16 hours without food and water. Fecal output of 40 cows and 12 steers was assessed and 12 esophageally-fistulated cows were obtained for diet samples. Treatments included: 1) range vs. subirrigated meadow, 2) September vs. November weaning, 3) September vs. November weaning on subirrigated meadow, 4) September vs. November weaning on range.

The results found that forage organic matter intake was similar for all grazing and weaning treatments. Cow body weights and BCS differed between range and meadow, as well as September vs. November weaning. Cows grazing subirrigated pasture regained more growth than the range grazed cows. Additionally, weaning in September increased body weight and BCS.

**Reece, P.E., J.T. Nichols, J.E. Brummer, R.K. Engel, and K.M. Eskridge. 1994. Harvest date and fertilizer effects on native and interseeded wetland meadows. Journal of Range Management 47(3): 178-183.**

This study evaluates dry matter yield and forage quality on a prairie wetland meadow near Whitman, Nebraska. The study was split-split plot experimental design with the whole plots randomly set in three complete blocks. All plots were hayed and fertilizer applied later in the study. Basal area of plant species was measured on all native



and interseeded plots with a 10-point frame at 10 main locations within each plot. The vegetation in the plots included Garrison creeping foxtail, Bebb sedge, Crowe sedge, Hayden sedge, Nebraska sedge, slender sedge, common rush, compressed spikerush, bluejoint reedgrass, prairie cordgrass, Kentucky bluegrass, etc. Sampling was obtained and oven-dried for dry-matter yield, protein concentration and digestibility estimates.

The results found that forage quality, dry-matter yield and response to spring-applied were similar for native wetland meadow vegetation and interseeded areas over harvest dates; the primary difference being abundance of sedges. Sedge-dominated tended to be more productive than wetland meadows. Harvest date decisions have the greatest potential to affect dry-matter yield and protein concentrations of herbage.

APPENDIX A. MLRA 60A, ECOLOGICAL SITE CLASSES SHOWING THE ECOLOGICAL SITES, ECOLOGICAL SITE IDS, AND PLANT COMMUNITY CLASSES THAT WERE CORRELATED TO EACH SITE CLASS.

| MLRA | Ecological Site Class Name | Ecological Site Names                                                                                                                                                    | Ecological Site ID              |
|------|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 60A  | Loamy Terrace              | Clayey Overflow                                                                                                                                                          | R060AY021SD                     |
|      |                            | Loamy Overflow                                                                                                                                                           | R060AY020SD                     |
|      |                            | Loamy Terrace                                                                                                                                                            | R060AY022SD                     |
|      |                            | Lowland                                                                                                                                                                  | R060AY042SD                     |
|      |                            | <b>Plant Community Class Names</b>                                                                                                                                       | <b>Plant Community Class ID</b> |
|      |                            | Spring Rhizomatous Grass, Spring Midgrass, Summer Tallgrass, Summer Perennial Forb, Spring Perennial Forb, Deciduous Shrub, Deciduous Tree                               | 060A.3.1.1                      |
|      |                            | Summer Stoloniferous Grass, Summer Shortgrass, Spring Perennial Grasslike, Spring Rhizomatous Grass, Spring Annual Grass, Spring Perennial Forb, Summer Perennial Forb   | 060A.3.1.2                      |
|      |                            | Spring Rhizomatous Grass, Summer Stoloniferous Grass, Spring Annual Grass(I), Spring Rhizomatous Grass(I), Summer Perennial Forb, Spring Midgrass(I), Evergreen Subshrub | 060A.3.2.1                      |
|      |                            |                                                                                                                                                                          |                                 |
|      |                            |                                                                                                                                                                          |                                 |
| MLRA | Ecological Site Class Name | Ecological Site Names                                                                                                                                                    | Ecological Site ID              |
| 60A  | Loamy Upland               | Clayey 13-16" PZ                                                                                                                                                         | R060AY011SD                     |
|      |                            | Clayey 16-18" PZ                                                                                                                                                         | R060AY040SD                     |
|      |                            | Loamy 13-16" PZ                                                                                                                                                          | R060AY010SD                     |
|      |                            | Loamy 16-18" PZ                                                                                                                                                          | R060AY041SD                     |
|      |                            | <b>Plant Community Class Names</b>                                                                                                                                       | <b>Plant Community Class ID</b> |
|      |                            | Spring Rhizomatous Grass, Spring Midgrass, Summer Midgrass, Summer Perennial Forb, Spring Perennial Forb, Summer Shortgrass, Spring Perennial Grasslike                  | 060A.6.1.1                      |
|      |                            | Evergreen Shrub, Spring Midgrass(I), Summer Stoloniferous Grass, Spring Rhizomatous Grass, Spring Annual Grass(I), Summer Shortgrass                                     | 060A.6.2.1                      |

| <b>MLRA</b> | <b>Ecological Class Name</b>                                                                                                                                    | <b>Site Ecological Site Names</b>                                                                                                         | <b>Ecological Site ID</b>       |  |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|--|
| 60A         | <b>Saline Bottomland</b>                                                                                                                                        | Closed Depression                                                                                                                         | R060AY019SD                     |  |
|             |                                                                                                                                                                 | Saline Lowland                                                                                                                            | R060AY007SD                     |  |
|             |                                                                                                                                                                 | Saline Subirrigated                                                                                                                       | R060AY036SD                     |  |
|             |                                                                                                                                                                 | <b>Plant Community Class Names</b>                                                                                                        | <b>Plant Community Class ID</b> |  |
|             | Spring Rhizomatous Grass, Summer Rhizomatous Grass, Spring Perennial Grasslike, Summer Midgrass, Summer Perennial Forb, Spring Perennial Forb, Summer Tallgrass | 060A.35.1.1                                                                                                                               |                                 |  |
| <b>MLRA</b> | <b>Ecological Class Name</b>                                                                                                                                    | <b>Site Ecological Site Names</b>                                                                                                         | <b>Ecological Site ID</b>       |  |
| 60A         | <b>Sandy Upland</b>                                                                                                                                             | Sands                                                                                                                                     | R060AY008SD                     |  |
|             |                                                                                                                                                                 | Sandy                                                                                                                                     | R060AY009SD                     |  |
|             |                                                                                                                                                                 | <b>Plant Community Class Names</b>                                                                                                        | <b>Plant Community Class ID</b> |  |
|             |                                                                                                                                                                 | Summer Tallgrass, Summer Midgrass, Summer Perennial Forb, Spring Midgrass, Summer Shortgrass, Spring Perennial Grasslike, Deciduous Shrub | 060A.29.1.1                     |  |
|             | Spring Rhizomatous Grass(I), Spring Annual Grass(I), Summer Midgrass, Spring Rhizomatous Grass, Summer Tallgrass, Spring Midgrass, Summer Shortgrass            | 060A.29.2.1                                                                                                                               |                                 |  |
| <b>MLRA</b> | <b>Ecological Class Name</b>                                                                                                                                    | <b>Site Ecological Site Names</b>                                                                                                         | <b>Ecological Site ID</b>       |  |
| 60A         | <b>Shallow Porous Clay Upland</b>                                                                                                                               | Porous Clay                                                                                                                               | R060AY030SD                     |  |
|             |                                                                                                                                                                 | Shallow Clay                                                                                                                              | R060AY017SD                     |  |
|             |                                                                                                                                                                 | Shallow Porous Clay                                                                                                                       | R060AY043SD                     |  |
|             |                                                                                                                                                                 | <b>Plant Community Class Names</b>                                                                                                        | <b>Plant Community Class ID</b> |  |
|             | Summer Midgrass, Spring Rhizomatous Grass, Summer Tallgrass, Summer Perennial Forb, Spring Perennial Forb, Spring Midgrass, Spring Perennial Grasslike          | 060A.33.1.1                                                                                                                               |                                 |  |
|             | Summer Stoloniferous Grass, Summer Shortgrass, Spring Rhizomatous Grass, Spring Perennial Grasslike, Spring Annual Grass, Spring Midgrass, Summer Tallgrass     | 060A.33.1.2                                                                                                                               |                                 |  |
|             | Ecological Site Community: Summer Midgrass, Spring Rhizomatous Grass, Spring Perennial Grasslike, Summer Tallgrass, Evergreen Tree                              | 060A.33.2.1                                                                                                                               |                                 |  |

| <b>MLRA</b> | <b>Ecological Class Name</b>                     | <b>Site Ecological Site Names</b>                                                                                                                              | <b>Ecological Site ID</b> |
|-------------|--------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| 60A         | <b>Shallow Porous Clay Upland</b><br>(Continued) | Spring Annual Grass(I), Spring Rhizomatous Grass, Summer Stoloniferous Grass, Spring Midgrass(I), Summer Perennial Forb(I), Spring Midgrass, Summer Shortgrass | 060A.33.3.1               |

| <b>MLRA</b> | <b>Ecological Class Name</b> | <b>Site Ecological Site Names</b>                                                                                                                                    | <b>Ecological Site ID</b>       |
|-------------|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 60A         | <b>Shallow Upland</b>        | Claypan                                                                                                                                                              | R060AY013SD                     |
|             |                              | Dense Clay                                                                                                                                                           | R060AY018SD                     |
|             |                              | Saline Upland                                                                                                                                                        | R060AY026SD                     |
|             |                              | Shallow Dense Clay                                                                                                                                                   | R060AY025SD                     |
|             |                              | Shallow Loamy                                                                                                                                                        | R060AY024SD                     |
|             |                              | Thin Claypan                                                                                                                                                         | R060AY015SD                     |
|             |                              | Thin Upland                                                                                                                                                          | R060AY012SD                     |
|             |                              | <b>Plant Community Class Names</b>                                                                                                                                   | <b>Plant Community Class ID</b> |
|             |                              | Spring Rhizomatous Grass, Spring Midgrass, Summer Perennial Forb, Spring Perennial Forb, Summer Shortgrass, Summer Midgrass, Evergreen Subshrub                      | 060A.18.1.1                     |
|             |                              | Summer Stoloniferous Grass, Summer Perennial Forb, Spring Perennial Grasslike, Spring Rhizomatous Grass, Summer Shortgrass, Spring Midgrass, Summer Midgrass         | 060A.18.1.2                     |
|             |                              | Spring Rhizomatous Grass, Evergreen Shrub, Cacti, Evergreen Subshrub, Spring Annual Grass(I), Summer Perennial Forb, Deciduous Subshrub                              | 060A.18.2.1                     |
|             |                              | Spring Rhizomatous Grass, Summer Stoloniferous Grass, Summer Perennial Forb(I), Spring Annual Grass(I), Summer Shortgrass, Spring Annual Forb(I), Spring Midgrass(I) | 060A.18.3.1                     |

| <b>MLRA</b> | <b>Ecological Class Name</b> | <b>Site Ecological Site Names</b>                                                                                                             | <b>Ecological Site ID</b>       |
|-------------|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 60A         | <b>Very Shallow Upland</b>   | Very Shallow                                                                                                                                  | R060AY016SD                     |
|             |                              | Shallow Sandy                                                                                                                                 | R060AY044SD                     |
|             |                              | <b>Plant Community Class Names</b>                                                                                                            | <b>Plant Community Class ID</b> |
|             |                              | Spring Midgrass, Summer Midgrass, Summer Perennial Forb, Spring Perennial Forb, Spring Rhizomatous Grass, Summer Tallgrass, Summer Shortgrass | 060A.32.1.1                     |

| <b>MLRA</b> | <b>Ecological Class Name</b> | <b>Site Ecological Site Names</b>                                                                                                                                                            | <b>Ecological Site ID</b>                      |
|-------------|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|
| 60A         | <b>Wet Bottomland</b>        | Subirrigated<br>Wetland                                                                                                                                                                      | R060AY003SD<br>R060AY002SD                     |
|             |                              | <b>Plant Community Class Names</b><br>Summer Tallgrass, Spring Perennial Grasslike, Spring Midgrass, Spring Rhizomatous Grass, Summer Perennial Forb, Summer Annual Grass, Spring Shortgrass | <b>Plant Community Class ID</b><br>060A.22.1.1 |

## APPENDIX B. MLRA 60A, ECOLOGICAL SITE CLASS AND COMMUNITY CLASS SUMMARY

| Site Class Name | State                          | Comm Class ID | ESD Comm Class                                                                                                                             | ESD Lbs/Ac | NRI Community Class                                                                                                                                                       | NRI Dominant Species (Symbol)(Lbs/ac)                                                                                                                                                                | NRI Lbs/Ac | # PSUs |
|-----------------|--------------------------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|--------|
| Loamy Terrace   | Native Herbaceous              | 060A.3.1.1    | Spring Rhizomatous Grass, Spring Midgrass, Summer Tallgrass, Summer Perennial Forb, Spring Perennial Forb, Deciduous Shrub, Deciduous Tree | 2700       | Spring Rhizomatous Grass, Spring Midgrass, Spring Perennial Forb, Evergreen Subshrub, Herbaceous Vine, Summer Stoloniferous Grass, Summer Perennial Forb                  | western wheatgrass(PASM), slender wheatgrass(ELTR7), green needlegrass(NAVI4), Gardner's saltbush(ATGA), American vetch(VIAM), common dandelion(TAOF), Buffalograss(BODA2), desert biscuitroot(LOFO) | 2545       | 1      |
| Loamy Terrace   | Native Herbaceous              | 060A.3.1.2    |                                                                                                                                            |            | Summer Stoloniferous Grass, Summer Shortgrass, Spring Perennial Grasslike, Spring Rhizomatous Grass, Spring Annual Grass(I), Spring Perennial Forb, Summer Perennial Forb | Buffalograss(BODA2), blue grama(BOGR2), sedge(CAREX), western wheatgrass(PASM), threadleaf sedge(CAFI), cheatgrass(BRTE), aster(ASTER), goldenrod(SOLID)                                             | 3468       | 2      |
| Loamy Terrace   | Native - Non-Native Herbaceous | 060A.3.2.1    |                                                                                                                                            |            | Spring Rhizomatous Grass, Summer Stoloniferous Grass, Spring Annual Grass(I), Spring Rhizomatous Grass(I), Summer Perennial Forb, Spring Midgrass(I), Evergreen Subshrub  | western wheatgrass(PASM), Buffalograss(BODA2), cheatgrass(BRTE), smooth brome(BRIN2), crested wheatgrass(AGCR), white prairie aster(SYFA), broom snakeweed(GUSA2), Japanese brome(BRAR5)             | 3795       | 5      |
| Loamy Upland    | Native Herbaceous              | 060A.6.1.1    | Spring Rhizomatous Grass, Spring Midgrass, Summer Midgrass, Summer Perennial Forb, Spring Perennial Forb, Summer Shortgrass,               | 1975       | Spring Rhizomatous Grass, Summer Stoloniferous Grass, Spring Midgrass, Summer Shortgrass, Spring Perennial Forb, Summer Perennial Forb, Herbaceous Vine                   | western wheatgrass(PASM), Buffalograss(BODA2), blue grama(BOGR2), green needlegrass(NAVI4), American vetch(VIAM), sedge(CAREX), prairie Junegrass(KOMA), scarlet globemallow(SPCO)                   | 2125       | 20     |

| Site Class Name            | State                            | Comm Class ID | ESD Comm Class                                                                                                                                                  | ESD Lbs/Ac | NRI Community Class                                                                                                                                  | NRI Dominant Species (Symbol)(Lbs/ac)                                                                                                                                                                             | NRI Lbs/Ac | # PSUs |
|----------------------------|----------------------------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|--------|
|                            |                                  |               | Spring Perennial Grasslike                                                                                                                                      |            |                                                                                                                                                      |                                                                                                                                                                                                                   |            |        |
| Loamy Upland               | Native Woody - Native Herbaceous | 060A.6.2.1    |                                                                                                                                                                 |            | Evergreen Shrub, Spring Midgrass(I), Summer Stoloniferous Grass, Spring Rhizomatous Grass, Spring Annual Grass(I), Summer Shortgrass                 | crested wheatgrass(AGCR), big sagebrush(ARTR2), Buffalograss(BODA2), western wheatgrass(PASM), rubber rabbitbrush(ERNA10), Japanese brome(BRAR5), blue grama(BOGR2), woolly plantain(PLPA2), field brome(BRAR5)   | 2401       | 3      |
| Saline Bottomland          | Native Herbaceous                | 060A.35.1.1   | Spring Rhizomatous Grass, Summer Rhizomatous Grass, Spring Perennial Grasslike, Summer Midgrass, Summer Perennial Forb, Spring Perennial Forb, Summer Tallgrass | 2333       |                                                                                                                                                      |                                                                                                                                                                                                                   |            |        |
| Sandy Upland               | Native - Non-Native Herbaceous   | 060A.29.2.1   |                                                                                                                                                                 |            | Spring Rhizomatous Grass(I), Spring Annual Grass(I), Summer Midgrass, Spring Rhizomatous Grass, Summer Tallgrass, Spring Midgrass, Summer Shortgrass | intermediate wheatgrass(THIN6), western wheatgrass(PASM), prairie sandreed(CALO), needleandthread(HECO26), alkali sacaton(SPAI), cheatgrass(BRTE), Japanese brome(BRAR5), crested wheatgrass(AGCR)                | 1132       | 4      |
| Shallow Porous Clay Upland | Native Herbaceous                | 060A.33.1.1   | Summer Midgrass, Spring Rhizomatous Grass, Summer Tallgrass, Summer Perennial Forb, Spring Perennial Forb, Spring Midgrass, Spring                              | 1285       | Spring Rhizomatous Grass, Summer Midgrass, Spring Midgrass, Summer Perennial Forb, Coniferous Tree, Spring Perennial Forb, Summer Shortgrass         | western wheatgrass(PASM), green needlegrass(NAVI4), sideoats grama(BOCU), little bluestem(SCSC), Rocky Mountain juniper(JUSC2), prairie dropseed(SPHE), white sagebrush(ARLU), silverleaf Indian breadroot(PEAR6) | 1288       | 3      |

| Site Class Name            | State                            | Comm Class ID | ESD Comm Class                                                                                                                                  | ESD Lbs/Ac | NRI Community Class                                                                                                                                              | NRI Dominant Species (Symbol)(Lbs/ac)                                                                                                                                                   | NRI Lbs/Ac | # PSUs |
|----------------------------|----------------------------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|--------|
|                            |                                  |               | Perennial Grasslike                                                                                                                             |            |                                                                                                                                                                  |                                                                                                                                                                                         |            |        |
| Shallow Porous Clay Upland | Native Herbaceous                | 060A.33.1.2   |                                                                                                                                                 |            | Summer Stoloniferous Grass, Summer Shortgrass, Spring Rhizomatous Grass, Spring Perennial Grasslike, Spring Annual Grass(I), Spring Midgrass, Summer Tallgrass   | Buffalograss(BODA2), blue grama(BOGR2), western wheatgrass(PASM), threadleaf sedge(CAFI), Japanese brome(BRAR5), green needlegrass(NAVI4), big bluestem(ANGE), crested wheatgrass(AGCR) | 2202       | 2      |
| Shallow Porous Clay Upland | Native Herbaceous - Native Woody | 060A.33.2.1   | Ecological Site Community: Summer Midgrass, Spring Rhizomatous Grass, Spring Perennial Grasslike, Summer Tallgrass, Evergreen Tree              |            |                                                                                                                                                                  |                                                                                                                                                                                         |            |        |
| Shallow Porous Clay Upland | Native - Non-Native Herbaceous   | 060A.33.3.1   |                                                                                                                                                 |            | Spring Annual Grass(I), Spring Rhizomatous Grass, Summer Stoloniferous Grass, Spring Midgrass(I), Summer Perennial Forb(I), Spring Midgrass, Summer Shortgrass   | cheatgrass(BRTE), western wheatgrass(PASM), buffalograss(BODA2), crested wheatgrass(AGCR), sweetclover(MEOF), needleandthread(HECO26), blue grama(BOGR2), sedge(CAREX)                  | 1765       | 9      |
| Shallow Upland             | Native Herbaceous                | 060A.18.1.1   | Spring Rhizomatous Grass, Spring Midgrass, Summer Perennial Forb, Spring Perennial Forb, Summer Shortgrass, Summer Midgrass, Evergreen Subshrub | 1083       | Spring Rhizomatous Grass, Summer Stoloniferous Grass, Summer Midgrass, Spring Midgrass, Spring Perennial Forb, Summer Perennial Forb, Spring Perennial Grasslike | western wheatgrass(PASM), buffalograss(BODA2), sideoats grama(BOCU), needleandthread(HECO26), sedge(CAREX), little bluestem(SCSC), Montana wheatgrass(ELAL7), green needlegrass(NAVI4)  | 1278       | 20     |



| Site Class Name     | State                            | Comm Class ID | ESD Comm Class                                                                                                                                | ESD Lbs/Ac | NRI Community Class                                                                                                                                                  | NRI Dominant Species (Symbol)(Lbs/ac)                                                                                                                                                               | NRI Lbs/Ac | # PSUs |
|---------------------|----------------------------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|--------|
| Shallow Upland      | Native Herbaceous                | 060A.18.1.2   |                                                                                                                                               |            | Summer Stoloniferous Grass, Summer Perennial Forb, Spring Perennial Grasslike, Spring Rhizomatous Grass, Summer Shortgrass, Spring Midgrass, Summer Midgrass         | Buffalograss(BODA2), sedge(CAREX), western wheatgrass(PASM), blue grama(BOGR2), slimflower scurfpea(PSTE5), dotted blazing star(LIPU), sideoats grama(BOCU), threadleaf sedge(CAFI)                 | 1650       | 8      |
| Shallow Upland      | Native Woody - Native Herbaceous | 060A.18.2.1   |                                                                                                                                               |            | Spring Rhizomatous Grass, Evergreen Shrub, Cacti, Evergreen Subshrub, Spring Annual Grass(I), Summer Perennial Forb, Deciduous Subshrub                              | big sagebrush(ARTR2), western wheatgrass(PASM), Montana wheatgrass(ELAL7), Opuntia spp.(OPUNT), Nuttall's saltbush(ATNU2), Japanese brome(BRAR5), branched false goldenweed(OOMU), knotweed(POLYG4) | 863        | 3      |
| Shallow Upland      | Native - Non-Native Herbaceous   | 060A.18.3.1   |                                                                                                                                               |            | Spring Rhizomatous Grass, Summer Stoloniferous Grass, Summer Perennial Forb(I), Spring Annual Grass(I), Summer Shortgrass, Spring Annual Forb(I), Spring Midgrass(I) | western wheatgrass(PASM), Buffalograss(BODA2), sweetclover(MEOF), blue grama(BOGR2), crested wheatgrass(AGCR), Japanese brome(BRAR5), sweetclover(MELIL), cheatgrass(BRTE), field brome(BRAR5)      | 1726       | 23     |
| Very Shallow Upland | Native Herbaceous                | 060A.32.1.1   | Spring Midgrass, Summer Midgrass, Summer Perennial Forb, Spring Perennial Forb, Spring Rhizomatous Grass, Summer Tallgrass, Summer Shortgrass | 1050       |                                                                                                                                                                      |                                                                                                                                                                                                     |            |        |

| Site Class Name | State                            | Comm Class ID | ESD Comm Class                                                                                                                                         | ESD Lbs/Ac | NRI Community Class                                                                           | NRI Dominant Species (Symbol)(Lbs/ac)                                                                                                                            | NRI Lbs/Ac | # PSUs |
|-----------------|----------------------------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-----------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|--------|
| Wet Bottomland  | Native Herbaceous - Native Woody | 060A.22.1.1   | Summer Tallgrass, Spring Perennial Grasslike, Spring Midgrass, Spring Rhizomatous Grass, Summer Perennial Forb, Summer Annual Grass, Spring Shortgrass | 4900       | Summer Tallgrass, Deciduous Shrub, Summer Perennial Forb, Spring Rhizomatous Grass(l), Lichen | prairie cordgrass(SPPE), western snowberry(SYOC), Canada goldenrod(SOCA6), smooth brome(BRIN2), smooth sumac(RHGL), Woods' rose(ROWO), biological crust(SDH_BIO) | 4029       | 1      |

## APPENDIX C. MLRA 60A, NRI PERCENT COVER VALUES BY COMMUNITY CLASS

| Site Class Name            | Comm Class ID                                                                                                                                                             | Bunch-grass | Sodgrass | Shrub | Forb + AnnGrass | Lichen | BareGrnd | Rock | Litter | Basal | Avg Plant Ht (ft) | Avg % Slope |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|----------|-------|-----------------|--------|----------|------|--------|-------|-------------------|-------------|
| Loamy Terrace              | 060A.3.1.2                                                                                                                                                                | 5%          | 47%      | 3%    | 43%             | 1%     | 9%       | 0%   | 58%    | 29%   | 0.66              | 7           |
|                            | Summer Stoloniferous Grass, Summer Shortgrass, Spring Perennial Grasslike, Spring Rhizomatous Grass, Spring Annual Grass(I), Spring Perennial Forb, Summer Perennial Forb |             |          |       |                 |        |          |      |        |       |                   |             |
| Loamy Terrace              | 060A.3.2.1                                                                                                                                                                | 1%          | 77%      | 0%    | 22%             | 0%     | 8%       | 0%   | 81%    | 8%    | 1.48              | 3           |
|                            | Spring Rhizomatous Grass, Summer Stoloniferous Grass, Spring Annual Grass(I), Spring Rhizomatous Grass(I), Summer Perennial Forb, Spring Midgrass(I), Evergreen Subshrub  |             |          |       |                 |        |          |      |        |       |                   |             |
| Loamy Upland               | 060A.6.1.1                                                                                                                                                                | 16%         | 36%      | 0%    | 12%             | 0%     | 27%      | 1%   | 66%    | 1%    | 1.05              | 5           |
|                            | Spring Rhizomatous Grass, Summer Stoloniferous Grass, Spring Midgrass, Summer Shortgrass, Spring Perennial Forb, Summer Perennial Forb, Herbaceous Vine                   |             |          |       |                 |        |          |      |        |       |                   |             |
| Loamy Upland               | 060A.6.2.1                                                                                                                                                                | 9%          | 13%      | 5%    | 57%             | 0%     | 7%       | 4%   | 86%    | 2%    | 0.95              | 3           |
|                            | Evergreen Shrub, Spring Midgrass(I), Summer Stoloniferous Grass, Spring Rhizomatous Grass, Spring Annual Grass(I), Summer Shortgrass                                      |             |          |       |                 |        |          |      |        |       |                   |             |
| Sandy Upland               | 060A.29.2.1                                                                                                                                                               | 4%          | 28%      | 9%    | 42%             | 0%     | 31%      | 0%   | 40%    | 0%    | 1.03              | 1           |
|                            | Spring Rhizomatous Grass(I), Spring Annual Grass(I), Summer Midgrass, Spring Rhizomatous Grass, Summer Tallgrass, Spring Midgrass, Summer Shortgrass                      |             |          |       |                 |        |          |      |        |       |                   |             |
| Shallow Porous Clay Upland | 060A.33.1.1                                                                                                                                                               | 28%         | 17%      | 26%   | 4%              | 0%     | 61%      | 4%   | 11%    | 1%    | 1.41              | 15          |
|                            | Spring Rhizomatous Grass, Summer Midgrass, Spring Midgrass, Summer Perennial Forb, Coniferous Tree, Spring Perennial Forb, Summer Shortgrass                              |             |          |       |                 |        |          |      |        |       |                   |             |
| Shallow Porous Clay Upland | 060A.33.3.1                                                                                                                                                               | 8%          | 13%      | 19%   | 53%             | 0%     | 19%      | 2%   | 65%    | 7%    | 1.37              | 16          |
|                            | Spring Annual Grass(I), Spring Rhizomatous Grass, Summer Stoloniferous Grass, Spring Midgrass(I), Summer Perennial Forb(I), Spring Midgrass, Summer Shortgrass            |             |          |       |                 |        |          |      |        |       |                   |             |
| Shallow Upland             | 060A.18.1.1                                                                                                                                                               | 14%         | 39%      | 4%    | 16%             | 2%     | 44%      | 2%   | 41%    | 4%    | 0.87              | 6           |
|                            | Spring Rhizomatous Grass, Summer Stoloniferous Grass, Summer Midgrass, Spring Midgrass, Spring Perennial Forb, Summer Perennial Forb, Spring Perennial Grasslike          |             |          |       |                 |        |          |      |        |       |                   |             |
| Shallow Upland             | 060A.18.1.2                                                                                                                                                               | 27%         | 37%      | 4%    | 6%              | 2%     | 51%      | 4%   | 15%    | 8%    | 0.61              | 7           |
|                            | Summer Stoloniferous Grass, Summer Perennial Forb, Spring Perennial Grasslike, Spring Rhizomatous Grass, Summer Shortgrass, Spring Midgrass, Summer Midgrass              |             |          |       |                 |        |          |      |        |       |                   |             |
| Shallow Upland             | 060A.18.2.1                                                                                                                                                               | 4%          | 23%      | 13%   | 10%             | 1%     | 67%      | 1%   | 27%    | 2%    | 0.74              | 3           |
|                            | Spring Rhizomatous Grass, Evergreen Shrub, Cacti, Evergreen Subshrub, Spring Annual Grass(I), Summer Perennial Forb, Deciduous Subshrub                                   |             |          |       |                 |        |          |      |        |       |                   |             |
| Shallow Upland             | 060A.18.3.1                                                                                                                                                               | 18%         | 37%      | 3%    | 31%             | 0%     | 11%      | 1%   | 71%    | 6%    | 0.94              | 15          |
|                            | Spring Rhizomatous Grass, Summer Stoloniferous Grass, Summer Perennial Forb(I), Spring Annual Grass(I), Summer Shortgrass, Spring Annual Forb(I), Spring Midgrass(I)      |             |          |       |                 |        |          |      |        |       |                   |             |

## APPENDIX D. MLRA 60A, REPRESENTATIVE SOIL MAP UNIT COMPONENTS

### Loamy Terrace Ecological Site Class

| Area Symbol | Soil Survey Area                                                 | Map Unit | Component | Component Acres |
|-------------|------------------------------------------------------------------|----------|-----------|-----------------|
| SD019       | Butte County, South Dakota                                       | Sr       | Stetter   | 23865           |
| SD047       | Fall River County, South Dakota                                  | Lo       | Lohmiller | 17934           |
| SD600       | Meade County, South Dakota, Southern Part                        | St       | Stetter   | 14568           |
| SD606       | Custer and Pennington Counties Area, Prairie Parts, South Dakota | Lo       | Lohmiller | 11823           |
| SD019       | Butte County, South Dakota                                       | Ss       | Stetter   | 10548           |

### Loamy Upland Ecological Site Class

| Area Symbol | Soil Survey Area                          | Map Unit | Component | Component Acres |
|-------------|-------------------------------------------|----------|-----------|-----------------|
| SD047       | Fall River County, South Dakota           | PeB      | Pierre    | 95867           |
| SD600       | Meade County, South Dakota, Southern Part | KbB      | Kyle      | 40885           |
| SD600       | Meade County, South Dakota, Southern Part | NcA      | Nunn      | 37719           |
| SD019       | Butte County, South Dakota                | PrB      | Pierre    | 32748           |
| SD019       | Butte County, South Dakota                | KIB      | Kyle      | 24153.          |

### Saline Bottomland Ecological Site Class

| Area Symbol | Soil Survey Area                          | Map Unit | Component | Component Acres |
|-------------|-------------------------------------------|----------|-----------|-----------------|
| SD019       | Butte County, South Dakota                | Sb       | Sage      | 6062            |
| SD019       | Butte County, South Dakota                | WnB      | Sage      | 3861            |
| SD019       | Butte County, South Dakota                | Lo       | Sage      | 2046            |
| SD600       | Meade County, South Dakota, Southern Part | SkB      | Hoven     | 1474            |
| SD063       | Harding County, South Dakota              | SbA      | Sage      | 1216            |

### Sandy Upland Ecological Site Class

| Area Symbol | Soil Survey Area                          | Map Unit | Component    | Component Acres |
|-------------|-------------------------------------------|----------|--------------|-----------------|
| SD047       | Fall River County, South Dakota           | AsB      | Ascalon      | 15099           |
| SD047       | Fall River County, South Dakota           | VaE      | Valent       | 11612           |
| SD600       | Meade County, South Dakota, Southern Part | AsB      | Assinniboine | 8801            |
| SD600       | Meade County, South Dakota, Southern Part | Ba       | Bankard      | 5916            |
| SD047       | Fall River County, South Dakota           | JaB      | Jayem        | 5845            |

### Shallow Porous Clay Upland Ecological Site Class

| Area Symbol | Soil Survey Area                                                 | Map Unit | Component | Component Acres |
|-------------|------------------------------------------------------------------|----------|-----------|-----------------|
| SD606       | Custer and Pennington Counties Area, Prairie Parts, South Dakota | SbF      | Samsil    | 91332           |
| SD600       | Meade County, South Dakota, Southern Part                        | SaE      | Samsil    | 56774           |
| SD047       | Fall River County, South Dakota                                  | SaE      | Samsil    | 20946           |
| SD601       | Meade County, South Dakota, Northern Part                        | SaD      | Samsil    | 19457           |
| SD047       | Fall River County, South Dakota                                  | MpE      | Midway    | 14753           |

### Shallow Upland Ecological Site Class

| <b>Area Symbol</b> | <b>Soil Survey Area</b>                                          | <b>Map Unit</b> | <b>Component</b> | <b>Component Acres</b> |
|--------------------|------------------------------------------------------------------|-----------------|------------------|------------------------|
| SD019              | Butte County, South Dakota                                       | ToB             | Twotop           | 27211                  |
| SD019              | Butte County, South Dakota                                       | EpD             | Epsie            | 12400                  |
| SD047              | Fall River County, South Dakota                                  | SnE             | Shingle          | 12135                  |
| SD606              | Custer and Pennington Counties Area, Prairie Parts, South Dakota | BfA             | Beckton          | 10457                  |
| SD600              | Meade County, South Dakota, Southern Part                        | SwB             | Swanboy          | 9820                   |

### Very Shallow Upland Ecological Site Class

| <b>Area Symbol</b> | <b>Soil Survey Area</b>                                          | <b>Map Unit</b> | <b>Component</b> | <b>Component Acres</b> |
|--------------------|------------------------------------------------------------------|-----------------|------------------|------------------------|
| SD606              | Custer and Pennington Counties Area, Prairie Parts, South Dakota | StE             | Schamber         | 4787                   |
| SD606              | Custer and Pennington Counties Area, Prairie Parts, South Dakota | NeD             | Nihill           | 528                    |
| SD606              | Custer and Pennington Counties Area, Prairie Parts, South Dakota | EnD             | Nihill           | 281                    |
| SD019              | Butte County, South Dakota                                       | RdE             | Schamber         | 117                    |

### Wet Bottomland Ecological Site Class

| <b>Area Symbol</b> | <b>Soil Survey Area</b>                   | <b>Map Unit</b> | <b>Component</b> | <b>Component Acres</b> |
|--------------------|-------------------------------------------|-----------------|------------------|------------------------|
| SD047              | Fall River County, South Dakota           | N658E           | Herdcamp         | 1931                   |
| SD613              | Shannon County Area, South Dakota         | N658E           | Herdcamp         | 474                    |
| SD600              | Meade County, South Dakota, Southern Part | Le              | Herdcamp         | 174                    |
| SD019              | Butte County, South Dakota                | Gh              | Herdcamp         | 74                     |

## APPENDIX E. MLRA 60A, COMMON PLANTS AND FUNCTIONAL GROUPS

| Common Name                  | Accepted Symbol | Scientific Name              | Functional Group              |
|------------------------------|-----------------|------------------------------|-------------------------------|
| alfalfa                      | MEDIC           | Medicago                     | Spring Perennial Forb(I)      |
| alfalfa                      | MESA            | Medicago sativa              | Spring Perennial Forb(I)      |
| alkali sacaton               | SPAI            | Sporobolus airoides          | Summer Midgrass               |
| alpine golden buckwheat      | ERFL4           | Eriogonum flavum             | Summer Perennial Forb         |
| Alyssum                      | ALYSS           | Alyssum                      | Spring Annual Forb(I)         |
| alyssumleaf phlox            | PHAL3           | Phlox alyssifolia            | Spring Perennial Forb         |
| American bird's-foot trefoil | LOUN            | Lotus unifoliolatus          | Summer Annual Forb            |
| American licorice            | GLLE3           | Glycyrrhiza lepidota         | Summer Perennial Forb         |
| American milkvetch           | ASAM3           | Astragalus americanus        | Summer Perennial Forb         |
| American sloughgrass         | BESY            | Beckmannia syzigachne        | Summer Annual Grass           |
| American vetch               | VIAM            | Vicia americana              | Herbaceous Vine               |
| annual ragweed               | AMAR2           | Ambrosia artemisiifolia      | Summer Annual Forb            |
| aromatic aster               | SYOB            | Symphyotrichum oblongifolium | Summer Perennial Forb         |
| wormwood                     | ARTEM           | Artemisia                    | Evergreen Shrub               |
| aster                        | ASTER           | Aster                        | Spring Perennial Forb         |
| aster                        | SYMPH4          | Symphyotrichum               | Summer Perennial Forb         |
| ballhead ipomopsis           | IPCO5           | Ipomopsis congesta           | Summer Perennial Forb         |
| Baltic rush                  | JUARL           | Juncus balticus              | Spring Perennial<br>Grasslike |
| bastard toadflax             | COUM            | Comandra umbellata           | Spring Perennial Forb         |
| beaked spikerush             | ELRO2           | Eleocharis rostellata        | Summer Perennial<br>Grasslike |
| bearded wheatgrass           | ELTRS           | Elymus subsecundus           | Summer Perennial<br>Grasslike |
| bearded wheatgrass           | ELCA11          | Elymus caninus               | Spring Tallgrass(I)           |
| bedstraw                     | GALIU           | Galium                       | Spring Perennial Forb         |
| big bluestem                 | ANGE            | Andropogon gerardii          | Summer Tallgrass              |
| big sagebrush                | ARTR2           | Artemisia tridentata         | Evergreen Shrub               |
| bighead pygmycudweed         | EVPR            | Evax prolifera               | Spring Annual Forb            |
| bindweed                     | CONVO           | Convolvulus                  | Summer Perennial<br>Forb(I)   |
| bird's-foot trefoil          | LOCO6           | Lotus corniculatus           | Spring Perennial Forb(I)      |
| black medick                 | MELU            | Medicago lupulina            | Summer Annual Forb(I)         |
| blacksamson echinacea        | ECAN2           | Echinacea angustifolia       | Summer Perennial Forb         |
| bladderpod                   | LESQU           | Lesquerella                  | Spring Perennial Forb         |
| blazing star                 | LIATR           | Liatris                      | Summer Perennial Forb         |
| blue flax                    | LIPE2           | Linum perenne                | Summer Perennial<br>Forb(I)   |
| blue grama                   | BOGR2           | Bouteloua gracilis           | Summer Shortgrass             |
| blue lettuce                 | LATA            | Lactuca tatarica             | Summer Perennial Forb         |
| bluebunch wheatgrass         | PSSP6           | Pseudoroegneria spicata      | Spring Midgrass               |
| borage                       | BORAG           | Borage                       | Spring Annual Forb            |
| branched false<br>goldenweed | OOMU            | Oonopsis multicaulis         | Deciduous Subshrub            |

| <b>Common Name</b>         | <b>Accepted Symbol</b> | <b>Scientific Name</b>  | <b>Functional Group</b>     |
|----------------------------|------------------------|-------------------------|-----------------------------|
| breadroot                  | PEDIO2                 | Pediomelum              | Spring Perennial Forb       |
| bristlegrass               | SETAR                  | Setaria                 | Summer Midgrass             |
| brittle pricklypear        | OPFR                   | Opuntia fragilis        | Cacti                       |
| broadbeard beardtongue     | PEAN4                  | Penstemon angustifolius | Spring Perennial Forb       |
| broom snakeweed            | GUSA2                  | Gutierrezia sarothrae   | Evergreen Subshrub          |
| buckwheat                  | ERIOG                  | Eriogonum               | Spring Perennial Forb       |
| buffaloberry               | SHEPH                  | Shepherdia              | Deciduous Shrub             |
| buffalobur nightshade      | SORO                   | Solanum rostratum       | Spring Annual Forb          |
| buffalograss               | BODA2                  | Bouteloua dactyloides   | Summer Stoloniferous Grass  |
| Buffalograss               | BODA2                  | Buchloe dactyloides     | Summer Stoloniferous Grass  |
| bulrush                    | SCHOE6                 | Schoenoplectus          | Summer Perennial Grasslike  |
| California seablite        | SUCA                   | Suaeda californica      | Evergreen Subshrub          |
| Canada bluegrass           | POCO                   | Poa compressa           | Spring Rhizomatous Grass(I) |
| Canada goldenrod           | SOCA6                  | Solidago canadensis     | Summer Perennial Forb       |
| Canada thistle             | CIAR4                  | Cirsium arvense         | Summer Perennial Forb(I)    |
| Canada wildrye             | ELCA4                  | Elymus canadensis       | Spring Midgrass             |
| Canadian anemone           | ANCA8                  | Anemone canadensis      | Spring Perennial Forb       |
| Canadian horseweed         | COCA5                  | Conyza canadensis       | Spring Annual Forb          |
| candle anemone             | ANCY                   | Anemone cylindrica      | Summer Perennial Forb       |
| Carolina draba             | DRRE2                  | Draba reptans           | Spring Annual Forb          |
| catchfly                   | SILEN                  | Silene                  | Spring Annual Forb          |
| cheatgrass                 | BRTE                   | Bromus tectorum         | Spring Annual Grass(I)      |
| chokecherry                | PRVI                   | Prunus virginiana       | Deciduous Shrub             |
| cinquefoil                 | POTEN                  | Potentilla              | Summer Perennial Forb       |
| climbing false buckwheat   | POSC3                  | Polygonum scandens      | Herbaceous Vine             |
| clover                     | TRIFO                  | Trifolium               | Spring Perennial Forb       |
| clustered field sedge      | CAPR5                  | Carex praegracilis      | Spring Perennial Grasslike  |
| common barley              | HOVU                   | Hordeum vulgare         | Spring Annual Grass         |
| common chickweed           | STME2                  | Stellaria media         | Spring Annual Forb(I)       |
| common dandelion           | TAOF                   | Taraxacum officinale    | Spring Perennial Forb       |
| common milkweed            | ASSY                   | Asclepias syriaca       | Summer Perennial Forb       |
| common mouse-ear chickweed | CEFO2                  | Cerastium fontanum      | Summer Perennial Forb(I)    |
| common pepperweed          | LEDE                   | Lepidium densiflorum    | Spring Annual Forb          |
| common snowberry           | SYAL                   | Symphoricarpos albus    | Deciduous Shrub             |
| common spikerush           | ELPA3                  | Eleocharis palustris    | Spring Perennial Grasslike  |
| common starlily            | LEMO4                  | Leucocrinum montanum    | Spring Perennial Forb       |
| common sunflower           | HEAN3                  | Helianthus annuus       | Summer Annual Forb          |
| common wheat               | TRAE                   | Triticum aestivum       | Spring Annual Grass(I)      |

| <b>Common Name</b>      | <b>Accepted Symbol</b> | <b>Scientific Name</b>                           | <b>Functional Group</b>     |
|-------------------------|------------------------|--------------------------------------------------|-----------------------------|
| common yarrow           | ACMI2                  | Achillea millefolium                             | Spring Perennial Forb       |
| common yellow oxalis    | OXST                   | Oxalis stricta                                   | Summer Perennial Forb       |
| coneflower              | RATIB                  | Ratibida                                         | Summer Perennial Forb       |
| coneflower              | ECHIN                  | Echinacea                                        | Summer Perennial Forb       |
| Conyza                  | CONYZ                  | Conyza                                           | Spring Annual Forb          |
| creeping jenny          | LYNU                   | Lysimachia nummularia                            | Summer Perennial Forb(I)    |
| creeping juniper        | JUHO2                  | Juniperus horizontalis                           | Evergreen Shrub             |
| creeping meadow foxtail | ALAR                   | Alopecurus arundinaceus                          | Spring Rhizomatous Grass(I) |
| crested wheatgrass      | AGCR                   | Agropyron cristatum                              | Spring Midgrass(I)          |
| curly dock              | RUCR                   | Rumex crispus                                    | Spring Perennial Forb(I)    |
| curlycup gumweed        | GRSQ                   | Grindelia squarrosa                              | Summer Annual Forb          |
| curlytop knotweed       | POLA4                  | Polygonum lapathifolium                          | Summer Annual Forb          |
| currant                 | RIBES                  | Ribes                                            | Deciduous Shrub             |
| Cusick's bluegrass      | POCU3                  | Poa cusickii                                     | Spring Perennial Grasslike  |
| Dalea spp.              | DALEA                  | Dalea                                            | Deciduous Subshrub          |
| davy mannagrass         | GLLE2                  | Glyceria leptostachya                            | Spring Midgrass             |
| deathcamas              | ZIGAD                  | Zigadenus                                        | Spring Perennial Forb       |
| desert biscuitroot      | LOFO                   | Lomatium foeniculaceum                           | Spring Perennial Forb       |
| dotted blazing star     | LIPU                   | Liatris punctata                                 | Summer Perennial Forb       |
| dwarf false indigo      | AMNA                   | Amorpha nana                                     | Deciduous Subshrub          |
| eastern pasqueflower    | PUPA5                  | Pulsatilla patens                                | Spring Perennial Forb       |
| eastern poison ivy      | TORA2                  | Toxicodendron radicans                           | Deciduous Subshrub          |
| Evening Primrose        | OENOT                  | Oenothera                                        | Spring Perennial Forb       |
| fall rosette grass      | DIWI5                  | Dichanthelium wilcoxianum                        | Summer Shortgrass           |
| false boneset           | BREU                   | Brickellia eupatorioides                         | Summer Perennial Forb       |
| false flax              | CAMEL                  | Camelina                                         | Summer Annual Forb          |
| false pennyroyal        | HEDEO                  | Hedeoma                                          | Summer Annual Grass(I)      |
| fescue                  | FESTU                  | Festuca                                          | Spring Midgrass             |
| fetid marigold          | DYPA                   | Dyssodia papposa                                 | Summer Annual Forb          |
| field bindweed          | COAR4                  | Convolvulus arvensis                             | Summer Perennial Forb(I)    |
| field chickweed         | CEAR4                  | Cerastium arvense                                | Summer Perennial Forb       |
| field pennycress        | THAR5                  | Thlaspi arvense                                  | Spring Annual Forb(I)       |
| field pepperweed        | LECA5                  | Lepidium campestre                               | Spring Annual Forb(I)       |
| field pussytoes         | ANNE                   | Antennaria neglecta                              | Spring Perennial Forb       |
| field sagewort          | ARCAB4                 | Artemisia campestris ssp. borealis var. borealis | Summer Perennial Forb       |
| field sagewort          | ARCA12                 | Artemisia campestris                             | Summer Perennial Forb       |
| field sowthistle        | SOAR2                  | Sonchus arvensis                                 | Summer Perennial Forb(I)    |
| fireberry hawthorn      | CRCH                   | Crataegus chrysocarpa                            | Deciduous Shrub             |
| flax                    | LINUM                  | Linum                                            | Spring Perennial Forb       |



| <b>Common Name</b>      | <b>Accepted Symbol</b> | <b>Scientific Name</b>     | <b>Functional Group</b>     |
|-------------------------|------------------------|----------------------------|-----------------------------|
| fleabane                | ERIGE2                 | Erigeron                   | Summer Perennial Forb       |
| flexile milkvetch       | ASFL2                  | Astragalus flexuosus       | Summer Perennial Forb       |
| Flodman's thistle       | CIFL                   | Cirsium flodmanii          | Summer Perennial Forb       |
| foothill arnica         | ARFU3                  | Arnica fulgens             | Spring Perennial Forb       |
| fourwing saltbush       | ATCA2                  | Atriplex canescens         | Evergreen Shrub             |
| fowl bluegrass          | POPA2                  | Poa palustris              | Spring Midgrass             |
| foxtail barley          | HOJU                   | Hordeum jubatum            | Spring Shortgrass           |
| Gardner's saltbush      | ATGA                   | Atriplex gardneri          | Evergreen Subshrub          |
| goatsbeard              | TRAGO                  | Tragopogon                 | Summer Perennial Forb       |
| goldenaster             | CHRYS7                 | Chrysopsis                 | Summer Perennial Forb       |
| goldenrod               | SOLID                  | Solidago                   | Spring Perennial Forb       |
| goosefoots              | CHENO                  | Chenopodium                | Spring Annual Forb          |
| greasewood              | SAVE4                  | Sarcobatus vermiculatus    | Evergreen Shrub             |
| green ash               | FRPE                   | Fraxinus pennsylvanica     | Deciduous Tree              |
| green carpetweed        | MOVE                   | Mollugo verticillata       | Spring Annual Forb          |
| green dragon            | ARDR3                  | Arisaema dracontium        | Spring Perennial Forb       |
| green molly             | BAAM4                  | Kochia americana           | Evergreen Subshrub          |
| green needlegrass       | NAVI4                  | Nassella viridula          | Spring Midgrass             |
| groundplum milkvetch    | ASCR2                  | Astragalus crassicaarpus   | Spring Perennial Forb       |
| hairy false goldenaster | HEVI4                  | Heterotheca villosa        | Spring Perennial Forb       |
| hairy grama             | BOHI2                  | Bouteloua hirsuta          | Summer Shortgrass           |
| hardstem bulrush        | SCAC3                  | Schoenoplectus acutus      | Spring Perennial Grasslike  |
| Heller's rosette grass  | DIOL                   | Dichanthelium oligosanthes | Spring Midgrass             |
| herb sophia             | DESO2                  | Descurainia sophia         | Spring Annual Forb          |
| hoary fleabane          | ERCA4                  | Erigeron canus             | Summer Perennial Forb       |
| hoary puccoon           | LICA12                 | Lithospermum canescens     | Spring Perennial Forb       |
| Horsetail               | EQUIS                  | Equisetum                  | Spring Perennial Grasslike  |
| Indiangrass             | SONU2                  | Sorghastrum nutans         | Summer Tallgrass            |
| Indianhemp              | APCA                   | Apocynum cannabinum        | Summer Perennial Forb       |
| inland rush             | JUIN2                  | Juncus interior            | Spring Perennial Grasslike  |
| inland saltgrass        | DISP                   | Distichlis spicata         | Summer Rhizomatous Grass    |
| intermediate wheatgrass | THIN6                  | Thinopyrum intermedium     | Spring Rhizomatous Grass(I) |
| Japanese brome          | BRAR5                  | Bromus japonicus           | Spring Annual Grass(I)      |
| Juniper                 | JUNIP                  | Juniperus                  | Coniferous Tree             |
| Kentucky bluegrass      | POPR                   | Poa pratensis              | Spring Rhizomatous Grass(I) |
| knotweed                | POLYG4                 | Polygonum                  | Summer Perennial Forb       |
| kochia                  | BASC5                  | Kochia scoparia            | Spring Annual Forb(I)       |
| lacy tansyaster         | MAPI                   | Machaeranthera pinnatifida | Spring Perennial Forb       |
| lambquarters            | CHAL7                  | Chenopodium album          | Spring Annual Forb          |
| lambstongue ragwort     | SEIN2                  | Senecio integerrimus       | Spring Perennial Forb       |

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|------------------------|------------------------|------------------------------------|----------------------------|
| large Indian breadroot | PEES                   | Pediomelum esculentum              | Summer Perennial Forb      |
| leadplant              | AMCA6                  | Amorpha canescens                  | Deciduous Subshrub         |
| leafy spurge           | EUES                   | Euphorbia esula                    | Summer Perennial Forb(I)   |
| lemon scurfpea         | PSLA3                  | Psoralegium lanceolatum            | Spring Perennial Forb      |
| lesser spikemoss       | SEDE2                  | Selaginella densa                  | Fern                       |
| lettuce                | LACTU                  | Lactuca                            | Summer Annual Forb(I)      |
| lilac penstemon        | PEGR5                  | Penstemon gracilis                 | Spring Perennial Forb      |
| little barley          | HOPU                   | Hordeum pusillum                   | Spring Annual Grass        |
| little bluestem        | SCSC                   | Schizachyrium scoparium            | Summer Midgrass            |
| littleleaf pussytoes   | ANMI3                  | Antennaria microphylla             | Spring Perennial Forb      |
| littlepod false flax   | CAMI2                  | Camelina microcarpa                | Spring Annual Forb(I)      |
| locoweed               | OXYTR                  | Oxytropis                          | Spring Annual Forb         |
| longbract spiderwort   | TRBR                   | Tradescantia bracteata             | Summer Perennial Forb      |
| longleaf phlox         | PHLO2                  | Phlox longifolia                   | Spring Perennial Forb      |
| long-stolon sedge      | CAIN9                  | Carex inops                        | Spring Perennial Grasslike |
| Louisiana broomrape    | ORLU                   | Orobanche ludoviciana              | Summer Perennial Forb      |
| maidenstears           | SIVU                   | Silene vulgaris                    | Summer Perennial Forb(I)   |
| marsh muhly            | MURA                   | Muhlenbergia racemosa              | Spring Rhizomatous Grass   |
| mat muhly              | MURI                   | Muhlenbergia richardsonis          | Summer Rhizomatous Grass   |
| matted sandmat         | CHSE4                  | Chamaesyce serpens                 | Summer Annual Forb         |
| meadow zizia           | ZIAP                   | Zizia aptera                       | Spring Perennial Forb      |
| milfoil                | ACHIL                  | Achillea                           | Spring Perennial Forb      |
| milfoil wattle         | ACMI                   | Acacia millefolia                  | Deciduous Shrub            |
| milkvetch              | ASTRA                  | Astragalus                         | Spring Perennial Forb      |
| milkweed               | ASCLE                  | Asclepias                          | Spring Perennial Forb      |
| mint                   | MENTH                  | Mentha                             | Spring Perennial Forb(I)   |
| Missouri goldenrod     | SOMI2                  | Solidago missouriensis             | Summer Perennial Forb      |
| Missouri milkvetch     | ASMI10                 | Astragalus missouriensis           | Spring Perennial Forb      |
| Montana wheatgrass     | ELAL7                  | Elymus albicans                    | Summer Rhizomatous Grass   |
| mountain big sagebrush | ARTRV                  | Artemisia tridentata ssp. vaseyana | Evergreen Shrub            |
| mouse-ear chickweed    | CERAS                  | Cerastium                          | Summer Annual Forb(I)      |
| mustard                | BRASS2                 | Brassica                           | Spring Annual Forb(I)      |
| muttongrass            | POFE                   | Poa fendleriana                    | Spring Shortgrass          |
| Nailwort               | PARON                  | Paronychia                         | Summer Perennial Forb      |
| narrowleaf goosefoot   | CHLE4                  | Chenopodium leptophyllum           | Summer Annual Forb         |
| narrowleaf stoneseed   | LIIN2                  | Lithospermum incisum               | Spring Annual Forb         |
| needleandthread        | HECO26                 | Hesperostipa comata                | Spring Midgrass            |
| needleandthread        | HECOC8                 | Hesperostipa comata ssp. comata    | Spring Midgrass            |
| needlegrass            | HESPE11                | Hesperostipa                       | Spring Midgrass            |

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|----------------------------------|------------------------|-----------------------------|-------------------------------|
| needleleaf sedge                 | CADU6                  | Carex duriuscula            | Summer Perennial<br>Grasslike |
| New England aster                | SYNO2                  | Symphotrichum novae-angliae | Summer Perennial Forb         |
| nightshade                       | SOLAN                  | Solanum                     | Spring Perennial Forb         |
| northern bedstraw                | GABO2                  | Galium boreale              | Spring Perennial Forb         |
| Norwegian cinquefoil             | PONO3                  | Potentilla norvegica        | Summer Annual Forb            |
| Nuttall's alkaligrass            | PUNU2                  | Puccinellia nuttalliana     | Spring Rhizomatous<br>Grass   |
| Nuttall's saltbush               | ATNU2                  | Atriplex nuttallii          | Evergreen Shrub               |
| oak                              | QUERC                  | Quercus                     | Evergreen Tree                |
| obtuse sedge                     | CAOB4                  | Carex obtusata              | Summer Perennial<br>Grasslike |
| old man's whiskers               | GETR                   | Geum triflorum              | Spring Perennial Forb         |
| Onion spp.                       | ALLIU                  | Allium                      | Spring Perennial Forb         |
| Opuntia spp.                     | OPUNT                  | Opuntia                     | Cacti                         |
| orchardgrass                     | DAGL                   | Dactylis glomerata          | Spring Midgrass(I)            |
| other introduced annual<br>forbs | 2FA                    |                             | Spring Annual Forb(I)         |
| other native annual forbs        | 2FA                    |                             | Spring Annual Forb            |
| other native perennial<br>forbs  | 2FP                    |                             | Spring Perennial Forb         |
| pale agoseris                    | AGGL                   | Agoseris glauca             | Spring Perennial Forb         |
| pasqueflower                     | PULSA                  | Pulsatilla                  | Spring Perennial Forb         |
| peachleaf willow                 | SAAM2                  | Salix amygdaloides          | Deciduous Shrub               |
| Pennsylvania cinquefoil          | POPE8                  | Potentilla pensylvanica     | Summer Perennial Forb         |
| Pennsylvania sedge               | CAPE6                  | Carex pensylvanica          | Spring Perennial<br>Grasslike |
| pennycress                       | MICRO18                | Microthlaspi                | Spring Annual Forb(I)         |
| pennycress                       | THLAS                  | Thlaspi                     | Spring Perennial Forb(I)      |
| Penstemon spp.                   | PENST                  | Penstemon                   | Summer Perennial Forb         |
| pepperweed                       | LEPID                  | Lepidium                    | Spring Annual Forb            |
| Philadelphia fleabane            | ERPH                   | Erigeron philadelphicus     | Spring Perennial Forb         |
| phlox                            | PHLOX                  | Phlox                       | Spring Perennial Forb         |
| plains bluegrass                 | POAR3                  | Poa arida                   | Spring Rhizomatous<br>Grass   |
| plains milkvetch                 | ASGI5                  | Astragalus gilviflorus      | Spring Perennial Forb         |
| plains milkweed                  | ASPU                   | Asclepias pumila            | Summer Perennial Forb         |
| plains muhly                     | MUCU3                  | Muhlenbergia cuspidata      | Summer Midgrass               |
| plains pricklypear               | OPPO                   | Opuntia polyacantha         | Cacti                         |
| plains reedgrass                 | CAMO                   | Calamagrostis montanensis   | Summer Rhizomatous<br>Grass   |
| Plantago spp.                    | PLANT                  | Plantago                    | Spring Annual Forb            |
| porcupinegrass                   | HESP11                 | Hesperostipa spartea        | Spring Midgrass               |
| prairie bluebells                | MELA3                  | Mertensia lanceolata        | Spring Perennial Forb         |
| prairie cordgrass                | SPPE                   | Spartina pectinata          | Summer Tallgrass              |
| prairie dropseed                 | SPHE                   | Sporobolus heterolepis      | Summer Midgrass               |

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|-------------------------|------------------------|-------------------------------|-----------------------------|
| prairie fleabane        | ERST3                  | Erigeron strigosus            | Summer Annual Forb          |
| prairie Junegrass       | KOMA                   | Koeleria macrantha            | Spring Midgrass             |
| prairie rose            | ROAR3                  | Rosa arkansana                | Deciduous Subshrub          |
| prairie sagewort        | ARFR4                  | Artemisia frigida             | Evergreen Subshrub          |
| prairie sandreed        | CALO                   | Calamovilfa longifolia        | Summer Tallgrass            |
| prairie spiderwort      | TROC                   | Tradescantia occidentalis     | Summer Perennial Forb       |
| prairie thermopsis      | THRH                   | Thermopsis rhombifolia        | Spring Perennial Forb       |
| prairie threeawn        | AROL                   | Aristida oligantha            | Summer Midgrass             |
| prairie wedgescale      | SPOB                   | Sphenopholis obtusata         | Spring Annual Grass(I)      |
| prickly lettuce         | LASE                   | Lactuca serriola              | Spring Annual Forb(I)       |
| prickly rose            | ROAC                   | Rosa acicularis               | Deciduous Subshrub          |
| Prunus spp.             | PRUNU                  | Prunus                        | Deciduous Shrub             |
| purple dalea            | DALA4                  | Dalea lasiathera              | Spring Perennial Forb       |
| purple locoweed         | OXLA3                  | Oxytropis lambertii           | Summer Perennial Forb       |
| purple meadow-rue       | THDA                   | Thalictrum dasycarpum         | Spring Perennial Forb       |
| purple milkvetch        | ASAG2                  | Astragalus agrestis           | Spring Perennial Forb       |
| purple prairie clover   | DAPU5                  | Dalea purpurea                | Summer Perennial Forb       |
| purple threeawn         | ARPU9                  | Aristida purpurea             | Summer Midgrass             |
| Pursh seepweed          | SUCA2                  | Suaeda calceoliformis         | Summer Annual Forb          |
| pussytoes               | ANTEN                  | Antennaria                    | Spring Perennial Forb       |
| pygmyflower rockjasmine | ANSE4                  | Androsace septentrionalis     | Summer Annual Forb          |
| quackgrass              | ELRE4                  | Elymus repens                 | Spring Rhizomatous Grass(I) |
| rabbitbrush             | CHRYS9                 | Chrysothamnus                 | Evergreen Shrub             |
| rabbit-tobacco          | PSOB3                  | Pseudognaphalium obtusifolium | Summer Annual Forb          |
| ragweed                 | AMBRO                  | Ambrosia                      | Summer Annual Forb          |
| rayless alkali aster    | SYCI2                  | Symphyotrichum ciliatum       | Summer Annual Forb          |
| rayless sunflower       | HERA                   | Helianthus radula             | Summer Perennial Forb       |
| reed canarygrass        | PHAR3                  | Phalaris arundinacea          | Spring Rhizomatous Grass    |
| reedgrass               | CALAM                  | Calamagrostis                 | Summer Rhizomatous Grass    |
| rockcress               | ARABI2                 | Arabis                        | Spring Perennial Forb       |
| rockjasmine             | ANDRO3                 | Androsace                     | Summer Perennial Forb       |
| rose                    | ROSA5                  | Rosa                          | Deciduous Shrub             |
| rosy pussytoes          | ANRO2                  | Antennaria rosea              | Summer Perennial Forb       |
| rough bentgrass         | AGSC5                  | Agrostis scabra               | Summer Midgrass             |
| rough cocklebur         | XAST                   | Xanthium strumarium           | Spring Annual Forb          |
| rough false pennyroyal  | HEHI                   | Hedeoma hispida               | Summer Annual Forb          |
| rubber rabbitbrush      | ERNA10                 | Ericameria nauseosa           | Evergreen Shrub             |
| rush                    | JUNCU                  | Juncus                        | Spring Perennial Grasslike  |
| rush skeletonplant      | LYJU                   | Lygodesmia juncea             | Spring Perennial Forb       |
| Russian thistle         | SAKA                   | Salsola kali                  | Spring Annual Forb(I)       |
| saline saltbush         | ATSU2                  | Atriplex subspicata           | Spring Annual Forb          |
| sand bluestem           | ANHA                   | Andropogon hallii             | Summer Tallgrass            |

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|---------------------------------|------------------------|--------------------------|----------------------------|
| sand dropseed                   | SPCR                   | Sporobolus cryptandrus   | Summer Midgrass            |
| sand muhly                      | MUAR2                  | Muhlenbergia arenicola   | Summer Midgrass            |
| sand sagebrush                  | ARFI2                  | Artemisia filifolia      | Evergreen Shrub            |
| Sandberg bluegrass              | POSE                   | Poa secunda              | Spring Shortgrass          |
| sandcherry                      | PRPU3                  | Prunus pumila            | Deciduous Shrub            |
| sanddune wallflower             | ERCA14                 | Erysimum capitatum       | Spring Perennial Forb      |
| scaly blazing star              | LISQ                   | Liatris squarrosa        | Summer Perennial Forb      |
| scarlet beeblossom              | GACO5                  | Gaura coccinea           | Summer Perennial Forb      |
| scarlet globemallow             | SPCO                   | Sphaeralcea coccinea     | Spring Perennial Forb      |
| Schweinitz's flatsedge          | CYSC3                  | Cyperus schweinitzii     | Summer Perennial Grasslike |
| scouringrush horsetail          | EQHY                   | Equisetum hyemale        | Fern                       |
| scratchgrass                    | MUAS                   | Muhlenbergia asperifolia | Summer Rhizomatous Grass   |
| scurfpea                        | PSORA2                 | Psoralegium              | Spring Perennial Forb      |
| sedge                           | CAREX                  | Carex                    | Spring Perennial Grasslike |
| seepweed                        | SUAED                  | Suaeda                   | Evergreen Subshrub         |
| sheep fescue                    | FEOV                   | Festuca ovina            | Spring Midgrass            |
| shortawn foxtail                | ALAE                   | Alopecurus aequalis      | Spring Midgrass            |
| shortbeak sedge                 | CABR10                 | Carex brevior            | Spring Perennial Grasslike |
| shortbristle<br>needleandthread | HECU9                  | Hesperostipa curtiseta   | Spring Midgrass            |
| shy wallflower                  | ERIN7                  | Erysimum inconspicuum    | Spring Perennial Forb      |
| Siberian elm                    | ULPU                   | Ulmus pumila             | Deciduous Tree             |
| sideoats grama                  | BOCU                   | Bouteloua curtipendula   | Summer Midgrass            |
| silver buffaloberry             | SHAR                   | Shepherdia argentea      | Deciduous Shrub            |
| silver cinquefoil               | POAR8                  | Potentilla argentea      | Summer Perennial Forb(I)   |
| silver sagebrush                | ARCA13                 | Artemisia cana           | Evergreen Subshrub         |
| silverberry                     | ELCO                   | Elaeagnus commutata      | Deciduous Shrub            |
| silverleaf Indian breadroot     | PEAR6                  | Pediomelum argophyllum   | Summer Perennial Forb      |
| silverscale saltbush            | ATAR2                  | Atriplex argentea        | Summer Annual Forb         |
| silverweed cinquefoil           | ARAN7                  | Argentina anserina       | Spring Perennial Forb      |
| sixweeks fescue                 | VUOC                   | Vulpia octoflora         | Spring Annual Grass        |
| skeletonplant                   | LYGOD                  | Lygodesmia               | Spring Perennial Forb      |
| skullcap                        | SCUTE                  | Scutellaria              | Spring Annual Forb         |
| skunkbush sumac                 | RHTR                   | Rhus trilobata           | Deciduous Shrub            |
| slender goldenweed              | MAGR10                 | Machaeranthera gracilis  | Spring Annual Forb         |
| slender milkvetch               | ASGR3                  | Astragalus gracilis      | Spring Perennial Forb      |
| slender wheatgrass              | ELTR7                  | Elymus trachycaulus      | Spring Midgrass            |
| slimflower scurfpea             | PSTE5                  | Psoralegium tenuiflorum  | Summer Perennial Forb      |
| small geranium                  | GEPU2                  | Geranium pusillum        | Spring Annual Forb(I)      |
| small tumbleweed mustard        | SILO3                  | Sisymbrium loeselii      | Summer Annual Forb(I)      |
| small-flower fame flower        | PHPA29                 | Talinum parviflorum      | Summer Perennial Forb      |

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|---------------------------|------------------------|------------------------------|-----------------------------|
| small-leaf pussytoes      | ANPA4                  | Antennaria parvifolia        | Summer Perennial Forb       |
| smooth blue aster         | SYLA3                  | Symphotrichum laeve          | Summer Perennial Forb       |
| smooth brome              | BRIN2                  | Bromus inermis               | Spring Rhizomatous Grass(l) |
| smooth horsetail          | EQLA                   | Equisetum laevigatum         | Fern                        |
| smoothsheath sedge        | CALA14                 | Carex laevivaginata          | Summer Perennial Grasslike  |
| snowberry                 | SYMPH                  | Symphoricarpos               | Deciduous Shrub             |
| soapweed yucca            | YUGL                   | Yucca glauca                 | Monocot Shrub               |
| spiderwort                | TRADE                  | Tradescantia                 | Summer Perennial Forb       |
| spikeoat                  | AVHO3                  | Helictotrichon hookeri       | Spring Midgrass             |
| spiny phlox               | PHHO                   | Phlox hoodii                 | Spring Perennial Forb       |
| Sporobolus spp.           | SPORO                  | Sporobolus                   | Summer Midgrass             |
| Sprengel's sedge          | CASP7                  | Carex spengelii              | Spring Perennial Grasslike  |
| spurge                    | EUPHO                  | Euphorbia                    | Summer Perennial Forb       |
| stemless four-nerve daisy | TEAC                   | Tetraneuris acaulis          | Summer Perennial Forb       |
| stickseed                 | HACKE                  | Hackelia                     | Summer Perennial Forb       |
| stickseeds                | LAPPU                  | Lappula                      | Spring Annual Forb          |
| sticky cinquefoil         | POGL9                  | Potentilla glandulosa        | Spring Perennial Forb       |
| stickywilly               | GAAP2                  | Galium aparine               | Spring Annual Forb          |
| stiff goldenrod           | OLRI                   | Oligoneuron rigidum          | Summer Perennial Forb       |
| stiff sunflower           | HEPA19                 | Helianthus pauciflorus       | Summer Perennial Forb       |
| stiffstem flax            | LIRI                   | Linum rigidum                | Summer Annual Forb          |
| sunflower                 | HELIA3                 | Helianthus                   | Summer Annual Forb          |
| sweetclover               | MELIL                  | Melilotus                    | Spring Annual Forb(l)       |
| sweetclover               | MEOF                   | Melilotus officinalis        | Spring Annual Forb(l)       |
| switchgrass               | PAVI2                  | Panicum virgatum             | Summer Tallgrass            |
| tall cinquefoil           | POAR7                  | Potentilla arguta            | Summer Perennial Forb       |
| tall yellow sweetclover   | MEAL3                  | Melilotus altissimus         | Summer Perennial Forb(l)    |
| tanseyleaf tansyaster     | MATA2                  | Machaeranthera tanacetifolia | Spring Perennial Forb       |
| tansymustard              | DESCU                  | Descurainia                  | Spring Annual Forb          |
| tarragon                  | ARDR4                  | Artemisia dracunculus        | Summer Perennial Forb       |
| textile onion             | ALTE                   | Allium textile               | Spring Perennial Forb       |
| thickspike wheatgrass     | ELLA3                  | Elymus lanceolatus           | Spring Tallgrass            |
| thistle                   | CIRSI                  | Cirsium                      | Summer Perennial Forb       |
| threadleaf sedge          | CAFI                   | Carex filifolia              | Spring Perennial Grasslike  |
| Threeawn                  | ARIST                  | Aristida                     | Summer Midgrass             |
| trefoil                   | LOTUS                  | Lotus                        | Spring Perennial Forb       |
| triangle orache           | ATPR                   | Atriplex prostrata           | Summer Annual Forb          |
| trumpet flower            | COLLO                  | Collomia                     | Summer Annual Forb          |
| tumblegrass               | SCPA                   | Schedonnardus paniculatus    | Summer Midgrass             |
| tumblemustard             | THELY3                 | Thelypodopsis                | Spring Annual Forb          |
| twistspine pricklypear    | OPMA2                  | Opuntia macrorhiza           | Cacti                       |

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|----------------------------|------------------------|----------------------------------------|--------------------------|
| upright prairie coneflower | RACO3                  | Ratibida columnifera                   | Summer Perennial Forb    |
| velvety goldenrod          | SOMO                   | Solidago mollis                        | Summer Perennial Forb    |
| vetch                      | VICIA                  | Vicia                                  | Herbaceous Vine          |
| violet woodsorrel          | OXVI                   | Oxalis violacea                        | Spring Perennial Forb    |
| wallflower                 | ERYSI                  | Erysimum                               | Spring Perennial Forb    |
| wavyleaf thistle           | CIUN                   | Cirsium undulatum                      | Summer Perennial Forb    |
| western daisy fleabane     | ERBE2                  | Erigeron bellidiastrum                 | Summer Annual Forb       |
| western poison ivy         | TORY                   | Toxicodendron rydbergii                | Deciduous Subshrub       |
| western ragweed            | AMPS                   | Ambrosia psilostachya                  | Summer Perennial Forb    |
| western rockjasmine        | ANOC2                  | Androsace occidentalis                 | Summer Annual Forb       |
| western snowberry          | SYOC                   | Symphoricarpos occidentalis            | Deciduous Shrub          |
| western wheatgrass         | PASM                   | Pascopyrum smithii                     | Spring Rhizomatous Grass |
| Wheat                      | TRITI                  | Triticum                               | Spring Annual Grass(I)   |
| white ash                  | FRAM2                  | Fraxinus americana                     | Deciduous Tree           |
| white heath aster          | SYER                   | Symphyotrichum ericoides               | Summer Perennial Forb    |
| white pasqueflower         | PUOC                   | Pulsatilla occidentalis                | Spring Perennial Forb    |
| white penstemon            | PEAL2                  | Penstemon albidus                      | Spring Perennial Forb    |
| white prairie aster        | SYFA                   | Symphyotrichum falcatum                | Summer Perennial Forb    |
| white prairie clover       | DACA7                  | Dalea candida                          | Summer Perennial Forb    |
| white sagebrush            | ARLUL2                 | Artemisia ludoviciana ssp. ludoviciana | Spring Perennial Forb    |
| white sagebrush            | ARLU                   | Artemisia ludoviciana                  | Summer Perennial Forb    |
| white sweetclover          | MEOF                   | Melilotus alba                         | Spring Annual Forb(I)    |
| whitetop                   | CADR                   | Cardaria draba                         | Spring Perennial Forb(I) |
| whorled milkweed           | ASVE                   | Asclepias verticillata                 | Summer Perennial Forb    |
| whorled milkwort           | POVE                   | Polygala verticillata                  | Summer Annual Forb       |
| whorled milkwort           | POAM9                  | Polygala ambigua                       | Summer Annual Forb       |
| wild bergamot              | MOFI                   | Monarda fistulosa                      | Summer Perennial Forb    |
| wild mint                  | MEAR4                  | Mentha arvensis                        | Summer Perennial Forb    |
| wild oat                   | AVFA                   | Avena fatua                            | Spring Annual Grass(I)   |
| windflower                 | ANEMO                  | Anemone                                | Summer Perennial Forb    |
| winterfat                  | KRLA2                  | Krascheninnikovia lanata               | Evergreen Subshrub       |
| witchgrass                 | PACA6                  | Panicum capillare                      | Summer Annual Grass      |
| Woods' rose                | ROWO                   | Rosa woodsii                           | Deciduous Shrub          |
| woodsorrel                 | OXALI                  | Oxalis                                 | Spring Perennial Forb    |
| woolly plantain            | PLPA2                  | Plantago patagonica                    | Spring Annual Forb       |
| wormwood                   | ARAB3                  | Artemisia absinthium                   | Spring Perennial Forb(I) |
| Wyoming besseya            | BEWY                   | Besseya wyomingensis                   | Spring Perennial Forb    |
| yellow owl's-clover        | ORLU2                  | Orthocarpus luteus                     | Spring Annual Forb       |
| yellow salsify             | TRDU                   | Tragopogon dubius                      | Spring Annual Forb(I)    |
| yellow sundrops            | CASE12                 | Calylophus serrulatus                  | Summer Perennial Forb    |
| Yucca spp.                 | YUCCA                  | Yucca                                  | Monocot Shrub            |

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