Ecological site R043AX974MT
Montane Swale Drummond's willow (Salix drummondii)-alderleaf buckthorn (Rhamnus alnifolia)

Last updated: 9/08/2023
Accessed: 04/24/2024

General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

MLRA notes

Major Land Resource Area (MLRA): 043A–Northern Rocky Mountains

This MLRA is located in Montana (43 percent), Idaho (34 percent), and Washington (23 percent). It makes up about 31,435 square miles (81,460 square kilometers). It has no large cities or towns. It has many national forests, including the Okanogan, Colville, Kootenai, Lolo, Flathead, Coeur d'Alene, St. Joe, Clearwater, and Kaniksu National Forests.

This MLRA is in the Northern Rocky Mountains Province of the Rocky Mountain System. It is characterized by rugged, glaciated mountains; thrust- and block-faulted mountains; and hills and valleys. Steep-gradient rivers have cut deep canyons. Natural and manmade lakes are common.

The major Hydrologic Unit Areas (identified by four-digit numbers) that make up this MLRA are: Kootenai-Pend Oreille-Spokane (1701), 67 percent; Upper Columbia (1702), 18 percent; and Lower Snake (1706), 15 percent. Numerous rivers originate in or flow through this area, including, the Sanpoil, Columbia, Pend Oreille, Kootenai, St. Joe, Thompson, and Flathead Rivers.

This area is underlain primarily by stacked slabs of layered sedimentary or metasedimentary bedrock. The bedrock formations range from Precambrian to Cretaceous in age. The rocks consist of shale, sandstone, siltstone, limestone, argillite, quartzite, gneiss, schist, dolomite, basalt, and granite. The formations have been faulted and stacked into a series of imbricate slabs by regional tectonic activity. Pleistocene glaciers carved a rugged landscape that includes sculpted hills and narrow valleys filled with till and outwash. Continental glaciation over road the landscape in the northern half of the MLRA while glaciation in the southern half was confined to montane settings.

The average annual precipitation is 25 to 60 inches (635 to 1,525 millimeters) in most of this area, but it is as much as 113 inches (2,870 millimeters) in the mountains and is 10 to 15 inches (255 to 380 millimeters) in the western part of the area. Summers are dry. Most of the precipitation during fall, winter, and spring is snow. The average annual temperature is 32 to 51 degrees F (0 to 11 degrees C) in most of the area, decreasing with elevation. In most of the area, the freeze-free period averages 140 days and ranges from 65 to 215 days. It is longest in the low valleys of Washington, and it decreases in length with elevation. Freezing temperatures occur every month of the year on high mountains, and some peaks have a continuous cover of snow and ice.

The dominant soil orders in this MLRA are Andisols, Inceptisols, and Alfisols. Many of the soils are influenced by Mount Mazama ash deposits. The soils in the area have a frigid or cryic soil temperature regime; have an ustic, xeric, or udic soil moisture regime; and dominantly have mixed mineralogy. They are shallow to very deep, are very poorly drained to well drained, and have most of the soil texture classes. The soils at the lower elevations include Udivitrands, Vitrixerands and Haplustalfs. The soils at the higher elevations include Dystrocryepts, Eutrocryepts, Vitricryands , and Haplocryalfs. Cryorthents, Cryepts, and areas of rock outcrop are on ridges and peaks above timberline

This area is in the northern part of the Northern Rocky Mountains. Grand fir, Douglas-fir, western red cedar, western hemlock, western larch, lodgepole pine, subalpine fir, ponderosa pine, whitebark pine, and western white pine are the dominant overstory species, depending on precipitation, temperature, elevation, and landform aspect. The understory vegetation varies, also depending on climatic and landform factors. Some of the major wildlife species in this area are whitetailed deer, mule deer, elk, moose, black bear, grizzly bear, coyote, fox, and grouse. Fish, mostly in the trout and salmon families, are abundant in streams, rivers, and lakes.

More than one-half of this area is federally owned and administered by the U.S. Department of Agriculture, Forest Service. Much of the privately-owned land is controlled by large commercial timber companies. The forested areas are used for wildlife habitat, recreation, watershed, livestock grazing, and timber production. Meadows provide summer grazing for livestock and big game animals. Less than 3 percent of the area is cropland.

LRU notes

This ecological site resides in MLRA 43A in the Livingston-Lewis-Apgar Mountains which includes the bulk of Glacier National Park (GNP) and the lower western valley portions along the Flathead River. The landscape is mountains and landforms include glaciated mountains with associated features such as U-shaped valleys, mountain slopes, alpine ridges, cirques, valley floors and moraines. Glaciation of this area was in the form of alpine, icecaps and valley outlet glaciers. It also includes associated alluvium and outwash features. This area includes low valleys to tall mountains with elevation ranging 989-2,762 m (3,250-9,050 ft.). The climate is cold and wet with mean annual air temperature of 3 degrees Celsius (37 degrees F.), mean frost free days of 65 days and mean annual precipitation of 1295 mm (51 in.) and relative effective annual precipitation is 169 cm (66 in.). The soil temperature regime is cryic and the soil moisture regime is udic. The geology of this area is dominated by metasedimentary rocks of the Belt Supergroup (Grinnell argillite and Siyeh limestone) with minor Tertiary sediments. Soils are generally weakly developed on mountain slopes within U-shaped valleys. Parent materials are commonly of colluvium, till, and residuum from metasedimentary rocks. Limestone bedrock within this part of the Belt Supergroup is not highly calcareous and due to high precipitation received in this area most carbonates at mid and upper elevations have been leached from the soil profiles. Bedrock depth varies greatly with location, landform and slope position. Volcanic ash is often found in the soil surface with various degrees of mixing. Thicker volcanic ash can be found on more stable positions on mid and upper elevation slopes that are protected from wind erosion. Volcanic ash is not typically found in low elevation areas on stream and outwash terraces associated with streams and rivers. There are numerous large lakes including St. Mary, Bowman, Kintla, Lake Sherburne, Logging, Upper Waterton and numerous creeks (

Classification relationships

NPS Plant Community Name: *Salix drummondiana* Temporarily Flooded Shrubland Alliance (*Salix drummondiana*/*Calamagrostis canadensis* Shrubland) CEGL002667.

Ecological site concept

Ecological Site Concept
These sites are primarily in swales or drainageways on glacial moraines or glacial valley floors, but can also occur in sloughs in floodplains. Shrubby swale sites are dominated by the tall statured shrub Drummond's willow (*Salix drummondiana*). Other willows, particularly Booths willow (*Salix boothii*) and Bebbs willow (*Salix bebbiana*) other shrub species including twinberry honeysuckle (*Lonicera involucrata*), alderleaf buckthorn (*Rhamnus alnifolia*), prickly currant (*Ribes lacustre*) and common snowberry (*Symphoricarpos albus*) can be present at the site. On hummocks within the understory of the willow dominated swale, moss species dominate along with obligate wetland species purple marshlocks (*Comarum palustre*), bog laurel (*Kalmia polifolia*) and dwarf red blackberry (*Rubus pubescens*). The understory is generally dominated by the grasses, bluejoint (*Calamagrostis canadensis*), mountain brome (*Bromus marginatus*) and rough bentgrass (*Agrostis scabra*), with a variety of sedge species including smallwing sedge (*Carex microptera*) and golden sedge (*Carex aurea*). A variety of forbs are present including fireweed (*Chamerion angustifolium*), field horsetail (*Equisetum arvense*), fragrant bedstraw (*Galium triflorum*), common cowparsnip (*Heracleum maximum*), feathery false lily of the valley (*Maianthemum racemosum*), wild mint (*Mentha arvensis*), western sweetroot (*Osmorhiza occidentalis*), alpine leafybract aster (*Symphyotrichum foliaceum*), western meadow-rue (*Thalictrum occidentale*), stinging nettle (*Urtica dioica*) and American vetch (*Vicia americana*). When this ecological site is found near the vicinity of a beaver dam, then the water table will be higher,

ponding will last for a longer duration and the understory will be dominated by the sedges Northwest Territory sedge (*Carex utriculata*) and or shortstalk sedge (*Carex podocarpa*). Soils found on these sites are very deep, very poorly to somewhat poorly drained and have a water table that fluctuates seasonally. Soils are typically mostly mineral soils, but organic material may be present although not in enough thickness to classify the soils in the Histosols soil order. The soil parent material is typically alluvium, outwash or till derived from metamorphic and sedimentary rock. The ground surface usually has high litter cover and very low bare soil due to the abundant vegetation cover. These soils are within the following taxonomic subgroups: Oxyaquic Argicryolls, Typic Cryaqualfs, and Cryaquents. Diagnostic features include a dark mollic epipedon or an ochric epipedon, a zone of clay accumulation in an argillic horizon, and endosaturation and/or a reduced matrix due to the presence of a water table. Soils that have more of an organic surface layer may also have fibric soil materials. Clay at the surface ranges 20-23 percent, while within 20 cm of the surface clay content ranges higher from 23-38 percent. Organic layer thickness covering the surface ranges 2-5 cm in thickness.

Associated sites

F043AX951MT	**Lower Subalpine Cool Dry Coniferous subalpine fir- Engelmann spruce/ Sitka alder/ thinleaf huckleberry/ common beargrass** 43A Lower Subalpine Coniferous Cool Moderately Dry, (ABLA/CLUN2-XETE) ecological site is found in cool, moderately dry mid-elevations that span the lower subalpine areas. It is found primarily on lateral moraine and glacial valley wall landforms, on back or footslope positions, at elevations ranging 1,000 to 2,100 meters (3,300-6,900 feet), on all aspects and on moderate to steep slopes ranging 10-35 percent.The 43A Lower Subalpine Coniferous Cool Moderately Dry, (ABLA/CLUN2-XETE) site has soils associated with this Ecological Site that are very deep and well drained. These soils have developed in glacial till or colluvium parent materials derived from metasedimentary rock that typically have varying amounts of influence of volcanic ash in the soil surface layers. The dominant taxonomic soil order associated with these soils is Inceptisols with Andic subgroups indicating that there is 18 to 37 (7-14.5 inches) centimeters of volcanic ash. The 43A Lower Subalpine Coniferous Cool Moderately Dry, (ABLA/CLUN2-XETE) ecological site has a reference vegetation community with an overstory of subalpine fir and Engelmann spruce with an understory of Sitka alder, huckleberry, beargrass and queencup bead lily.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Salix drummondiana* (2) *Rhamnus alnifolia*
Herbaceous	(1) *Calamagrostis canadensis* (2) *Equisetum arvense*

Physiographic features

These sites are primarily in swales or drainageways on glacial moraines or glacial valley floors, but can also occur in sloughs in floodplains. They are mineral soils with little or no surface organic layer accumulated in the upper horizons of the soil pedon. The soils associated with this vegetation community are generally silt deposits from overbank deposition that have a moderately high water table (27-39 inches), and most roots occur in the top 6 inches (Windell, 1986). Soils in areas with tertiary or cretaceous deposits often have an increase in clay that causes seasonal floods or ponding as well as directs flow creating a linear pattern on the moraine landforms. This ecological site is commonly found on margins of ponds or lakes within a larger riparian area, point bars of active large rivers, below beaver ponds, within old beaver ponds that have drained, or in abandoned channels (Cooper, 2006). These soils are saturated by spring floods but can have ground water well below the surface during parts of the growing season. Hansen (1995) found the Drummond’s willow/bluejoint habitat type to be found adjacent to waterways or in broad valleys. Soils nearest floodplains are frequently poorly developed, contain high percentages of gravel and cobbles, are generally coarse textured, and have moderate stream gradients which lead to rapid movement of highly aerated groundwater. In broad valleys silt to clay loam textures tend to be dominant with water tables ranging from the surface to greater than 1 m (39 inches) deep during the growing season. Redoximorphic features are common throughout the soil profile.

Figure 1. Landscape view of site.

Figure 2. Landscape view of ecological site.

Table 2. Representative physiographic features

Landforms	(1) Mountains > Drainageway (2) Mountains > Glacial-valley floor (3) Mountains > Flood plain (4) Mountains > Ground moraine (5) Mountains > Landslide
Flooding duration	Long (7 to 30 days)
Flooding frequency	None to occasional
Ponding duration	Long (7 to 30 days)
Ponding frequency	None to frequent
Elevation	3,280–6,561 ft
Slope	5–15%
Water table depth	0–39 in
Aspect	W, NW, N, NE, E, SE, S, SW

Climatic features

This ecological site is found in the cryic soil temperature regime and the aquic soil moisture regime. Cryic soils have average annual temperature of less than 8 degrees C, with less than 5 degrees C difference from winter to summer. Aquic soil moisture regimes are a reducing regime in a soil that is virtually free of dissolved oxygen because it is saturated by water. These soils have a water table at or near the surface for much year, except during summer. This site is found on the west side of the Continental Divide which has more maritime weather influences, and in smaller areas east of the Continental Divide which has a more continental weather influences.

WEST GLACIER CLIMATE STATION:
Mean Average Precipitation 26-69 inches
Mean Average Annual Temperature 32-43 degrees
Frost-free days: 50-70 days

Table 3. Representative climatic features

Frost-free period (characteristic range)	17-57 days
Freeze-free period (characteristic range)	76-117 days
Precipitation total (characteristic range)	20-26 in
Frost-free period (actual range)	6-68 days
Freeze-free period (actual range)	66-127 days
Precipitation total (actual range)	20-28 in
Frost-free period (average)	37 days
Freeze-free period (average)	97 days
Precipitation total (average)	23 in

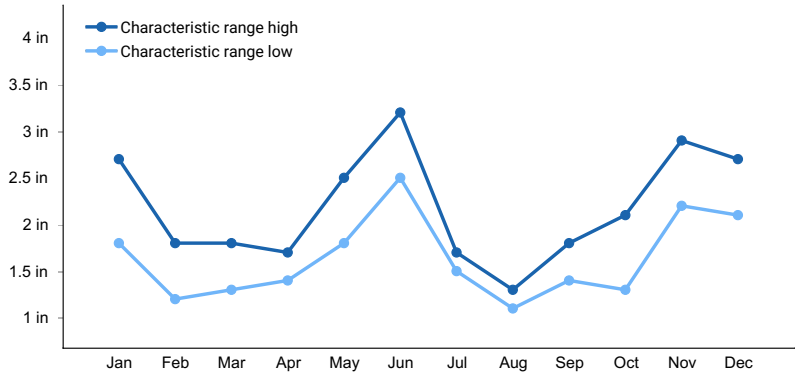


Figure 3. Monthly precipitation range

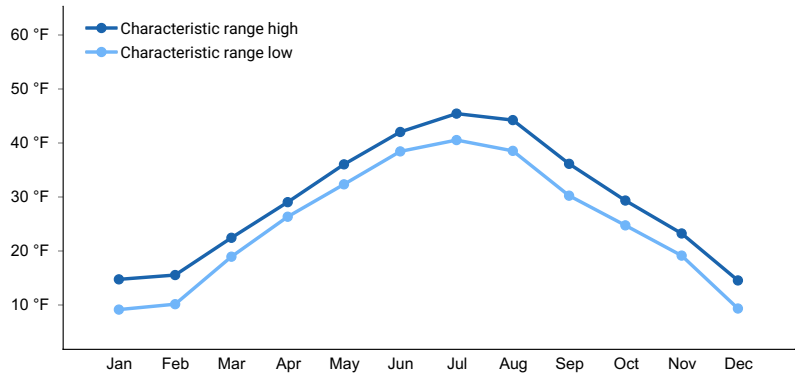


Figure 4. Monthly minimum temperature range

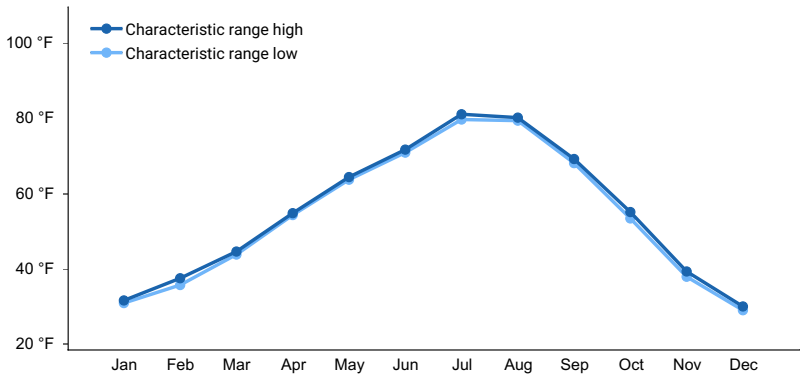


Figure 5. Monthly maximum temperature range

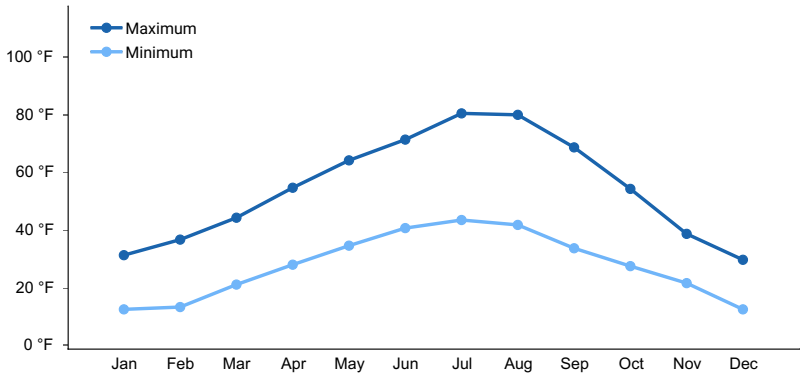


Figure 6. Monthly average minimum and maximum temperature

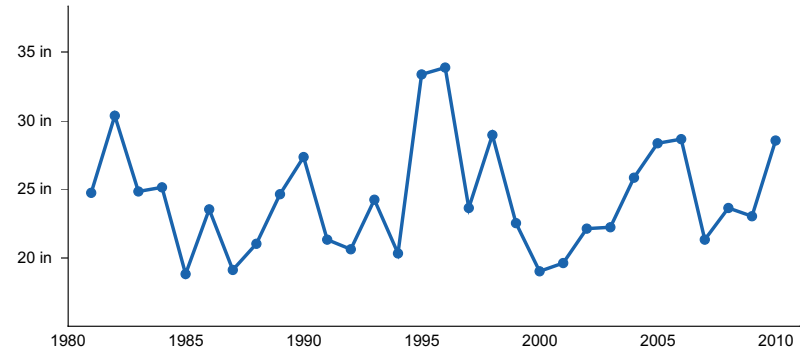


Figure 7. Annual precipitation pattern

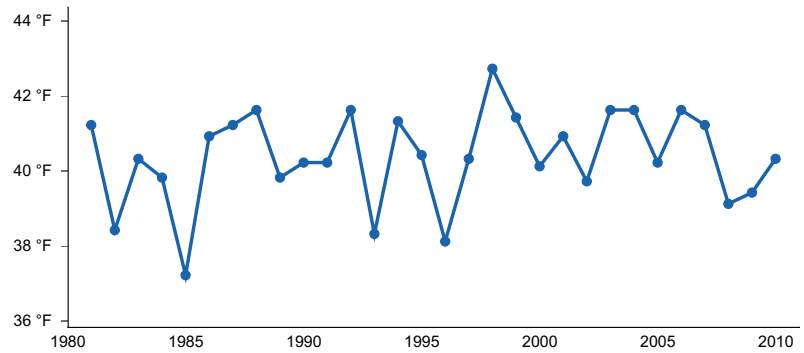


Figure 8. Annual average temperature pattern

Climate stations used

- (1) POLEBRIDGE 1 N [USC00246618], Essex, MT
- (2) POLEBRIDGE [USC00246615], Essex, MT
- (3) WEST GLACIER [USC00248809], Kalispell, MT

Influencing water features

There is flooding and ponding at this site. The flooding frequency is occasional with long duration during the months of April through June. The ponding is frequent with long duration during the months of April through June. The depth of ponding is 0-12 cm. The water table depth fluctuates from 24 to 39 inches and is seasonal from April through July.

Under the hydrologic system classification defined by Cowardin (1979), this ecological site fits the following categories System=palustrine; Class-scrub-shrub; Subclass-broadleaved deciduous; Water Regime (nontidal)=seasonally flooded to saturated to temporarily flooded. (Cowardin, 1979)

Wetland description

System=palustrine; Class-scrub-shrub; Subclass-broadleaved deciduous; Water Regime (nontidal)=seasonally flooded to saturated to temporarily flooded. (Cowardin, 1979)

Soil features

These sites are primarily in swales or drainageways on glacial moraines or glacial valley floors, but can also occur in sloughs in floodplains. Soils found on these sites are very deep, very poorly to somewhat poorly drained and have a water table that fluctuates seasonally. Soils are typically mostly mineral soils, but organic material may be present although not in enough thickness to classify the soils in the Histosols soil order. The soil parent material is typically alluvium, outwash or till derived from metamorphic and sedimentary rock. The ground surface usually has high litter cover and very low bare soil due to the abundant vegetation cover. These soils are within the following taxonomic subgroups: Oxyaquic Argicryolls, Typic Cryaqualfs, and Cryaquents. Diagnostic features include a dark mollic epipedon or an ochric epipedon, a zone of clay accumulation in an argillic horizon, and endosaturation and/or a reduced matrix due to the presence of a water table. Soils that have more of an organic surface layer may also have fibric soil materials. Clay at the surface ranges 20-23 percent, while within 20 cm of the surface clay content ranges higher from 23-38 percent. Organic layer thickness covering the surface ranges 2-5 cm in thickness. (Soil Survey Staff, 2015). For more information on soil taxonomy, please follow this link: http://http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/class/?cid=nrcs142p2_053580

SOIL SERIES: CROWNMOUNTAIN, IPASHA, TYPIC CRYAQUENTS
OLD SOIL SERIES NAMES: TYPIC CRYAQUENTS WAS OTOKOMI
SOIL TAXONOMY:
CROWNMOUNTAIN Fine, mixed, superactive Oxyaquic Argicryolls
IPASHA Fine-loamy, mixed, superactive Argic Cryaquolls
TYPIC CRYAQUENTS Loamy-skeletal, mixed, superactive, nonacid Typic Cryaquents

Figure 9. Soils associated with this ecological site.

Table 4. Representative soil features

Parent material	(1) Alluvium–metasedimentary rock (2) Mass movement deposits–metasedimentary rock
Surface texture	(1) Peaty loam (2) Loam
Family particle size	(1) Fine (2) Fine-loamy (3) Loamy-skeletal
Drainage class	Very poorly drained to poorly drained
Permeability class	Moderately slow to moderate
Soil depth	Not specified
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (3.8-7.5in)	Not specified
Soil reaction (1:1 water) (4.5-6.8in)	Not specified

Ecological dynamics

Ecological Dynamics of the Site
This ecological site is primarily in swales or drainageways on glacial moraines or glacial valley floors, but can also occur in sloughs in floodplains. These shrubby swales are within the lower subalpine lifezone which includes the subalpine fir (*Abies lasiocarpa*)-Engelmann spruce (*Picea engelmannii*) ecological zone and within these cool habitats are not restricted to streamsides but also occupy moist, well-aerated soils of meadows, broad valley bottoms, side slope seeps and stream and pond margins (Boggs, 1990).

STATE 1.0
These shrubby swales are within the subalpine fir (*Abies lasiocarpa*)-Engelmann spruce (*Picea engelmannii*) ecological zone and within these cool habitats are not restricted to streamsides but also occupy moist, well-aerated soils of meadows, broad valley bottoms, side slope seeps and stream and pond margins (Boggs, 1990). Shrubby swale sites are dominated by the tall statured shrub Drummond's willow (*Salix drummondiana*). Drummond's willow is a deciduous shrub generally between 6.5 and 13 feet tall (Hitchcock, 1964). Other willows, particularly Booth's willow (*Salix boothii*) and Bebb's willow (*Salix bebbiana*) other shrub species including twinberry honeysuckle (*Lonicera involucrata*), alderleaf buckthorn (*Rhamnus alnifolia*), prickly currant (*Ribes lacustre*) and common snowberry (*Symphoricarpos albus*) can be present at the site. Though infrequent, other shrubs may represent a high cover percent including rose species, redosier dogwood (*Cornus sericea* ssp. sericea), Sitka alder (*Alnus viridis* ssp. sinuata), russet buffaloberry (*Shepherdia canadensis*) and American red raspberry (*Rubus idaeus*). On hummocks within the understory of the willow dominated swale, moss species dominate along with obligate wetland species purple marshlocks (*Comarum palustre*), bog laurel (*Kalmia polifolia*) and dwarf red blackberry (*Rubus pubescens*). The understory is generally dominated by the grasses, bluejoint (*Calamagrostis canadensis*), mountain brome (*Bromus marginatus*) and rough bentgrass (*Agrostis scabra*), with a variety of sedge species including smallwing sedge (*Carex microptera*) and golden sedge (*Carex aurea*). A variety of forbs are present including fireweed (*Chamerion angustifolium*), field horsetail (*Equisetum arvense*), fragrant bedstraw (*Galium triflorum*), common cowparsnip (*Heracleum maximum*), feathery false lily of the valley (*Maianthemum racemosum*), wild mint (*Mentha arvensis*), western sweetroot (*Osmorhiza occidentalis*), alpine leafybract aster (*Symphyotrichum foliaceum*), western meadow-rue (*Thalictrum occidentale*), stinging nettle (*Urtica dioica*) and American vetch (*Vicia americana*). When this ecological site is found near the vicinity of a beaver dam, then the water table will be higher, ponding will last for a longer duration and the understory will be dominated by the sedges Northwest Territory sedge (*Carex utriculata*) and or shortstalk sedge (*Carex podocarpa*).

Drummond's willow is a prolific seed producer and colonizes recently scoured alluvial surfaces (Haeussler, 1986). Over time, fine particulate matter and litter collect beneath willows eventually raising the water table above the annual flood stage and grasses develop in the understory. This ecological site is maintained by occasional flooding

and or frequent ponding of the site. If water table balance changes significantly, then species changes can occur to transition the community phase from the reference phase of this ecological site. If flooding, ponding or water table increase then sedge species may increase and outcompete grasses, forbs and willows. If flooding, ponding or water table decrease then upland plant species including shrubs, grasses and conifers will invade, establish and increase in numbers. Beavers are important to the health of wetlands by creating dams and ponds which aid in controlling channel down-cutting, streambank erosion, and downstream movement of sediment. Dams raise the water table and trap sediments creating a broad wetland environment.
In a study of willow establishment within Rocky Mountain N.P., Cooper (2006) found that landform and effective flood regime determined establishment patterns and that climate change could effect this process. Specifically, willows established on point bar landforms that were formed from meandering streams and had moderate to high flood flows (2-5 year return interval flow) and had continuous establishment at intermediate elevations above channel. Abandoned beaver ponds created when beaver ponds drained, needed infrequent large flood event (>5 year return interval flow) and had periodic establishment prior to dam breach and brief episodes of widespread establishment following abandonment. The establishment was at high elevations relative to the active channel. Abandoned channels, created by channel avulsion, were associated with moderate to high effective flood flows (2-5 year return interval flow) and willow establishment was continuous over limited period of time (as oxbow fills). The establishment was at low to moderate elevations relative to active channel.
While fire is relatively infrequent in the moist habitats that this ecological site is found within, it can occur during dry conditions. Drummond's willow vigorously resprouts following fire, therefore prescribed fire is an effective method of rejuvenating decadent stands (Boggs, 1990). Drummond's willow will sprout from root crown following top kill by fire. Quick, hot fires increase sprouting response of willows. The wind dispersed seed is an important colonizer of burned areas. Therefore, Drummond's willow is a "survivor" species and an off-site colonizer species in response to fire.
Overgrazing by wildlife or livestock can reduce vigor of this ecological site and result in willows of uneven stem age distribution, highlining, clubbing or dead clumps. The understory structure would also change with overgrazing. There would be a reduction in bluejoint and tufted hairgrass (*Deschampsia cespitosa*) and an increase in stinging nettles and field horsetail.
This ecological site is important to wildlife. Moose consume large amounts of Drummond's willow in the winter (Chadde, 1988). Elk and white-tailed deer have light use of willow. Drummond's willow is palatable to livestock and big game, even though its protein value is poor and energy value is fair. Plants can recover well after overgrazing, if grazing and browsing are excluded for a period of time (Chadde, 1988). Drummond's willow creates thickets from 8 to twelve feet high and provide cover for songbirds.

COMMUNITY PHASE 1.1:
Drummond's willow (Salix drummondii)-Alderleaf buckthorn (*Rhamnus alnifolia*)/bluejoint (*Calamagrostis canadensis*)/field horsetail (*Equisetum arvense*).

Summarization of canopy cover of species present at community phase 1.1 of this ecological site, including constancy and average canopy cover value, 8 sites (includes 4 NPS original site data and 4 NRCS revisits and 4 NRCS only sites). Species with high constancy occur often, those with low constancy are rare. The average canopy cover is the average of the values for which it occurred. Therefore, species that are rare (only occurred once) show the canopy cover value for the one time it was found. Minimum and maximum canopy cover show the range of cover that the species was found. Drummond's willow is the indicator species with very high frequency and canopy cover. Other frequently occurring species include common snowberry, alderleaf buckthorn, field horsetail, and bluejoint.

Summarization of total annual production by species in pounds per acre for the reference community (1.1) of this ecological site, 8 sites. Drummond's willow dominates this ecological site in average annual production with secondary species including stinging nettles and bluejoint. At one site only, Northwest Territory sedge dominated the understory.

TOTAL ANNUAL PRODUCTION 1925#/acre-(4367#/acre was a particularly lush site of *Salix drummondiana* overstory with *Carex utriculata* understory)

Community Pathways

1.1a- Fire disturbance leading top-kill and then resprouting of shrub species and bluejoint; establishment of post-fire colonizers (fireweed). Low severity, fast moving fire which does not severely affect shrub and grasses growing

points allows these shrubs and bluejoint grass to resprout. The bare mineral soil is also capable of sustaining colonizing herbaceous species that are wind driven onto the site.

1.2a-Time without disturbance transitioning shrub resprouts to mature shrubs; diversification of understory species. The post-fire disturbance vegetation community of resident shrub species and bluejoint grass continue to grow to maturing and herbaceous colonizing species such as fireweed gradually reduce their understory dominance as other forb and grass species are introduced or longer duration growing forbs reestablish.

1.1b-Overgrazing and/or overbrowsing of plants reducing vigor and change shrub structure leading to a reduction in vigor and changing species composition away from (reduction) of palatable species such as bluejoint to less palatable species such as stinging nettles and field horsetail.

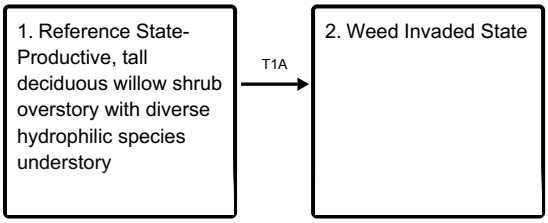
1.3a-Rest from grazing and/or browsing which allows the species composition and vigor to return to the reference community by allowing the recovery of bluejoint and shrub species.

T1A Overgrazing and overbrowsing; change in hydrology leading to drier site conditions; introduction, establishment and dominance of weeds.

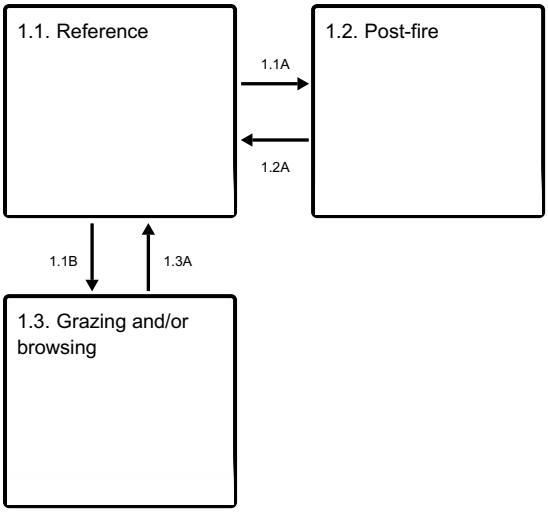
STATE 2
This state has sustained prolonged and/or intensive overgrazing by livestock and/or overbrowsing by wildlife particularly moose and elk. Ungulate grazing would be considered within the range of normal functioning disturbances (Community Phase 1.3) that may change some species composition but is considered capable of returning to the reference phase, if it were light grazing, seasonal or rotational, did not lead to extensive trailing, wallowing or cut banking of flow through channels within the swale or drainageway. Ungulate hoof action can break up the soil, which can lead to unvegetated microsites conducive to weed species establishment (if seed propagules are present); in addition, pugging and hummocking can create some surface flow patterns which may accelerate water loss from the swale. Urine and feces can change nutrient concentration as well. If the ungulate use is low, then it is viewed as normally functioning. The saturated soils likely are susceptible to trampling and compaction though high water tables throughout the growing season tend to limit access by livestock and thereby reduce impacts. If the ungulate use is high, concentrated or during sensitive periods of plant growth, the impact can be severe and cause a state change by affecting soil compaction, water loss through trailing, pugging, hummocking changing surface flow patterns, severe changes in nutrient concentration through very high levels of urine and feces as well. These disturbances also could be exacerbated by drought or other disturbances higher upslope in the watershed that affect surface sheet flow. A state change has occurred when montane weed species dominate the vegetation community with a concomitant reduction in the reference community species of Drummond’s willow, Sitka willow, Booth’s willow, prickly current, Sitka alder, and bluejoint.

State and transition model

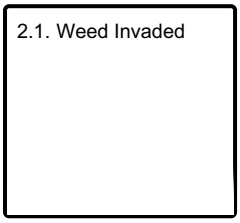
Ecosystem states



State 1 submodel, plant communities



State 2 submodel, plant communities



State 1
Reference State-Productive, tall deciduous willow shrub overstory with diverse hydrophilic species understory

Montane swale sites are dominated by the tall statured shrub Drummond's willow (*Salix drummondiana*). Drummond's willow is a deciduous shrub generally between 2-4 m or 6.5 and 13 feet tall (Hitchcock, 1964). Other willows, particularly Booth's willow (*Salix boothii*) and Bebb's willow (*Salix bebbiana*) other shrub species including twinberry honeysuckle (*Lonicera involucrata*), alderleaf buckthorn (*Rhamnus alnifolia*), prickly currant (*Ribes lacustre*) and common snowberry (*Symphoricarpos albus*) can be present at the site. Though infrequent, other shrubs may represent a high cover percent including rose species, redosier dogwood (*Cornus sericea* ssp. sericea), Sitka alder (*Alnus viridis* ssp. sinuata), russet buffaloberry (*Shepherdia canadensis*) and American red raspberry (*Rubus idaeus*). On hummocks within the understory of the willow dominated swale, moss species dominate along with obligate wetland species purple marshlocks (*Comarum palustre*), bog laurel (*Kalmia polifolia*) and dwarf red blackberry (*Rubus pubescens*). The understory is generally dominated by the grasses, bluejoint (*Calamagrostis canadensis*), mountain brome (*Bromus marginatus*) and rough bentgrass (*Agrostis scabra*), with a variety of sedge species including smallwing sedge (*Carex microptera*) and golden sedge (*Carex aurea*). A variety of forbs are present including fireweed (*Chamerion angustifolium*), field horsetail (*Equisetum arvense*), fragrant bedstraw (*Galium triflorum*), common cowparsnip (*Heracleum maximum*), feathery false lily of the valley (*Maianthemum racemosum*), wild mint (*Mentha arvensis*), western sweetroot (*Osmorhiza occidentalis*), alpine leafybract aster (*Symphyotrichum foliaceum*), western meadow-rue (*Thalictrum occidentale*), stinging nettle (*Urtica dioica*) and American vetch (*Vicia americana*). When this ecological site is found near the vicinity of a beaver dam, then the water table will be higher, ponding will last for a longer duration and the understory will be dominated by the sedges Northwest Territory sedge (*Carex utriculata*) and or shortstalk sedge (*Carex podocarpa*). Beaver damming, within the areas that do have some water flow in channels, can lead to changes in plant species composition by flooding one area and concomitantly drying another. These are viewed as naturally functioning disturbances that would lead to ponding and inundation of an area and therefore drying of another area. Presence of beaver damming would potentially lead to a mosaic effect on the plant communities potentially as opposed to the typical willow swale vegetation within a larger landscape of conifer dominated environment. Drummond's willow is a prolific seed producer and colonizes recently scoured alluvial surfaces (Haeussler, 1986). Over time, fine particulate matter and litter collect beneath willows eventually raising the water table above the annual flood stage and grasses develop in the understory. This ecological site is maintained by occasional flooding and or frequent ponding of the site. If water table balance changes significantly, then species changes can occur to transition the community phase from the reference phase of this ecological site. If flooding, ponding or water table increase then sedge species may

increase and outcompete grasses, forbs and willows. If flooding, ponding or water table decrease then upland plant species including shrubs, grasses and conifers will invade, establish and increase in numbers. Beavers are important to the health of wetlands by creating dams and ponds which aid in controlling channel down-cutting, streambank erosion, and downstream movement of sediment. Dams raise the water table and trap sediments creating a broad wetland environment. In a study of willow establishment within Rocky Mountain N.P., Cooper (2006) found that landform and effective flood regime determined establishment patterns and that climate change could affect this process. Specifically, willows established on point bar landforms that were formed from meandering streams and had moderate to high flood flows (2-5-year return interval flow) and had continuous establishment at intermediate elevations above channel. Abandoned beaver ponds created when beaver ponds drained, needed infrequent large flood event (>5-year return interval flow) and had periodic establishment prior to dam breach and brief episodes of widespread establishment following abandonment. The establishment was at high elevations relative to the active channel. Abandoned channels, created by channel avulsion, were associated with moderate to high effective flood flows (2-5-year return interval flow) and willow establishment was continuous over limited period of time (as oxbow fills). The establishment was at low to moderate elevations relative to active channel. While fire is relatively infrequent in the moist habitats that this ecological site is found within, it can occur during dry conditions. Generally, these swales are so saturated that fires will move around these low lying areas and stay within the conifer community. Low or mixed severity fires only account for 32% of the fires and have a mean interval of 750 years in the Northwest (USDA, USFS, Fire Effects Information System, Fire Regimes). High severity fires that occur during severe drought years, account for 68% of the fires occurring and have a mean interval of 350 years (USDA, USFS, Fire Effects Information System, Fire Regimes). So, fires are rare within this site, but would serve to limit conifer encroachment. Drummond's willow vigorously resprouts following fire, therefore prescribed fire is an effective method of rejuvenating decadent stands (Boggs, 1990). Drummond's willow will sprout from root crown following top kill by fire. Quick, hot fires increase sprouting response of willows. The wind dispersed seed is an important colonizer of burned areas. Therefore, Drummond's willow is a "survivor" species and an off-site colonizer species in response to fire. Overgrazing by wildlife or livestock can reduce vigor of this ecological site and result in willows of uneven stem age distribution, highlining, clubbing or dead clumps. The understory structure would also change with overgrazing. There would be a reduction in bluejoint and tufted hairgrass (*Deschampsia cespitosa*) and an increase in stinging nettles and field horsetail. This ecological site is important to wildlife. Moose consume large amounts of Drummond's willow in the winter (Chadde, 1988). Elk and white-tailed deer have light use of willow. Drummond's willow is palatable to livestock and big game, even though its protein value is poor and energy value is fair. Plants can recover well after overgrazing, if grazing and browsing are excluded for a period of time (Chadde, 1988). Drummond's willow creates thickets from 8 to twelve feet high and provide cover for songbirds.

Community 1.1
Reference

Figure 10. Typical swale thicket with numerous shrub layers and thick understory of grasses, forbs and sedges.

Figure 11. Close up view of understory including a mound with purple marshlocks, sedges, rushes, and forbs.

Figure 12. Mixed understory at ecological site.

Drummond’s willow (Salix drummondii)-Alderleaf buckthorn (*Rhamnus alnifolia*)/bluejoint (*Calamagrostis canadensis*)/field horsetail (*Equisetum arvense*) Structure: multistoried; high vigor

Community 1.2
Post-fire

Resprouting Drummond's willow-Sitka willow-Booth's willow-prickly currant-Sitka alder/bluejoin/fireweed Structure: resprouts; colonizer species

Community 1.3
Grazing and/or browsing

Drummond's willow (Sitka willow-Booth's willow-prickly currant-Sitka alder/stinging nettles-field horsetail (bluejoint))

Structure: low vigor, uneven stem age distribution, highlining, clubbing or dead clumps of shrubs; less bluejoint and more stinging nettles-field horsetail.

Pathway 1.1A
Community 1.1 to 1.2

Fire disturbance leading top-kill and then resprouting of shrub species and bluejoint; establishment of post-fire colonizers (fireweed). Low severity, fast moving fire which does not severely affect shrub and grasses growing points allows these shrubs and bluejoint grass to resprout. The bare mineral soil is also capable of sustaining colonizing herbaceous species that are wind driven onto the site.

Pathway 1.1B
Community 1.1 to 1.3

Overgrazing and/or overbrowsing of plants reducing vigor and change shrub structure leading to a reduction in vigor and changing species composition away from (reduction) of palatable species such as bluejoint to less palatable species such as stinging nettles and field horsetail.

Pathway 1.2A
Community 1.2 to 1.1

Time without disturbance transitioning shrub resprouts to mature shrubs; diversification of understory species. The post-fire disturbance vegetation community of resident shrub species and bluejoint grass continue to grow to maturing and herbaceous colonizing species such as fireweed gradually reduce their understory dominance as other forb and grass species are introduced or longer duration growing forbs reestablish.

Pathway 1.3A
Community 1.3 to 1.1

Rest from grazing and/or browsing which allows the species composition and vigor to return to the reference community by allowing the recovery of bluejoint and shrub species.

State 2
Weed Invaded State

This state has sustained prolonged and/or intensive overgrazing by livestock and/or overbrowsing by wildlife particularly moose and elk. Ungulate grazing would be considered within the range of normal functioning disturbances (Community Phase 1.3) that may change some species composition but is considered capable of returning to the reference phase, if it were light grazing, seasonal or rotational, did not lead to extensive trailing, wallowing or cut banking of flow through channels within the swale or drainageway. Ungulate hoof action can break up the soil, which can lead to unvegetated microsites conducive to weed species establishment (if seed propagules are present); in addition, pugging and hummocking can create some surface flow patterns which may accelerate water loss from the swale. Urine and feces can change nutrient concentration as well. If the ungulate use is low, then it is viewed as normally functioning. The saturated soils likely are susceptible to trampling and compaction though high water tables throughout the growing season tend to limit access by livestock and thereby reduce impacts. If the ungulate use is high, concentrated or during sensitive periods of plant growth, the impact can be severe and cause a state change by affecting soil compaction, water loss through trailing, pugging, hummocking changing surface flow patterns, severe changes in nutrient concentration through very high levels of urine and feces as well. These disturbances also could be exacerbated by drought or other disturbances higher upslope in the watershed that affect surface sheet flow. A state change has occurred when montane weed species dominate the vegetation community with a concomitant reduction in the reference community species of Drummond’s willow, Sitka willow, Booth’s willow, prickly current, Sitka alder, and bluejoint.

Community 2.1
Weed Invaded

Dominant: Montane weed species/stinging nettles-field horsetail Decrease: Drummond's willow (Sitka willow-

Booth's willow-prickly currant-Sitka alder)

Transition T1A
State 1 to 2

Overgrazing and overbrowsing; change in hydrology leading to drier site conditions; introduction, establishment and dominance of weeds.

Additional community tables

Table 5. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
bluejoint	CACA4	*Calamagrostis canadensis*	–	–	10–40
shortstalk sedge	CAPO	*Carex podocarpa*	–	–	37.5
Northwest Territory sedge	CAUT	*Carex utriculata*	–	–	30
mountain brome	BRMA4	*Bromus marginatus*	–	–	15
golden sedge	CAAU3	*Carex aurea*	–	–	7
swordleaf rush	JUEN	*Juncus ensifolius*	–	–	7
rough bentgrass	AGSC5	*Agrostis scabra*	–	–	0.5–5
Hitchcock's smooth woodrush	LUGLH	*Luzula glabrata var. hitchcockii*	–	–	3
timothy	PHPR3	*Phleum pratense*	–	–	2
brome	BROMU	*Bromus*	–	–	0.5
Forb/Herb					
stinging nettle	URDI	*Urtica dioica*	–	–	5–80
western sweetroot	OSOC	*Osmorhiza occidentalis*	–	–	5–30
redosier dogwood	COSES	*Cornus sericea ssp. sericea*	–	–	15
common cowparsnip	HEMA80	*Heracleum maximum*	–	–	1–10
Lyall's angelica	ANAR3	*Angelica arguta*	–	–	10
heartleaf arnica	ARCO9	*Arnica cordifolia*	–	–	10
western meadow-rue	THOC	*Thalictrum occidentale*	–	–	2–10
Canadian white violet	VICA4	*Viola canadensis*	–	–	5
northern bog violet	VINE	*Viola nephrophylla*	–	–	5
Canada goldenrod	SOCA6	*Solidago canadensis*	–	–	5
wild mint	MEAR4	*Mentha arvensis*	–	–	0.5–5
Engelmann's aster	EUEN	*Eucephalus engelmannii*	–	–	5
maiden blue eyed Mary	COPA3	*Collinsia parviflora*	–	–	3
western showy aster	EUCO36	*Eurybia conspicua*	–	–	3
desertparsley	LOMAT	*Lomatium*	–	–	3
common yarrow	ACMI2	*Achillea millefolium*	–	–	1–3
fireweed	CHAN9	*Chamerion angustifolium*	–	–	0.5–3
bog laurel	KAPO	*Kalmia polifolia*	–	–	2
fragrant bedstraw	GATR3	*Galium triflorum*	–	–	0.5–2
feathery false lily of the valley	MARA7	*Maianthemum racemosum*	–	–	1–2
alpine leafybract aster	SYFO2	*Symphyotrichum foliaceum*	–	–	1–2
American vetch	VIAM	*Vicia americana*	–	–	0.5–1

smallwing sedge	CAMI7	*Carex microptera*	–	–	0.5–1
purple marshlocks	COPA28	*Comarum palustre*	–	–	1
Virginia strawberry	FRVI	*Fragaria virginiana*	–	–	0.5
yellow avens	GEAL3	*Geum aleppicum*	–	–	0.5
largeleaf avens	GEMA4	*Geum macrophyllum*	–	–	0.5
white thistle	CIHO	*Cirsium hookerianum*	–	–	0.5
bunchberry dogwood	COCA13	*Cornus canadensis*	–	–	0.5
scarlet pimpernel	ANAR	*Anagallis arvensis*	–	–	0.5
giant red Indian paintbrush	CAMI12	*Castilleja miniata*	–	–	0.5
tower rockcress	ARGL	*Arabis glabra*	–	–	0.5
common dandelion	TAOF	*Taraxacum officinale*	–	–	0.5
true forget-me-not	MYSC	*Myosotis scorpioides*	–	–	0.5
Fern/fern ally					
field horsetail	EQAR	*Equisetum arvense*	–	–	0.5–10
scouringrush horsetail	EQHY	*Equisetum hyemale*	–	–	0.5
Shrub/Subshrub					
Drummond's willow	SADR	*Salix drummondiana*	–	–	25–90
alderleaf buckthorn	RHAL	*Rhamnus alnifolia*	–	–	10–27
twinberry honeysuckle	LOIN5	*Lonicera involucrata*	–	–	5–12
Bebb willow	SABE2	*Salix bebbiana*	–	–	10
prickly currant	RILA	*Ribes lacustre*	–	–	0.5–5
common snowberry	SYAL	*Symphoricarpos albus*	–	–	0.5–5
dwarf red blackberry	RUPU	*Rubus pubescens*	–	–	5
rose	ROSA5	*Rosa*	–	–	1
American red raspberry	RUID	*Rubus idaeus*	–	–	0.5
creeping barberry	MARE11	*Mahonia repens*	–	–	0.5
russet buffaloberry	SHCA	*Shepherdia canadensis*	–	–	0.5
Sitka alder	ALVIS	*Alnus viridis ssp. sinuata*	–	–	0.5
Tree					
subalpine fir	ABLA	*Abies lasiocarpa*	–	0–39	0.5
lodgepole pine	PICO	*Pinus contorta*	–	0–39	0.5

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Approval

Kirt Walstad, 9/08/2023

Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	
Contact for lead author	
Date	12/18/2020
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

   _____

2. **Presence of water flow patterns:**

   _____

3. **Number and height of erosional pedestals or terracettes:**

   _____

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

5. **Number of gullies and erosion associated with gullies:**

6. **Extent of wind scoured, blowouts and/or depositional areas:**

7. **Amount of litter movement (describe size and distance expected to travel):**

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

    Sub-dominant:

    Other:

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

14. **Average percent litter cover (%) and depth (in):**

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

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17. **Perennial plant reproductive capability:**
