USDA Natural Resources Conservation Service

Ecological site R072XY113KS
Gravelly Hills

Accessed: 04/26/2024

General information

Approved. An approved ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model, enough information to identify the ecological site, and full documentation for all ecosystem states contained in the state and transition model.

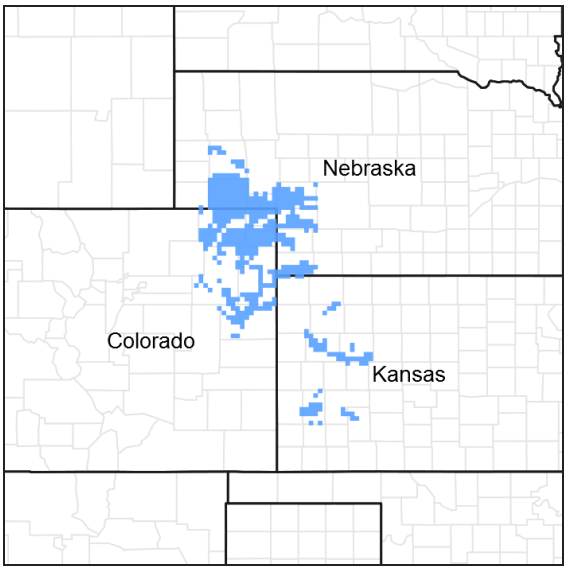


Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

MLRA notes

Major Land Resource Area (MLRA): 072X–Central High Tableland

Major Land Resource Area (MLRA) 72--Central High Tableland. This area is in Kansas (54 percent), Nebraska (25 percent), and Colorado (21 percent). A very small part of the area is in Wyoming. The area makes up about 34,550 square miles (89,535 square kilometers). It includes the towns of Garden City, Goodland, and Colby, Kansas; Imperial, North Platte, Ogallala, and Sidney, Nebraska; and Holyoke and Wray, Colorado. Interstate 70 bisects the area, and Interstates 76 and 80 follow the south side of the South and North Platte Rivers, respectively. The Cimarron National Grasslands occur in the southwest corner of the MLRA.

Classification relationships

Major land resource area (MLRA): 072-Central High Tableland

Ecological site concept

The Gravelly Hills ecological site occurs on a wide variety of landforms in the Central High Tablelands. It can occur in stream terraces, alluvial fans, foot slopes, and uplands. It is generally made up of complex slopes commonly greater than 10 percent. The site is characterized by 15-35 percent rock fragments in the surface horizon. The soils characteristic of this site formed in loamy, sandy, and gravelly soil material deposited over gravelly material on

stream terraces, alluvial fans, foot slopes, and uplands.

Associated sites

R072XY100KS	**Loamy Tableland** The Loamy Tableland ecological site is located on plains, rises, and hillslopes on tablelands. The Gravelly Hills ecological site can occur adjacent to this site.
R072XY101KS	**Limy Slopes** The Limy Slopes ecological site is located on shoulders and backslopes on hillslopes on tableland landscapes. The gravelly hills site can be found adjacent to this site.
R072XY111KS	**Sandy Plains** The Sandy Plains ecological site occurs on plains and tablelands. The gravelly hills site can be found adjacent to this site.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Schizachyrium scoparium* (2) *Bouteloua curtipendula*

Physiographic features

This site is extensive in the northwest part of MLRA 72 although can be found as far south as Kearny county Kansas. This site occurs on level to steep terraces or tertiary terrace remnants that cap ridges, crests, and upper slopes of undulating or rolling uplands. This site is dominated by loamy, sandy, and gravelly soil material deposited over gravelly material. Slopes range from 0 to 60 percent.

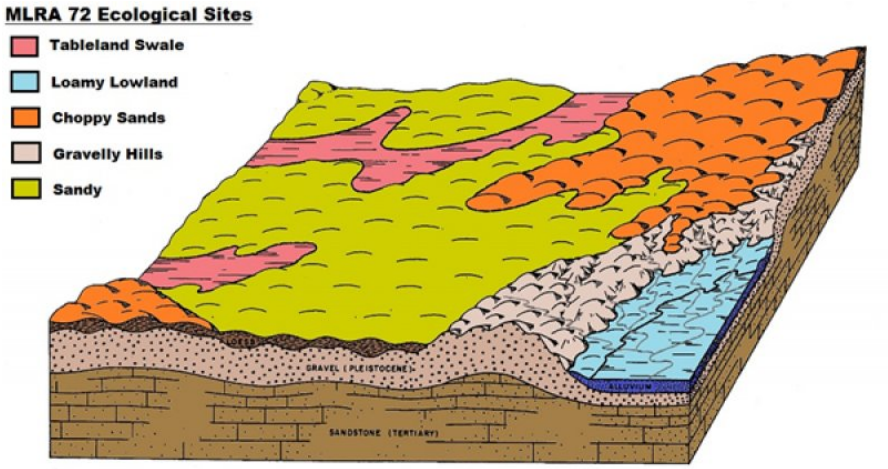


Figure 2. MLRA 72 block diagram

Table 2. Representative physiographic features

Landforms	(1) Ridge (2) Knoll (3) Hill
Flooding frequency	None
Ponding frequency	None
Elevation	701–1,606 m
Slope	0–60%
Ponding depth	0 cm

Aspect	Aspect is not a significant factor

Climatic features

The average annual precipitation in this area is 14 to 25 inches (355 to 635 millimeters). It fluctuates widely from year to year. Most of the rainfall occurs as high-intensity, convective thunderstorms during the growing season. The maximum precipitation occurs from late spring through early autumn. Precipitation in winter occurs as snow. The annual snowfall ranges from about 16 inches (40 centimeters) in the southern part of the area to 35 inches (90 centimeters) in the northern part. The average annual temperature is 46 to 57 degrees F (8 to 14 degrees C). The freeze-free period averages 161 days and ranges from 135 to 210 days, increasing in length from northwest to southeast. Climate data comes from the Natural Resources Conservation Service (NRCS) National Water and Climate Center. The data set is from 1981-2010.

Table 3. Representative climatic features

Frost-free period (average)	133 days
Freeze-free period (average)	151 days
Precipitation total (average)	483 mm

Climate stations used

- (1) JULESBURG [USC00054413], Julesburg, CO
- (2) KIMBALL 2NE [USC00254440], Kimball, NE
- (3) HAIGLER [USC00253515], Haigler, NE
- (4) OGALLALA [USC00256200], Ogallala, NE
- (5) SIDNEY 6 NNW [USC00257830], Gurley, NE
- (6) LEROY 9 WSW [USC00054945], Sterling, CO
- (7) RUSSELL SPRINGS 3N [USC00147050], Winona, KS
- (8) LODGEPOLE [USC00254900], Lodgepole, NE

Influencing water features

No significant water features inherent of this site or adjacent sites that influence vegetation and/or management of this site.

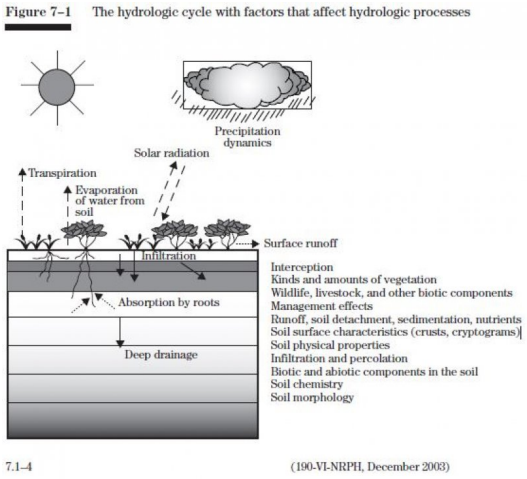


Figure 7. Fig.7-1 from National Range and Pasture Handbook

Soil features

The soils associated with the Gravelly Hills ecological site are shallow to moderately deep over sand and gravel. These soils contain significant amounts of gravel throughout the root zone. They formed in loamy, sandy, and gravelly soil material deposited over gravelly material on stream terraces, alluvial fans, foot slopes, and uplands.

The available water capacity of these soils is very low to low. The content of organic matter in these soils is low to moderate, in the surface layer.

Exposed areas of gravel are inherent to this site. The amount of bare ground varies with the amount of surface gravel. Where slopes are gentle, water flow paths should be broken, irregular in appearance or discontinuous with numerous debris dams or vegetative barriers, and exhibit slight to no evidence of rills, wind scoured areas or pedestaled plants.

As slopes become steep, bare areas may increase. Expect to find evidence of water flow patterns and pedestaled plants. Sub-surface soil layers, where not affected by gravel, are non-restrictive to water movement and root penetration.

Major soil series correlated to this ecological site include Blueridge, Dix, Eckley, Schamber, and Peetz.

These attributes represent 0-40 inches in depth or to the first restrictive layer.

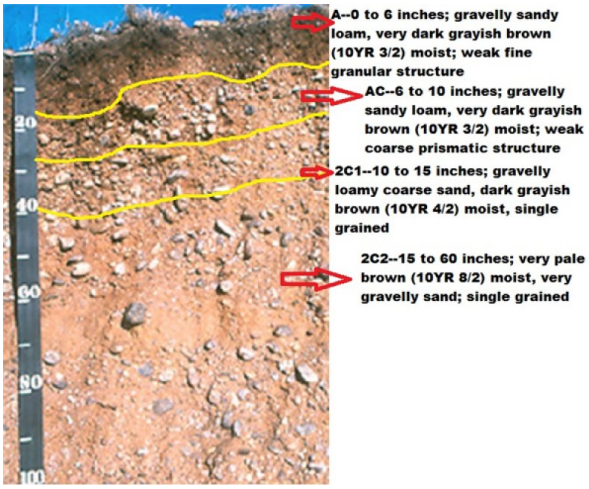


Figure 8. Dix soil series profile, Kimball co. NE soil surve

Table 4. Representative soil features

Surface texture	(1) Gravelly loam (2) Gravelly sandy loam (3) Coarse sand
Family particle size	(1) Sandy
Drainage class	Excessively drained
Permeability class	Very rapid to moderately rapid
Soil depth	102–203 cm
Surface fragment cover <=3"	0–50%
Surface fragment cover >3"	0–15%
Available water capacity (0-101.6cm)	0–10.72 cm
Calcium carbonate equivalent (0-101.6cm)	0–15%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	5.6–8.4

Subsurface fragment volume <=3" (Depth not specified)	10–68%
Subsurface fragment volume >3" (Depth not specified)	0–25%

Ecological dynamics

The information in this ecological site description (ESD), including the state-and-transition model (STM), was developed using archeological and historical data, professional experience, and scientific studies. The information is representative of a complex set of plant communities. Not all scenarios or plants are included. Key indicator plants, animals, and ecological processes are described to inform land management decisions.

The plant community for the Gravelly Hills ecological site is dynamic due to the complex interaction of many ecological processes. The interpretive plant community for this site is the Reference Plant Community. The Reference Plant Community has been determined by the study of rangeland relic areas, areas protected from excessive disturbance, and areas under long-term rotational grazing strategies. Trends in plant community dynamics ranging from heavily grazed to lightly grazed areas, seasonal use pastures, and historical accounts have also been used.

This ecological site is made up of a Grassland State and a Sod State. The Grassland State is characterized by non-broken land (no tillage), warm season mid and tall grasses, sod-forming grasses, forbs, and shrubs. The Sod State is dominated by a warm season, sod forming grass, with annual grasses, and forbs.

This site developed with occasional fires as part of the ecological processes. Historically, it is believed that the fires were infrequent, randomly distributed, and started by lightning at various times throughout the season when thunderstorms were likely to occur. It is also believed that pre-European inhabitants may have used fire as a management tool for attracting herds of large migratory herbivores (bison, elk, deer, and pronghorn). The impact of fire over the past 100 years has been relatively insignificant due to the human control of wildfires.

The degree of herbivory (feeding on herbaceous plants) has a significant impact on the dynamics of the site. Historically, periodic grazing by herds of large migratory herbivores was a primary influence. Secondary influences of herbivory by species such as prairie dogs, grasshoppers, gophers, and root feeding organisms impacted the vegetation historically, and continue to this day.

The management of herbivory by humans through grazing of domestic livestock and/or manipulation of wildlife populations has been a major influence on the ecological dynamics of the site. This management coupled with the High Plains climate largely dictates the plant communities for the site.

Drought cycles were part of the natural range of variability within the site and have historically had a major impact upon the vegetation. The species composition changes according to the duration and severity of the drought cycle (Albertson and Weaver 1946).

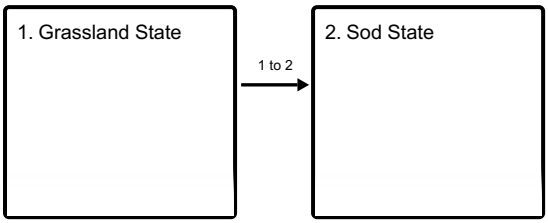
Vegetation changes are expected within this ecological site and will be dependent on the sites geographical location inside Major Land Resource Area (MLRA) 72. Variation in precipitation east and west is not as affected as is temperature north and south. The northern part of MLRA 72 is characterized by cooler temperatures and shorter growing season in respect to the southern end. As a result, cool season bunchgrasses and sod formers proliferate. Growth of native cool season plants begins about April 15, and continues to about June 15. Native warm season plants begin growth about May 15, and continue to about August 15. Green up of cool season plants may occur in September and October if adequate moisture is available (weather data from National Climate Data Center 1980-2010).

A state-and-transition model diagram for the Gravelly Hills ecological site (R072XY113KS) is shown after this narrative. The descriptions of each state, transition, community phase, and community pathway will follow the model. The model is based on expert evaluation of available experimental research, field observations, professional consensus, and interpretations. It is likely to change as knowledge and available data increases. These plant communities may not represent every possibility, but they are the most prevalent and repeatable plant communities. The plant composition table shown below has been developed from the best available knowledge at the time of this

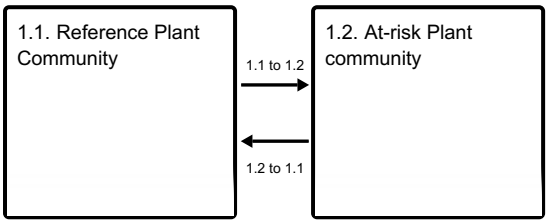
revision. As more data is collected, some of these plant communities may be revised or removed and new ones may be added. None of these plant communities should necessarily be thought of as “Desired Plant Communities”. According to the USDA NRCS National Range and Pasture Handbook, Desired Plant Communities will be determined by the decision-makers and will meet minimum quality criteria established by NRCS. The main purpose for including any description of a plant community here is to capture the current knowledge and experience at the time of this revision.

State and transition model

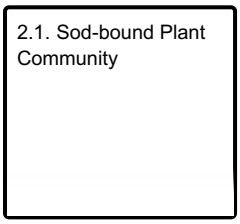
Ecosystem states



State 1 submodel, plant communities



State 2 submodel, plant communities



State 1
Grassland State

The Reference State is supported by empirical data, historical data, and local expertise. The Grassland State is defined by two native plant communities that are a result of periodic fire, drought, and grazing. These events are part of the natural disturbance regime and climatic process. The Reference Plant Community is dominated by warm season mid grasses. The At-risk Plant Community is dominated by a warm season sod-forming shortgrass with decreasing amounts of warm season mid grasses.

Community 1.1
Reference Plant Community

This plant community is the interpretive plant community for this site and is considered to be the Reference Plant Community. This community evolved with grazing by large herbivores and is suited to grazing by domestic livestock. Historically, fires occurred infrequently. This plant community can be found on areas that are grazed and where the grazed plants receive adequate recovery periods during the growing season. The potential vegetation is approximately 75-85 percent grasses and grass-likes, 5-15 percent forbs, and 5-10 percent woody plants. The principal mid grasses are little bluestem and sideoats grama. Secondary grasses include blue grama, big bluestem, prairie sandreed, switchgrass, needleandthread, hairy grama, and western wheatgrass. Threadleaf and sun sedge are common. Dominant forbs are purple prairie clover, dotted blazing star, and upright prairie coneflower. Skunkbush sumac and golden currant are a few of the major shrubs found in this plant community. Continuous grazing that does not allow for adequate recovery opportunities between grazing events causes this site to deteriorate. Grasses such as little bluestem, sideoats grama, switchgrass, prairie sandreed, and big bluestem decrease in both frequency and production. Grasses and grass-likes such as blue grama and threadleaf sedge will increase. If proper recovery periods between grazing events are not allowed during the growing season, blue grama

will eventually develop into a patchy sodbound condition. Mid and tall grasses will eventually be removed from the plant community. Cushion plants such as sessile nailwort in addition to Fendler threeawn, wormwood, fringed sagebrush, small soapweed, and cheatgrass will increase or invade the site. In time, continuous use in combination with high stock densities or long term non-use (rest), and lack of fire can result in large amounts of bare ground. As plant community cover decrease from bunchgrasses to more of the sod grasses there is a decrease in infiltration, interception, and an increase in surface runoff (Thurow et. al. 1986). Total annual production ranges from 600 to 1,700 pounds of air-dried vegetation per acre per year and will average 1,200 pounds.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	538	1076	1524
Forb	101	202	286
Shrub/Vine	34	67	95
Total	**673**	**1345**	**1905**

Figure 10. Plant community growth curve (percent production by month). KS1572, Little Bluestem, Sideoats Grama, w/some Big Bluestem.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	5	25	30	25	10	5	0	0	0

Community 1.2
At-risk Plant community

The At-risk Plant Community developed with continuous grazing without adequate recovery periods during the growing season. The dominant grass is blue grama. Little bluestem and sideoats grama are present as secondary grasses in the community. Big bluestem, switchgrass, prairie sandreed, needle and thread, western wheatgrass, purple prairie clover, and skunkbush sumac have significantly decreased in abundance. Hairy grama, sand dropseed, Fendler threeawn as well as Hood’s phlox, hairy goldenaster, Cuman ragweed, slimflower scurfpea, and small soapweed yucca have increased. Total annual production and plant vigor have decreased. Reduction of dominant Reference Plant Community species and an increase of warm season short grasses has begun to alter the biotic integrity of this community. Water and nutrient cycles are becoming impaired due to the reduction of canopy cover. Litter levels have been reduced due to a change in species composition. Total annual production ranges from 400 to 1,000 pounds of air-dried vegetation per acre per year and will average 600 pounds.

Pathway 1.1 to 1.2
Community 1.1 to 1.2

A shift from the Reference Community toward the blue grama, remnant mid-tall grass community, occurs if the site is subject to continuous, season-long grazing, inadequate rest, and recovery periods during the growing season. Mid, warm-season grasses are also commonly reduced by repeated grazing at the growing point and by defoliation below recommended grazing heights.

Pathway 1.2 to 1.1
Community 1.2 to 1.1

Recovery of the mid grasses, tall-grasses, and associated forbs characteristic of the Reference Plant Community, or of a community very similar to Reference community, requires many years of careful management. The management required includes a forage and animal balance with extended periods of rest and recovery during the growing season. Remnant stands of the desired species should be present or located nearby as seed sources for reestablishment.

State 2
Sod State

The Grassland State ecosystem has been driven beyond the limits of ecological resilience and has crossed a threshold into a Sod state. The designation of the Sod state denotes changes in plant community composition. This change in plant composition affects hydrologic function of the system. This alternative state should be treated as a hypothesis that will be tested through long term observation of ecosystem behavior and repeated application of conservation and restoration practices. This state should be re-evaluated and refined continually.

Community 2.1
Sod-bound Plant Community

The Sod-bound Plant Community developed with continued grazing without adequate recovery periods between grazing events. Blue grama and threadleaf sedge dominate the plant community. These species exhibit a mosaic sod-bound appearance. Tall grasses have been removed. Little bluestem and sideoats grama may remain in remnant amounts on steeper slopes. Forbs and shrubs that have increased are wormwood, Cuman ragweed, spiny phlox, false hairy golden aster, fringed sagebrush, and soapweed yucca. Cushion plants such as sessile nailwort have increased. Species diversity and production have been severely reduced. The amount of litter has decreased. Nutrient and hydrologic cycles are impaired due to the loss of deeper-rooted grasses, forbs, and shrubs. Rills are evident and soil loss is obvious, especially on steeper slopes. Pedestalled plants with exposed roots maybe common. Within the geographical extent of this site and inside this plant community there can be areas of bare ground where annuals significantly increased. Plants that may be present are Russian thistle, kochia, Fendler threeawn, cheatgrass, cushion plants (sessile nailwort, spiny phlox), and soapweed yucca. Remnant amounts of blue and/or hairy grama may still be present. This plant community is resistant to change due to grazing and drought tolerance of blue grama. A significant amount of production and diversity has been lost when compared to the Reference Community. Loss of mid and tall warm season grasses, shrub component, and nitrogen fixing forbs have impacted the energy flow and nutrient cycling. Water infiltration is reduced due to the massive shallow root system, “root pan”, characteristic of sodbound blue grama. Soil loss from water erosion may be noticeable where water flow paths are connected. As plant community cover decrease from bunchgrasses to more of the sod grasses there is a decrease in infiltration, interception, and an increase in surface runoff (Thurow et. al. 1986). Blue grama provides this site with a unique feature in that the leaves on blue grama remain semi-dormant during drought periods but resume growing each time adequate moisture is available during the growing season. Reseeding of blue grama is unlikely because young seedlings seldom survive the extended drought periods that are common on this site. Blue grama does maintain itself by tillering. This also provides blue grama with another unique feature of being able to withstand drought and heavy grazing use. Typically, blue grama is a bunchgrass but quickly forms a sodbound condition when heavily grazed. Total annual production ranges from 150 to 600 pounds of air-dried vegetation per acre per year and will average 400 pounds.

Transition 1 to 2
State 1 to 2

The following management and environmental factors affect the transition from the Reference State toward the Sod State. Long term, heavy, continuous grazing, with no forage and animal balance to allow adequate recovery periods between grazing events will convert the reference plant community to a community of blue grama sod. Drought, in combination with this type of management will quicken the rate at which the reference community pathways to the sod bound community. Restoration to the reference state is not well documented. Implicit restoration activities include management that incorporates long-term prescribed grazing (>40 years), a forage and animal balance, and adequate rest and recovery periods. A change to the state and transition model will be made as documentation and existence of restoration becomes evident.

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Mid and tall grasses Dominant 50%**			269–673	
	sideoats grama	BOCU	*Bouteloua curtipendula*	135–336	–
	little bluestem	SCSC	*Schizachyrium scoparium*	67–202	–

	big bluestem	ANGE	*Andropogon gerardii*	67–157	–
	switchgrass	PAVI2	*Panicum virgatum*	0–67	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–56	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	0–45	–
	Fendler threeawn	ARPUL	*Aristida purpurea var. longiseta*	0–22	–
	plains muhly	MUCU3	*Muhlenbergia cuspidata*	0–11	–
	ring muhly	MUTO2	*Muhlenbergia torreyi*	0–11	–
2	**Short grasses Subdominant 22%**			90–291	
	blue grama	BOGR2	*Bouteloua gracilis*	45–135	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	45–135	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–67	–
3	**Cool season Minor component 5%**			0–67	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–45	–
	western wheatgrass	PASM	*Pascopyrum smithii*	0–34	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–22	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–22	–
	squirreltail	ELELE	*Elymus elymoides ssp. elymoides*	0–11	–
	sixweeks fescue	VUOC	*Vulpia octoflora*	0–11	–
4	**Sedges Minor component 3%**			0–45	
	needleleaf sedge	CADU6	*Carex duriuscula*	0–22	–
	threadleaf sedge	CAFI	*Carex filifolia*	0–22	–
	sun sedge	CAINH2	*Carex inops ssp. heliophila*	0–22	–
Forb					
5	**Forbs Subdominant 15%**			67–202	
	dotted blazing star	LIPU	*Liatris punctata*	6–22	–
	beardtongue	PENST	*Penstemon*	6–22	–
	slimflower scurfpea	PSTE5	*Psoralidium tenuiflorum*	6–22	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	6–22	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	6–22	–
	purple prairie clover	DAPU5	*Dalea purpurea*	6–22	–
	lacy tansyaster	MAPIP4	*Machaeranthera pinnatifida ssp. pinnatifida var. pinnatifida*	6–22	–
	purple locoweed	OXLA3	*Oxytropis lambertii*	0–11	–
	white locoweed	OXSE	*Oxytropis sericea*	0–11	–
	alpine feverfew	PAAL6	*Parthenium alpinum*	0–11	–
	creeping nailwort	PASE	*Paronychia sessiliflora*	0–11	–
	sulphur-flower buckwheat	ERUM	*Eriogonum umbellatum*	0–11	–
	shaggy dwarf morning-glory	EVNU	*Evolvulus nuttallianus*	0–11	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–11	–
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	0–11	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–11	–
	pussytoes	ANTEN	*Antennaria*	0–11	

	pussytoes	ANTEN	*Antennaria*	0–11	–
	tarragon	ARDR4	*Artemisia dracunculus*	0–11	–
	twogrooved milkvetch	ASBI2	*Astragalus bisulcatus*	0–11	–
	spiny milkvetch	ASKE	*Astragalus kentrophyta*	0–11	–
	woolly locoweed	ASMO7	*Astragalus mollissimus*	0–11	–
	white prairie clover	DACA7	*Dalea candida*	0–11	–
	nineanther prairie clover	DAEN	*Dalea enneandra*	0–11	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–11	–
	greenthread	THELE	*Thelesperma*	0–11	–
	threadleaf ragwort	SEFLF	*Senecio flaccidus var. flaccidus*	0–11	–
	spiny phlox	PHHO	*Phlox hoodii*	0–11	–
	woolly plantain	PLPA2	*Plantago patagonica*	0–11	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	0–11	–
Shrub/Vine					
6	**Shrub MInor component 5%**			22–67	
	prairie sagewort	ARFR4	*Artemisia frigida*	6–17	–
	spreading buckwheat	EREF	*Eriogonum effusum*	0–17	–
	rubber rabbitbrush	ERNAG	*Ericameria nauseosa ssp. nauseosa var. glabrata*	0–17	–
	spinystar	ESVIV	*Escobaria vivipara var. vivipara*	0–17	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–17	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–17	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	6–17	–
	chokecherry	PRVIV	*Prunus virginiana var. virginiana*	0–17	–
	skunkbush sumac	RHTR	*Rhus trilobata*	6–17	–
	golden currant	RIAU	*Ribes aureum*	0–17	–
	soapweed yucca	YUGL	*Yucca glauca*	6–17	–

Animal community

Grazing by domestic livestock is one of the major income-producing industries in the area. Rangelands in this area provide yearlong forage under prescribed grazing for cattle, sheep, horses, and other herbivores. During the dormant period, livestock may need supplementation based on reliable forage analysis.

Grazing Interpretations:
Calculating safe stocking rates. Proper stocking rates should be incorporated into a grazing management strategy that protects the resource, maintains or improves rangeland health, and is consistent with management objectives. In addition to usable forage, safe stocking rates should consider ecological condition, trend of the site, past grazing use history, season of use, stock density, kind and class of livestock, forage digestibility, forage nutritional value, variation of harvest efficiency based on desirability preference of plant species and/or grazing system, and site grazability factors (such as steep slopes, site inaccessibility, or distance to drinking water).

Often the current plant community does not entirely match any particular community as described in this ecological site description. Because of this, a resource inventory is necessary to document plant composition and production. Proper interpretation of inventory data will permit the establishment of a safe initial stocking rate.

No two years have exactly the same weather conditions. For this reason, year-to-year and season-to season fluctuations in forage production are to be expected on grazing lands. Livestock producers must make timely adjustments in the numbers of animals or in the length of grazing periods to avoid overuse of forage plants when

production is unfavorable and to make advantageous adjustments when forage supplies are above average.

Stocking rates may be improved through the use of vegetation monitoring and actual use records that include number and type of livestock, the timing and duration of grazing, and utilization levels. Actual use records over time will assist in making stocking rate adjustments based on the variability factors.

Average annual production must be measured or estimated to properly assess useable forage production and stocking rates.

Hydrological functions

Water is the principal factor limiting forage production on this site. Areas where ground cover is less than 50 percent have the greatest potential to have reduced infiltration and higher runoff.

Recreational uses

This site provides hunting, hiking, photography, bird watching and other opportunities. The wide varieties of plants that bloom from spring until fall have an aesthetic value that appeals to visitors.

Wood products

No appreciable wood products are present on the site.

Other products

None noted

Other information

Site Development and Testing Plan.
Future work (for approved ESD) includes field visits to verify ecological site concepts with field staff. Field staff include but are not limited to project office leader, area soil scientist, state soil scientist, ecological site specialist, state rangeland conservationist, area rangeland management specialist, and local field personal. This site includes collaboration between Kansas, Colorado, and Nebraska. Field visits are to be determined by spatial extent of the site as well as personal knowledge of the site. Activity during field visits will include but are not limited to identifying the soil, landform, plant community, and verifying existing site concepts.

Inventory data references

Information presented here has been derived from NRCS clipping data, numerous ocular estimates, and other inventory data. Field observations from experienced range personnel was used extensively to develop this ecological site description.

Those involved in developing ESD Gravelly Hills North include Harvey Sprock from Colorado; Carol Eakins, Chuck Markley, Jeff Nichols, and Mary Schrader from Nebraska; Joan Gienger and Ted Houser from Kansas.

Range Condition Guides and Technical Range Site Descriptions for Kansas, Gravelly Hills, USDA, Soil Conservation Service, August, 1967

Range Site Description for Colorado, Gravel Breaks, USDA-Soil Conservation Service, December 1975

Range Site Description for Nebraska, Shallow to Gravel, USDA-Soil Conservation Service, August, 1981 Schacht, Walter H., Larsen, Dana. Section III

Range Sites, Shallow to Gravel Range Site, The Board of Regents of the University of Nebraska, publication

Ecological Site Description for Kansas, Gravelly Hills North (R072XA010KS), located in Ecological Site Information

System (ESIS), 2007

Ecological Site Description for Colorado, Gravel Breaks(R072XY062CO), located in Ecological Site Information System (ESIS)

Other references

Albertson, F. W. and Weaver, J. E., "Reduction of Un-Grazed Mixed Prairie to Short Grass as a Result of Drought and Dust" (1946). Agronomy & Horticulture -- Faculty Publications. Paper 496.

Andrews, R. and R. Righter. 1992. Colorado Birds. Denver Museum Nat. Hist., Denver, CO. 442 pp.

High Plains Regional Climate Center, University of Nebraska, (http://hpcc.unl.edu)

Thurow, T.L., W.H. Blackburn, and C.A. Taylor, Jr. 1986. Hydrologic characteristics of vegetation types as affected by livestock grazing systems, Edwards Plateau, Texas. J. Range Manage. 39:505-509.

USDA, NRCS. National Water and Climate Center, (http://wcc.nrcs.usda.gov)

USDA, NRCS. National Range and Pasture Handbook, September 1997

USDA, NRCS. National Soil Information System, Information Technology Center, (http://nasis.nrcs.usda.gov)

USDA, NRCS. 2002. The PLANTS Database, Version 3.5 (http://plants.usda.gov).

Contributors

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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.

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Date	04/07/2016
Approved by	David Kraft
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** None

2. **Presence of water flow patterns:** None to minimal on gentle slopes (< 15%). Flow paths should be broken, irregular in appearance. As slope steepness increases, flow paths become more apparent and may be connected.

3. **Number and height of erosional pedestals or terracettes:** None to slight on gentle slopes. Expect some evidence of pedestalled plants when slopes exceed 15%.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Less than 5% bare ground is found on this site.

5. **Number of gullies and erosion associated with gullies:** None

6. **Extent of wind scoured, blowouts and/or depositional areas:** None

7. **Amount of litter movement (describe size and distance expected to travel):** Expect minimal size litter to travel short distances, associated with water flow patterns following extremely high intensity storms.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Stability class of 4-5 under canopies and in intercanopy spaces.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Typical A is 0-6 inches; very dark grayish brown (10YR 3/3), moist; weak fine granular structure; soft, very friable; neutral; clear smooth boundary.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** High grass canopy and basal cover and small gaps between plants should reduce raindrop impact and slow overland flow, providing increased time for infiltration to occur.

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

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: Warm Season midgrass some tallgrasses (50%) sideoats grama > little bluestem > big bluestem > switchgrass > sand dropseed

Sub-dominant: Shortgrasses-warm season (22%) blue grama > hairy grama > buffalograss

Other: Forbs (10%) cool season grasses (5%) shrubs (5%) sedges (3%)

Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** The majority of plants are alive and vigorous. Some mortality and decadence is expected for the site. This in part is due to drought, unexpected wildfire or a combination of the two events. This would be expected for both dominant and sub-dominant groups.

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14. **Average percent litter cover (%) and depth (in):** Plant litter is distributed evenly throughout the site. 25-40% litter cover at 0.25 or less inch depth. Litter cover during and following extended drought can range from 10-20%.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 600-1700 lbs/acre. Representative value is 1200 lbs/forage/acre. Below normal precipitation during the growing season expect 600 lbs/forage/acre and above normal precipitation during the growing season expect 1700 lbs/forage/acre. If utilization has occurred, estimate the annual production removed or expected and include this amount when making the total site production estimate.

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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:** None

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17. **Perennial plant reproductive capability:** The number and distribution of tillers or rhizomes is assessed relative to the expected production of the perennial warm season midgrass and shortgrasses.
