USDA Natural Resources
Conservation Service

Ecological site R081DY295TX
Flagstone Hill 8-14 PZ

Last updated: 9/19/2023
Accessed: 04/30/2025

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.

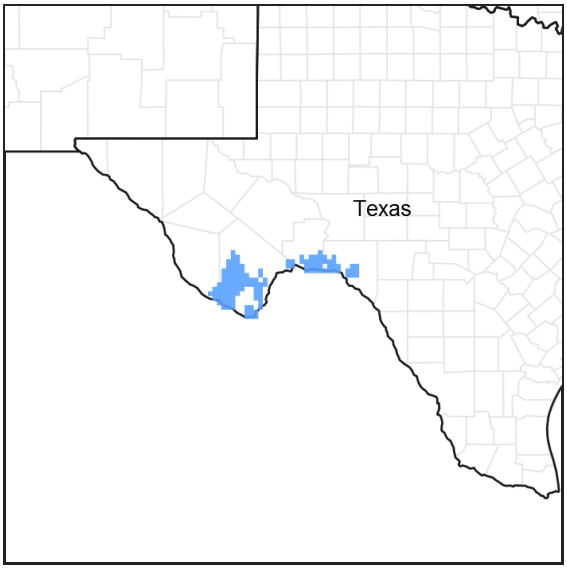


Figure 1. Mapped extent

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): 081D–Southern Edwards Plateau

This area is underlain primarily by limestones in the Austin Chalk, Boquillas Flags, Devil's River, Santa Elena, Buda, and Del Rio Clay Formations of Cretaceous age. Quaternary sand and gravel are in the river valleys.

The 81D is in the hyperthermic thermic zone.

Classification relationships

International Vegetation Classification:
Bouteloua ramosa Herbaceous Vegetation
Unique Identifier: CEGL004522

USDA-NRCS Ag Handbook 296.

Ecological site concept

The site consists of shallow, well drained soils that are moderately permeable above a very slowly permeable limestone bedrock. This site is dominated by Chino grama with scattered shrubs in the reference state. Species

composition by weight is approximately 60 percent grass, 30 percent shrub, 10 percent forbs.

Associated sites

R042AB263TX	**Basalt Hill, Hot Desert Shrub** In some areas, the Basalt Hill site is exposed as sills on side slopes and foot slopes, while the Flagstone Hill site is on shoulders and crests.
R042AB264TX	**Igneous Hill and Mountain, Hot Desert Shrub** Igneous parent material originating from trachyte or rhyolite.
R081DY297TX	**Gravelly 8-14 PZ** Gravelly alluvium originating from limestone instead of flaggy limestone.
R081DY592TX	**Limestone Hill 8-14 PZ** Limestone Hill has gravels, cobbles, and stones and a calcic horizon.

Similar sites

R081DY592TX	**Limestone Hill 8-14 PZ** Soils of this site have a calcic horizon, and do not contain channers and flagstones.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Larrea tridentata*
Herbaceous	(1) *Bouteloua ramosa*

Physiographic features

The site is located on gently sloping to very steep hill slopes and mountains. Slopes range from 1 to 60 percent. Elevation and aspect significantly affects production and site resiliency. Runoff is medium on 1 to 3 percent slopes, high on 3 to 5 percent slopes, and very high on slopes greater than 5 percent.

Table 2. Representative physiographic features

Landforms	(1) Plateau > Ridge (2) Plateau > Hill (3) Plateau > Plateau (4) Plateau > Erosion remnant
Runoff class	High to very high
Flooding frequency	None
Ponding frequency	None
Elevation	1,800–4,450 ft
Slope	1–30%
Aspect	Aspect is not a significant factor

Table 3. Representative physiographic features (actual ranges)

Runoff class	Medium to very high
Flooding frequency	None
Ponding frequency	None
Elevation	1,100–5,800 ft
Slope	1–60%

Climatic features

The average annual precipitation ranges from 8 to 14 inches. The annual total can vary from two to 21 inches. Most of the precipitation occurs as widely scattered thunderstorms of high intensity and short duration during the summer. Occasional precipitation occurs as light rainfall during the cool season. Negligible amounts of precipitation falls in the form of sleet or snow.

Mean annual air temperature is 70° F. Daytime temperatures exceeding 100° F are common from May through September. Frost-free period ranges from 246 to 256 days. Freeze-free period ranges from 277 to 290 days.

The average relative humidity in mid-afternoon is about 25 percent. Relative humidity is higher at night, and the average at dawn is about 57 percent. The sun shines 81 percent of the time in summer and 75 percent in winter. The prevailing wind is from the southwest. Average wind speed is highest, around 11 miles per hour, in March and April.

The combination of low rainfall and relative humidity, warm temperatures, and high solar radiation creates a significant moisture deficit. The annual Class-A pan evaporation is approximately 94 inches.

Table 4. Representative climatic features

Frost-free period (characteristic range)	240-280 days
Freeze-free period (characteristic range)	270-300 days
Precipitation total (characteristic range)	8-15 in
Frost-free period (actual range)	240-280 days
Freeze-free period (actual range)	270-300 days
Precipitation total (actual range)	8-15 in
Frost-free period (average)	250 days
Freeze-free period (average)	280 days
Precipitation total (average)	13 in

Climate stations used

- (1) LANGTRY [USC00415048], Comstock, TX
- (2) DRYDEN TERRELL CO AP [USW00003032], Dryden, TX
- (3) PERSIMMON GAP [USC00416959], Big Bend National Park, TX

Influencing water features

None.

Wetland description

N/A

Soil features

The site consists of shallow, well-drained soils that are moderately permeable above a very slowly permeable limestone bedrock. The soil formed in residuum and colluvium weathered from flaggy limestone interbedded with chalk and marl (Cretaceous Boquillas Formation). Strongly cemented channers and flagstones cover 5-80 percent of the soil surface. In a representative profile, the surface layer is a pale brown, very channery loam about 2 inches thick. The next layer is pale brown, very channery loam 2 to 5 inches in depth. Fractured limestone ranges from 5 to 10 inches thick. From 10 to 40 inches is interbedded limestone bedrock.

The Boquillas Formation can exhibit varying degrees of weathering potential resulting in stair-step topography. The

harder, less fractured, and more weather resistant limestone layers form the “treads” and the more easily weathered and fractured layers form the steeper risers. Water infiltration, plant production and diversity are greater within the risers than the treads. However, the presence of flagstones and channers forces water movement to meander slowly through the profile, a feature that can create a more droughty soil.

Soil temperature regime is hyperthermic (mean annual soil temperature to a depth of 20 inches is greater than 72º Fahrenheit). The representative soil series is Mariscal.

Table 5. Representative soil features

Parent material	(1) Residuum–limestone (2) Colluvium–limestone
Surface texture	(1) Very channery loam (2) Very channery silt loam (3) Very channery sandy loam
Family particle size	(1) Loamy-skeletal
Drainage class	Moderately well drained to well drained
Permeability class	Slow to moderately slow
Depth to restrictive layer	4–20 in
Soil depth	4–20 in
Surface fragment cover <=3"	40–75%
Surface fragment cover >3"	5–30%
Available water capacity (0-20in)	0.1–0.8 in
Calcium carbonate equivalent (0-20in)	40–70%
Electrical conductivity (0-20in)	0–1 mmhos/cm
Sodium adsorption ratio (0-20in)	0–2
Soil reaction (1:1 water) (0-20in)	7.9–8.4
Subsurface fragment volume <=3" (4-20in)	30–60%
Subsurface fragment volume >3" (4-20in)	5–20%

Ecological dynamics

The reference plant community on the Flagstone Hill 8-14 PZ site consists of bunch and stoloniferous grasses along with a variety of perennial forbs and woody shrubs.

Existing plant species composition and production varies with the interaction of yearly weather conditions, location, aspect, elevation, geologic attributes, and the natural variability of the soils. Probably the factor that most influenced the historic vegetative composition of the site was extended dry weather. High rainfall events did occur but were episodic. The perennial grasses dominating the site could survive the periodic droughts as long as the density of woody plants did not become excessive, and top-removal of the grass plants did not occur too frequently. Overgrazing amplifies the effects of drought. Insects, rodents, infrequent fire, and herbivores such as mule deer and desert bighorn sheep were also present. Bison were not documented in the historical record as being present in any significant amount. A lack of water was probably a contributing factor.

Early historical records do not always provide information specific to a site but can provide insight as to conditions existing in a general vicinity. Accounts suggest cattle, sheep, and horses were introduced into the southwest from

Mexico in the mid-1500's. However, extensive ranching did not begin in the Trans-Pecos region until the 1880s. Early explorers described the vegetation as they traveled over parts of the Trans-Pecos. For instance, Captain John Pope in 1854 described a portion of the Trans-Pecos area as ...destitute of wood and water, except at particular points, but covered with a luxuriant growth of the richest and most nutritious grasses known to this continent…. Other early travelers describe the scattered springs and water sources that were found in the region. Wagon travel could only be accomplished, along trails that had both water and forage sufficient for overnight stops. Livestock numbers peaked in the late 1880's following the arrival of railroads. Some historical accounts document ranches with stocking rates as high as one animal unit per four acres, however, this was far from sustainable in this environment.

Decades of overgrazing with loss of vegetation and erosion make it a slow process to return to the historic community. For example, in 1944, the southernmost portion of the Trans-Pecos area was set aside as Big Bend National Park. Grazing activities with cattle ceased. In 1944, most of the Limestone Hill and Mountain 14-19 PZ ecological site were probably degraded and dominated by woody shrubs. After 60 years of no grazing, the majority of sites have not recovered to the historic plant community which provides insight into the length of time it takes for recovery in this environment.

The large livestock herds brought in during the favorable years, mainly sheep, could not be sustained during the drought. Overgrazing became a major issue as the extended dry weather was a harsh taskmaster to the early stock growers.

Cattle use on rangeland declines significantly on slopes steeper than 15 percent; however, cattle numbers were never very large. Sheep and goats, however, are able to utilize steeper slopes. It should be noted that abusive grazing by different kinds and classes of livestock will result in different impacts on the site. One effect of the removal of the vegetated cover was to expose bare ground to erosion. Another effect was the deterioration of perennial grasses which removed the source of fine fuel to sustain periodic fires. More than likely, fires were not very frequent and when they did occur, the burn pattern was a mosaic governed by terrain and vegetative features.

Due to a combination of climate, soils, and geology, the Flagstone Hill 8-14 PZ ecological site is highly susceptible to disturbances and management prescriptions, either alone or in combination. Disturbances may quickly cause one stable community to cross a compositional and functional threshold into an alternative and often nonreversible stable community.

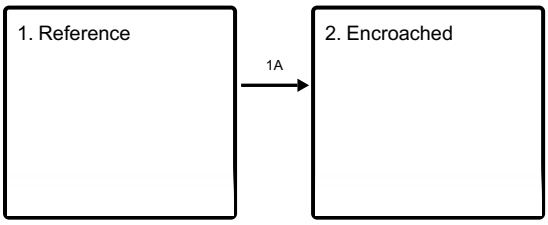
An indication of vegetation change caused by overgrazing includes a shift from a Mid/Shortgrass / Shrub Community (1.1) to a nonreversible Chino grama / Shrub Community (2.1) and ultimately to a Shrubs / Shortgrasses Community (2.2). The most palatable grasses and shrubs will decrease dramatically with overgrazing while some unpalatable woody plants and forbs will increase. However, the inherently low overall productivity of the site limits woody plant encroachment following overgrazing. In addition, loss of soil covers, such as vegetation and litter, in some low elevation areas can increase soil temperatures creating a drier and more inhospitable environment for seeds to germinate. Consequently, the Shrubs / Shortgrasses Community (2.2) is a sparse and less diverse and resilient plant community.

The following diagram suggests general pathways that the vegetation on this site might follow. There may be other states not shown in the diagram. This information is intended to show what might happen in a given set of circumstances; it does not mean that this would happen the same way in every instance. Local professional guidance should always be sought before pursuing a treatment scenario.

State and Transition Model

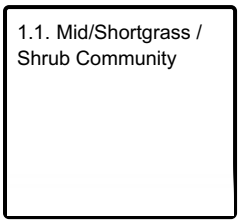
State and transition model

Ecosystem states

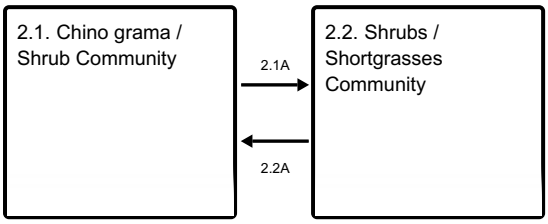


T1A - Prolonged drought coupled with excessive grazing pressure

State 1 submodel, plant communities



State 2 submodel, plant communities



State 1
Reference

The Reference state is considered to be representative of the natural range of variation under pre-Euro settlement conditions. Community phase changes are primarily driven by prolonged drought.

Dominant plant species

- Chino grama (*Bouteloua ramosa*), grass
- threeawn (*Aristida*), grass

Community 1.1
Mid/Shortgrass / Shrub Community

The Chino grama/Midgrass Shrubland State (1.0) is the reference plant community for the Flagstone Hill Ecological Site. Grasses total approximately 60% of the species composition by air dry weight, while shrubs and forbs account for 30% and 10% respectively. A high diversity of grasses is characteristic of this community. Depending on rainfall and grazing disturbance, average annual production ranges from 200-500 lbs/ac. Currently, plant communities similar to the reference can be found in areas that were protected from or inaccessible to many livestock. Ecological process (water cycle, nutrient cycle, and energy flow) are functioning with optimum efficiency due to the adequate amount of organic materials and surface fragments that cover the soil surface. The species diversity of this plant community provides excellent food and cover for wildlife. Extended dry weather causes an overall decline in grass cover and production and can cause some retrogression. However, the reference plant community evolved with plants that have drought tolerance. Long-term retrogression is triggered primarily by abusive grazing which causes an immediate decrease and eradication of the most palatable plants such as bush muhly, Arizona cottontop, black grama, menodora, and ratany. This will shift the community to a nonreversible Chino grama/Shortgrass Shrubland State (2.0). Mariola will increase at higher altitudes while lechuguilla will increase at lower latitudes. Creosotebush, whitethorn acacia, and prickleleaf dogweed will increase throughout the site's range. Although species composition of woody plants will shift slightly, overall canopy cover will not increase greatly. This occurs because of the inherently low productivity of the site. At this point, recovery of the more desirable grasses is doubtful. Long-term climate change may favor shrubs over grasses but the impact is still being studied. Conservation practices such as prescribed grazing can help maintain ecological integrity in this community. Stocking rates need to be flexible and adjusted to carrying capacity because of sporadic rainfall.

Table 6. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	160	280	400
Shrub/Vine	30	52	75
Forb	10	18	25
Tree	0	0	0
Total	**200**	**350**	**500**

Table 7. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	15-20%
Grass/grasslike foliar cover	15-35%
Forb foliar cover	3-7%
Non-vascular plants	0%
Biological crusts	0%
Litter	0%
Surface fragments >0.25" and <=3"	30-50%
Surface fragments >3"	40-60%
Bedrock	0-15%
Water	0%
Bare ground	1-2%

Table 8. Soil surface cover

Tree basal cover	0%
Shrub/vine/liana basal cover	2-3%
Grass/grasslike basal cover	4-5%
Forb basal cover	1-2%
Non-vascular plants	0%
Biological crusts	0%
Litter	15-30%
Surface fragments >0.25" and <=3"	20-50%
Surface fragments >3"	50-80%
Bedrock	0-15%
Water	0%
Bare ground	1-2%

Table 9. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	–	–	–	2-5%
>0.5 <= 1	–	3-5%	2-5%	1-2%
>1 <= 2	–	6-7%	13-30%	–
>2 <= 4.5	–	6-8%	–	–
>4.5 <= 13	–	–	–	–
>13 <= 40	–	–	–	–
>40 <= 80	–	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

Figure 9. Plant community growth curve (percent production by month). TX4002, Chino grama/Shortshrub Community. Chino and black grama with less than 20% woody canopy of shrubs..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1	2	2	2	8	8	20	25	15	15	1

State 2
Encroached

The Encroached state is characterized by an increase in bare ground and cover of woody vegetation.

Dominant plant species

- desert myrtlecroton (*Bernardia obovata*), shrub
- Chino grama (*Bouteloua ramosa*), grass

Community 2.1
Chino grama / Shrub Community

Figure 10. 2.1 Chino grama / Shrub Community

The Chino grama / Shrub Community (2.1) is the result of continuous overgrazing with drought accelerating the transition. Overgrazing initially reduces the most palatable plants and provides a competitive advantage to Chino grama. Although palatable when green, Chino grama's drought tolerance and aggressive nature allows it to persist and increase through initial overgrazing and drought. At this point, an irreversible composition threshold has been crossed. Chino grama becomes the dominant grass within the community. Sub-dominant grasses include three-awns, fluffgrass, and slim tridens. Few subdominant palatable grasses species can be seen protected by shrubs or cactus. Creosotebush, whitethorn acacia, and prickleleaf dogweed displace more palatable shrubs and forbs. If grazing pressure is not removed, Chino grama will decrease, shifting the plant community to the

Shrubs/Shortgrasses Community (2.2). There are some forms of brush management that will suppress certain shrubs. When brush management is coupled with prescribed some recovery of the plant community is possible. However, even with prolonged deferment of grazing, many of the lost plants of the reference will not be able to recover naturally or otherwise due to climatic and soil limitations. The brush management may have to be repeated over time to maintain the desired plant community. Percentage of total plant community composition by weight is estimated to be 50 percent grass, 40 percent shrubs, and 10 percent forbs.

Resilience management. Although some plants species are displaced from the reference, overall grass and woody plant canopy cover remains similar to reference community. This results in a site functioning similar ecologically to the reference. This is important for reducing runoff and increasing resource retention. However, plant species diversity decreases which will reduce food selection for wildlife. This plant community is suitable for prescribed grazing.

Table 10. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	150	225	300
Shrub/Vine	120	180	240
Forb	30	45	60
Tree	0	0	0
Total	**300**	**450**	**600**

Figure 12. Plant community growth curve (percent production by month). TX4003, Shortgrass/Shrub Dominant Community. Shortgrasses dominate with 50% woody canopy of shrubs..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1	2	2	2	8	8	20	25	15	15	1

Community 2.2
Shrubs / Shortgrasses Community

Figure 13. 2.2 Shrubs /Shortgrasses Community

The Shrubs /Shortgrasses Community (2.2) is the result of excessive over-utilization of plant resources. Drought conditions will only worsen the health of the site. Sparse woody plants dominate the community with few grasses and forbs. The most palatable grasses, forbs, and shrubs have been permanently eliminated or drastically reduced in frequency. At the northernmost range of the site, the dominant shrubs are creosotebush, mariola, whitethorn acacia, and Gregg’s coldenia. Within the southernmost range, the site is dominated by creosote, lechuguilla, pricklypear, candelilla, and Gregg’s coldenia. Fluffgrass is the most common grass in all areas in addition to threeawns, slim tridens, and Chino grama. In areas with low surface fragments, the reduction of grass cover will potentially result in soil erosion. This plant community does not provide adequate food and shelter for many wildlife mammals that occur in the area. Percentage of total plant community composition by weight is estimated to be 15

percent grass, 75 percent shrubs, and 10 percent forbs.

Resilience management. With several years of prescribed grazing, some form of brush management and favorable rainfall on the northernmost range and/or highest elevations, this plant community has the potential to return to a Chino grama/ Shrub community (2.1). However, prescribed grazing and favorable rainfall on the southernmost range and/ or lowest elevations may not be able to return to community 2.1, because this plant community is less resilient.

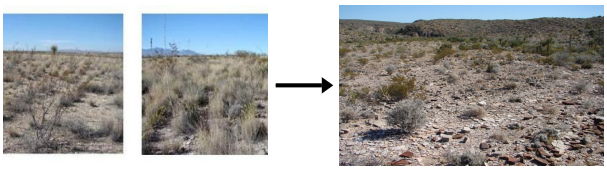
Table 11. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Shrub/Vine	75	190	300
Grass/Grasslike	15	35	60
Forb	10	25	40
Tree	0	0	0
Total	**100**	**250**	**400**

Figure 15. Plant community growth curve (percent production by month). TX4005, Shrub/Shortgrass Community. Shrub dominant with shortgrasses..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1	2	2	2	8	8	20	25	15	15	1

Pathway 2.1A
Community 2.1 to 2.2

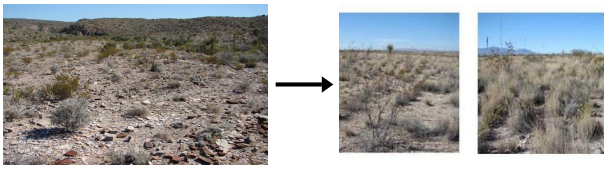


Chino grama / Shrub Community

Shrubs / Shortgrasses Community

With improper grazing and extended drought conditions, the Chino grama/Shrub Community will shift into the Shrubs/Shortgrasses Community.

Pathway 2.2A
Community 2.2 to 2.1



Shrubs / Shortgrasses Community

Chino grama / Shrub Community

With Prescribed Grazing and favorable rainfall, the Shrubs/Shortgrasses Community can be reverted back to the Chino grama/Shrub Community.

Conservation practices

Prescribed Grazing

Transition T1A
State 1 to 2

With improper grazing and extended drought conditions, the Chino/Midgrass Shrubland State will transition to the Chino/Shortgrass Shrubland State.

Transition 1A
State 1 to 2

Improper grazing and extended drought.

Additional community tables

Table 12. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Midgrass**			80–200	
	Chino grama	BORA4	*Bouteloua ramosa*	80–200	–
2	**Midgrasses**			40–100	
	threeawn	ARIST	*Aristida*	20–50	–
	slim tridens	TRMU	*Tridens muticus*	20–50	–
3	**Midgrasses**			20–50	
	black grama	BOER4	*Bouteloua eriopoda*	10–25	–
	bush muhly	MUPO2	*Muhlenbergia porteri*	10–25	–
4	**Mid/Shortgrasses**			20–50	
	fall witchgrass	DICO6	*Digitaria cognata*	10–25	–
	Hall's panicgrass	PAHA	*Panicum hallii*	10–25	–
5	**Shortgrasses**			10–25	
	red grama	BOTR2	*Bouteloua trifida*	4–10	–
	low woollygrass	DAPU7	*Dasyochloa pulchella*	4–10	–
	hairy woollygrass	ERPI5	*Erioneuron pilosum*	2–5	–
Shrub/Vine					
6	**Shrubs**			20–50	
	desert myrtlecroton	BEOB	*Bernardia obovata*	5–10	–
	resinbush	VIST	*Viguiera stenoloba*	5–10	–
	ocotillo	FOSP2	*Fouquieria splendens*	5–10	–
	Texas lignum-vitae	GUAN	*Guaiacum angustifolium*	3–8	–
	shortleaf jefea	JEBR	*Jefea brevifolia*	3–8	–
	Texas barometer bush	LEFR3	*Leucophyllum frutescens*	3–8	–
	featherplume	DAFO	*Dalea formosa*	2–5	–
	rough jointfir	EPAS	*Ephedra aspera*	1–3	–
	Rio Grande saddlebush	MOSC	*Mortonia scabrella*	1–3	–
7	**Shrubs**			5–15	
	whitethorn acacia	ACCO2	*Acacia constricta*	1–3	–
	creosote bush	LATR2	*Larrea tridentata*	1–3	–
	guayule	PAAR5	*Parthenium argentatum*	1–3	–
	mariola	PAIN2	*Parthenium incanum*	1–3	–
	plumed crinklemat	TIGR	*Tiquilia greggii*	1–3	–
8	**Fibrous/Succulents**			4–10	

	lechuguilla	AGLE	*Agave lechuguilla*	1–3	–
	candelilla	EUAN3	*Euphorbia antisyphilitica*	1–3	–
	Texas false agave	HETE7	*Hechtia texensis*	1–3	–
	pricklypear	OPUNT	*Opuntia*	1–3	–
Forb					
9	**Perennial Forbs**			10–24	
	pricklypear	OPUNT	*Opuntia*	5–15	–
	Christmas cactus	CYLE8	*Cylindropuntia leptocaulis*	5–10	–
	candelilla	EUAN3	*Euphorbia antisyphilitica*	5–10	–
	croton	CROTO	*Croton*	1–5	–
	plains blackfoot	MELE2	*Melampodium leucanthum*	1–5	–
	bicolor fanmustard	NECA3	*Nerisyrenia camporum*	1–5	–
	globemallow	SPHAE	*Sphaeralcea*	1–5	–
	pricklyleaf dogweed	THAC	*Thymophylla acerosa*	1–3	–
	vervain	VERBE	*Verbena*	1–3	–
	zinnia	ZINNI	*Zinnia*	1–3	–
	bushsunflower	SIMSI	*Simsia*	1–3	–
10	**Annual Forbs**			0–1	
	Forb, annual	2FA	*Forb, annual*	0–1	–

Animal community

The Reference Community (1.1) and the Chino grama / Shrub Community (2.1) are suited for a prescribed grazing system for the production of livestock, including cattle, sheep, and goats. Areas with lower relief are more suited for cattle grazing. Steep mountain slopes are more accessible to sheep and goats. Continuous grazing causes a gradual decline in range health reducing livestock nutrition and habitat quality for wildlife. Livestock should be stocked at carrying capacity in proportion to the grazeable grass, forbs, and browse. Vegetative growth is episodic mirroring the rainfall. For this reason, stocker type livestock operations may be more suitable than year-round stocking.

Many types of wildlife use the site. Invertebrates, reptiles, birds, and mammals either use the site as their primary habitat or visit from adjacent sites. Common mammals include mule deer, black-tailed jackrabbit, cottontail rabbit, javelina, coyote, skunk, woodrats, many nocturnal mice, and occasionally mountain lions and desert bighorn sheep. Game birds include scaled quail and dove. Numerous songbirds and raptors also occur in the area. Diversity in both plant species and plant communities over short distances is important for healthy wildlife populations.

Plant Preference by Animal Kind:
These preferences are somewhat general in nature as the preferences for plants is dependent upon grazing experience, time of year, availability of choices, and total forage supply.

Legend: P=Preferred D=Desirable U=Undesirable N=Not Consumed T=Toxic X=Used, but not degree of utilization unknown
Preferred – Percentage of plant in animal diet is greater than it occurs on the land
Desirable – Percentage of plant in animal diet is similar to the percentage composition on the land
Undesirable – Percentage of plant in animal diet is less than it occurs on the land
Not Consumed – Plant would not be eaten under normal conditions. Only consumed when other forages not available.
Toxic – Rare occurrence in diet and, if consumed in any tangible amounts results in death or severe illness in animal

Hydrological functions

The existing plant community with representative plant species, current soil conditions (soil health), current management, climate, and geomorphology, and slope gradient determine the dynamics of the water cycle. Plant, litter, and rock cover are important factors, which protect the site from erosion. Total production and the types of plant species present also have great impact on hydrologic dynamics (infiltration capacity, runoff, and soil losses).

The Boquillas Geologic Formation exhibits varying degrees of weathering potential resulting in “stair-step” topography. The harder, less fractured, and more weather resistant limestone layers form the “treads” and the more easily weathered and fractured layers form the steeper “risers”. Water infiltration, plant production and diversity are greater within the risers than the treads. As slope gradient increases so does the potential for increased runoff. In addition, the presence of flagstones and channers forces water movement to meander slowly through the profile, a feature that can create a more droughty soil.

With reference to the transitional pathway diagram, the Historic Climax Plant Community State 1 is associated with optimum hydrologic function within this site. The high degree of hydrologic function in State 1 is due to the adequate vegetative cover and dominance of deep-rooted midgrasses compared to more shallow rooted shortgrasses. When properly managed, these species provide adequate cover that will minimize runoff. One of the key concepts to high hydrologic function is the structure and morphology of the root system and other biotic and abiotic factors as explained above. During high rainfall periods, water will percolate beyond the immediate surface root zone via fractures in the bedrock. As this water moves downward, it contributes to the recharge of groundwater.

Some runoff naturally occurs due to the low overall biomass production and common occurrence of high intensity summer rainfall. In addition to plant cover, surface rock fragments assist with minimizing runoff and reducing raindrop impact.

Although a shift in species composition has occurred, the Chino grama/ Shrub Community (2.1) is still associated with good hydrologic function. Within the upper range of canopy cover, Chino grama maintains hydrologic function through above and belowground biomass. The flaggy and channery rock fragments help provide important ground cover. As retrogression occurs, the lack of sufficient herbaceous vegetative cover will impair hydrologic function. Consequently, the Shrubs/Shortgrasses Community (2.2) is associated with decreased infiltration and increases runoff especially in areas with low ground cover (rocks and litter).

Recreational uses

The Flagstone Hill 8-14 PZ Ecological Site is limited for outdoor recreational uses. The numerous and loose rock fragments makes a poor surface for hiking. Rock fragments, slope, and depth to bedrock make campsite preparation difficult. High summer temperatures also limit recreational uses.

Wood products

None.

Other products

Flagstones are used for home construction, walls, and sidewalks.

Other information

None.

Inventory data references

Information presented here has been derived from the Flagstone Hille Range Site description, literature, limited NRCS clipping and cover data, field observations and personal contacts with range and wildlife trained personnel.

Site Development and Testing Plan
Future work, as described in a Project Plan, to validate the information in this Provisional Ecological Site

Description is needed. This will include field activities to collect low, medium and high intensity sampling, soil correlations, and analysis of that data. Annual field reviews should be done by soil scientists and vegetation specialists. A final field review, peer review, quality control, and quality assurance reviews of the ESD will be needed to produce the final document.
Annual reviews of the Project Plan are to be conducted by the Ecological Site Technical Team.

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Approval

Bryan Christensen, 9/19/2023

Acknowledgments

Site Development and Testing Plan:

Future work, as described in a Project Plan, to validate the information in this Provisional Ecological Site Description is needed. This will include field activities to collect low, medium and high intensity sampling, soil correlations, and analysis of that data. Annual field reviews should be done by soil scientists and vegetation specialists. A final field review, peer review, quality control, and quality assurance reviews of the ESD will be needed to produce the final document. Annual reviews of the Project Plan are to be conducted by the Ecological Site Technical Team.

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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.

Author(s)/participant(s)	Michael Margo, RMS, NRCS, Marfa, Texas
Contact for lead author	Zone RMS, San Angelo, Texas, 325-944-0147
Date	07/28/2008

Approved by	Bryan Christensen
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, except following high intesity storms, when short (less than 1 m) and discontinuous flow patterns may appear. Flow patterns in drainages are linear and continuous.

3. **Number and height of erosional pedestals or terracettes:** None.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 1-5% bare ground. Inherently low percent bare ground due to high surface rock cover. Rock cover is approximately 80%

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):** In drainages, there can be significant amounts of litter moved long distances. On most of the site, minimal and short distance (<5ft) of litter movement associated with high intense rainfall.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Stability values anticipated to be 3-4 in the interspaces and 4-5 under plant canopies. Values need verification at reference sites.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** 1-3 inches thick, pale brown surface horizon with a medium granular structure.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** A high canopy cover of midgrass bunch and stoloniferous grasses will help minimize runoff and maximize infiltration. Grasses should comprise approximately 60% of total plant compostion by weight. Shrubs will comprise about 30% by weight.

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be**

mistaken for compaction on this site): None.

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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 perennial mid bunchgrass >

    Sub-dominant: Warm-season perennial mid/short stoloniferous = Warm-season perennial short bunchgrass = Mid/tall Shrubs >

    Other: Subshrubs = Semi-succulent/Succulent = Perennial forbs > Annual forbs

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** All grasses will show some mortality and decadence in addition to annual forbs. Mid/tall perennial shrubs will show some mortality or decadence only after prolonged and severe droughts. Subshrubs will be less resistant to severe droughts than mid/tall perennial shrubs.

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14. **Average percent litter cover (%) and depth (in):** Steep slopes will inherently average less litter cover than nearly level slopes.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 300 - 600 pounds/acre

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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:** All species should be capable of reproducing.
