

Vegetation Classification at Lake Meredith NRA and Alibates Flint Quarries NM

A Report for the USGS-NPS Vegetation Mapping Program

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September 2005

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Introduction

This report and its appendices are part of a larger project to classify and map the vegetation at Lake Meredith National Recreation Area (LAMR) and Alibates NM (ALFL). The project is part of the USGS-NPS Vegetation Mapping Program, which is an effort by USGS and the National Park Service to classify and map the vegetation at over 250 parks across the United States. More information on the Vegetation Mapping Program can be found at <http://biology.usgs.gov/npsveg/>. A general summary of steps in the project is outlined below

1. Project Planning
2. Field Data Collection for Classification
3. Data Entry
4. Vegetation Classification, including data analysis
5. Description of Vegetation Classes
6. Production of Key to Vegetation Classes
7. Field Reconnaissance for Mapping
8. Photo Interpretation
9. Map Production
10. Accuracy Assessment

This report includes the results of steps 3, 4, 5, and 6 above. It contains a description of the vegetation classification process, a description of each vegetation community at LAMR and ALFL, a field key to those communities, and a description of each Ecological System found at LAMR and ALFL. Latin names are used for plant taxa in this document. A list of the latin names and corresponding common name for all taxa identified during this project can be found in Appendix A. All sections of this report will be integrated into the final project report which will contain information on all aspects of the project. The final project report will be produced by the Bureau of Reclamation and is anticipated to be finished by the end of 2005.

Classification Process

Data Management

During the summer of 2004 182 plots were sampled. Two-hundred-seventy-five taxa were identified on the plots (Appendix A). After all the plot data were collected, they were entered into PLOTS2 (NatureServe 2005), an MS Access derived database developed for the USGS-NPS Vegetation Mapping Program. Plant names were standardized using the USDS Plants database (USDA 2004). Several subspecific taxa were combined when they were judged ecologically similar or there were inconsistencies in whether the field crew recorded subspecific epithets or not. For example, most field forms had *Populus deltoides* but two *Populus deltoides* var.

monilifera. All records were combined to *Populus deltoides* for analysis. During data collection the field crews recorded the presence of taxa within different strata on the plots. These were simplified to three strata for analysis – Tree, Shrub/Sapling, and Field Layer (tree seedlings and herbaceous species). Thus, if *Populus deltoides* occurred as seedlings, saplings, and mature trees it would be listed three times in the database and considered three separate taxa during the analysis.

The plots were distributed over a broad ecological spectrum with the strongest perceived gradient being moisture. We elected to split the dataset into two subsets before beginning to have more homogeneous subsets to start our analyses. We used a designation given by the field crews for each plot to create a wetland/floodplain subset and an upland subset. A few plots were so clearly on the border between the two that we included them in both from the beginning. We began with a Wetland subset with 55 plots and an Upland subset with 133 plots. The plots in each subset were separate from each other, except for the few that were in both from the beginning, but during subsequent analyses several were transferred from one to the other as it became clear that they were most similar to plots in the other subset. For example, some of the drier *Populus deltoides*-dominated stands were originally placed with the Upland subset but they were eventually combined with the other cottonwood stands in the final results. As a final step to clean up the database and reduce noise in the data we eliminated taxa that occurred in only one plot in each subset and had less than 5% cover.

Data Analysis

Our classification process was to use standard multivariate analytical software to detect patterns in the species data and to interpret those patterns using the environmental data and comments from the field crew. Ecologists who knew the area well were also consulted for some of the most difficult questions. Although this is a standard method to analyze ecological data, it is important to keep in mind that this was all done in the context of the National Vegetation Classification (NVC) (Grossman et al 1998). As we were analyzing the data, we were continually comparing the results to existing NVC associations to determine when groups of plots fit those NVC associations. Maintaining a regional view while analyzing a local dataset sometimes affected how the plots were grouped. For example, the *Salix exigua*-dominated plots were close to the *Baccharis salicina*-dominated plots throughout most of the analyses but we separated them into two associations based partially on the fact that we know there are *Salix exigua* stands and *Baccharis salicina* stands across the southern Great Plains that are not so closely related in species composition.

The PLOTS2 database mirrors the field forms and allows for easy data entry and management but does not have any analytical functions. We used PC-Ord (McCune and Mefford 1997) for our multivariate analyses. All species records (species by strata combinations) were exported. Each analytical method has different assumptions, strengths, and weaknesses so we employed more than one and compare results. For this project we used two ordination methods Detrended

Canonical Analysis (DCA), Non-metric Multidimensional Scaling (NMS), and a clustering technique using Flexible Beta linkage and Relative Sorensen distance measure.

After each analysis, plots were assigned to the groups identified by the clustering program and summary statistics were calculated for each group. The summary statistics used were average cover and frequency of each taxon in each group. These summary statistics were compared to NVC association concepts and to other groups to determine when a group of plots fit the concept of an NVC association and to get a sense of the internal variability within each group. In addition, the plots were displayed on the ordination scatterplots to further determine the relation of plots within a group and of one group to another. Groups of plots that corresponded to NVC association concepts were removed and the remaining plots were subjected to the same analyses again. The Wetland subset of plots required four iterations before all plots were assigned and the Upland subset required five iterations. The final assignment of plots to vegetation communities was strongly influenced by the clustering and ordination analyses but did not exactly reflect the results of either. Environmental and physiognomic factors such as slope, soil type, percent cover by different vegetation strata were also used to interpret the multivariate results and group plots into communities. Because there is no quantitative way to combine all these data inputs and because we were working within the context of a national classification, the NVC, the ecological judgment of the people doing the analyses was an important factor in deciding how plots were assigned to vegetation communities.

Classification Results

As might be expected in a dry environment like northern Texas, moisture was a strong gradient throughout the analyses. The first groups that came out of the analyses corresponded to readily distinguishable NVC associations at either extreme of the moisture gradient such as cattail marsh or rocky juniper woodlands. Further iterations identified more subtle variations such as between different floodplain woodlands or upland grassland communities. Many of the communities were readily identified by a combination of shared floristic composition evident in the multivariate analyses and similar environmental setting. Although the actual analyses required several iterations, this pattern of vegetation at LAMR and ALFL can be seen by looking at an ordination scatterplot of the Upland and Wetland subsets with the final, interpreted vegetation patterns overlaid. In Figure 1 the Wetland subset of plots are displayed. The first axis in the ordination appears to follow a moisture gradient with dry-mesic cottonwood plots on the far left (A) to semi-permanently flooded marsh plots (D) on the far right. The floodplain shrublands (C), made up of *Tamarix ramosissima*, *Baccharis salicina*, and *Salix exigua* associations, occupy intermediate space. Section B is dominated by mesic grasslands that occur in the Canadian River floodplain and larger tributary valleys.

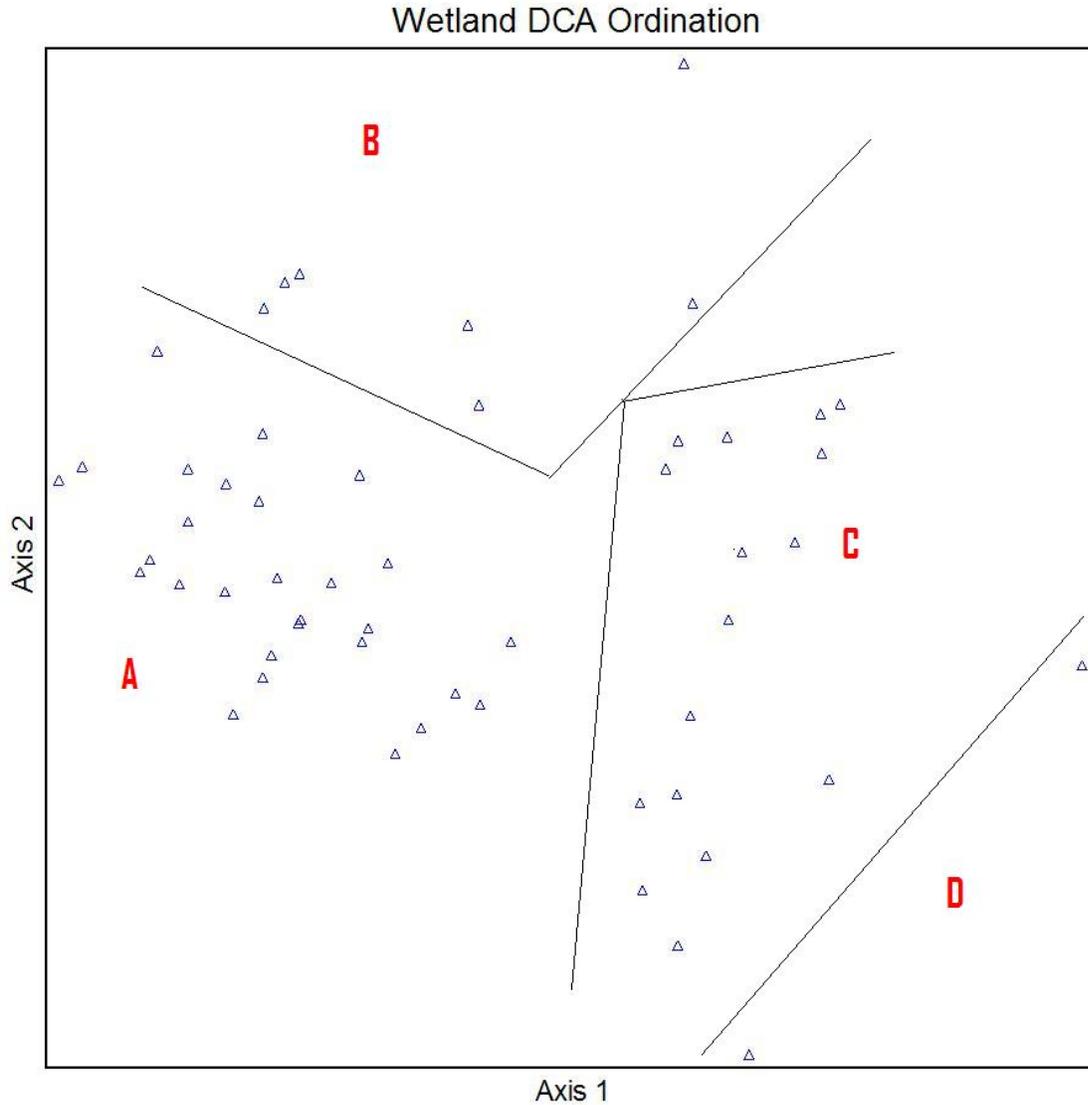


Figure 1. DCA Ordination of Wetland plots at Lake Meredith NRA and Alibates Flint Quarries NM. The solid lines separate plots in general vegetation types.

In Figure 2 the Upland subset of plots are displayed. Again, the first axis appears to follow a moisture gradient from communities found on rocky slopes and thin soils through mesic mixedgrass prairies (G) on the right. A more detailed look at the different sections of the scatterplot shows that the section labeled A contains dry juniper woodland plots, B contains dry, rocky shrublands, C contains upland prairie, D contains prairie and shrub communities on rocky slopes, E contains sandy soiled shrublands, F contains mesquite shrublands and shortgrass prairie, G contains mesic grasslands. The dry-mesic *Populus*-dominated stands (H) that were in this dataset remain at the top of the scatterplot.

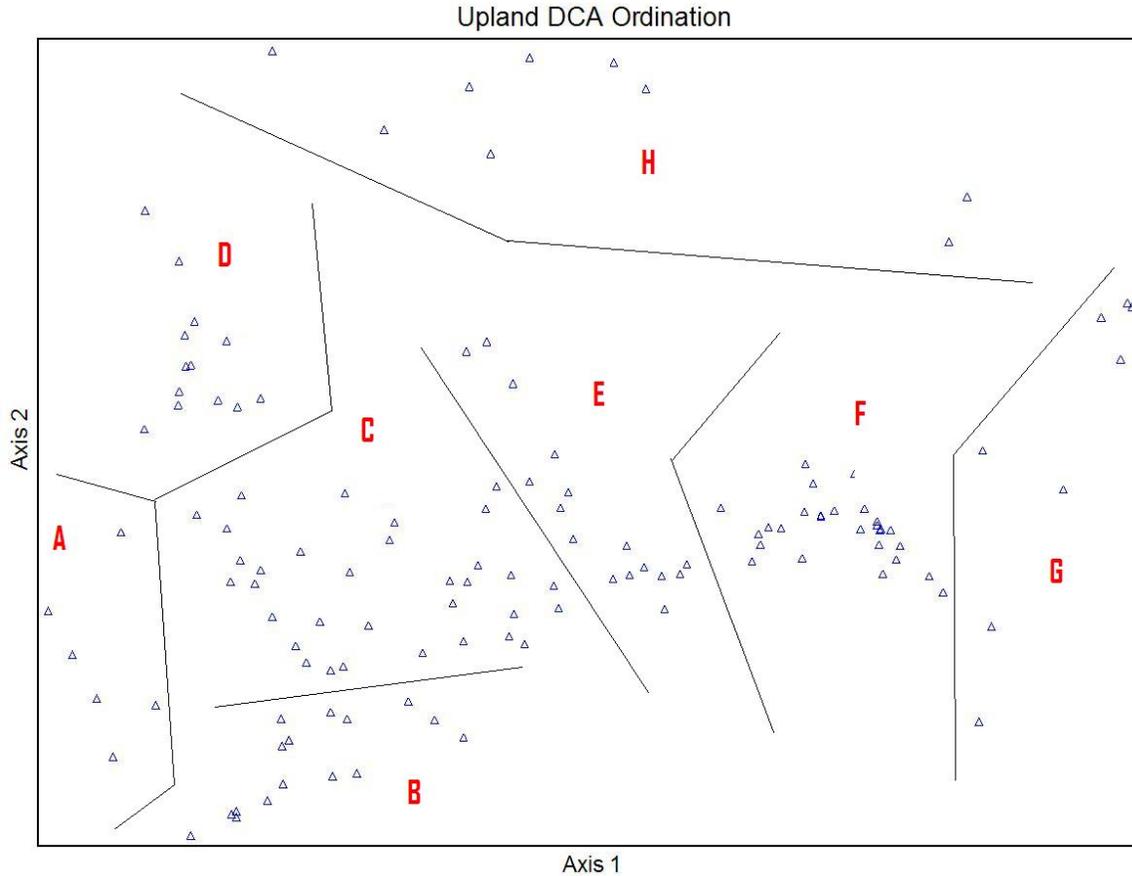


Figure 2. DCA Ordination of upland plots at Lake Meredith NRA and Alibates Flint Quarries NM. The solid lines separate plots general vegetation types.

Based on interpretation of the analyses described in the previous section, the plots from LAMR and ALFL were assigned to one of 29 vegetation communities. Twenty-eight of these were classified to the Association level and one was at the Alliance level (Table 1). Ten of the associations were new to the NVC. The plots that were left at the Alliance level were dominated by *Populus deltoides* but had floristic and physiognomic compositions that did not fit well with other plots nor with existing NVC associations. After all the plots were assigned to vegetation communities, summary statistics were generated for the communities. One way to display the relationship between the final, defined communities is to treat the aggregated community statistics as if they were individual plots, that is, calculate a single average cover statistic for each species in a community and then use the community-level data as a single sample in the analyses. We did an ordination of the community data to show how the communities related to each other once they were aggregated. The pattern of the vegetation can be seen in Figure 3. Section A is herbaceous marshes, Section B is floodplain shrublands, Section C is *Populus*-dominated woodlands, Section D is mesic grasslands, Section E is deep-soiled upland grasslands and shrublands, and Section F is dry upland grasslands, shrublands, and woodlands on shallow soils and rocky slopes. The pattern evident in the ordinations of the individual plots is repeated

with Axis 1 appearing to follow a moisture gradient from wet to dry. Names of individual communities corresponding to the numbers in Figure 3 can be found in Table 2.

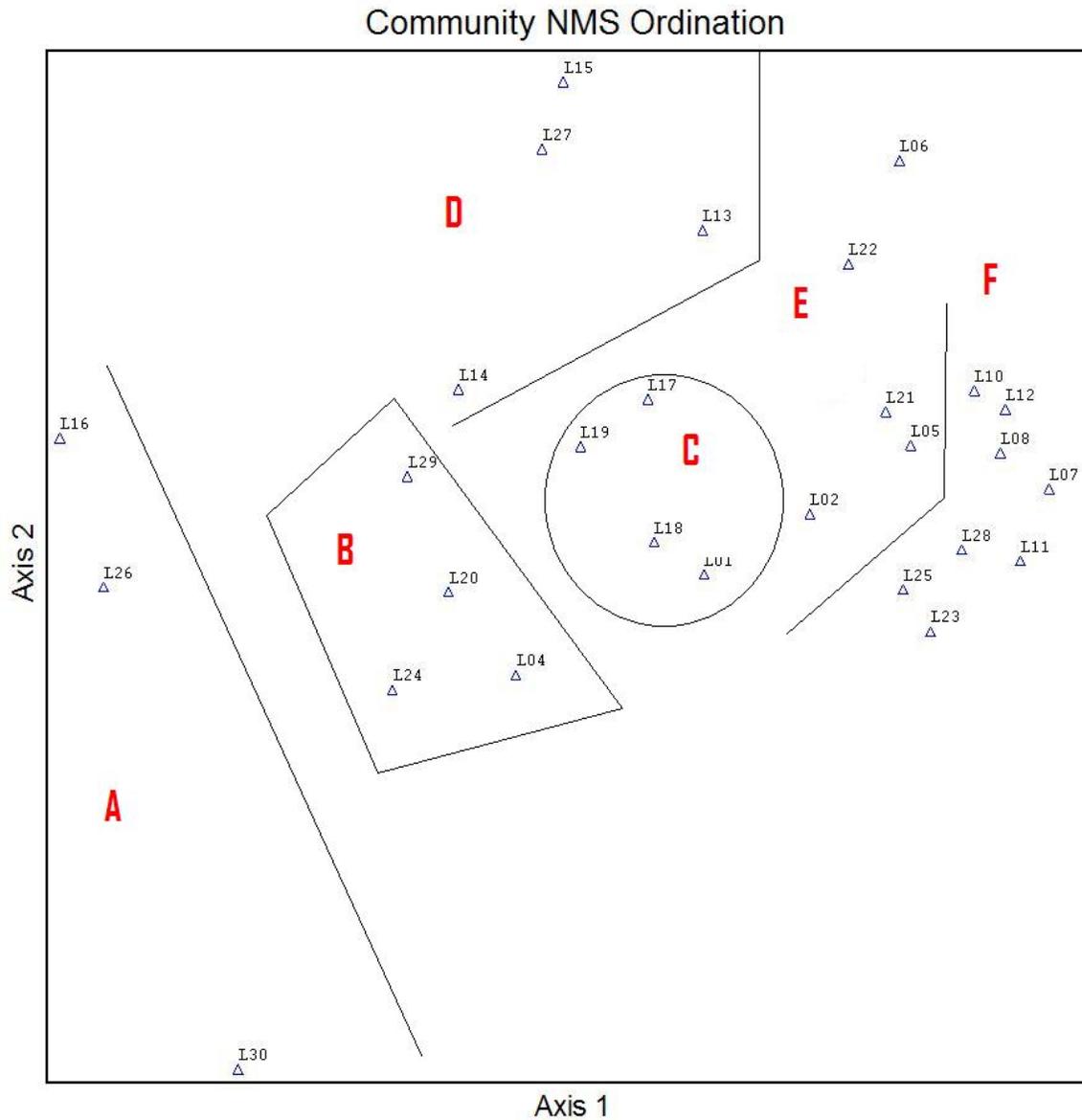


Figure 3: NMS Ordination of Aggregated Community Samples at Lake Meredith NRA and Alibates Flint Quarries NM. Names of the communities can be found in Table 2.

Table 1: List of NVC Communities at Lake Meredith NRA and Alibates NM.

Classified Community Name	Common Name	NVC ELCODE
Floodplain Woodlands		
Populus deltoides - Celtis laevigata / Sapindus saponaria Woodland	Eastern Cottonwood - Sugarberry / Soapberry Woodland	NEW
Populus deltoides / Panicum virgatum - Schizachyrium scoparium Woodland	Eastern Woodland / Switchgrass - Little Bluestem Woodland	CEGL001454
Populus deltoides / Pascopyrum smithii - Panicum virgatum Woodland	Eastern Cottonwood / Western Wheatgrass - Switchgrass Woodland	NEW
Populus deltoides Woodland Alliance	Eastern Cottonwood Woodland Alliance	A.636
Floodplain Shrublands		
Baccharis salicina Shrubland	Great Plains False Willow Shrubland	NEW
Salix exigua Temporarily Flooded Shrubland	Coyote Willow Temporarily Flooded Shrubland	CEGL001197
Tamarisk spp. Temporarily Flooded Shrubland	Tamarisk spp. Temporarily Flooded Shrubland	CEGL003114
Wetland Herbaceous Communities		
Phragmites australis Western North America Temperate Semi-Natural Herbaceous Vegetation	Common Reed Western North America Temperate Semi-Natural Herbaceous Vegetation	CEGL001475
Schoenoplectus pungens - Distichlis spicata Herbaceous Vegetation	Threesquare - Saltgrass Herbaceous Vegetation	CEGL005988
Typha (angustifolia, domingensis, latifolia) - Schoenoplectus americanus Herbaceous Vegetation	(Narrowleaf Cattail, Southern Cattail, Broadleaf Cattail) - Chairmaker's Bulrush Herbaceous Vegetation	CEGL002032
Floodplain Grasslands		
Andropogon hallii - Calamovilfa gigantea Herbaceous Vegetation	Sand Bluestem - Giant Sandreed Herbaceous Vegetation	CEGL004016
Pascopyrum smithii - Bouteloua gracilis Herbaceous Vegetation	Western Wheatgrass - Hairy Grama Herbaceous Vegetation	CEGL001578
Sporobolus airoides Southern Plains Herbaceous Vegetation	Alkali Sacaton Southern Plains Herbaceous Vegetation	CEGL001685

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Mesic Grasslands		
Panicum obtusum Herbaceous Vegetation	Vine Mesquite Herbaceous Vegetation	CEGL002708
Panicum virgatum - Pascopyrum smithii Southern Herbaceous Vegetation	Switchgrass - Western Wheatgrass Southern Herbaceous Vegetation	NEW
Upland Woodlands and Shrublands		
Juniperus monosperma / Bouteloua curtipendula Woodland	One-seed Juniper / Sideoats Grama Woodland	CEGL000708
Artemisia filifolia – Rhus trilobata Shrubland	Sand Sagebrush - Squawbush Shrubland	NEW
Artemisia filifolia / Bouteloua (curtipendula, gracilis) Shrubland	Sand Sagebrush / (Sideoats Grama, Hairy Grama) Shrubland	CEGL002176
Cercocarpus montanus Shrubland	Mountain Mahogany Shrubland	CEGL001086
Dalea formosa - Mimosa borealis Dwarf-shrubland	Feather Dalea - Catclaw Mimosa Dwarf-shrubland	NEW
Gutierrezia sarothrae - Yucca glauca Dwarf-shrubland	Broom Snakeweed - Soapweed Yucca Dwarf-shrubland	NEW
Krascheninnikovia lanata Dwarf-Shrubland	Winterfat Dwarf-shrubland	NEW
Prosopis glandulosa / Bouteloua curtipendula Shrubland	Mesquite / Sideoats Grama Shrubland	CEGL002194
Prosopis glandulosa var. glandulosa / Bouteloua gracilis – Buchloe dactyloides Shrubland	Mesquite / Hairy Grama - Buffalograss Shrubland	CEGL003877
Rhus trilobata / Bouteloua curtipendula - Schizachyrium scoparium Shrubland	Squawbush / Sideoats Grama - Little Bluestem Shrubland	NEW
Upland Grasslands		
Bouteloua curtipendula - Bouteloua (gracilis, eriopoda) Herbaceous Vegetation	Sideoats Grama - (Sideoats Grama, Black Grama) Herbaceous Vegetation	CEGL002250
Bouteloua gracilis - Buchloe dactyloides Herbaceous Vegetation	Hairy Grama - Buffalograss Herbaceous Vegetation	CEGL001756
Schizachyrium scoparium - Bouteloua curtipendula Western Great Plains Herbaceous Vegetation	Little Bluestem - Sideoats Grama Western Great Plains Herbaceous Vegetation	CEGL001594
Sporobolus cryptandrus – Schizachyrium scoparium – Bouteloua curtipendula Herbaceous Vegetation	Sand Dropseed - Little Bluestem - Sideoats Grama Herbaceous Vegetation	NEW

Table 2: List of Vegetation Communities from Figure 3

L01	Andropogon hallii - Calamovilfa gigantea Herbaceous Vegetation
875BL02	Artemisia filifolia – Rhus trilobata Shrubland
877BL03	Artemisia filifolia / Bouteloua (curtipendula, gracilis) Shrubland
879BL04	Baccharis salicina Shrubland
	Bouteloua curtipendula - Bouteloua (gracilis, eriopoda) Herbaceous
881BL05	Vegetation
883BL06	Bouteloua gracilis – Buchloe dactyloides Herbaceous Vegetation
885BL07	Cercocarpus montanus Shrubland
887BL08	Dalea formosa - Mimosa borealis Dwarf-shrubland
889BL10	Gutierrezia sarothrae - Yucca glauca Dwarf-shrubland
891BL11	Juniperus monosperma / Bouteloua curtipendula Woodland
893BL12	Krascheninnikovia lanata Dwarf-Shrubland
895BL13	Panicum obtusum Herbaceous Vegetation
897BL14	Panicum virgatum - Pascopyrum smithii Southern Herbaceous Vegetation
899BL15	Pascopyrum smithii - Bouteloua gracilis Herbaceous Vegetation
	Phragmites australis Western North America Temperate Semi-Natural
901BL16	Herbaceous Vegetation
903BL17	Populus deltoides - Celtis laevigata / Sapindus saponaria Woodland
905BL18	Populus deltoides / Panicum virgatum - Schizachyrium scoparium Woodland
907BL19	Populus deltoides / Pascopyrum smithii - Panicum virgatum Woodland
909BL20	Populus deltoides Woodland Alliance
911BL21	Prosopis glandulosa / Bouteloua curtipendula Shrubland
	Prosopis glandulosa var. glandulosa / Bouteloua gracilis - Buchloe
913BL22	dactyloides Shrubland
	Rhus trilobata / Bouteloua curtipendula - Schizachyrium scoparium
915BL23	Shrubland
917BL24	Salix exigua Temporarily Flooded Shrubland
	Schizachyrium scoparium - Bouteloua curtipendula Western Great Plains
919BL25	Herbaceous Vegetation
921BL26	Schoenoplectus pungens - Distichlis spicata Herbaceous Vegetation
923BL27	Sporobolus airoides Southern Plains Herbaceous Vegetation
	Sporobolus cryptandrus - Schizachyrium scoparium - Bouteloua curtipendula
925BL28	Herbaceous Vegetation
927BL29	Tamarisk spp. Temporarily Flooded Shrubland
	Typha (angustifolia, domingensis, latifolia) - Schoenoplectus americanus
929BL30	Herbaceous Vegetation

DISCUSSION

The pattern of vegetation on the ground is similar to what can be seen in the ordinations discussed previously but doesn't reflect it exactly. A theoretical transect can be imagined starting at the edge of the Canadian River and climbing out of the valley to the rolling uplands. At the edge of the Canadian River, and extending out into it to some degree, are the marsh communities dominated by *Phragmites australis*, *Typha* spp., and *Schoenoplectus* spp. Crossing the floodplain, one would find shrublands with water at or near the surface for at least part of the year and dominated by *Baccharis salicina* and *Tamarix ramosissima*. Some areas will have *Salix exigua* but most of these stands have been invaded by *B. salicina* and *T. ramosissima*. The *Populus deltoides* woodlands tend to be relatively dry at the surface for most or all of the year. Tall and midgrasses dominate the understory of the *Populus deltoides* woodlands. Presumably, the sandy soils dry out at the surface to allow the grasses to thrive while the deeper rooted trees can reach sufficient subsurface water to survive. One *Populus deltoides* woodland, the *Populus deltoides* – *Celtis laevigata* / *Sapindus saponaria* Woodland, is not found in the main river valley. This association is found in the tributary draws and valleys leading into the main river valley. This is the driest of the *Populus deltoides* communities and likely rarely, if ever, has surface water. Enough sub-surface water is present to support the trees but the understory contains species often found in the surrounding upland prairies. Intermixed with the floodplain *Populus deltoides* woodlands are floodplain grasslands. These are dominated by many of the same species that occur under the *P. deltoides* trees, especially *Andropogon hallii*, *Pascopyrum smithii*, *Panicum virgatum*, and *Schizachyrium scoparium*.

The steeper slopes of the main river valley and associated "breaks" tend to have rocky soils which, combined with rapid runoff of water due to the sloping ground, create dry environments. Most of the dwarf-shrubland communities are concentrated on these slopes or on the rim just above the valley. The *Dalea formosa*-*Mimosa borealis* Dwarf-shrubland can be found on isolated rocky hilltops or ridges surrounded by rolling uplands. Most of the stands of dwarf-shrubland communities are small.

The rolling uplands are dominated by a combination of the *Bouteloua* spp.-dominated shortgrass communities and *Prosopis glandulosa* or *Artemisia filifolia* shrublands. Mesic grasslands, usually dominated by *Panicum obtusum* or *Pascopyrum smithii*, do occur in swales or other areas that receive extra runoff from the surrounding landscape.

There is one final note concerning the possible future of the floodplain communities at LAMR. The field crews did not note any *Populus deltoides* seedlings in any of their plots and only five plots had any *P. deltoides* saplings – only one of those had more than 1% cover from those saplings. This may be a result of the creation of Lake Meredith by the construction of the Sanford Dam – stopping flooding and scouring events necessary for *P. deltoides* regeneration – competition from exotic species such as *Tamarix* spp., the result of altered land uses of the valley bottom (recreation, grazing), or some other factor. Whatever the cause, as the current cohort of *P. deltoides* age and die it seems likely that many of the stands will be converted to non-woodland floodplain communities.

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Appendix A: List of Plant Taxa Identified During Field Sampling at Lake Meredith NRA and Alibates Flint Quarries NM.

Scientific Name	Common Name	Family
<i>Abronia fragrans</i>	snowball sand verbena	Nyctaginaceae
<i>Allium</i>	onion	Liliaceae
<i>Amaranthus blitoides</i>	mat amaranth	Amaranthaceae
<i>Amaranthus retroflexus</i>	redroot amaranth	Amaranthaceae
<i>Ambrosia psilostachya</i>	Cuman ragweed	Asteraceae
<i>Ambrosia trifida</i>	great ragweed	Asteraceae
<i>Amorpha canescens</i>	leadplant	Fabaceae
<i>Amorpha fruticosa</i>	desert false indigo	Fabaceae
<i>Amphiachyris dracunculoides</i>	prairie broomweed	Asteraceae
<i>Andropogon gerardii</i>	big bluestem	Poaceae
<i>Andropogon hallii</i>	sand bluestem	Poaceae
<i>Aphanostephus ramosissimus</i>	plains dozedaisy	Asteraceae
<i>Aphanostephus riddellii</i>	Riddell's dozedaisy	Asteraceae
<i>Aphanostephus skirrhobasis</i>	Arkansas dozedaisy	Asteraceae
<i>Apocynum cannabinum</i>	Indianhemp	Apocynaceae
<i>Argemone polyanthemus</i>	crested pricklypoppy	Papaveraceae
<i>Argythamnia humilis</i>	low silverbush	Euphorbiaceae
<i>Aristida purpurea</i>	purple threeawn	Poaceae
<i>Artemisia campestris</i> ssp. caudata	field sagewort	Asteraceae
<i>Artemisia carruthii</i>	Carruth's sagewort	Asteraceae
<i>Artemisia filifolia</i>	sand sagebrush	Asteraceae
<i>Artemisia ludoviciana</i>	white sagebrush	Asteraceae
<i>Asclepias</i>	milkweed	Asclepiadaceae
<i>Asclepias engelmanniana</i>	Engelmann's milkweed	Asclepiadaceae
<i>Asclepias latifolia</i>	broadleaf milkweed	Asclepiadaceae
<i>Asclepias viridiflora</i>	green comet milkweed	Asclepiadaceae
<i>Astragalus</i>	milkvetch	Fabaceae
<i>Astragalus gracilis</i>	slender milkvetch	Fabaceae
<i>Astragalus mollissimus</i>	woolly locoweed	Fabaceae
<i>Astragalus nuttallianus</i>	smallflowered milkvetch	Fabaceae
<i>Astragalus racemosus</i>	cream milkvetch	Fabaceae
<i>Atriplex canescens</i>	fourwing saltbush	Chenopodiaceae
<i>Baccharis salicina</i>	Great Plains false willow	Asteraceae
<i>Berlandiera lyrata</i>	lyreleaf greeneyes	Asteraceae
<i>Bidens frondosa</i>	devil's beggartick	Asteraceae
<i>Bothriochloa saccharoides</i>	silver bluestem	Poaceae
<i>Bouteloua curtipendula</i>	sideoats grama	Poaceae
<i>Bouteloua eriopoda</i>	black grama	Poaceae
<i>Bouteloua gracilis</i>	blue grama	Poaceae

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<i>Bouteloua hirsuta</i>	hairy grama	Poaceae
<i>Bromus catharticus</i>	rescuegrass	Poaceae
<i>Bromus japonicus</i>	Japanese brome	Poaceae
<i>Buchloe dactyloides</i>	buffalograss	Poaceae
<i>Caesalpinia jamesii</i>	James' holdback	Fabaceae
<i>Calamovilfa gigantea</i>	giant sandreed	Poaceae
<i>Callirhoe involucrata</i>	purple poppymallow	Malvaceae
<i>Calylophus serrulatus</i>	yellow sundrops	Onagraceae
<i>Calylophus tubicula</i>	Texas sundrops	Onagraceae
<i>Carex planostachys</i>	cedar sedge	Cyperaceae
<i>Celtis laevigata</i> var. <i>reticulata</i>	netleaf hackberry	Ulmaceae
<i>Cenchrus spinifex</i>	coastal sandbur	Poaceae
<i>Centaurea americana</i>	American star-thistle	Asteraceae
<i>Cephalanthus occidentalis</i>	common buttonbush	Rubiaceae
<i>Cercocarpus montanus</i>	alderleaf mountain mahogany	Rosaceae
<i>Chaetopappa ericoides</i>	rose heath	Asteraceae
<i>Chamaesyce prostrata</i>	prostrate sandmat	Euphorbiaceae
<i>Chenopodium</i>	goosefoot	Chenopodiaceae
<i>Chenopodium album</i>	lambsquarters	Chenopodiaceae
<i>Chloracantha spinosa</i>	spiny chloracantha	Asteraceae
<i>Chloris verticillata</i>	tumble windmill grass	Poaceae
<i>Chrysothamnus pulchellus</i>	southwestern rabbitbrush	Asteraceae
<i>Chrysothamnus viscidiflorus</i>	yellow rabbitbrush	Asteraceae
<i>Cirsium undulatum</i>	wavyleaf thistle	Asteraceae
<i>Cleome serrulata</i>	Rocky Mountain beeplant	Capparaceae
<i>Comandra umbellata</i> ssp. <i>pallida</i>	pale bastard toadflax	Santalaceae
<i>Commelina erecta</i>	whitemouth dayflower	Commelinaceae
<i>Convolvulus arvensis</i>	field bindweed	Convolvulaceae
<i>Conyza canadensis</i>	Canadian horseweed	Asteraceae
<i>Croton texensis</i>	Texas croton	Euphorbiaceae
<i>Cryptantha minima</i>	little cryptantha	Boraginaceae
<i>Cucurbita foetidissima</i>	Missouri gourd	Cucurbitaceae
<i>Cycloloma atriplicifolium</i>	winged pigweed	Chenopodiaceae
<i>Cynodon dactylon</i>	Bermudagrass	Poaceae
<i>Cyperus schweinitzii</i>	Schweinitz's flatsedge	Cyperaceae
<i>Dalea aurea</i>	golden prairie clover	Fabaceae
<i>Dalea candida</i>	white prairie clover	Fabaceae
<i>Dalea enneandra</i>	nineanther prairie clover	Fabaceae
<i>Dalea formosa</i>	featherplume	Fabaceae
<i>Dalea purpurea</i>	violet prairie clover	Fabaceae
<i>Delphinium carolinianum</i>	Carolina larkspur	Ranunculaceae
<i>Desmanthus illinoensis</i>	prairie bundleflower	Fabaceae
<i>Digitaria cognata</i>	Carolina crabgrass	Poaceae
<i>Dimorphocarpa wislizeni</i>	touristplant	Brassicaceae
<i>Distichlis spicata</i>	inland saltgrass	Poaceae
<i>Echinacea angustifolia</i>	blacksamson echinacea	Asteraceae

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<i>Echinocereus reichenbachii</i>	lace hedgehog cactus	Cactaceae
<i>Echinochloa crus-galli</i>	barnyardgrass	Poaceae
<i>Eleocharis</i>	spikerush	Cyperaceae
<i>Elymus canadensis</i>	Canada wildrye	Poaceae
<i>Elymus elymoides</i>	squirreltail	Poaceae
<i>Engelmannia peristenia</i>	Engelmann's daisy	Asteraceae
<i>Equisetum laevigatum</i>	smooth horsetail	Equisetaceae
<i>Eragrostis curtipedicellata</i>	gummy lovegrass	Poaceae
<i>Erigeron</i>	fleabane	Asteraceae
<i>Erigeron modestus</i>	plains fleabane	Asteraceae
<i>Eriogonum alatum</i> var. <i>alatum</i>	winged buckwheat	Polygonaceae
<i>Eriogonum annuum</i>	annual buckwheat	Polygonaceae
<i>Eriogonum jamesii</i>	James' buckwheat	Polygonaceae
<i>Eriogonum longifolium</i>	longleaf buckwheat	Polygonaceae
<i>Eriogonum wrightii</i>	bastardsage	Polygonaceae
<i>Erioneuron pilosum</i>	hairy woollygrass	Poaceae
<i>Escobaria vivipara</i>	spinystar	Cactaceae
<i>Euphorbia</i>	spurge	Euphorbiaceae
<i>Euphorbia davidii</i>	David's spurge	Euphorbiaceae
<i>Evolvulus nuttallianus</i>	shaggy dwarf morning-glory	Convolvulaceae
<i>Faidherbia albida</i>	appling acacia	Fabaceae
<i>Forestiera pubescens</i>	stretchberry	Oleaceae
<i>Froelichia gracilis</i>	slender snakecotton	Amaranthaceae
<i>Gaillardia pulchella</i>	firewheel	Asteraceae
<i>Gaillardia suavis</i>	perfumeballs	Asteraceae
<i>Gaura coccinea</i>	scarlet beeblossom	Onagraceae
<i>Gaura suffulta</i>	kisses	Onagraceae
<i>Gaura villosa</i>	woolly beeblossom	Onagraceae
<i>Glycyrrhiza lepidota</i>	American licorice	Fabaceae
<i>Grindelia papposa</i>	Spanish gold	Asteraceae
<i>Grindelia squarrosa</i>	curlycup gumweed	Asteraceae
<i>Gutierrezia sarothrae</i>	broom snakeweed	Asteraceae
<i>Haploesthes greggii</i>	false broomweed	Asteraceae
<i>Hedyotis nigricans</i>	diamondflowers	Rubiaceae
<i>Helenium microcephalum</i>	smallhead sneezeweed	Asteraceae
<i>Helianthus annuus</i>	common sunflower	Asteraceae
<i>Hesperostipa comata</i>	needle and thread	Poaceae
<i>Hesperostipa neomexicana</i>	New Mexico feathergrass	Poaceae
<i>Heterotheca</i>	false goldenaster	Asteraceae
<i>Heterotheca canescens</i>	hoary false goldenaster	Asteraceae
<i>Heterotheca stenophylla</i>	stiffleaf false goldenaster	Asteraceae
<i>Heterotheca subaxillaris</i>	camphorweed	Asteraceae
<i>Hoffmannseggia glauca</i>	Indian rushpea	Fabaceae
<i>Hordeum pusillum</i>	little barley	Poaceae
<i>Houstonia acerosa</i>	needleleaf bluet	Rubiaceae
<i>Hymenopappus flavescens</i>	collegeflower	Asteraceae

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<i>Ipomoea leptophylla</i>	bush morning-glory	Convolvulaceae
<i>Ipomopsis longiflora</i>	flaxflowered ipomopsis	Polemoniaceae
<i>Juncus</i>	rush	Juncaceae
<i>Juniperus monosperma</i>	oneseed juniper	Cupressaceae
<i>Kochia scoparia</i>	Mexican-fireweed	Chenopodiaceae
<i>Krameria lanceolata</i>	trailing krameria	Krameriaceae
<i>Krascheninnikovia lanata</i>	winterfat	Chenopodiaceae
<i>Lactuca</i>	lettuce	Asteraceae
<i>Lactuca serriola</i>	prickly lettuce	Asteraceae
<i>Lemna valdiviana</i>	valdivia duckweed	Lemnaceae
<i>Lesquerella argyrea</i>	silver bladderpod	Brassicaceae
<i>Lesquerella gordonii</i>	Gordon's bladderpod	Brassicaceae
<i>Lesquerella ovalifolia</i>	roundleaf bladderpod	Brassicaceae
<i>Liatris punctata</i>	dotted blazing star	Asteraceae
<i>Linum rigidum</i>	stiffstem flax	Linaceae
<i>Linum rupestre</i>	rock flax	Linaceae
<i>Linum sulcatum</i>	grooved flax	Linaceae
<i>Lithospermum incisum</i>	narrowleaf stoneseed	Boraginaceae
<i>Lolium arundinaceum</i>	tall fescue	Poaceae
<i>Lygodesmia aphylla</i>	rose rush	Asteraceae
<i>Machaeranthera</i>	tansyaster	Asteraceae
<i>Machaeranthera pinnatifida</i> ssp. pinnatifida	lacy tansyaster	Asteraceae
<i>Machaeranthera tanacetifolia</i>	tanseyleaf tansyaster	Asteraceae
<i>Melampodium leucanthum</i>	plains blackfoot	Asteraceae
<i>Mentzelia nuda</i> var. <i>stricta</i>	bractless blazingstar	Loasaceae
<i>Mentzelia strictissima</i>	grassland blazingstar	Loasaceae
<i>Mimosa borealis</i>	fragrant mimosa	Fabaceae
<i>Mimosa microphylla</i>	littleleaf sensitive-briar	Fabaceae
<i>Mirabilis linearis</i>	narrowleaf four o'clock	Nyctaginaceae
<i>Mirabilis nyctaginea</i>	heartleaf four o'clock	Nyctaginaceae
<i>Muhlenbergia arenicola</i>	sand muhly	Poaceae
<i>Muhlenbergia asperifolia</i>	scratchgrass	Poaceae
<i>Muhlenbergia racemosa</i>	marsh muhly	Poaceae
<i>Oenothera macrocarpa</i>	bigfruit evening-primrose	Onagraceae
<i>Oenothera speciosa</i>	pinkladies	Onagraceae
<i>Opuntia fragilis</i>	brittle pricklypear	Cactaceae
<i>Opuntia imbricata</i>	tree cholla	Cactaceae
<i>Opuntia leptocaulis</i>	Christmas cactus	Cactaceae
<i>Opuntia macrorhiza</i>	twistspine pricklypear	Cactaceae
<i>Opuntia phaeacantha</i>	tulip pricklypear	Cactaceae
<i>Opuntia polyacantha</i>	plains pricklypear	Cactaceae
<i>Oxytropis lambertii</i>	purple locoweed	Fabaceae
<i>Palafoxia sphacelata</i>	othake	Asteraceae
<i>Panicum hallii</i>	Hall's panicgrass	Poaceae
<i>Panicum obtusum</i>	vine mesquite	Poaceae
<i>Panicum virgatum</i>	switchgrass	Poaceae

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<i>Paronychia jamesii</i>	James' nailwort	Caryophyllaceae
<i>Pascopyrum smithii</i>	western wheatgrass	Poaceae
<i>Paspalum setaceum</i>	thin paspalum	Poaceae
<i>Pediomelum rhombifolium</i>	Gulf Indian breadroot	Fabaceae
<i>Penstemon</i>	beardtongue	Scrophulariaceae
<i>Penstemon fendleri</i>	Fendler's penstemon	Scrophulariaceae
<i>Phacelia integrifolia</i>	gypsum phacelia	Hydrophyllaceae
<i>Phalaris arundinacea</i>	reed canarygrass	Poaceae
<i>Phragmites australis</i>	common reed	Poaceae
<i>Physalis longifolia</i>	longleaf groundcherry	Solanaceae
<i>Plantago patagonica</i>	woolly plantain	Plantaginaceae
<i>Plantago rhodosperma</i>	redseed plantain	Plantaginaceae
<i>Pluchea carolinensis</i>	cure for all	Asteraceae
<i>Pluchea odorata</i>	sweetscent	Asteraceae
<i>Polanisia dodecandra</i>	redwhisker clammyweed	Capparaceae
<i>Polanisia jamesii</i>	James' clammyweed	Capparaceae
<i>Polygala alba</i>	white milkwort	Polygalaceae
<i>Polygonum</i>	knotweed	Polygonaceae
<i>Polygonum lapathifolium</i>	curlytop knotweed	Polygonaceae
<i>Populus deltoides</i>	eastern cottonwood	Salicaceae
<i>Portulaca</i>	purslane	Portulacaceae
<i>Portulaca oleracea</i>	little hogweed	Portulacaceae
<i>Prosopis glandulosa</i>	honey mesquite	Fabaceae
<i>Prunus angustifolia</i>	Chickasaw plum	Rosaceae
<i>Psilostrophe tagetina</i>	woolly paperflower	Asteraceae
<i>Psoralidium tenuiflorum</i>	slimflower scurfpea	Fabaceae
<i>Ptelea trifoliata</i>	common hoptree	Rutaceae
<i>Pteridium</i>	brackenfern	Dennstaedtiaceae
<i>Quincula lobata</i>	Chinese lantern	Solanaceae
<i>Ratibida columnifera</i>	upright prairie coneflower	Asteraceae
<i>Rhus trilobata</i>	skunkbush sumac	Anacardiaceae
<i>Ribes aureum</i>	golden currant	Grossulariaceae
<i>Rosa woodsii</i>	Woods' rose	Rosaceae
<i>Rumex altissimus</i>	pale dock	Polygonaceae
<i>Rumex crispus</i>	curly dock	Polygonaceae
<i>Salix exigua</i>	narrowleaf willow	Salicaceae
<i>Salix nigra</i>	black willow	Salicaceae
<i>Salsola kali</i>	Russian thistle	Chenopodiaceae
<i>Sapindus saponaria</i>	wingleaf soapberry	Sapindaceae
<i>Schedonnardus paniculatus</i>	tumblegrass	Poaceae
<i>Schizachyrium scoparium</i>	little bluestem	Poaceae
<i>Schoenoplectus acutus</i>	hardstem bulrush	Cyperaceae
<i>Schoenoplectus maritimus</i>	cosmopolitan bulrush	Cyperaceae
<i>Schoenoplectus pungens</i>	common threesquare	Cyperaceae
<i>Scutellaria drummondii</i>	Drummond's skullcap	Lamiaceae
<i>Scutellaria resinosa</i>	sticky skullcap	Lamiaceae

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Senecio	ragwort	Asteraceae
Senecio flaccidus	threadleaf ragwort	Asteraceae
Senecio riddellii	Riddell's ragwort	Asteraceae
Setaria	bristlegrass	Poaceae
Setaria leucopila	streambed bristlegrass	Poaceae
Setaria parviflora	marsh bristlegrass	Poaceae
Setaria vulpiseta	plains bristlegrass	Poaceae
Solanum	nightshade	Solanaceae
Solanum elaeagnifolium	silverleaf nightshade	Solanaceae
Solanum rostratum	buffalobur nightshade	Solanaceae
Solidago	goldenrod	Asteraceae
Solidago missouriensis	Missouri goldenrod	Asteraceae
Solidago petiolaris	downy ragged goldenrod	Asteraceae
Sorghastrum nutans	Indiangrass	Poaceae
Sorghum halepense	Johnsongrass	Poaceae
Sphaeralcea angustifolia	copper globemallow	Malvaceae
Sphaeralcea coccinea	scarlet globemallow	Malvaceae
Sporobolus airoides	alkali sacaton	Poaceae
Sporobolus compositus var. compositus	composite dropseed	Poaceae
Sporobolus contractus	spike dropseed	Poaceae
Sporobolus cryptandrus	sand dropseed	Poaceae
Sporobolus giganteus	giant dropseed	Poaceae
Stenosiphon linifolius	false gaura	Onagraceae
Stillingia sylvatica	queen's-delight	Euphorbiaceae
Strophostyles helvula	trailing fuzzybean	Fabaceae
Symphotrichum ericoides	white heath aster	Asteraceae
Tamarix ramosissima	saltcedar	Tamaricaceae
Taraxacum officinale	common dandelion	Asteraceae
Tetraneris scaposa	stemmy four-nerve daisy	Asteraceae
Teucrium laciniatum	lacy germander	Lamiaceae
Thelesperma ambiguum	Colorado greenthread	Asteraceae
Thelesperma filifolium	stiff greenthread	Asteraceae
Tidestromia lanuginosa	woolly tidestromia	Amaranthaceae
Toxicodendron rydbergii	western poison ivy	Anacardiaceae
Tradescantia occidentalis	prairie spiderwort	Commelinaceae
Tragia	noseburn	Euphorbiaceae
Tragia nepetifolia	catnip noseburn	Euphorbiaceae
Tragia ramosa	branched noseburn	Euphorbiaceae
Tragopogon dubius	yellow salsify	Asteraceae
Tridens flavus	purpletop tridens	Poaceae
Tridens muticus	slim tridens	Poaceae
Tridens texanus	Texas fluffgrass	Poaceae
Triplasis purpurea	purple sandgrass	Poaceae
Tripsacum dactyloides	eastern gamagrass	Poaceae
Typha domingensis	southern cattail	Typhaceae
Verbena	vervain	Verbenaceae

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Vernonia baldwinii	Baldwin's ironweed	Asteraceae
Veronica anagallis-aquatica	water speedwell	Scrophulariaceae
Vitis rupestris	sand grape	Vitaceae
Vulpia octoflora	sixweeks fescue	Poaceae
Yucca glauca	soapweed yucca	Agavaceae
Zinnia grandiflora	Rocky Mountain zinnia	Asteraceae

Appendix B: Vegetation Key for Plant Communities at Lake Meredith NRA and Alibates Flint Quarries NM.

Upland Associations

Upland Associations – those occurring on true upland terrain not directly influenced by the water regimes of the river and associated streams.

1a. *Evergreen trees present at > 25% canopy cover, Juniper is the dominant tree, Deciduous shrubs make up approx. 10% of total canopy cover. Stands occupying gravelly hills or rough slopes..... 2*

2. One seeded juniper (*Juniperus monosperma*) is dominant with canopies ranging from 25 to 35%; juniper ranges from 2 – 5 m tall; understory shrubs include Skunkbush sumac (*Rhus trilobata*), Feather dalea (*Dalea formosa*), and Catclaw mimosa (*Mimosa borealis*); important forbs include Plains actinea (*Tetaneuris scaposa*), longleaf buckwheat (*Eriogonum longifolium*), baby white aster (*Chaetopappa ericoides*), and trailing ratany (*Krameria lanceolata*); important grass species are Sideoats grama (*Bouteloua curtipendula*), Black grama (*Bouteloua eriopoda*), Sand dropseed (*Sporobolus cryptandrus*), Wright threeawn (*Aristida purpurea*), and Little bluestem (*Schizachyrium scoparium*).

..... [Juniperus monosperma / Bouteloua curtipendula Woodland](#)

1b. *Tall and short deciduous shrubs dominating with 25% or more canopy cover; Mesquite (*Prosopis glandulosa*) is the dominant shrub; herbaceous stratum usually well developed. Short and mid grasses dominate the ground layer. Soils moderately deep to deep clay loams to fine sandy loams.*

3. Mesquite is the dominant species and can occur as both a short or tall shrub; other shrub species are rare; height ranges from 1.2 – 3 m in general; canopy ranges from 25% to 35%; some small open areas may occur within the canopy; terrain is mostly level to gently sloping; short grass species dominate the ground layer with Blue grama (*Bouteloua gracilis*) being most prevalent; forbs are few; some cacti species (*Opuntia* sp.) are often present.

..... [Prosopis glandulosa / Bouteloua gracilis Shrubland](#)

4. Mesquite is the dominant species and can occur as both a short or tall shrub; height ranges from 1.2 – 3 m in general; canopies range from 20 to 30%; frequent plants of yucca (*Yucca glauca*) and occasional Sand sagebrush (*Artemisia filifolia*) may occur along with moderate amounts of Broom snakeweed (*Gutierrezia sarothrae*); the terrain is gently sloping to moderately sloping and the ground layer is a mixture of short and mid grasses with Sideoats grama (*Bouteloua curtipendula*) being most prevalent; Blue grama, (*Bouteloua gracilis*), and Sand dropseed (*Sporobolus cryptandrus*) are also common.

..... [Prosopis glandulosa / Bouteloua curtipendula Shrubland](#)

1c. Shrublands with few trees present on sandy soils with rolling terrain. Short shrubs dominate with most plants less than 2 m in height.

5. Short shrubs on rolling sandy terrain; approximately equal amounts of Skunkbush (*Rhus trilobata*) and Sand sagebrush (*Artemisia filifolia*) with the Skunkbush occupying the more rolling sand hills; canopies range from 25 to 40%; numerous perennial forbs present; grass species are Dropseeds (*Sporobolus* spp.), Little bluestem (*Schizachyrium scoparium*), and Sand bluestem (*Andropogon hallii*).

.....[Artemisia filifolia – Rhus trilobata Shrubland](#)

6. Short shrubs are dominant with occasional tall shrubs; Sand sagebrush (*Artemisia filifolia*) is the dominant species with scattered Mesquite (*Prosopis glandulosa*) and Yucca (*Yucca glauca*) being present; shrub canopy cover ranges from 20 to 35%; common grass species are Sideoats grama (*Bouteloua curtipendula*) and Blue grama (*Bouteloua gracilis*); usually sandy to sandy loam soils on gentle slopes; this community is often positioned between the sandier soils of the *Artemisia filifolia – Rhus trilobata* Shrubland and the more loamy soils of the *Prosopis glandulosa / Bouteloua gracilis* Shrubland and may intergrade with them at the edges.

.....[Artemisia filifolia / Bouteloua \(curtipendula, gracilis\) Shrubland](#)

1d. Shrublands located on steep talus slopes; slopes exceed 25% and average approx. 40%. Large and small rocks cover up to 40% of the land surface. Short shrubs prevail but there are infrequent tall shrubs present. Trees are rare and if present, they are small. The herbaceous layer includes a good variety of forbs and several grass species. Mid and tall grass species are present with aspect playing an important role in diversity and productivity.

7. Skunkbush sumac (*Rhus trilobata*) is the dominant shrub species with small quantities of Feather dalea (*Dalea formosa*), and Catclaw mimosa (*Mimosa borealis*) present; occasionally Hoptree (*Ptelea trifoliata*) is found; shrub cover ranges from 20 to 30%; found on steep canyon walls above the Canadian River floodplain and along the associated canyons that incise into the surrounding uplands; visible talus of large to small dolomite rocks and boulders; major grass species are Sideoats grama (*Bouteloua curtipendula*) and Little bluestem (*Schizachyrium scoparium*); other species include Slim tridens (*Tridens muticus*), and Sand dropseed (*Sporobolus cryptandrus*); on the more mesic north or east facing slopes, Indiangrass (*Sorghastrum nutans*) and Big bluestem (*Andropogon gerardii*) can be found in small quantities

.....[Rhus trilobata / Bouteloua curtipendula – Schizachyrium scoparium Shrubland](#)

1e. Short and Dwarf Shrublands on very shallow, calcareous, rocky soils with varying amounts of exposed bedrock located on rimrocks, ridges, and escarpment edges above the river floodplain. Canopy cover is less than 20% for shrubs in most cases and all vegetation tends to be sparse. Stands small in size.

8. Mountain mahogany (*Cercocarpus montanus*) dominant; plants are from 0.3 – 2 m tall and have a canopy cover of 10 to 15% on most sites; occasional plants of Skunkbush sumac (*Rhus trilobata*) and Feather dalea (*Dalea formosa*); there are few forbs and grasses present; the vegetation would be described as sparse; rock cover on the surface is as high as 50%; many of the plants appear to be growing out of fractures and crevices in the dolomite bedrock; the prevalent forb species include longleaf buckwheat (*Eriogonum longifolium*) and Plains actinea (*Tetranneuris scaposa*); common grasses are Wright threeawn (*Aristida purpurea*) and Sideoats grama (*Bouteloua curtipendula*).

..... [Cercocarpus montanus Shrubland](#)

9. Feather dalea (*Dalea formosa*) is the dominant shrub with lesser amounts of Catclaw mimosa (*Mimosa borealis*); vegetation cover is sparse; perennial forbs that are characteristic for the community include Broom nailwort (*Paronychia jamesii*), longleaf buckwheat (*Eriogonum longifolium*), Plains actinea (*Tetranneuris scaposa*) and Broom snakeweed (*Gutierrezia sarothrae*); scattered grasses include Wright threeawn (*Aristida purpurea*), Sideoats grama (*Bouteloua curtipendula*), Slim tridens (*Tridens muticus*), and occasionally New Mexico stipa (*Stipa neomexicana*); community boundaries are distinct and stands tend to be small.

..... [Dalea formosa – Mimosa borealis Dwarf-shrubland](#)

10. Winterfat (*Krascheninnikovia lanata*) dominates this small plant community. The community is rare in the park and seldom covers more than a fraction of an acre; associated shrubs include Catclaw mimosa (*Mimosa borealis*), Mesquite (*Prosopis glandulosa*), Feather dalea (*Dalea formosa*), and Skunkbush sumac (*Rhus trilobata*); common grasses are Blue grama (*Bouteloua gracilis*), Wright threeawn (*Aristida purpurea*), and New Mexico stipa (*Stipa neomexicana*).

..... [Krascheninnikovia lanata Dwarf-shrubland](#)

1f. Dwarf Shrublands on rolling gravelly hills

11. Broom snakeweed (*Gutierrezia sarothrae*) dominant, often with >50% cover; occurs on gravelly soils that are outwash from the Ogallala formation; associated species include Plains yucca (*Yucca glauca*) and Catclaw mimosa (*Mimosa borealis*), and Feather dalea (*Dalea formosa*); common grasses include Black grama (*Bouteloua eriopoda*), Wright threeawn (*Aristida purpurea*), Slim tridens (*Tridens muticus*), and Sand dropseed (*Sporobolus cryptandrus*); common forbs are Baby white aster (*Chaetopappa ericoides*), Longleaf buckwheat (*Eriogonum longifolium*), and Broom nailwort (*Paronychia jamesii*); cacti species, Grassland prickly pear (*Opuntia macrorhiza*) and Lace cactus (*Echinocereus reichenbachii*), are sometimes common.

..... [Gutierrezia sarothrae – Yucca glauca Dwarf-shrubland](#)

1g. Dominated by perennial grasses. Woody plants generally less than 10% canopy cover and even rare on certain sites. Forbs are moisture dependent and usually less than 10% of the total vegetative composition.

12. Dominated by perennial shortgrasses Blue grama (*Bouteloua gracilis*) with lesser amounts of Buffalograss (*Buchloe dactyloides*); forbs few except in above average rainfall years; few shrubs or trees present; sometimes scattered Mesquite (*Prosopis glandulosa*); scattered cacti species common (*Opuntia* sp.); sites level to slightly sloping deep loam and clay loam soils.

.....[Bouteloua gracilis - Buchloe dactyloides Herbaceous Vegetation](#)

13. Vine mesquite (*Panicum obtusum*) is the dominant grass in this community; other associated grass species include Silver bluestem (*Bothriochloa laguroides*), Sideoats grama (*Bouteloua curtipendula*), and Western wheatgrass (*Pascopyrum smithii*); forbs are few with the most common species being Silverleaf nightshade (*Solanum eleagnifolius*), Annual sunflower (*Helianthus annuus*), and American basketflower (*Centauria americana*); this community receives extra runoff water from surrounding upland sites.

.....[Panicum obtusum Herbaceous Vegetation](#)

14. Western wheatgrass (*Pascopyrum smithii*) dominates this grassland community; associated species include Canada wildrye (*Elymus canadensis*), Japanese brome (*Bromus japonicus*), and Vine mesquite (*Panicum obtusum*); forbs include Narrowleaf globemallow (*Sphaeralcea angustifolia*), Winecup or Low poppy mallow (*Callirhoe involucrata*), Velvet leaf gaura (*Gaura villosa*), American basketflower (*Centauria americana*), and Western ragweed (*Ambrosia psilostachya*); possibly a few trees associated with this grassland, especially Cottonwood (*Populus deltoides*) and Hackberry (*Celtis laevigata*); occurs along drainage ways.

.....[Pascopyrum smithii Herbaceous Vegetation](#)

15. Perennial grasslands with mid and short grasses dominating; Sideoats grama (*Bouteloua curtipendula*) is usually the dominant species but with significant amounts of other mid and short grasses including Blue grama (*Bouteloua gracilis*), Black grama (*Bouteloua eriopoda*), Hairy grama (*Bouteloua hirsuta*), Sand dropseed (*Sporobolus cryptandrus*), and Perennial threeawn (*Aristida* spp.); occurs on calcareous, moderately deep to shallow soils with gentle to moderate slopes mainly on broad, convex ridgetops and sloping uplands; there is usually scattered Yucca and scattered Broom snakeweed (*Gutierrezia sarothrae*).

.....[Bouteloua curtipendula – Bouteloua \(gracilis, eriopoda\) Herbaceous Vegetation](#)

16. Perennial grasslands occupying sloping hillsides and steep talus slopes; mid and tall grasses dominate; dominated by Little bluestem (*Schizachyrium scoparium*) and Sideoats grama (*Bouteloua curtipendula*); other grass species occurring in lesser amounts include Big bluestem (*Andropogon gerardii*), Indiangrass (*Sorghastrum nutans*), Tall dropseed (*Sporobolus asper*); on the dryer exposures Sideoats grama (*Bouteloua curtipendula*) dominates and on more mesic exposures Little bluestem (*Schizachyrium scoparium*) dominates; occasional shrubs, such as Skunkbush sumac (*Rhus trilobata*), Sand sagebrush (*Artemisia filifolia*), or Catclaw mimosa (*Mimosa borealis*) may occur; scattered plants of Mesquite (*Prosopis glandulosa*) may be found on the dryer south and west exposures.

.....[Schizachyrium scoparium – Bouteloua curtipendula Herbaceous Vegetation](#)

1g. *Sparingly Vegetated Outcrops.* Gypsum exposed at the surface, total vegetation cover is low.

17. The plant community that occurs on these areas is limited to those species that can tolerate the harsh conditions of gypsiferous soils and extremely limited plant available moisture. Areas that

are almost pure gypsum have very little vegetation present. They may occur as rounded outcrops or as ledges on hillsides. If the amount of gypsum is somewhat less, a few tolerant species may prevail. Grass species that can tolerate high gypsum content are Little bluestem (*Schizachyrium scoparium*), Sand dropseed (*Sporobolus cryptandrus*), Bottlebrush squirreltail (*Sitanion hystrix*), Hairy grama (*Bouteloua hirsuta*), and Sideoats grama (*Bouteloua curtipendula*). Forbs that tolerate high gypsum content are Fluttermill (*Oenothera macrocarpa*), Halfshrub sundrop (*Calylophus serrulata*), False broomweed (*Haploesthes greggii*), Lambert's loco (*Oxytropis lambertii*), Gyp bluecurls (*Phacelia integrifolia*), and Stickleaf (*Mentzelia strictissima*). Occasionally Broom snakeweed (*Gutierrezia sarothrae*), Plains yucca (*Yucca glauca*), and Skunkbush sumac (*Rhus trilobata*) will be found as isolated plants.

[Sporobolus cryptandrus – Schizachyrium scoparium – Bouteloua curtipendula Herbaceous Vegetation](#)

Vegetation key for Plant Associations of Lake Meredith NRA: **Riparian Associations**

Riparian Associations – those occurring in Canadian River floodplain and the flood plains of major contributing streams.

1a. *Deciduous riparian woodlands* – *Deciduous trees making up 25% or greater of total canopy cover*..... 2

2a. Cottonwood (*Populus deltoides*) dominant (25% or more canopy); few other trees abundant in the canopy 3

2b. Mixed deciduous tree species with Cottonwood being < 20% canopy cover and other deciduous species making up > 20% canopy cover; Hackberry and Western soapberry abundant in the canopy and sub-canopy 4

3a. Cottonwoods with 50% or more canopy cover, few other tree species present; scattered understory shrubs, sparse grasses and forbs.

.....[Populus deltoides Woodland Alliance](#)

3b. Cottonwoods with > 25% canopy cover; scattered shrub understory; significant cover of tall and mid grass species in the understory and in open spaces in the canopy; major grass species are Switchgrass (*Panicum virgatum*), Little bluestem (*Schizachyrium scoparium*), and Indiangrass (*Sorghastrum nutans*).

.....[Populus deltoides / Panicum virgatum - Schizachyrium scoparium Woodland](#)

3c. Cottonwood with > 25% canopy cover; major grass species consist of Western wheatgrass (*Pascopyrum smithii*) and lesser amounts of Switchgrass and other tall grasses.

.....[Populus deltoides / Pascopyrum smithii – Panicum virgatum Woodland](#)

4a. Cottonwoods (*Populus deltoides*) co-dominant with Hackberry (*Celtis laevigata*) and Western soapberry (*Sapindus saponaria*); Cottonwoods tending toward larger trees with a more scattered appearance; Hackberry and Western soapberry sometimes are more abundant in the canopy and subcanopy than Cottonwood; understory shrubs usually present, mainly Sand plum (*Prunus gracilis*) and Skunkbush sumac (*Rhus trilobata*), and occasionally Sand sagebrush (*Artemisia filifolia*); some grasses and forbs are present in the understory, but are limited by shading of the trees; this community usually occurs in dryer riparian zones.

.....[Populus deltoides - Celtis laevigata / Sapindus saponaria Woodland](#)

1b. *Shrub Dominant Communities – Some trees may be present but generally < 10% canopy. Shrubs short to tall, deciduous, with canopies of at least 25%; herbaceous stratum limited. Shrub plant population usually dense* 5

5a. Tall shrubs (narrow-leafed), deciduous, 2 – 3.5 m. in height with some shorter plants 1 – 2 m. in height; plant population usually dense; Salt cedar (*Tamarix ramosissima*) is the dominant species; herbaceous stratum is limited; the shrubs sometimes occur in bands following elevated sandy dunes along old stream terraces; canopies usually > 30% sometimes > 60%.
..... [Tamarix spp. Temporarily Flooded Shrubland](#)

5b. Short shrubs (less than 2 m.), usually dense populations; scattered Cottonwoods; Willow baccharis (*Baccharis salicina*) is the dominant species; some scattered Salt cedar (*Tamarix ramosissima*) occur within the community; some herbaceous species are present but shrub competition is severe; Common reedgrass (*Phragmites australis*), Switchgrass (*Panicum virgatum*), and Scratchgrass muhly (*Muhlenbergia asperifolia*) may occur.
..... [Baccharis salicina Shrubland](#)

5c. Shrub dominated with scattered cottonwoods; short to tall shrubs 1 – 2.5 m. in height mostly forming dense colonies; Sandbar willow (*Salix exigua*) is the dominant species; occasional Tamarix and Baccharis plants are interspersed in the community; herbaceous stratum is limited due to competition from shrubs; size of the community is usually small compared to other shrub communities; Common reedgrass and Switchgrass may occur.
..... [Salix exigua Temporarily Flooded Shrubland](#)

1c. *Communities dominated by grasses – Trees and shrubs present but not usually more than 15% canopy cover. Tall and mid grasses prevail. Forbs are generally not more than 10% of total vegetative production*..... 6

6a. Tall grasses dominate with scattered to moderate shrub cover and a few trees mostly Cottonwoods; Switchgrass (*Panicum virgatum*) is the most prevalent grass species but Sand bluestem (*Andropogon hallii*), Western wheatgrass (*Pascopyrum smithii*), and Dropseeds (*Sporobolus* spp.) are also frequent; this community usually occurs as semi-open areas between shrub communities in the river floodplain.
..... [Panicum virgatum - Pascopyrum smithii Southern Herbaceous Vegetation](#)

6b. Tall grasses dominate with Sand bluestem (*Andropogon hallii*) and Giant sandreed (*Calamovilfa gigantea*) being the most prevalent species; this community occurs on sandy alluvium usually near to the river streambed; grass cover is more sparse than other riparian grassland communities; forbs are frequent with Wild Licorice (*Glycorhiza lepidota*) being one of the most prevalent; Sandbar willow (*Salix exigua*) and Salt cedar (*Tamarix ramosissima*) are present, usually in small amounts; frequent flooding affects vegetation establishment.
..... [Andropogon hallii - Calamovilfa gigantea Herbaceous Vegetation](#)

6c. Alkali sacaton (*Sporobolus airoides*) dominates sometimes being as much as 80% of the grass vegetation; other grass species present in smaller quantities include Meadow dropseed (*Sporobolus*

asper), Western wheatgrass (*Pascopyrum smithii*), Vine mesquite (*Panicum obtusum*), and Switchgrass (*Panicum virgatum*); forbs are usually few; some shrubs may be present including Mesquite (*Prosopis glandulosa*) on areas bordering uplands; this community often occurs at the outer extreme of the riparian zone and may blend into upland communities.

.....[Sporobolus airoides Southern Plains Herbaceous Vegetation](#)

6d. Common reedgrass dominates the community and often appears to be a pure stand but always includes small quantities other grasses and some shrubs; this community often occurs as bands along the current streambed or as small colonies; generally the stands are small.

[Phragmites australis Western North American Temperate Semi-Natural Herbaceous Vegetation](#)

1d. *Draw-Down Areas (Mud Flats); silt bars often at the upper extreme of the reservoir, Wetland vegetation prevails; mainly Cattails (Typha spp.) and Bulrush (Schoenoplectus spp.). 7*

7a. Cattails (*Typha latifolia, angustifolia, domingensis*) dominate; areas of heavy siltation often at the upper end of the lake; small to large stands of Cattails with some occasional Bulrush nearer the water; much of the area appears to be mud flats; the surface appears dry in many cases but the substrate is quite wet; these areas are frequently flooded.

[Typha \(angustifolia, domingensis, latifolia\) – Schoenoplectus americanus Herbaceous Vegetation](#)

7b. Softstem bulrush (*Schoenoplectus validus*) and Three-square bulrush (*Schoenoplectus americanus*) strongly dominant; areas of heavy siltation often at the upper end of the lake; stands usually small.

.....[Schoenoplectus americanus Great Plains Herbaceous Vegetation](#)

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II. Woodland

II.A.4.N.a. Rounded-crowned temperate or subpolar needle-leaved evergreen woodland

A.504 Juniperus monosperma Woodland Alliance

One-seed Juniper Woodland Alliance

[CEGL000708] *Juniperus monosperma* / *Bouteloua curtipendula* Woodland

Translated Name: **One-seed Juniper / Sideoats Grama Woodland**

Common Name: **One-seed Juniper / Sideoats Grama Woodland**

Ecological System(s):

- Colorado Plateau Pinyon-Juniper Woodland (CES304.767)
 - Inter-Mountain Basins Juniper Savanna (CES304.782)
 - Southwestern Great Plains Canyon (CES303.664)
 - Southern Rocky Mountain Juniper Woodland and Savanna (CES306.834)
 - Southern Rocky Mountain Pinyon-Juniper Woodland (CES306.835)
-

ENVIRONMENTAL DESCRIPTION

The environmental factors that influence the composition and structure of this community are: climate, soils, topography, aspect, natural fire, and grazing pressure. This community occurs on moderate to steeply sloping shallow soils with moderate amounts of small rocks or gravel throughout the profile. These areas tend to be droughty and do not store great amounts of moisture in the soil. However, most of the soil moisture that is present is available to the plants. The shallow soils and relatively steep terrain favors a mixed community of shrubs and herbaceous plants. Grazing pressure on this community has not been excessive due to being less accessible to livestock.

VEGETATION DESCRIPTION

This community is dominated by *Juniperus monosperma* with an understory of smaller shrubs, grasses, and forbs. The amount of juniper in the community has generally increased over the past several decades. More mesic slopes facing east or north grow larger juniper and tend to have more species diversity. *Rhus trilobata* is the most prominent shrub with some occurrence of *Dalea formosa* and *Mimosa borealis*. The most common grass is *Bouteloua curtipendula* which is well distributed throughout the community. Other common grasses include *Bouteloua eriopoda*, *Bouteloua hirsuta*, and *Aristida purpurea*. On more mesic slopes *Schizachyrium scoparium* is often present in significant amounts. The most common forbs are *Tetranneuris scaposa*, *Krameria lanceolata*, *Melampodium leucanthum*, and *Chaetopappa ericoides*.

MOST ABUNDANT SPECIES

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Needle-leaved tree	<i>Juniperus monosperma</i>
Tall shrub/sapling	Broad-leaved deciduous	<i>Rhus trilobata</i>
Short shrub	Broad-leaved deciduous	<i>Rhus trilobata</i> , <i>Mimosa borealis</i>
Herbaceous	Graminoid	<i>Bouteloua curtipendula</i> , <i>Aristida purpurea</i>
Herbaceous	Forb	<i>Chaetopappa ericoides</i> , <i>Tetranneuris scaposa</i>

CHARACTERISTIC SPECIES

OTHER NOTEWORTHY SPECIES

CLASSIFICATION COMMENTS

This community is not unlike other communities of *Juniperus monosperma* in the Canadian Breaks of New Mexico. At about 5000 ft. elevation, *Pinus edulis* will begin to occur with the juniper.

OTHER COMMENTS

ELEMENT DISTRIBUTION

The most extensive area of this community is found just off the Lake Meredith Recreation Area on the LX Ranch, just to the west of Chicken Creek. There are small “pockets” of this Juniper community along the steep slopes mainly in the area from Bonita Creek to McBride Canyon. The community is more prone to occur in the Triassic sandstone geologic formations and in the accompanying gravelly hills.

This community is fairly common throughout the Canadian River breaks stretching from western Oklahoma into New Mexico. In most cases, the communities are not extensive in size but are well distributed.

ELEMENT SOURCES

Inventory Notes:

Plots: 57, 80, 81, 108, 146, 166

Local Description Authors: JR Bell

II.B.2.N.b. Temporarily flooded cold-deciduous woodland

A.636 Populus deltoides Temporarily Flooded Woodland Alliance

Eastern Cottonwood Temporarily Flooded Woodland Alliance

Populus deltoides Temporarily Flooded Woodland Alliance ***Cottonwood Temporarily Flooded Woodland Alliance***

ENVIRONMENTAL DESCRIPTION

The environmental factors that influence this plant community alliance are: climate, soil (depth and texture), and depth to water table, frequency of flooding, natural fire, competition, and grazing pressure. Stands of this alliance are found on sandy alluvial soils. Periodic flooding may inundate this alliance.

VEGETATION DESCRIPTION

This alliance has *Populus deltoides* as the major tree species. All communities within this alliance have that feature in common. The tree canopy is usually over 50% and the understory is heavily shaded. There are almost no other tree species present and a large variation in the shrub strata. In general, *Salix exigua*, *Amorpha fruticosa*, *Baccharis salicina*, and occasional *Rhus trilobata* are the main shrubs present. There are few forbs and grasses present except in localized situations. Grass species found are usually shade tolerant species such as *Tridens flavus*, *Pascopyrum smithii*, and *Elymus canadensis*. *Vitis rupestris* is often found in abundance. This community is most often found at the mouth of major creeks that empty into the Canadian River.

MOST ABUNDANT SPECIES

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Broad-leaved deciduous tree	<i>Populus deltoides</i>
Tall shrub/sapling	Broad-leaved deciduous	<i>Salix exigua</i>
Vines	Broad-leaved deciduous	<i>Vitis rupestris</i>
Herbaceous	Graminoid	<i>Elymus canadensis</i> , <i>Pascopyrum smithii</i>
Herbaceous	Forb	<i>Conyza canadensis</i> , <i>Ambrosia psilostachya</i> , <i>Artemisia caudata</i>

CHARACTERISTIC SPECIES

OTHER NOTEWORTHY SPECIES

Salix exigua, *Vitis rupestris*

CLASSIFICATION COMMENTS

This alliance is common throughout the southern great plains region with some variation in the understory species.

Human activities such as off road vehicle traffic also may influence the development of these communities. Natural fire affected riparian communities in the prairie river environments by suppressing woody vegetation to at least some degree. In pre-settlement times, these riparian

areas tended to be more of a grassland with shrubs and trees scattered in groves or mottes along the stream. Woody vegetation has increased since impoundments have been constructed upstream and flooding has been reduced during major rainfall events. Prolonged grazing by domestic livestock tends to reduce the recruitment of *Populus deltoides* in most of these environs. This area has not been grazed in several years. Parts of the area have been subjected to prescribed burns in localized situations. Many of the Cottonwood communities have been invaded by *Tamarix ramosissima* and *Baccharis salicina* has increased over a major portion of the floodplain. These species are very competitive and may inhibit the establishment of *Populus deltoides* seedlings.

OTHER COMMENTS

ELEMENT DISTRIBUTION

This alliance is fairly common within the park although most of the *Populus* communities are included in associations. There is a good example of this alliance located at the mouth of Bonita Creek and at the mouth of Chicken Creek. It can also be found at lower Plum Creek.

ELEMENT SOURCES

Inventory Notes:

Plots: 39, 56, 86

Local Description Authors: JR Bell

[NEW] *Populus deltoides* – *Celtis laevigata* / *Sapindus saponaria* Woodland

Translated Name: **Eastern Cottonwood - Sugarberry / Soapberry Woodland**

Common Name: **Cottonwood - Hackberry / Soapberry Floodplain Woodland**

Ecological System(s):

- Western Great Plains Floodplain (CES303.678)
 - Western Great Plains Riparian Woodland and Shrubland (CES303.956)
-

ENVIRONMENTAL DESCRIPTION

The environmental factors that influence the composition and structure of this community are: climate, soil (depth and texture), depth to water table, natural fire, frequency of flooding, and grazing pressure. The areas occupied by this community are best characterized as dry riparian areas. The underground stream flow that is present in the river floodplains is not present on these sites. There is ground water present but it is usually at least 2 meters to the water table, and the width of the saturated zone is limited. Soils are usually sandy in texture and are alluvial in origin. These sites are usually a few meters higher in elevation than the river floodplain. These sites do receive runoff from surrounding steeply sloping upland sites and occasionally flood for brief periods.

VEGETATION DESCRIPTION

This community is classified as a woodland. The total tree canopy usually ranges from 40 to 60%. The largest tree species present is *Populus deltoides*. This species occurs in this community as large trees, often several feet apart and up to 15 m. in height, with *Celtis laevigata* and *Sapindus saponaria* present in varying amounts in the secondary layer. The *Sapindus saponaria* tend to grow in small groves while the *Celtis laevigata* may occur as solitary trees or small groves. These species are usually less than 8 m. in height. The shrub layer is sparse to moderate with *Prunus gracilis* and *Rhus trilobata* being the most common. Occasionally *Artemisia filifolia* will occur as scattered plants. The ground layer consists of grasses and forbs and is quite variable depending on amount of shading. The major grass species are *Panicum virgatum*, *Pascopyrum smithii*, *Sporobolus cryptandrus*, *Aristida purpurea*, *Andropogon hallii*, *Bouteloua curtipendula*, and occasionally *Sorghastrum nutans*. The most prevalent forbs include: *Solanum eleagnifolium*, *Ambrosia psilostachya*, *Heterotheca latifolia*, and *Hoffmannseggia jamesii*.

MOST ABUNDANT SPECIES

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Broad-leaved deciduous tree	<i>Populus deltoides</i> , <i>Sapindus saponaria</i> , <i>Celtis laevigata</i>
Tall shrub	Broad-leaved deciduous	<i>Rhus trilobata</i>
Short shrub	Broad-leaved deciduous	<i>Prunus gracilis</i> , <i>Rhus trilobata</i>
Herbaceous	Graminoid	<i>Pascopyrum smithii</i> , <i>Bouteloua curtipendula</i> , <i>Sporobolus cryptandrus</i>
Herbaceous	Forb	<i>Ambrosia psilostachya</i>

CHARACTERISTIC SPECIES

OTHER NOTEWORTHY SPECIES

CLASSIFICATION COMMENTS

This community is fairly common along streams and in canyons in the Texas panhandle and in the western rolling plains of Texas. Almost every creek that runs into the Canadian River will have this community occurring along it.

Human activities such as off road vehicles and camping sites may influence the community also. This community is dominated by trees and shrubs with a grass/forb ground level strata. Natural fire in pre-settlement times probably kept the woody plants suppressed to some extent but larger trees such as the *Populus* often survived the fires due to variation in the fine fuel cover. Both *Celtis* and *Sapindus* are resprouting species and are somewhat fire resistant. Grazing pressure will reduce the amount of perennial tall grasses present in the community if prolonged.

OTHER COMMENTS

ELEMENT DISTRIBUTION

This community is quite prevalent and can be found in the McBride Canyon area, the Plum Creek area, along Turkey Creek, and Mullinaw Creek.

ELEMENT SOURCES

Inventory Notes:

Plots: 2, 7, 8, 83, 109, 128, 161, 162, 182

Local Description Authors: JR Bell

[NEW] *Populus deltoides* / *Pascopyrum smithii* – *Panicum virgatum* Woodland
Translated Name: **Eastern Cottonwood / Western Wheatgrass – Switchgrass Woodland**
Common Name: **Cottonwood / Western Wheatgrass Floodplain Woodland**

Ecological System(s):

- Western Great Plains Floodplain (CES303.678)
 - Western Great Plains Riparian Woodland and Shrubland (CES303.956)
-

ENVIRONMENTAL DESCRIPTION

The environmental factors that influence the composition and structure of this community are: climate, soil (depth and texture), depth to water table, frequency of flooding, natural fire, and grazing pressure. This community occurs on flat to gently sloping sites along the floodplain of the Canadian River and major tributaries. Soils are sandy and alluvial in origin.

VEGETATION DESCRIPTION

This community is an open woodland with tree canopy averaging 25-35%. *Populus deltoides* is the major tree species. Few shrubs are present in general but scattered *Rhus trilobata*, *Baccharis salicina*, *Amorpha fruticosa*, *Prunus gracilis*, and shrubby *Celtis laevigata* occur. Shrub cover is usually less than 10%. The understory vegetation is mainly perennial grasses with cool season grasses dominating. The major species of grass is *Pascopyrum smithii*. Lesser amounts of *Elymus canadensis* also occurs. The predominant warm season grass is *Panicum virgatum*. This understory community is often shaded most of the day. Grasses make up the majority of the understory with forbs usually being 10 to 15%. Most frequently found forb species include *Ambrosia psilostachya*, *Gaura suffulta*, *Gaura coccinea*, *Heterotheca latifolia*, *Aster ericoides*, and *Glycorhiza lepidota*.

MOST ABUNDANT SPECIES

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Broadleafed deciduous trees	<i>Populus deltoides</i>
Tall shrub/sapling	Broad-leaved deciduous	<i>Populus deltoides</i> , <i>Amorpha fruticosa</i> ,
Short shrub	Broad-leaved deciduous	<i>Baccharis salicina</i> , <i>Rhus trilobata</i>
Herbaceous	Graminoid	<i>Pascopyrum smithii</i> , <i>Panicum virgatum</i>
Herbaceous	Forb	<i>Ambrosia psilostachya</i> , <i>Gaura</i> sp., <i>Aster ericoides</i>

CHARACTERISTIC SPECIES

OTHER NOTEWORTHY SPECIES

Occasional invasive species – mainly *Tamarix ramosissima*.

CLASSIFICATION COMMENTS

This community is fairly widespread throughout the southern plains region with some minor variations locally.

In many areas where this community exists, the influence of man's activities, such as off road vehicle traffic, affect the health of this and associated communities. Natural fire affected the communities in the riparian zones of all prairie rivers because it most likely curtailed woody

plant growth to some degree. Periodic fire may have kept trees and shrubs from becoming firmly established in some areas. Grassland communities were most likely more dominant in pre-settlement times. Historical accounts seem to bear this out at least to some extent. Overall watershed conditions play a part in community development as well. Major flooding does not occur as it once did due to impoundments upstream. This may allow for easier establishment of woody plant communities.

OTHER COMMENTS

ELEMENT DISTRIBUTION

This community occurs throughout the park. The communities will vary from small to fairly large. Typical areas are found in the Rosita Creek Flat area and along the Plum Creek drainage.

ELEMENT SOURCES

Inventory Notes:

Plots: 64, 94, 95, 169, 170, 175

Local Description Authors: JR Bell

[CEGL001454] *Populus deltoides* / *Panicum virgatum* - *Schizachyrium scoparium*
 Woodland

Translated Name: **Eastern Cottonwood / Switchgrass - Little Bluestem Woodland**

Common Name: **Cottonwood / Switchgrass Floodplain Woodland**

Ecological System(s):

- Western Great Plains Floodplain (CES303.678)
 - Western Great Plains Riparian Woodland and Shrubland (CES303.956)
 - Northwestern Great Plains Canyon (CES303.658)
-

ENVIRONMENTAL DESCRIPTION

The environmental factors that influence the composition and structure of this community are: climate, soil (depth and texture) depth to water table, frequency of flooding, natural fire, and grazing pressure. In many areas where this community exists, the influence of man's activities, such as off road vehicle traffic, affect the health of this and associated communities. Natural fire affected the communities in the riparian zones of all prairie rivers in that it would likely have curtailed the establishment of woody plant populations. Grassland communities were most likely more dominant in pre-settlement times. Historical accounts seem to bear this out as well. Overall watershed conditions play a part as well. Flooding of major proportions does not occur as it once did due to impoundments upstream. This may allow for easier establishment of trees and shrubs in some areas of the floodplain. This community was found near major streams on flat areas with silty loam and loamy sand soils.

VEGETATION DESCRIPTION

This community is classified as a woodland. *Populus deltoides* is the major tree species. Canopy cover is 25% to 35%. Few shrubs are present but scattered *Rhus trilobata*, *Prunus gracilis*, *Baccharis salicina*, *Amorpha fruticosa*, and shrubby *Celtis laevigata* do occur. These do not usually make up more than 10% cover. The understory vegetation is mainly comprised of warm season tall grass species. The grass cover is greatest in areas that are less shaded. The most prevalent species are *Panicum virgatum*, *Schizachyrium scoparium*, *Elymus canadensis*, *Sorghastrum nutans*, and *Sporobolus asper*. Grasses comprise from 45 to 60% total canopy. Forbs are not usually numerous but species such as *Glycorhiza lepidota*, *Ambrosia psilostachya*, *Gaura villosa*, *Solidago* sp., *Aster ericoides*, *Conyza canadensis*, and *Heterotheca latifolia* may make up as much as 5- 10 % of total canopy cover.

MOST ABUNDANT SPECIES

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Broad-leaved deciduous tree	<i>Populus deltoides</i>
Tall shrub/sapling	Broad-leaved deciduous	<i>Amorpha fruticosa</i> , <i>Rhus trilobata</i>
Short shrub	Broad-leaved deciduous	<i>Baccharis salicina</i> , <i>Rhus trilobata</i>
Herbaceous	Graminoid	<i>Panicum virgatum</i> , <i>Sorghastrum nutans</i> , <i>Schizachyrium scoparium</i>
Herbaceous	Forb	<i>Ambrosia psilostachya</i> , <i>Glycorhiza lepidota</i> , <i>Aster ericoides</i>

CHARACTERISTIC SPECIES

OTHER NOTEWORTHY SPECIES

Some occasional invasive species - mainly *Tamarix ramosissima*.

CLASSIFICATION COMMENTS

This community is fairly widespread throughout the southern plains region with some minor variations locally.

OTHER COMMENTS

ELEMENT DISTRIBUTION

This community occurs throughout the park. The communities will vary from just a few acres to as much as 50 acres and possibly larger. A typical area is located at the lower end of the Rosita Creek flats area. This happens to be an area where a great deal of off road vehicle traffic occurs. There are examples of this community in the Plum Creek area, and from the mouth of Bonita Creek to Chicken Creek and on the opposite side of the river from these areas.

ELEMENT SOURCES

Inventory Notes:

Plots: Plots 3, 4, 63, 88, 101, 181

Local Description Authors: JR Bell

III. Shrubland

III.A.4.N.a. Lowland microphyllous evergreen shrubland

A.816 Artemisia filifolia Shrubland Alliance

Sand Sagebrush Shrubland Alliance

[NEW] *Artemisia filifolia* – *Rhus trilobata* Shrubland

Translated Name: **Sand Sagebrush – Squawbush Shrubland**

Common Name: **Sandsage – Skunkbush Shrubland**

Ecological System(s):

- Western Great Plains Sandhill Shrubland (CES303.671)
-

ENVIRONMENTAL DESCRIPTION

The environmental factors that influence the composition and structure of this community are: climate, soil (texture and depth), natural fire, and grazing pressure. This community occurs on deep, coarse textured upland soils on gently sloping to undulating terrain. Infiltration of precipitation is rapid and runoff is slight. The soils are colluvial in nature and have often been reworked by wind. Natural fires estimated occurrence was every 8 – 10 years in pre-settlement times, but now are almost non-existent. Grazing by domestic livestock in the past has often been severe.

VEGETATION DESCRIPTION

The community is dominated by shrubs, most of which would be classified as short shrubs. *Artemisia filifolia* is the dominant species, with lesser amounts of *Rhus trilobata* present. Several species of tall grass and mid grass are present along with a variety of forbs. The dominant tall grass species are *Sporobolus cryptandrus*, *Stipa comata*, *Andropogon hallii*, and *Schizachyrium scoparium*. The amount of *Stipa comata* present is dependent on the amount of winter precipitation received. Wet winters will result in more of this species being present. The major forbs are *Tradescantia occidentalis*, *Commelina erecta*, *Ipomoea leptophylla*, *Stillingia sylvatica*, *Gaura suffulta*, *Ambrosia psilostachya*, *Gaillardia pulchella*, and *Mentzelia nuda*.

MOST ABUNDANT SPECIES

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Short shrub	narrow leaf deciduous	<i>Artemisia filifolia</i>
Short shrub	Broad-leaved deciduous	<i>Rhus trilobata</i>
Herbaceous	Graminoid	<i>Sporobolus cryptandrus</i> <i>Stipa comata</i> , <i>Schizachyrium scoparium</i>
Herbaceous	Forb	<i>Commelina erecta</i> , <i>Ambrosia psilostachya</i>

CHARACTERISTIC SPECIES

Artemisia filifolia, *Rhus trilobata*, *Sporobolus cryptandrus*

OTHER NOTEWORTHY SPECIES

Occasional groves of *Sapindus saponaria* and scattered thickets of *Prunus gracilis* may be found locally.

CLASSIFICATION COMMENTS

This association has similar plant communities located in other parts of the Texas panhandle, eastern New Mexico and western Oklahoma.

OTHER COMMENTS

ELEMENT DISTRIBUTION

This community can be found in the following locations on the Lake Meredith Recreational Area: West of the dirt road that connects the McBride Canyon area and the Mullinaw Creek area. The plant community is found west of the road approximately one half mile in the direction of the Canadian River. Also, the community can be observed at the extreme northeast corner of the Lake Meredith property to the south of FR 687 (road to Stinnett), to the south of the road approx. two thirds mile. There is a fairly large area of this community located on the Kritser Ranch just north of the Rosita Creek area.

Grazing pressure over long periods of time can cause a shift from tall grasses to mid and even short grass species. Heavy grazing will usually result in a greater abundance of weedy forb species such as *Ambrosia psilostachya* and *Heterotheca latifolia*. The elimination of natural fire from the ecological factors favors the shrubs over the grass. Shrubs are also more resistant to grazing pressure. The community has become more shrub dominated over time.

ELEMENT SOURCES

Inventory Notes:

Plots: 118, 120, 141, 179

Local Description Authors: JR Bell

[CEGL002176] *Artemisia filifolia* / *Bouteloua (curtipendula, gracilis)* Shrubland

Translated Name: **Sand Sagebrush / (Sideoats Grama, Blue Grama) Shrubland**

Common Name: **Sand Sagebrush / Grama Grass Shrubland**

Ecological System(s):

- Western Great Plains Sandhill Shrubland (CES303.671)
-

ENVIRONMENTAL DESCRIPTION

The environmental factors that determine the composition and structure of this community are: climate, soil (texture and depth), natural fire, and grazing pressure. This community occurs on deep, moderately coarse to medium textured colluvial soils on gently sloping to moderately sloping uplands. Infiltration and runoff are moderate.

VEGETATION DESCRIPTION

This community is dominated by *Artemisia filifolia* with the average canopy cover being approximately 20-25%. Shrubs vary from 1 to 1.5 m in height. There are scattered to frequent plants of *Prosopis glandulosa* present with trees up to 2.5 m in height, and scattered plants of *Yucca glauca*. The dominant grasses are *Bouteloua gracilis* and *Bouteloua curtipendula* with lesser amounts of *Sporobolus cryptandrus*, *Aristida purpurea*, and *Buchloe dactyloides*. Forbs are generally limited with the major species being *Ambrosia psilostachya* and *Gaillardia pulchella*.

MOST ABUNDANT SPECIES

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tall shrub	Broad-leaved deciduous	<i>Prosopis glandulosa</i>
Short shrub	Broad-leaved deciduous	<i>Artemisia filifolia</i>
Herbaceous	Graminoid	<i>Bouteloua gracilis</i>
Herbaceous	Forb	<i>Ambrosia psilostachya</i>

CHARACTERISTIC SPECIES

OTHER NOTEWORTHY SPECIES

CLASSIFICATION COMMENTS

This association is similar to the same community found throughout the region. It is a common association in the Texas panhandle, the South plains region of Texas and the western Rolling Plains of Texas. There are other similar communities in Oklahoma and eastern New Mexico although most of these lack *Prosopis glandulosa*.

Natural fire helped shape this community and fires occurred on a 8-10 year average time table. This community was most likely more of a grassland aspect in pre-settlement times. Fire suppression has favored the increase of shrubs within the community. Heavy grazing by domestic livestock has occurred in past years.

OTHER COMMENTS

ELEMENT DISTRIBUTION

This association can be found in the following locations within the Lake Meredith Recreational Area: Northeast of the Sanford Dam along FR 687 (Stinnett Hwy.) approx. $\frac{3}{4}$ mile east of the Hwy. intersection. Also in the area between McBride Canyon and Mullinaw Creek.

There is considerable acreage of this community along FR 1913 on the Sneed Ranch which lies to the north of the Blue West area of the park.

ELEMENT SOURCES

Inventory Notes:

Plots: 11, 16, 44, 53, 68, 69, 89, 119, 130, 142, 151, 152, 160

Local Description Authors: JR Bell

III.A.4.N.c. Temporarily flooded microphyllous shrubland

A.842 *Tamarix* spp. Semi-natural Temporarily Flooded Shrubland Alliance

Salt-cedar species Semi-natural Temporarily Flooded Shrubland Alliance

[CEGL003114] *Tamarix* spp. Temporarily Flooded Shrubland

Translated Name: **Salt-cedar species Temporarily Flooded Shrubland**

Common Name:

Ecological System(s):

- North American Warm Desert Lower Montane Riparian Woodland and Shrubland (CES302.748)
 - North American Warm Desert Riparian Woodland and Shrubland (CES302.753)
 - Western Great Plains Floodplain (CES303.678)
-

ENVIRONMENTAL DESCRIPTION

The environmental factors that influence the composition and structure of this community are: climate, soil, ground water (depth and amount), frequency of flooding, natural fire, competition, and possibly biological factors such as insect feeding. This community requires deep soils with an abundance of ground water. It occurs along streams and in riparian zones throughout the park.

VEGETATION DESCRIPTION

This community is dominated by *Tamarix ramosissima* (Salt Cedar). It occurs in almost pure stands in many places along the Canadian River streambank and across the floodplain. *Tamarix ramosissima* often occurs as bands of shrubs following old stream terraces. In most cases, there are very few understory plants able to establish and persist in thick stands of *T. ramosissima*. The community consists of both tall and short shrubs with the tallest being approximately 4 m in height. The stands are often very dense and impossible to walk through. The leaves accumulate salt and when dropped to the soil surface increase the content of salt in the soil which may act as an inhibitor to many other species. These bands of *Tamarix* can be observed from a high elevation along the cliffs above the floodplain. The size of the stands varies from small to large. The principal competitor with *T. ramosissima* is *Baccharis salicina* which is another high water use shrub. There are few grasses and forbs found in the Tamarisk shrubland community. Some grasses occurring in the understory are *Distichlis spicata*, *Muhlenbergia asperifolia*, and in some locations, *Phragmites australis*.

MOST ABUNDANT SPECIES

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tall shrub/sapling	Small-leaved deciduous	<i>Tamarix ramosissima</i>
Short shrub	Small-leaved deciduous	<i>Tamarix ramosissima</i> , <i>Baccharis salicina</i>
Herbaceous	Graminoid	<i>Muhlenbergia asperifolia</i> , <i>Distichlis spicata</i> , <i>Phragmites australis</i>
Herbaceous	Forb	<i>Apocynum cannabinum</i> , <i>Kochia scoparia</i> , <i>Ambrosia psilostachya</i>

CHARACTERISTIC SPECIES

OTHER NOTEWORTHY SPECIES

CLASSIFICATION COMMENTS

This community is common within the southern plains region and especially along the prairie rivers in the Texas panhandle, western rolling plains of Texas, western Oklahoma and northeastern New Mexico.

Seeds are spread by frequent flooding. Natural fire may have helped to suppress this community in the past. Livestock do not utilize this community as a grazing resource. This community is very competitive and there are few species that offer any major competition to Tamarisk. This community is considered alien and invasive. It will crowd out most of the native shrubs and trees once it becomes established. Tamarisk are known for their high water consumption and are partially responsible for decreased stream flow in many rivers and streams in the southwest.

OTHER COMMENTS

ELEMENT DISTRIBUTION

This community is widespread through out the park along the Canadian River floodplain. It can be observed from any high elevation vantage point above the floodplain.

ELEMENT SOURCES

Inventory Notes:

Plots: 30, 36, 37, 42, 75, 92, 97, 106, 145, 177

Local Description Authors: JR Bell

II.B.2.N.a. Temperate cold-deciduous shrubland

A.896 Cercocarpus montanus Shrubland Alliance

Mountain-mahogany Shrubland Alliance

[CEGL001086] *Cercocarpus montanus* / *Bouteloua curtipendula* Shrubland

Translated Name: **Mountain-mahogany / Sideoats Grama Shrubland**

Common Name: **Mountain Mahogany / Side-oats Grama Shrubland**

Ecological System(s):

- Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822)
 - Southwestern Great Plains Canyon (CES303.664)
 - Northwestern Great Plains Canyon (CES303.658)
-

ENVIRONMENTAL DESCRIPTION

The environmental factors that influence the composition and structure of this community are: climate, soil (depth), parent material, rock content, and landscape position. It is possible that wildlife browsing may also influence the community. The upland community occurs on dry, rocky hilltops and escarpments and occurs only in one locality on the park area. The soils are very shallow and exposed bedrock makes up approximately 25% of the land surface. Large and small rocks make up another 40 to 50%. Topography varies from gently sloping to steep. The parent material is dolomite and is referred to as the "Alibates lentil". Infiltration is very limited and only occurs in fissures in the rock surfaces. Runoff is rapid.

VEGETATION DESCRIPTION

This shrubland community is dominated by *Cercocarpus montanus*. The other common shrub is *Dalea formosa*. The common forbs are *Tetaneuris scaposa*, *Eriogonum longifolium*, *Krameria lanceolata*, *Zinnia grandiflora*, and *Hedyotis rigidiscula*. The most common grasses are *Aristida purpurea* and *Bouteloua curtipendula*. Total vegetative cover is sparse and often confined to small areas of soil accumulation and in fissures in the rock cover. Total biomass is quite low and litter is almost non-existent.

MOST ABUNDANT SPECIES

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tall shrub	Broad-leaved deciduous	<i>Cercocarpus montanus</i>
Short shrub	Broad-leaved deciduous	<i>Cercocarpus montanus</i> , <i>Dalea formosa</i>
Herbaceous	Graminoid	<i>Aristida purpurea</i>
Herbaceous	Forb	<i>Tetaneuris scaposa</i>

CHARACTERISTIC SPECIES

OTHER NOTEWORTHY SPECIES

CLASSIFICATION COMMENTS

This appears to be the only *C. montanus* community in the park. This community was found in only one general location and was sampled only twice. The total area occupied would not cover

more than 5 acres in size. It is not unlike some small communities that occur elsewhere in the Texas panhandle and eastern New Mexico.

Natural fire probably has a minimal effect on the community as lack of fuel would limit fire continuity. Mule deer and whitetail deer both prefer *C. montanus* as browse and may over browse this species in some localities, however, no evidence of over browsing exist on the park area.

OTHER COMMENTS

ELEMENT DISTRIBUTION

The community is found along the paved road known as the Cas Johnson Road which begins at the Hwy. 36 intersection and proceeds to the Alibates Ranger Station. The community occupies an escarpment and a separate hilltop approx. .5 mile south from the Ranger Station.

ELEMENT SOURCES

Inventory Notes:

Plots: 107, 122

Local Description Authors: JR Bell

III.B.2.N.a Temperate cold-deciduous shrubland

[NEW] *Rhus trilobata* Shrubland Alliance

Squawbush Shrubland Alliance

[NEW] *Rhus trilobata* / *Bouteloua curtipendula* – *Shizachyrium scoparium*

Shrubland

Translated Name: **Squawbush / Sideoats Grama – Little Bluestem Shrubland**

Common Name: **Skunkbush / Sideoats Grama – Little Bluestem Shrubland**

Ecological System(s):

- Southwestern Great Plains Canyon (CES303.664)
-

ENVIRONMENTAL DESCRIPTION

The environmental factors that influence the composition and structure of this community are: climate, soil, (depth, parent material), slope, aspect, natural fire, and rock cover. The community occurs on talus slopes with large and small rocks on the surface; rock cover ranges from 30-45%. The rocks are dolomite that has broken away from a layer at the top of the slopes. Some of the boulders are quite large. Soils are weathered Permian redbed material and loamy in texture. Slopes range from 25 to 50%. Runoff is rapid. Rock cover influences runoff patterns. Moisture is trapped under and around the exposed rock. East and north facing slopes are more heavily shaded and the vegetation is more diverse and production is greater on these aspects. Natural fire probably played a part in keeping shrubs under control in pre-settlement times.

VEGETATION DESCRIPTION

This community is a shrubland dominated by short shrubs up to 2 m in height with an occasional shrub up to 2.5 m. Canopies range from 25 to 30%. *Rhus trilobata* is the dominant shrub with lesser amounts of *Dalea formosa*, *Mimosa borealis*, *Ptelea trifoliata*, and occasional shrubby *Celtis laevigata*. In isolated instances, a few *Juniperus monosperma* may be observed. The dominant ground layer is mid and tall grasses with *Bouteloua curtipendula* and *Schizachyrium scoparium* being the most prevalent species. Grass cover is from 30 to 50%. Forbs are from 5 to 8% of the cover. The main forb species are: *Artemisia ludoviciana*, *Calylophus serrulata*, *Chaetopappa ericoides*, *Tetaneuris scaposa*, and *Eriogonum longifolium*. This community is generally quite productive considering the steepness of the terrain.

MOST ABUNDANT SPECIES

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tall shrub/sapling	Broad-leaved deciduous	<i>Rhus trilobata</i> , <i>Ptelea trifoliata</i>
Short shrub	Broad-leaved deciduous	<i>Rhus trilobata</i> , <i>Dalea formosa</i>
Herbaceous	Graminoid	<i>Bouteloua curtipendula</i> , <i>Schizachyrium scoparium</i>
Herbaceous	Forb	<i>Artemisia ludoviciana</i> <i>Chaetopappa ericoides</i>

CHARACTERISTIC SPECIES

OTHER NOTEWORTHY SPECIES

CLASSIFICATION COMMENTS

This community seems to be confined to a rather narrow geographic range. It is tied to the geology and slope pattern mentioned in the environmental description. The Alibates lentil (dolomite) is limited to three or four counties in the Texas panhandle along the Canadian River. Although none was found in the communities, there is some *Cercocarpus montanus* in other locations.

OTHER COMMENTS

ELEMENT DISTRIBUTION

This community is found throughout the park on steep slopes with mainly an east or north aspect.

A typical example is a northeast facing slope in McBride Canyon. Other examples are along the paved road going to the Alibates Ranger Station.

ELEMENT SOURCES

Inventory Notes:

Plots: 28, 55, 66, 84, 132, 156

Local Description Authors: JR Bell

III.B.2.N.d. Temporarily flooded cold-deciduous shrubland

[NEW] *Baccharis salicina* Shrubland Alliance

Great Plains False Willow Shrubland Alliance

[NEW] *Baccharis salicina* Shrubland

Translated Name: **Great Plains False Willow Shrubland**

Common Name: **False Willow Shrubland**

Ecological System(s):

- Western Great Plains Floodplain (CES303.678)
-

ENVIRONMENTAL DESCRIPTION

The environmental factors that influence the composition and structure of this community are: climate, soil (texture and depth to water table), frequency of flooding, natural fire, and grazing pressure. This riparian plant community occurs in the river floodplain usually on the first stream terrace. The water table is high, generally within 1.6 m of the soil surface, but will fluctuate somewhat due to season. The terrain is nearly level and the soils are alluvial sandy loams or silt loams with occasional sandier pockets. The area is occasionally to frequently flooded for short periods of time, but usually not to a depth of more than 0.3 – 0.5 m.

VEGETATION DESCRIPTION

The community is dominated by shrubs with *Baccharis salicina* being the dominant. In general, *Baccharis salicina* is a short shrub but can occasionally reach a height of 2 m. *Tamarix ramosissima* is frequent in the community with plants varying from 1 to 4 m in height. Occasional *Populus deltoides* trees are scattered throughout the community. The plant population of shrubs is usually dense to moderately dense and in places is difficult to walk through. There are some grass species present in the community but shading and competition from shrubs limit both frequency and production. The most common grass species are *Phragmites australis*, *Panicum virgatum*, and *Muhlenbergia asperifolia*. Forbs are infrequent with *Apocynum cannabinum* and *Ambrosia psilostachya* being the most common. There is evidence that this community has gone from one of approximately 50-50 shrubs and herbaceous plants to a shrub dominated community within the last 50 years. This may have been influenced by changes in underground water flow and the nature of flooding of the river and possibly by frequency of natural fire.

MOST ABUNDANT SPECIES

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Broad-leaved deciduous tree	<i>Populus deltoides</i>
Tall shrub	Needle-leaved deciduous	<i>Tamarix ramosissima</i>
Short shrub	Broad-leaved deciduous	<i>Baccharis salicina</i>
Herbaceous	Graminoid	<i>Phragmites australis</i> , <i>Panicum virgatum</i>
Herbaceous	Forb	<i>Apocynum cannabinum</i>

CHARACTERISTIC SPECIES

Baccharis salicina

OTHER NOTEWORTHY SPECIES

There are occasional colonies of *Tripsacum dactyloides* found in the community.

CLASSIFICATION COMMENTS

The Lake Meredith Recreational Area plant association is similar to other associations downstream along the Canadian River. This community occurs in the floodplains of other prairie rivers in the Texas panhandle and western Oklahoma, and possibly in New Mexico.

Natural fires occurred every 8 – 10 years in pre-settlement times but have been infrequent in the past 100 years. Grazing by domestic livestock was significant in the past but grazing has been excluded for the past several years. This site has become much more stable in regard to major floods due to impoundments upstream.

OTHER COMMENTS

ELEMENT DISTRIBUTION

This community can be found at various locations in the Lake Meredith Recreational Area. In all instances, this community is located in the river floodplain upstream from the Lake. The *Baccharis salicina* community may be found interspersed with *Tamarix ramosissima* communities and with communities of *Andropogon hallii* and other tall grass species. Location seems to depend on water table and width of the floodplain. The area around Mullinaw Crossing has a significant presence of this community as does the area downstream from the mouth of Bonita Creek.

ELEMENT SOURCES

Inventory Notes:

Plots: 5, 6, 54, 60, 165, 178

Local Description Authors: JR Bell

A.947 *Salix (exigua, interior) Temporarily Flooded Shrubland Alliance*
(Coyote Willow, Sandbar Willow) Temporarily Flooded Shrubland Alliance

[CEGL001197] *Salix exigua* Temporarily Flooded Shrubland

Translated Name: **Coyote Willow Temporarily Flooded Shrubland**

Common Name: **Coyote Willow Shrubland**

Ecological System(s):

- Northwestern Great Plains Floodplain (CES303.676)
 - Rocky Mountain Lower Montane Riparian Woodland and Shrubland (CES306.821)
-

ENVIRONMENTAL DESCRIPTION

The environmental factors that influence the composition and structure of this community are: climate, soil, frequency of flooding, depth to water table, and competition from other shrubs. Grazing pressure may in some instances also be a factor. This community depends on a permanent and stable ground water source that is near the soil surface. This species grows mainly along stream banks in soil that is continually wet. It may also grow away from the actual stream in bands that follow underground stream flow. During times of severe drought, these communities may become smaller and if ground water becomes limited, they may be severely reduced.

VEGETATION DESCRIPTION

This community is a shrubland dominated by *Salix exigua* (Sandbar willow). The stands are usually small and localized. They tend to grow along the main stream channel or along definite underground streams. *Salix exigua* may be either a tall or short shrub with the average height being approximately 1.5-2 m will sometimes form thick stands with an almost closed canopy. There may be substantial *Tamarix ramosissima* and *Baccharis salicina* growing within the community but *Salix exigua* is more dominant than either. There will often be individual plants of *Panicum virgatum* and/or *Phragmites australis* growing within this shrubland. The dense stands do not allow a great number of other species to persist. Occasional *Populus deltoides* may be present. Small (<2 m tall) *P. deltoides* may even be abundant.

MOST ABUNDANT SPECIES

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tall shrub/sapling	Broad-leaved deciduous	<i>Salix exigua</i>
Short shrub	Broad-leaved deciduous	<i>Salix exigua</i>
Herbaceous	Graminoid	<i>Phragmites australis</i>
Herbaceous	Forb	<i>Apocynum cannabinum</i>

CHARACTERISTIC SPECIES

OTHER NOTEWORTHY SPECIES

CLASSIFICATION COMMENTS

This community is common throughout the park area along the Canadian River streambed; however, these communities are usually not large and tend to be localized. This community is

found along all the prairie rivers in the Texas panhandle and the western rolling plains in Texas, as well as western Oklahoma and the Oklahoma panhandle.

Competition from shrubs such as Tamarix and Baccharis are a significant limiting factor in some areas. Livestock will sometimes graze the young willow shoots. This species along with other riparian shrubs relies on periodic flooding to distribute seed and create conditions that allow the continuation or establishment of the species.

OTHER COMMENTS

ELEMENT DISTRIBUTION

This community can be found along the Canadian River channel near the mouth of Plum Creek and in the Alibates boat ramp area, and between McBride and Mullinaw Creek along the stream bank. There are also some thick stands near the mouth of Bonita Creek.

ELEMENT SOURCES

Inventory Notes:

Plots: 45, 176

Local Description Authors: JR Bell

III.B.3.N.a. Extremely xeromorphic deciduous subdesert shrubland without succulents

A.1031 Prosopis glandulosa Shrubland Alliance

Honey Mesquite Shrubland Alliance

[CEGL002194] *Prosopis glandulosa* / *Bouteloua curtipendula* Shrubland

Translated Name: **Honey Mesquite / Sideoats Grama Shrubland**

Common Name: **Honey Mesquite / Sideoats Grama Shrubland**

Ecological System(s):

- North American Warm Desert Riparian Mesquite Bosque (CES302.752)
 - Western Great Plains Mesquite Woodland and Shrubland (CES303.668)
-

ENVIRONMENTAL DESCRIPTION

The environmental factors that influence the composition and structure of this community are: climate, soil (texture and depth) natural fire, invasion (seed source), and grazing pressure. The soils are moderately deep, and calcareous and occur on gently sloping terrain.

VEGETATION DESCRIPTION

This community is a shrubland with a good cover of perennial grasses at the ground layer. *Prosopis glandulosa* is the dominant shrub with lesser amounts of *Yucca glauca* and *Gutierrezia sarothrae*. Total canopy of shrubs is usually approximately 25%. The major grass species is *Bouteloua curtipendula* but may also have significant amounts of *Bouteloua gracilis* and *Sporobolus cryptandrus*. Forbs provide no more than 10% of the total cover. The most common forbs are *Tetaneuris scaposa*, *Chaetopappa ericoides*, and *Sphaeralcea coccinea*.

MOST ABUNDANT SPECIES

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tall shrub/sapling	Broad-leaved deciduous	<i>Prosopis glandulosa</i>
Short shrub	Broad-leaved deciduous	<i>Prosopis glandulosa</i>
Herbaceous	Graminoid	<i>Bouteloua curtipendula</i>
Herbaceous	Forb	<i>Tetaneuris scaposa</i> , <i>Chaetopappa ericoides</i>

CHARACTERISTIC SPECIES

OTHER NOTEWORTHY SPECIES

CLASSIFICATION COMMENTS

This is a common community but not usually extensive. Sometimes the canopy of *Prosopis glandulosa* may be less than 20% which would make this border on a grassland community. It is a common community in the Texas panhandle and western rolling plains.

This community is a shrubland but was once a grassland. In pre-settlement times there were few woody shrubs present. *Prosopis glandulosa* is a native shrub that was not found in great abundance on the high plains. This species has been spread by domestic livestock. Seedling emergence and establishment is greatly enhanced by passage through the ruminant's digestive

tract. In addition, natural fire likely kept many woody shrubs suppressed and aided in promoting a grassland. *Prosopis glandulosa* is generally not as prevalent in this community as in the *Prosopis-Bouteloua gracilis* community, but is generally sufficient in canopy to call the community a shrubland. Prolonged heavy grazing pressure results in lowered vigor of the major grasses and may promote the invasion of weedy shrubs such as *Gutierrezia sarothrae*. No grazing by any type of large herbivore and the elimination of natural fire promotes the increase of *Yucca glauca*, which has occurred in many of these communities.

OTHER COMMENTS

ELEMENT DISTRIBUTION

This shrubland is found in the North Canyon Area and along the paved road to Blue West Campground. It is widely distributed.

ELEMENT SOURCES

Inventory Notes:

Plots: 32, 40

Local Description Authors: JR Bell

[CEGL003877] *Prosopis glandulosa* var. *glandulosa* / *Bouteloua gracilis* -
Buchloe dactyloides Shrubland

Translated Name: **Honey Mesquite / Blue Grama - Buffalo Grass Shrubland**

Common Name:

Ecological System(s):

- North American Warm Desert Riparian Mesquite Bosque (CES302.752)
 - North American Warm Desert Wash (CES302.755)
 - Western Great Plains Mesquite Woodland and Shrubland (CES303.668)
-

ENVIRONMENTAL DESCRIPTION

The environmental factors that influence the composition and structure of this community are: climate, soil (depth and texture) natural fire, invasion (seed source), and grazing pressure. This community occurs on deep, medium to fine textured soils on nearly level to gently sloping terrain. It is typically found on mid to upper slopes or high level areas.

VEGETATION DESCRIPTION

This community is a shrubland dominated by *Prosopis glandulosa* with a canopy cover of > 25%. The shrubs may be short or tall with the range being generally from 1.5-3 m. in height. *Prosopis glandulosa* may be single stemmed or multistemmed and is a deep rooted, very competitive plant. The ground layer is dominated by short grasses with *Bouteloua gracilis* being the most prevalent species. *Sporobolus cryptandrus* is usually present but rarely abundant. Forbs tend to be few and are dependent on spring moisture. The more common forbs include: *Sphaeralcea coccinea*, *Ratibida columnaris*, *Thelesperma filifolia*, *Chaetopappa ericoides*, and *Amphiachyris dracunculoides*.

MOST ABUNDANT SPECIES

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tall shrub/sapling	Broad-leaved deciduous	<i>Prosopis glandulosa</i>
Short shrub	Broad-leaved deciduous	<i>Prosopis glandulosa</i>
Herbaceous	Graminoid	<i>Bouteloua gracilis</i>
Herbaceous	Forb	<i>Sphaeralcea coccinea</i> , <i>Thelesperma filifolia</i>

CHARACTERISTIC SPECIES

OTHER NOTEWORTHY SPECIES

CLASSIFICATION COMMENTS

This is a common plant community through out the Texas panhandle and the Texas western rolling plains region. It is one of the most common communities at the park.

This community is a shrubland but was once a grassland. In pre-settlement times there were few woody shrubs present. *Prosopis glandulosa* is a native shrub that was not found in great abundance on the high plains. This species has been spread by domestic livestock. Seedling emergence and establishment is greatly enhanced by passage through the ruminant's digestive tract. In addition, natural fire likely kept many woody shrubs suppressed and aided in promoting

a grassland. Prolonged heavy grazing pressure results in lowered vigor of the major grass species and may promote invasion of weedy half shrubs such as *Gutierrezia sarothrae*.

OTHER COMMENTS

ELEMENT DISTRIBUTION

This community can be found throughout the park. It is found mostly on upland areas well out of the Canadian River Canyon. There is a typical community found south of the Bugbee Shores community. And along the Fritch Fortress Road just past the Ranger Station.

ELEMENT SOURCES

Inventory Notes:

Plots: 1, 19, 49, 70, 93, 115, 116, 117, 121, 123, 124, 133, 136, 155, 159, 167, 171, 172, 173

Local Description Authors: JR Bell

IV. Dwarf-shrubland

IV.A.2.N.a– Extremely xeromorphic evergreen subdesert dwarf-shrubland

A.1104 Krascheninnikovia lanata Dwarf-shrubland Alliance

Winterfat Dwarf-shrubland Alliance

[NEW] *Krascheninnikovia lanata Dwarf-shrubland*

Translated Name: **Winterfat Dwarf-shrubland**

Common Name: *Winterfat Dwarf-shrubland*

Ecological System(s):

- Southwestern Great Plains Canyon (CES303.664)
-

ENVIRONMENTAL DESCRIPTION

The environmental factors that influence the composition and structure of this community are climate, soils, parent material, natural fire, and grazing/browsing history. This community occurs on shallow soils on ridges and on foot slopes along the Canadian River. In general, the soils are red bed derived and shallow in nature. It would seem that this shrub is able to grow on a variety of soils but prefers the more shallow, rocky areas. It is often found growing in association with other shrubs but may grow alone in small colonies. When this community is found it is never extensive and rarely occupies more than .33 acre. There is usually some evidence of deer browsing on this species and in areas where it is accessible, domestic livestock will browse it as well.

VEGETATION DESCRIPTION

This small community is dominated by *Krascheninnikovia lanata* with some other short shrubs also being present in lesser amounts. Associated shrubs present in the community include *Dalea formosa*, *Mimosa borealis*, *Atriplex canescens*, and occasionally small *Prosopis glandulosa*. The community gives the appearance of being droughty and forbs are few. *Tetrandeum scaposum*, *Gutierrezia sarothrae*, *Chaetopappa ericoides*, *Paronychia jamesii*, and *Eriogonum longifolium* are the most common. The most common grasses are *Aristida purpurea*, *Stipa neomexicana*, *Bouteloua gracilis*, and *Bouteloua curtipendula*.

MOST ABUNDANT SPECIES

Stratum

Short shrub
Herbaceous
Herbaceous

Lifeform

Broad-leaved deciduous
Graminoid
Forb

Species

Krascheninnikovia lanata
Aristida purpurea, *Bouteloua gracilis*
Tetrandeum scaposum

CHARACTERISTIC SPECIES

OTHER NOTEWORTHY SPECIES

CLASSIFICATION COMMENTS

Confidence in classifying this community is not definite. More investigation is needed in surrounding regions to determine if this community exists elsewhere as a true community, or perhaps as a component of a broader association. In the fall, this plant is very pleasing aesthetically as it produces showy white inflorescence which is in stark contrast to the surrounding red soil material in the area.

OTHER COMMENTS

ELEMENT DISTRIBUTION

This small community is found scattered throughout the Lake Meredith Recreational Area but usually occupies small areas within broader communities. It is commonly found on footslopes and along ridges in the steeper canyon country of the Canadian River Breaks on both sides of the river.

It is not known for certain whether this community is common in surrounding geographical regions. This species is most likely found west of this locality in the western Texas panhandle and into New Mexico, but it is not found to the east of this locality.

ELEMENT SOURCES

Inventory Notes:

Plots: 18, 52, 67, 77

Local Description Authors: JR Bell

IV.B.2.N.a – Cespitose cold-deciduous dwarf-shrubland

A.2528 *Gutierrezia sarothrae* Dwarf-shrubland Alliance

Broom Snakeweed Dwarf-shrubland Alliance

[NEW] *Gutierrezia sarothrae* – *Yucca glauca* Dwarf Shrubland

Translated Name: **Broom Snakeweed – Soapweed Yucca Dwarf-shrubland**

Common Name: *Snakeweed - Yucca Dwarf-shrubland*

Ecological System(s):

- Western Great Plains Shortgrass Prairie (CES303.672)
-

ENVIRONMENTAL DESCRIPTION

The environmental factors that influence the composition and structure of this community are: climate, soil (texture and depth), natural fire, and grazing pressure. This community occurs on moderately coarse to medium textured shallow or gravelly soils on ridges and moderately sloping uplands. Infiltration is moderately rapid and runoff is slight. The soils are outwash deposits that contain fairly high amounts of small to moderate sized gravel or caliche pebbles. These soils are calcareous and tend to be somewhat droughty in nature.

VEGETATION DESCRIPTION

This community is dominated by *Gutierrezia sarothrae* with *Yucca glauca* being the second most common species. *Opuntia macrorhiza* seems to be increasing on many areas where this community exists. There are several species of grass present but the grass is somewhat sparse and does not seem to be on the increase. The most common grass species are *Bouteloua gracilis*, *Bouteloua curtipendula*, and *Aristida purpurea*. There are several forb species present typified by *Eriogonum longifolium*, *Ambrosia psilostachya*, *Mentzelia nuda*, *Chaetopappa ericoides*, *Calylophus serrulata*, and *Haplopappus spinulosus*. Occasional plants of *Mimosa borealis* and *Dalea formosa* may occur locally.

MOST ABUNDANT SPECIES

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Half shrub	broadleaf deciduous	<i>Gutierrezia sarothrae</i>
Short shrub	evergreen	<i>Yucca glauca</i>
Herbaceous	graminoid	<i>Aristida purpurea</i> , <i>Bouteloua curtipendula</i>
Herbaceous	forb	<i>Chaetopappa ericoides</i> , <i>Eriogonum longifolium</i>

CHARACTERISTIC SPECIES

OTHER NOTEWORTHY SPECIES

CLASSIFICATION COMMENTS

Natural fires occurred every 8 – 10 years in pre-settlement times which tended to keep shrubs and half shrubs from dominating. Fire is infrequent in the present day environment. Grazing by domestic livestock has been moderate to heavy in the past but no grazing has occurred in several years. Shrubs and half shrubs have increased since settlement. The community has moved from more of a grassland toward shrub/half shrub domination over time.

The Lake Meredith plant community is similar to communities within the general region of the Texas panhandle, Oklahoma panhandle and western rolling plains of Texas.

OTHER COMMENTS

ELEMENT DISTRIBUTION

This community can be found throughout the park but is most common in the area near Alibates National Monument and in the rolling terrain between McBride and Mullinaw. There are large areas on the Sneed Ranch in the Blue West area. It should be pointed out that there are many sites with the same soils/topography that have somewhat different plant communities present. This community is degraded from its ecological potential due to past grazing pressure and lack of natural fire.

ELEMENT SOURCES

Inventory Notes:

Plots: 12, 33, 47, 82, 114, 148, 163

Local Description Authors: JR Bell

IV.B.3.N.a – Extremely xeromorphic deciduous subdesert dwarf-shrubland without succulents

[NEW] *Dalea formosa – Mimosa borealis Dwarf-shrubland Alliance*

Feather Dalea – Catclaw Mimosa Dwarf-shrubland

[NEW] *Dalea formosa – Mimosa borealis Dwarf-shrubland*

Translated Name: **Feather-plume Dalea – Pink Mimosa Dwarf-shrubland**

Common Name: *Dalea – Mimosa Dwarf-shrubland*

Ecological System(s):

- Southwestern Great Plains Canyon (CES303.664)
-

ENVIRONMENTAL DESCRIPTION

The environmental factors that influence the composition and structure of this community are: climate, soil (depth and parent material), rock cover, topography, and landscape position. The community occurs on very shallow upland soils with high rock content. Bedrock is exposed on approximately 15% of the land surface. Soils are never more than 4 inches in depth. Infiltration is limited due to soil depth and runoff is moderately rapid. Topography varies from gently sloping to moderately steep. The community is limited to narrow bands around the edge of escarpments and on very shallow ridges and hilltops.

VEGETATION DESCRIPTION

This community is a short shrub dominant with *Dalea formosa* being the dominant shrub. *Mimosa borealis* is secondary in abundance. Overall cover is somewhat sparse. Other shrubs that occur in token amounts include *Yucca glauca* and *Krascheninnikovia lanata*. Cacti species present in small amounts are *Opuntia phaeacantha* and *Echinocereus reichenbachii*. Common forbs are *Gutierrezia sarothrae*, *Tetaneuris scaposa*, and *Eriogonum longifolium*. *Aristida purpurea*, *Tridens muticus*, and *Bouteloua curtipendula* are the most prevalent grass species. The total biomass produced is low. Litter production is very low. Occasional cryptogamic crust are visible. Occasional lichens show up on rocks.

MOST ABUNDANT SPECIES

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Short shrub	Broad-leaved deciduous	<i>Dalea formosa</i> , <i>Mimosa borealis</i>
Herbaceous	Graminoid	<i>Aristida purpurea</i> , <i>Bouteloua curtipendula</i>
Herbaceous	Forb	<i>Gutierrezia sarothrae</i> , <i>Tetaneuris scaposa</i>

CHARACTERISTIC SPECIES

OTHER NOTEWORTHY SPECIES

Krascheninnikovia lanata is sometimes present in small amounts.

CLASSIFICATION COMMENTS

Natural fires may have occasionally occurred but lack of fine fuel limits fire possibilities in most areas. If fires occurred, the intensity would be limited. Grazing probably had limited effect on

the community as domestic livestock do not generally prefer these areas for grazing. Some wildlife browse was noted but not of a severe nature.

OTHER COMMENTS

ELEMENT DISTRIBUTION

This community is rather widespread on the park area. It is mainly confined to the escarpment areas overlooking the river, and to small shallow ridges in upland areas. One area where the community is fairly common is on the Alibates National Monument.

ELEMENT SOURCES

Inventory Notes:

Plots: 20, 26, 27, 34, 58, 125

Local Description Authors: JR Bell

V. Herbaceous Vegetation

V.A.5.N.a. Tall sod temperate grassland

A.1193 *Andropogon hallii* Herbaceous Alliance

Sand Bluestem Herbaceous Alliance

[CEGL004016] *Andropogon hallii* - *Calamovilfa gigantea* Herbaceous Vegetation

Translated Name: **Sand Bluestem - Big Sandreed Herbaceous Vegetation**

Common Name: **Sand Bluestem Prairie**

Ecological System(s):

- Western Great Plains Sand Prairie (CES303.670)
-

ENVIRONMENTAL DESCRIPTION

The environmental factors that determine the composition and structure of this community are: climate, soil, (texture and depth), frequency of flooding, natural fire, and grazing pressure. This riparian area community occurs on small dunes along the streambed and on first stream terraces. The soils are deep alluvial sands and have often been reworked by wind. Terrain is from nearly level to slightly undulating. Occasional flooding may occur which affects stability of vegetation. Some deposition may occur from time to time.

VEGETATION DESCRIPTION

This community is dominated by tall grasses with occasional shrubs. This site produces deep rooted plants that are adapted to coarse textured soils. The dominant grasses are *Andropogon hallii*, *Panicum virgatum*, *Sporobolus cryptandrus*, and *Calamovilfa gigantea*. *Sporobolus cryptandrus* and *Calamovilfa gigantea* usually occupy the wind-worked small dune areas while *Andropogon hallii* and *Panicum virgatum* are more prevalent on more level areas. Shrubs are *Salix exigua*, *Baccharis salicina*, and in some locations *Tamarix ramosissima*. *Salix exigua* tends to grow next to the streambank. There are occasional *Populus deltoides* saplings found but these are somewhat infrequent. *Tamarix ramosissima* is an exotic and is quite invasive in riparian locations in the park. Forbs are relatively few with *Ambrosia psilostachya* being the most frequently observed species. *Heterotheca latifolia* and *Glycorhiza lepidota* are also frequent.

MOST ABUNDANT SPECIES

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tall shrub/sapling	Broad-leaved deciduous	<i>Salix exigua</i>
Tall shrub	Needle-leaved deciduous	<i>Tamarix ramosissima</i>
Herbaceous	Graminoid	<i>Andropogon hallii</i> , <i>Panicum virgatum</i>
Herbaceous	Forb	<i>Ambrosia psilostachya</i>

CHARACTERISTIC SPECIES

OTHER NOTEWORTHY SPECIES

CLASSIFICATION COMMENTS

This community is similar to communities elsewhere in the same region. The species of tall grass may vary in dominance from one locality to the next and the amount of shrubs vary considerably. The community stability depends on frequency of flooding and the age of the deposited sediments. In a more upland setting, the community may be different.

Natural fire probably occurred every 8-10 years. At times in the past grazing pressure may have been significant. No grazing on the area has occurred in the last 15 – 20 years.

OTHER COMMENTS

ELEMENT DISTRIBUTION

This community is found at several locations along the banks of the Canadian River. It can be observed in the Rosita Creek area and in the Bonita Creek area on the opposite side of the river. It is a common occurrence in areas adjacent to the sandy streambed.

ELEMENT SOURCES

Inventory Notes:

Plots: 46, 59, 85, 164, 174

Local Description Authors: JR Bell

V.A.5.N.c. Medium-tall sod temperate or subpolar grassland

A.1238 *Panicum obtusum* Herbaceous Alliance

Vine-mesquite Herbaceous Alliance

[CEGL002708] *Panicum obtusum* Herbaceous Vegetation

Translated Name: **Vine-mesquite Herbaceous Vegetation**

Common Name:

Ecological System(s):

- Western Great Plains Floodplain (CES303.678)
-

ENVIRONMENTAL DESCRIPTION

The environmental factors that influence the composition and structure of this community are: climate, soils (texture, depth, and overflow), slope, natural fire and grazing pressure. This community occurs on broad, gently sloping overflow sites along major drainages. The soils are deep, medium to moderately fine textured with moderately high fertility. Infiltration is moderately rapid and runoff is moderate. The soils are formed from colluvial deposits and are considered uplands although overflow can occasionally occur. The productive capacity is greater than the adjoining upland communities due to receiving extra runoff from surrounding upland sites. Natural fire helped to shape the natural plant community and probably occurred every 8 to 10 years in pre-settlement times. This community is attractive to domestic grazing animals and has been subject to overgrazing in past decades.

VEGETATION DESCRIPTION

This community is a grassland dominated by *Panicum obtusum*. There are several other species of grass occurring in lesser amounts. These include *Pascopyrum smithii*, *Sporobolus asper* var. *hookerii* [= *Sporobolus compositus* (Poir.) Merr. var. *compositus*], *Bouteloua curtipendula*, and *Bothriochloa laguroides*. Forbs are variable in composition depending on moisture conditions. The major species include *Solanum eleagnifolium*, *Ambrosia psilostachya*, *Centaurea americana*, *Prionopsis ciliata* [= *Grindelia papposa* Nesom & Suh], *Gaura villosa*, and *Sphaeralcea angustifolia*. There are usually few shrubs present. *Prosopis glandulosa* occurs but is usually sparse. Cacti are rare although *Opuntia phaeacantha* and *Opuntia macrorhiza* are both present. Trees are rare except for occasional *Celtis reticulata*.

MOST ABUNDANT SPECIES

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Broad-leaved deciduous tree	<i>Celtis reticulata</i>
Tall shrub/sapling	Broad-leaved deciduous	<i>Prosopis glandulosa</i>
Herbaceous	Graminoid	<i>Panicum obtusum</i>
Herbaceous	Forb	<i>Solanum eleagnifolium</i>

CHARACTERISTIC SPECIES

OTHER NOTEWORTHY SPECIES

CLASSIFICATION COMMENTS

This community is similar to the global community. This community can be found in the Texas panhandle, Texas south plains, Texas rolling plains, eastern New Mexico and in the Oklahoma panhandle. It may be more extensive but this is not known.

Pascopyrum smithii herbaceous vegetation occurs in similar settings, however *P. smithii* is a cool season species. These two associations may occur in close proximity to one another.

OTHER COMMENTS

ELEMENT DISTRIBUTION

This community is fairly common on the park but occurs as small acreages along upland drainages. The exception to this is the area along Alibates Creek near the National Monument where the community occupies a fairly large acreage.

ELEMENT SOURCES

Inventory Notes:

Plots: 51, 90, 111, 143

Local Description Authors: JR Bell

A.1232 *Pascopyrum smithii* Herbaceous Alliance

Western Wheatgrass Herbaceous Alliance

[CEGL001578] *Pascopyrum smithii* - *Bouteloua gracilis* Herbaceous Vegetation

Translated Name: **Western Wheatgrass - Blue Grama Herbaceous Vegetation**

Common Name: **Western Wheatgrass - Blue Grama Mixedgrass Prairie**

Ecological System(s):

- Central Mixedgrass Prairie (CES303.659)
 - Southern Rocky Mountain Montane-Subalpine Grassland (CES306.824)
-

ENVIRONMENTAL DESCRIPTION

The environmental factors that influence the composition and structure of this community are: climate, soil (texture and depth), overflow, natural fire, and grazing pressure. This community is found in two different settings – one is broad, open valley floors which receive overflow from surrounding areas, and also in riparian areas with deep moderate textured soils with scattered trees. Terrain is gently sloping and usually occurs along water courses or in depressional areas in either upland or riparian environments. Some overflow from surrounding uplands or some occasional flooding usually characterizes the community. *Pascopyrum smithii* grows in shaded areas under deciduous trees as well as in open areas. Oftentimes, *Pascopyrum smithii* communities include *Panicum obtusum* and a few other grasses such as *Elymus canadensis*, and annual *Bromus* species. *Pascopyrum smithii* is generally resistant to grazing pressure. Natural fire helped to maintain grassland sites and may have occurred approximately every 8-10 years in pre-settlement times.

VEGETATION DESCRIPTION

The community is dominated by grasses with *Pascopyrum smithii* being the most abundant species. Other grasses occurring within the community are *Panicum obtusum*, *Elymus canadensis*, *Bromus japonicus*, *Bromus tectorum*, and occasionally *Panicum virgatum*. Shrubs are generally few but can occur locally. If trees are present, which often is the case, they are usually *Populus deltoides*, or *Celtis reticulata*. Forbs may be few or may be present in moderate amounts depending on the season. Major forb species are *Sphaeralcea angustifolia*, *Ambrosia psilostachya*, *Helianthus annuus*, *Centaurea americana*, and *Gaillardia pulchella*. Since *Pascopyrum smithii* is a cool season species, its degree of dominance depends somewhat on the amount of winter and early spring moisture. This is a grassland and should not be confused with *Populus deltoides* woodlands where *P. smithii* is present as an understory species.

MOST ABUNDANT SPECIES

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Broad-leaved deciduous tree	<i>Celtis reticulata</i> , <i>Populus deltoides</i>
Herbaceous	Graminoid	<i>Pascopyrum smithii</i>
Herbaceous	Forb	<i>Ambrosia psilostachya</i> , <i>Centaurea americana</i>

CHARACTERISTIC SPECIES

OTHER NOTEWORTHY SPECIES

CLASSIFICATION COMMENTS

The community present on the Lake Meredith Area is very similar to other communities that occur in similar settings throughout the southern plains.

OTHER COMMENTS

ELEMENT DISTRIBUTION

This community can be found throughout the park area. The communities tend to be small in acreage. The Alibates Creek area has a considerable presence of this community as well as along Plum Creek near the camping areas.

ELEMENT SOURCES

Inventory Notes:

Plots: 14, 23, 113

Local Description Authors: JR Bell

A.1225 *Schizachyrium scoparium* - *Bouteloua curtipendula* Herbaceous Alliance

Little Bluestem - Sideoats Grama Herbaceous Alliance

[CEGL001594] *Schizachyrium scoparium* - *Bouteloua curtipendula* Western Great Plains Herbaceous Vegetation

Translated Name: **Little Bluestem - Sideoats Grama Western Great Plains Herbaceous Vegetation**

Common Name: **Western Great Plains Little Bluestem Mixedgrass Prairie**

Ecological System(s):

- Central Mixedgrass Prairie (CES303.659)
 - Western Great Plains Foothill and Piedmont Grassland (CES303.817)
-

ENVIRONMENTAL DESCRIPTION

The environmental factors that influence the composition and structure of this community are: climate, soil (depth and texture), slope, aspect, natural fire, and grazing pressure. This grassland community prefers medium textured soils (loams, silt loams, and fine sandy loams) in gently sloping to steeply sloping terrain. Slopes range from 12 to 45%. The more steeply sloping areas will have considerable rock cover from talus that has broken away and fallen down from above. Aspect is important as the more mesic slopes (north and east) will produce more biomass and tend to favor the *Schizachyrium scoparium*.

VEGETATION DESCRIPTION

This grassland community is dominated by *Bouteloua curtipendula* and *Schizachyrium scoparium*. Few other herbaceous species are ever abundant. There are small amounts of woody shrubs present. On the dryer exposures, *Prosopis glandulosa* and *Mimosa borealis* will be found, while on the more mesic exposures *Rhus trilobata* will be the most prevalent shrub. There are a several perennial forbs present with the most common being *Artemisia ludoviciana*, *Tetrandeum scaposum*, *Chaetopappa ericoides*, *Calylophus serrulata*, and *Eriogonum longifolium*.

MOST ABUNDANT SPECIES

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tall shrub/sapling	Broad-leaved deciduous	<i>Prosopis glandulosa</i> , <i>Rhus trilobata</i>
Short shrub	Broad-leaved deciduous	<i>Prosopis glandulosa</i> , <i>Rhus trilobata</i> , <i>Mimosa borealis</i>
Herbaceous	Graminoid	<i>Bouteloua curtipendula</i> , <i>Schizachyrium scoparium</i>
Herbaceous	Forb	<i>Artemisia ludoviciana</i> , <i>Tetrandeum scaposum</i>

CHARACTERISTIC SPECIES

OTHER NOTEWORTHY SPECIES

CLASSIFICATION COMMENTS

Natural fire helped to maintain these grasslands by suppressing woody shrubs that established on the site. Heavy grazing pressure will reduce productivity and will generally lead to shorter growing grasses replacing the mid and tall grass species. The more steeply sloping areas have received little grazing pressure.

Similar to the *Rhus trilobata* / *Bouteloua curtipendula* – *Schizachyrium scoparium* Shrubland. This association has considerably less shrub cover.

OTHER COMMENTS

ELEMENT DISTRIBUTION

This community is widespread over the park area.

ELEMENT SOURCES

Inventory Notes:

Plots: 48, 103, 104, 105, 110, 112, 135

Local Description Authors: JR Bell

[CEGL001594] *Sporobolus cryptandrus* – *Schizachyrium scoparium* - *Bouteloua curtipendula* Herbaceous Vegetation

Translated Name: **Sand Dropseed – Little Bluestem - Sideoats Grama Herbaceous Vegetation**

Common Name: **Gypsum Outcrop Grassland**

Ecological System(s):

- Central Mixedgrass Prairie (CES303.659)
-

ENVIRONMENTAL DESCRIPTION

The environmental factors that influence the composition and structure of this community are: climate, soils (chemistry and mineralogy), topography, and aspect. This community occurs on gypsiferous soils on relatively small acreages. These communities are located on small hills, ridges, and ledges within the Permian Redbed geology. Gypsum content of the soils is high. The greater the gypsum content, the more sparse the individual plants and the more narrow the list of species becomes. Some sites are almost pure gypsum and have almost no vegetation present. At best, vegetation is sparse. It is unlikely that fire played a significant role in shaping this community due to the sparse cover. Grazing animals tend to shun these areas due to lack of plant palatability. The dryer south and west facing slopes tend to have the least amount of total vegetation present. Runoff is greater on sloping terrain and infiltration is limited.

VEGETATION DESCRIPTION

This community is usually sparsely vegetated with vegetation decreasing as the gypsum content increases. The plants that do occur are able to survive under extreme conditions of gypsiferous soil, low fertility, and low available water. The community may have grasses, forbs, and a few shrubs present. Number of species is limited. The most commonly occurring grasses are *Sporobolus cryptandrus*, *Bouteloua curtipendula*, *Schizachyrium scoparium*, *Erioneuron pilosum*, and *Aristida purpurea*. The more common forbs are *Calylophus serrulata*, *Oenothera macrocarpa*, *Phacelia integrifolia*, *Mentzelia strictissima*, *Eriogonum jamesii*, *Haploesthes greggii*, and *Hymenopappus flavescens*. Few shrubs occur, but scattered *Dalea formosa*, *Yucca glauca*, and occasional *Rhus trilobata* can be observed. Occasional cacti species are found with the most common species being *Echinocereus reichenbachii* and *Opuntia macrorhiza*.

MOST ABUNDANT SPECIES

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Short shrub	Broad-leaved deciduous	Dalea formosa, Rhus trilobata
Herbaceous	Graminoid	Sporobolus cryptandrus
Herbaceous	Forb	Mentzelia strictissima, Haploesthes greggii

CHARACTERISTIC SPECIES

OTHER NOTEWORTHY SPECIES

CLASSIFICATION COMMENTS

This community is distinct from surrounding vegetation and very similar to other communities occurring on similar sites in the rolling plains of western Texas and western Oklahoma.

This community is very similar to other communities that occur on similar sites within the western rolling plains of Texas and western Oklahoma.

OTHER COMMENTS

ELEMENT DISTRIBUTION

This community occurs in the Plum Creek area and in the Big Canyon area of the Lake Meredith Recreational Area. It is not an extensive site but is rather common in the Redbed geology.

ELEMENT SOURCES

Inventory Notes:

Plots: 22, 24, 41, 62, 65, 131

Local Description Authors: JR Bell

V.A.5.N.d. Medium-tall bunch temperate or subpolar grassland

A.1244 *Bouteloua curtipendula* Herbaceous Alliance

Sideoats Grama Herbaceous Alliance

[CEGL002250] *Bouteloua curtipendula* - *Bouteloua (eriopoda, gracilis)*

Herbaceous Vegetation

Translated Name: **Sideoats Grama - (Black Grama, Blue Grama) Herbaceous Vegetation**

Common Name: **Grama Mixedgrass Prairie**

Ecological System(s):

- Southeastern Great Plains Tallgrass Prairie (CES205.685)
 - Western Great Plains Shortgrass Prairie (CES303.672)
-

ENVIRONMENTAL DESCRIPTION

The environmental factors that influence the composition and structure of this community are: climate, soil (texture and depth), topography, natural fire, and grazing pressure. The community occurs on moderately deep, upland soils that are usually calcareous and of a loamy texture. Terrain is usually moderately sloping to rolling, but may be steep in some cases. Infiltration is from moderately rapid to moderately slow and runoff is moderate.

VEGETATION DESCRIPTION

This community occurs on uplands dominated by herbaceous species, mainly mid and short grasses. *Bouteloua curtipendula* is usually the dominant species, with lesser amounts of *Bouteloua gracilis*, *Bouteloua eriopoda*, *Bouteloua hirsuta*, *Sporobolus cryptandrus*, and *Aristida purpurea*. Forbs make up less than 10% of the community with the major species being *Sphaeralcea coccinea*, *Chaetopappa ericoides*, *Liatis punctata*, *Krameria lanceolata*, *Zinnia grandiflora*, *Tetaneuris scaposa*, *Gutierrezia sarothrae*, and *Ambrosia psilostachya*. There are a few short shrubs present mainly *Mimosa biuncifera*, *Yucca glauca*, *Prosopis glandulosa*, and *Rhus trilobata*. Occasional *Opuntia macrorhiza* also occurs.

MOST ABUNDANT SPECIES

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tall shrub	Broad-leaved deciduous	<i>Prosopis glandulosa</i>
Short shrub	Broad-leaved deciduous	<i>Mimosa biuncifera</i> , <i>Rhus trilobata</i>
Herbaceous	Graminoid	<i>Bouteloua curtipendula</i> , <i>gracilis</i> , <i>hirsuta</i>
Herbaceous	Forb	<i>Chaetopappa ericoides</i> , <i>Gutierrezia sarothrae</i> , <i>Ambrosia psilostachya</i>

CHARACTERISTIC SPECIES

OTHER NOTEWORTHY SPECIES

Krascheninnikovia lanata is sometimes found but infrequently.

CLASSIFICATION COMMENTS

The Lake Meredith Recreational Area plant association is similar to the global concept. This association can be found readily in the Texas panhandle, Oklahoma panhandle and western Oklahoma, as well as in eastern New Mexico.

Natural fires helped shape the community makeup and occurred every 8-10 years in pre-settlement times. Natural fires are infrequent present day. Grazing by domestic livestock may have been heavy in the past but there has been little or no grazing in the past several years.

OTHER COMMENTS

ELEMENT DISTRIBUTION

This plant community is extensive on the Lake Meredith Recreational Area. It is found over the entire park and may be fairly small or quite large in area.

ELEMENT SOURCES

Inventory Notes:

Plots: 10, 13, 15, 21, 31, 43, 50, 71, 72, 73, 74, 129, 134, 137, 140, 144, 149, 153, 157, 158, 180

Local Description Authors: JR Bell

A.1267 *Sporobolus airoides* Herbaceous Alliance

Alkali Sacaton Herbaceous Alliance

[CEGL001685] *Sporobolus airoides* Southern Plains Herbaceous Vegetation

Translated Name: **Alkali Sacaton Southern Plains Herbaceous Vegetation**

Common Name: **Alkali Sacaton Southern Plains Grassland**

Ecological System(s):

- Inter-Mountain Basins Greasewood Flat (CES304.780)
 - Chihuahuan-Sonoran Desert Bottomland and Swale Grassland (CES302.746)
 - Western Great Plains Floodplain (CES303.678)
 - Western Great Plains Saline Depression Wetland (CES303.669)
 - Western Great Plains Shortgrass Prairie (CES303.672)
-

ENVIRONMENTAL DESCRIPTION

The environmental factors that influence the composition and structure of this community are: climate, soil, (depth, texture, and alkalinity), natural fire, and grazing pressure. This community occurs on nearly level terrain with deep moderate to moderately fine textured soils with a high degree of alkalinity. It usually occupies broad colluvial fans or benches just outside the main river floodplain, but may be found in the outer reaches of the floodplain also.

VEGETATION DESCRIPTION

The community often appears as a near monoculture of *Sporobolus airoides*. Small amounts of *Panicum obtusum*, *Sporobolus asper*, *Distichlis spicata*, and *Pascopyrum smithii* are typically present. There may be a few small *Prosopis glandulosa* present in the more upland communities and scattered *Baccharis salicina* and *Tamarix ramosissima* in the lower lying areas of the outer floodplain. There are few forbs present with *Aster ericoides*, *Ambrosia psilostachya*, and *Gaillardia* sp. being the most common.

MOST ABUNDANT SPECIES

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Herbaceous	Graminoid	<i>Sporobolus airoides</i> , <i>Panicum obtusum</i>
Herbaceous	Forb	<i>Aster ericoides</i> , <i>Gaillardia</i> sp.

CHARACTERISTIC SPECIES

OTHER NOTEWORTHY SPECIES

CLASSIFICATION COMMENTS

Natural fire helped to suppress any woody plants that may have established in the community. Elimination of fire has resulted in more woody shrubs being present today. Livestock prefer this community at certain times of the year. *Sporobolus airoides* is able to stand moderate grazing pressure with no damage.

OTHER COMMENTS

ELEMENT DISTRIBUTION

This community is not extremely widespread in the park. It occurs in the Big Canyon, Saddle Horse Canyon area, and as small areas in the Plum Creek area.

ELEMENT SOURCES

Inventory Notes:

Plots: 61, 91

Local Description Authors: JR Bell

V.A.5.N.e. Short sod temperate or subpolar grassland

A.1282 *Bouteloua gracilis* Herbaceous Alliance

Blue Grama Herbaceous Alliance

[CEGL001756] *Bouteloua gracilis* - *Buchloe dactyloides* Herbaceous Vegetation

Translated Name: **Blue Grama - Buffalo Grass Herbaceous Vegetation**

Common Name: **Blue Grama - Buffalograss Shortgrass Prairie**

Ecological System(s):

- Apacherian-Chihuahuan Semi-Desert Grassland and Steppe (CES302.735)
 - Western Great Plains Foothill and Piedmont Grassland (CES303.817)
 - Western Great Plains Shortgrass Prairie (CES303.672)
-

ENVIRONMENTAL DESCRIPTION

The environmental factors that influence the composition and structure of this plant community are: climate, soil (texture and depth), topography (slope), natural fire and grazing pressure. The community occurs on uplands with nearly level to gently sloping terrain. The soils are colluvial, deep, fine textured, and generally occur at the highest landscape position. Infiltration is slow and runoff is slight.

VEGETATION DESCRIPTION

This community is a true upland grassland. It is dominated by short grass species, namely *Bouteloua gracilis* with lesser amounts of *Buchloe dactyloides*. Token amounts of other grass species may occur, including *Sporobolus cryptandrus*, *Panicum obtusum*, *Pascopyrum smithii*, *Muhlenbergia arenicola*, and *Eragrostis curtipedicillata*. Forbs are relatively few with the most common species being *Sphaeralcea coccinea*, *Thelesperma filifolia*, *Amphiachyris dracunculoides*, and *Ratibida columnaris*. Shrubs occur in limited numbers with *Prosopis glandulosa* being the most common species.

MOST ABUNDANT SPECIES

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tall shrub	Broad-leaved deciduous	<i>Prosopis glandulosa</i>
Herbaceous	Graminoid	<i>Bouteloua gracilis</i>
Herbaceous	Forb	<i>Sphaeralcea coccinea</i>

CHARACTERISTIC SPECIES

OTHER NOTEWORTHY SPECIES

CLASSIFICATION COMMENTS

The plant community on the Lake Meredith Recreational Area is similar to the global concept. This community is typical of associations in the southern high plains region.

Natural fires shaped the vegetation and occurred every 8 – 10 years. Natural fires are infrequent present day. Grazing by domestic livestock in the past has been often been moderate to severe. No grazing has been allowed on the park area for several years.

This association is frequently found intermingled with the *Prosopis glandulosa* / *Bouteloua gracilis* Shrubland.

OTHER COMMENTS

ELEMENT DISTRIBUTION

This community is not common on the Lake Meredith Recreational Area because most of the park is located in the Canadian River Canyon and does not include the higher elevation uplands. The community can be observed in the Bugbee Shores area, south of the community. Also, there are some large areas on the Palo Duro Ranch closely adjacent to the park land between McBride Canyon and Cas Johnson Road.

ELEMENT SOURCES

Inventory Notes:

Plots: 17, 78, 79, 126, 127, 139, 150 154, 168

Local Description Authors: JR Bell

V.A.5.N.j Temporarily flooded temperate or subpolar grassland
A.1354 *Pascopyrum smithii* Temporarily Flooded Herbaceous Alliance

[CEGL001594] *Panicum virgatum* – *Pascopyrum smithii* Southern Herbaceous Vegetation

Translated Name: **Switchgrass – Western Wheatgrass Southern Herbaceous Vegetation**

Common Name: **Switchgrass – Western Wheatgrass Floodplain Grassland**

Ecological System(s):

- Western Great Plains Floodplain (CES303.678)
-

ENVIRONMENTAL DESCRIPTION

The environmental factors that influence the composition and structure of this community are: climate, soil texture and depth to water table, frequency of flooding, slope, natural fire and grazing pressure. This community occurs on floodplains of major streams and along the Canadian River. The water table is generally within 1 m of the surface. The slopes are nearly level and the soils range from loamy to sandy. Flooding occurs occasionally to a depth not more than 0.3 to 0.6 m for brief periods. Soils consist of alluvium and are relatively young in age. Natural fires occurred approximately every 8 to 10 years on the average in pre-settlement times. This community is attractive to domestic grazing animals and may have been subjected to periodic heavy grazing in past decades.

VEGETATION DESCRIPTION

This community is dominated by grasses with *Panicum virgatum* being the most prevalent and somewhat lesser amounts of *Pascopyrum smithii*. Other grasses that may occur in lesser quantities are *Sporobolus airoides*, *Sporobolus asper* var. *hookerii*, *Elymus canadensis*, and *Distichlis spicata*. The productive capacity of the community is high with a good grass cover. Forbs are generally infrequent with *Glycorhiza lepidota*, *Aster ericoides* [= *Symphotrichum ericoides* (L.) Nesom var. *ericoides*], and *Ambrosia psilostachya* being the most common. Shrubs can be widely scattered to as much as a 10% canopy and consist of *Baccharis salicina* and *Tamarix ramosissima*.

MOST ABUNDANT SPECIES

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tall shrub/sapling	Needle leaf deciduous	<i>Tamarix ramosissima</i>
Short shrub	Broad-leaved deciduous	<i>Baccharis salicina</i>
Herbaceous	Graminoid	<i>Panicum virgatum</i> , <i>Pascopyrum smithii</i>
Herbaceous	Forb	<i>Glycorhiza lepidota</i> , <i>Ambrosia psilostachya</i>

CHARACTERISTIC SPECIES

OTHER NOTEWORTHY SPECIES

Baccharis salicina, *Tamarix ramosissima*

CLASSIFICATION COMMENTS

This community is similar to others that occur along the Canadian River and other prairie rivers in the same geographic region.

OTHER COMMENTS

ELEMENT DISTRIBUTION

This community is found along the floodplain of the Canadian River in many places throughout the Lake Meredith Recreational Area. The size of the community is generally not large and is often intermingled with shrubland communities throughout the riparian area.

ELEMENT SOURCES

Inventory Notes:

Plots: 25, 76, 87, 147

Local Description Authors: JR Bell

V.A.5.N.I. Semipermanently flooded temperate or subpolar grassland
A.1431 Phragmites australis Semipermanently Flooded Herbaceous Alliance
Common Reed Semipermanently Flooded Herbaceous Alliance

[CEGL001475] *Phragmites australis* Western North America Temperate Semi-natural Herbaceous Vegetation

Translated Name: **Common Reed Western North America Temperate Semi-natural Herbaceous Vegetation**

Common Name: **Western Reed Marsh**

Ecological System(s):

- North American Arid West Emergent Marsh (CES300.729)
 - Northern Columbia Plateau Basalt Pothole Ponds (CES304.058)
-

ENVIRONMENTAL DESCRIPTION

The environmental factors that influence the composition and structure of this community are: climate, soil (texture, depth to water table) frequency of flooding, and terrain. This community occurs in floodplains of major streams where the water table is close to the soil surface. The soils are usually sandy to silty alluvium and the terrain is nearly level. Grazing probably played a minimal part in the community development. Natural fire may have influenced the community by keeping competitive shrubs controlled.

VEGETATION DESCRIPTION

The community is dominated by *Phragmites australis* but may contain other species such as *Panicum virgatum* and *Baccharis salicina*. *Phragmites australis* often occurs in narrow bands immediately adjacent to the present stream channel. This species is scattered throughout the river floodplain and is often a part of other communities. When a dominant stand of *Phragmites* occurs, the area occupied is generally small and appears to depend on a particular ground water regime. It is common for the community to follow old stream terraces or the present channel. Occasionally, *Salix exigua* and *Tamarix* spp. plants occur within the community, but very few forbs are found. The most common forbs are *Glycorhiza lepidota*, and *Apocynum cannabinum*. A few short grasses are sometimes found in the understory with *Muhlenbergia asperifolia* and *Distichlis spicata* being the most common.

MOST ABUNDANT SPECIES

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tall shrub/sapling	Narrow-leaved deciduous	<i>Salix exigua</i> , <i>Tamarix ramosissima</i>
Short shrub	Narrow-leaved deciduous	<i>Baccharis salicina</i>
Herbaceous	Graminoid	<i>Phragmites australis</i>
Herbaceous	Forb	<i>Apocynum cannabinum</i>

CHARACTERISTIC SPECIES

OTHER NOTEWORTHY SPECIES

CLASSIFICATION COMMENTS

This community is similar to other Phragmites communities located along prairie rivers in the southern plains region.

OTHER COMMENTS

ELEMENT DISTRIBUTION

This community is found scattered throughout the Canadian River floodplain in the park. It is most frequently found adjacent to the current stream. Generally it occurs as narrow bands and appears to be an almost pure stand in some cases.

ELEMENT SOURCES

Inventory Notes:

Plots: 99

Local Description Authors: JR Bell

A.1433 *Schoenoplectus pungens* Semipermanently Flooded Herbaceous Alliance

Threesquare Semipermanently Flooded Herbaceous Alliance

[CEGL005988] *Schoenoplectus pungens* - *Distichlis spicata* Herbaceous Vegetation

Translated Name: **Threesquare - Saltgrass Herbaceous Vegetation**

Common Name:

Ecological System(s):

- Western Great Plains Floodplain (CES303.678)
-

ENVIRONMENTAL DESCRIPTION

The environmental factors that influence the composition and structure of this community are: climate, soil, silt load, length of inundation, water depth, and possibly water quality. This community resides around the edge of shallow standing water. The stands themselves may be close to the bank or in standing water. Usually there has been considerable deposition of silt in these areas. This community requires a particular water regime to establish and persist. Climatic fluctuations influence the water regime and therefore the plant community.

VEGETATION DESCRIPTION

This wetland community is heavily dominated by *Schoenoplectus americanus* (Three-square bulrush) and *Schoenoplectus validus* (Softstem bulrush). Often there are *Eleocharis* species present in lesser amounts. Closely associated communities are *Typha* and *Typha-Schoenoplectus* and species from these communities may also occur. The stands tend to be very small and fluctuate in size year to year depending on water regime. Plants are generally thick in population and range from 1 m to as much as 2 m in height.

MOST ABUNDANT SPECIES

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Herbaceous	Grasslike	<i>Schoenoplectus americanus</i> <i>Schoenoplectus validus</i>

CHARACTERISTIC SPECIES

OTHER NOTEWORTHY SPECIES

CLASSIFICATION COMMENTS

Comments: This community appears to be common in the region but requires a particular water regime. The *Schoenoplectus* community is often associated with *Typha* sp. as well as *Eleocharis* sp.

OTHER COMMENTS

ELEMENT DISTRIBUTION

Range: This community is not widespread in the park and is limited to the upper end of the lake where the water level is shallow and the silt load is high. It can also be found below the Sanford Dam.

ELEMENT SOURCES

Inventory Notes:

Plots: 98

Local Description Authors: JR Bell

A.1436 *Typha (angustifolia, latifolia) - (Schoenoplectus spp.) Semipermanently Flooded Herbaceous Alliance*

(Narrowleaf Cattail, Broadleaf Cattail) - (Clubrush species) Semipermanently Flooded Herbaceous Alliance

[CEGL002032] *Typha (angustifolia, domingensis, latifolia) - Schoenoplectus americanus* Herbaceous Vegetation

Translated Name: (Narrowleaf Cattail, Southern Cattail, Broadleaf Cattail) - Chairmaker's Bulrush Herbaceous Vegetation

Common Name: Southern Great Plains Cattail - Bulrush Marsh

Ecological System(s):

- Eastern Great Plains Wet Meadow, Prairie, and Marsh (CES205.687)
 - Western Great Plains Open Freshwater Depression Wetland (CES303.675)
 - Western Great Plains Floodplain (CES303.678)
-

ENVIRONMENTAL DESCRIPTION

The environmental factors that influence the composition and structure of this community are: frequency of flooding, degree of siltation, soil depth, degree of saturation, and wetting/drying cycle. This community occurs at the upper end of the reservoir where flow from the Canadian River enters the lake. There is a large area of silt deposits occurring on a generally flat alluvial floodplain. These areas are kept wet from underground streamflow as well as from periodic flooding. Some of the area is mud flats and some occurs as small to large islands of vegetation. As the water level lowers, more area is available for this community to establish, and by the same token, areas where this community is already established become dry enough that it begins to die off.

VEGETATION DESCRIPTION

This community is dominated by *Typha latifolia* (Cattail), *Schoenoplectus validus*, and *Schoenoplectus americanus*. The vegetative community is interspersed with areas of no vegetation (mud flats). *Typha latifolia* reaches a height of up to 10 feet in some places. Smaller areas of *Eleocharis macrostachya* and *Rumex* sp. occur in scattered colonies. As the area experiences drought periods, the amount of water available in the underground strata and in the soil above will fluctuate and in extended dry periods the vegetation may die off leaving large areas of dead material. As siltation continues to occur, and the stream channels change, the vegetative characteristics will change. Some shrubby species such as *Salix* spp. and *Tamarix ramosissima* also occur within the draw down area.

MOST ABUNDANT SPECIES

Lake Meredith National Recreation Area

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Herbaceous	grasslike	<i>Typha latifolia</i> , <i>Schoenoplectus</i> sp.
Herbaceous	Forb	<i>Rumex</i> sp.
Deciduous shrub	Tall /short shrub	<i>Salix exigua</i> , <i>Tamarix ramosissima</i>

CHARACTERISTIC SPECIES

OTHER NOTEWORTHY SPECIES

This community is common in wet areas with high degree of siltation occurring in similar types of situations within the southern plains region.

OTHER COMMENTS

ELEMENT DISTRIBUTION

This community is largely confined to two areas on the Lake Meredith Recreational Area. It is found at the upper end of the lake generally in the Alibates Creek area where the creek enters the river. It also occurs in small amounts downstream from the Sanford Dam. There may be small areas found in the Blue Creek area where water has receded due to a lowered water level in the lake.

ELEMENT SOURCES

Inventory Notes:

Plots: 96, 100, 102

Local Description Authors: JR Bell

References:

Illustrated Flora of North Central Texas, (Shinnery and Mahler), Diggs, Lipscomb, and O'Kennon. 1999. Austin College Center for Environmental Studies and Botanical Research Institute of Texas.

Texas Plants, A Checklist and Ecological Summary, Rev. 1975. F.W. Gould, Texas Agricultural Experiment Station, Texas A&M University, College Station Texas.

Wild Flowers of the United States, "Texas". 1970. Rickett, H.W., New York Botanical Garden, McGraw-Hill Book Company.

United States Department of Agriculture, Natural Resources Conservation Service – Field Office Technical Guide, Section II-E, Ecological Site Descriptions, MLRA 77, 2000-2003, Temple, TX.

Appendix D: Ecological Systems Descriptions for Lake Meredith NRA and Alibates Flint Quarries NM

CES300.729 North American Arid West Emergent Marsh

Primary Division:

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Herbaceous; Depressional [Lakeshore, Pond]; Mineral: W/ A-Horizon >10 cm; Aquatic Herb; Graminoid; Deep (>15 cm) Water; Saturated Soil

Concept Summary: This widespread ecological system occurs throughout much of the arid and semi-arid regions of western North America, typically surrounded by savanna, shrub steppe, steppe, or desert vegetation. Natural marshes may occur in depressions in the landscape (ponds, kettle ponds), as fringes around lakes, and along slow-flowing streams and rivers (such riparian marshes are also referred to as sloughs). Marshes are frequently or continually inundated, with water depths up to 2 m. Water levels may be stable, or may fluctuate 1 m or more over the course of the growing season. Water chemistry may include some alkaline or semi-alkaline situations, but the alkalinity is highly variable even within the same complex of wetlands. Marshes have distinctive soils that are typically mineral, but can also accumulate organic material. Soils have characteristics that result from long periods of anaerobic conditions in the soils (e.g., gleyed soils, high organic content, redoximorphic features). The vegetation is characterized by herbaceous plants that are adapted to saturated soil conditions. Common emergent and floating vegetation includes species of *Scirpus* and/or *Schoenoplectus*, *Typha*, *Juncus*, *Potamogeton*, *Polygonum*, *Nuphar*, and *Phalaris*. This system may also include areas of relatively deep water with floating-leaved plants (*Lemna*, *Potamogeton*, and *Brasenia*) and submergent and floating plants (*Myriophyllum*, *Ceratophyllum*, and *Elodea*).

Comments: This ecological system occurs in the arid and semi-arid regions of western North America, where semipermanently flooded habitats are found as small patches in the matrix of a relatively dry landscape.

DISTRIBUTION

Range: Occurs throughout much of the arid and semi-arid regions of western North America.

Divisions: 301:C, 302:C, 303:C, 304:C, 305:C, 306:C

TNC Ecoregions: 6:C, 7:C, 8:C, 9:C, 11:C, 17:C, 18:C, 19:C, 20:C, 21:C, 23:C, 24:C, 26:C, 27:C, 28:C, 29:C, 30:C, 68:C

Subnations: AB, AZ, BC, CA, CO, ID, MT, MXBC, MXCH, MXSO, ND, NE, NM, NV, OK, OR, SD, TX, UT, WA, WY

CONCEPT

Associations:

- *Calamagrostis canadensis* Western Herbaceous Vegetation (CEGL001559, G4)
- *Carex nebrascensis* Herbaceous Vegetation (CEGL001813, G4)
- *Carex utriculata* Herbaceous Vegetation (CEGL001562, G5)
- *Carex vesicaria* Herbaceous Vegetation (CEGL002661, G4Q)
- *Distichlis spicata* - (*Scirpus nevadensis*) Herbaceous Vegetation (CEGL001773, G4)
- *Eleocharis (montevidensis, palustris, quinqueflora)* Seasonally Flooded Herbaceous Vegetation [Placeholder] (CEGL003050, G5)
- *Glyceria borealis* Herbaceous Vegetation (CEGL001569, G4)

- *Juncus balticus* - *Carex rossii* Herbaceous Vegetation (CEGL001839, G2G4)
- *Juncus balticus* Herbaceous Vegetation (CEGL001838, G5)
- *Lemna* spp. Permanently Flooded Herbaceous Vegetation (CEGL003059, G3?)
- *Myriophyllum sibiricum* Herbaceous Vegetation (CEGL002000, GUQ)
- *Nuphar lutea* ssp. *polysepala* Herbaceous Vegetation (CEGL002001, G5)
- *Phalaris arundinacea* Western Herbaceous Vegetation (CEGL001474, G5)
- *Phragmites australis* Western North America Temperate Semi-natural Herbaceous Vegetation (CEGL001475, G5)
- *Potamogeton diversifolius* Herbaceous Vegetation (CEGL002007, G1?)
- *Potamogeton foliosus* Herbaceous Vegetation (CEGL002742, G3?)
- *Potamogeton natans* Herbaceous Vegetation (CEGL002925, G5?)
- *Ranunculus aquatilis* - *Callitriche palustris* Herbaceous Vegetation (CEGL001984, GU)
- *Ruppia (cirrhosa, maritima)* Permanently Flooded Herbaceous Vegetation [Placeholder] (CEGL003119, G1G3)
- *Salicornia rubra* Herbaceous Vegetation (CEGL001999, G2G3)
- *Schoenoplectus acutus* - *Typha latifolia* - (*Schoenoplectus tabernaemontani*) Sandhills Herbaceous Vegetation (CEGL002030, G4)
- *Schoenoplectus acutus* Herbaceous Vegetation (CEGL001840, G5)
- *Schoenoplectus americanus* - *Carex* spp. Herbaceous Vegetation (CEGL004144, GNR)
- *Schoenoplectus americanus* - *Eleocharis palustris* Herbaceous Vegetation (CEGL001585, G4)
- *Schoenoplectus americanus* - *Eleocharis* spp. Herbaceous Vegetation (CEGL001586, GNR)
- *Schoenoplectus americanus* - *Flaveria chlorifolia* - (*Helianthus paradoxus*) Herbaceous Vegetation (CEGL004592, G1)
- *Schoenoplectus americanus* Western Herbaceous Vegetation (CEGL001841, G3Q)
- *Schoenoplectus maritimus* Herbaceous Vegetation (CEGL001843, G4)
- *Schoenoplectus pungens* Herbaceous Vegetation (CEGL001587, G3G4)
- *Schoenoplectus tabernaemontani* Temperate Herbaceous Vegetation (CEGL002623, G5)
- *Sparganium angustifolium* Herbaceous Vegetation (CEGL001990, G4)
- *Sparganium eurycarpum* Herbaceous Vegetation (CEGL003323, G4)
- *Spartina gracilis* Herbaceous Vegetation (CEGL001588, GU)
- *Spartina pectinata* Western Herbaceous Vegetation (CEGL001476, G3?)
- *Stuckenia filiformis* Herbaceous Vegetation (CEGL002008, GU)
- *Triglochin maritima* Herbaceous Vegetation (CEGL001995, GU)
- *Typha (latifolia, angustifolia)* Western Herbaceous Vegetation (CEGL002010, G5)
- *Typha domingensis* Western Herbaceous Vegetation (CEGL001845, G5?)

Alliances:

- (*Potamogeton diversifolius*, *Stuckenia filiformis*) Permanently Flooded Herbaceous Alliance (A.1763)
- *Calamagrostis canadensis* Seasonally Flooded Herbaceous Alliance (A.1400)
- *Carex (rostrata, utriculata)* Seasonally Flooded Herbaceous Alliance (A.1403)
- *Carex nebrascensis* Seasonally Flooded Herbaceous Alliance (A.1417)
- *Carex vesicaria* Seasonally Flooded Herbaceous Alliance (A.2501)
- *Distichlis spicata* Intermittently Flooded Herbaceous Alliance (A.1332)
- *Eleocharis (montevidensis, palustris, quinqueflora)* Seasonally Flooded Herbaceous Alliance (A.1371)
- *Glyceria borealis* Semipermanently Flooded Herbaceous Alliance (A.1445)
- *Juncus balticus* Seasonally Flooded Herbaceous Alliance (A.1374)
- *Lemna* spp. Permanently Flooded Herbaceous Alliance (A.1747)
- *Myriophyllum sibiricum* Permanently Flooded Herbaceous Alliance (A.1761)
- *Nymphaea odorata* - *Nuphar* spp. Permanently Flooded Temperate Herbaceous Alliance (A.1984)
- *Phalaris arundinacea* Seasonally Flooded Herbaceous Alliance (A.1381)
- *Phragmites australis* Semipermanently Flooded Herbaceous Alliance (A.1431)
- *Potamogeton foliosus* Permanently Flooded Herbaceous Alliance (A.2518)
- *Potamogeton* spp. - *Ceratophyllum* spp. - *Elodea* spp. Permanently Flooded Herbaceous Alliance (A.1754)
- *Ranunculus aquatilis* Semipermanently Flooded Herbaceous Alliance (A.1679)
- *Ruppia (cirrhosa, maritima)* Permanently Flooded Herbaceous Alliance (A.1755)

- *Salicornia rubra* Seasonally Flooded Herbaceous Alliance (A.1818)
- *Schoenoplectus acutus* - (*Schoenoplectus tabernaemontani*) Semipermanently Flooded Herbaceous Alliance (A.1443)
- *Schoenoplectus americanus* Semipermanently Flooded Herbaceous Alliance (A.1432)
- *Schoenoplectus maritimus* Semipermanently Flooded Herbaceous Alliance (A.1444)
- *Schoenoplectus pungens* Semipermanently Flooded Herbaceous Alliance (A.1433)
- *Sparganium angustifolium* Permanently Flooded Herbaceous Alliance (A.1760)
- *Sparganium eurycarpum* Permanently Flooded Herbaceous Alliance (A.2598)
- *Spartina gracilis* Seasonally Flooded Herbaceous Alliance (A.1407)
- *Spartina pectinata* Temporarily Flooded Herbaceous Alliance (A.1347)
- *Triglochin maritima* Semipermanently Flooded Herbaceous Alliance (A.1681)
- *Typha (angustifolia, latifolia)* - (*Schoenoplectus* spp.) Semipermanently Flooded Herbaceous Alliance (A.1436)
- *Typha domingensis* Seasonally Flooded Temperate Herbaceous Alliance (A.1392)

High-ranked species: *Agelaius tricolor* (G2G3), *Bufo exsul* (G1Q), *Cyprinodon macularius* (G1), *Cyprinodon radiosus* (G1), *Cyprinodon salinus* (G1Q), *Sidalcea neomexicana* ssp. *thurberi* (G4?T3T4)

SPATIAL CHARACTERISTICS

Spatial Summary:

Size:

Heterogeneity:

Adjacent Ecological System Comments:

Other Comments:

SOURCES

References: Brown 1982, Comer et al. 2003, Cooper 1986b, Dick-Peddie 1993, Faber-Langendoen et al. 1997, Hansen et al. 1995, Kittel et al. 1994, Neely et al. 2001, Padgett et al. 1989, Rondeau 2001, Szaro 1989, Ungar 1965, Ungar 1972

Version: 21 Nov 2003

Stakeholders: Canada, Latin America, Midwest, Southeast, West

Concept Author: NatureServe Western Ecology Team

LeadResp: West

CES303.668 Western Great Plains Mesquite Woodland and Shrubland

Primary Division: Western Great Plains (303)

Land Cover Class: Shrubland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Concept Summary: This system is found primarily in the southern portion of the Western Great Plains Division, primarily in Texas, Oklahoma and eastern New Mexico. This system is dominated by *Prosopis glandulosa* with shortgrass species in the understory. *Ziziphus obtusifolia* and *Atriplex canescens* can codominate in some examples as can *Opuntia* species in heavily grazed areas. Historically this system probably occurred as a natural component on more fertile soils and along drainages.

Comments: With fire suppression and grazing, *Prosopis glandulosa* has been able to extend its range and become dense in examples of Western Great Plains Shortgrass Prairie (CES303.672) or Central Mixedgrass Prairie (CES303.659). Those areas should still be considered part of the prairie system.

DISTRIBUTION

Range: This system is primarily found in the southern portion of the Western Great Plains division, particularly in Texas, Oklahoma and eastern New Mexico.

Divisions: 303:C

TNC Ecoregions: 27:?, 28:C, 29:C, 33:C

Subnations: NM, OK, TX

CONCEPT

Associations:

- *Acacia farnesiana* - (*Prosopis glandulosa*) Woodland (CEGL002131, G5)
- *Prosopis glandulosa* - *Ziziphus obtusifolia* Shrubland (CEGL004939, G2G3)
- *Prosopis glandulosa* / *Bouteloua curtipendula* - *Nassella leucotricha* Woodland (CEGL002133, G3?)
- *Prosopis glandulosa* / *Bouteloua curtipendula* Shrubland (CEGL002194, GNR)
- *Prosopis glandulosa* / *Muhlenbergia porteri* Shrubland (CEGL001511, G5)
- *Prosopis glandulosa* var. *glandulosa* / *Bouteloua gracilis* - *Buchloe dactyloides* Shrubland (CEGL003877, GNR)

Alliances:

- *Acacia farnesiana* Woodland Alliance (A.660)
- *Prosopis glandulosa* Shrubland Alliance (A.1031)
- *Prosopis glandulosa* Woodland Alliance (A.611)

Environment: This system occurs naturally on more fertile soils and along drainages.

Vegetation: This system is dominated by *Prosopis glandulosa* with *Ziziphus obtusifolia*, and *Atriplex canescens* can codominate. *Opuntia* spp. can be prevalent in areas in heavily grazed examples of this system. The understory of this system is often dominated by shortgrass species.

Dynamics: Historically, fire controlled this system and limited the development of woody cover. Likewise, edaphic conditions and topographic factors limited this system to deep alluvial soils in relatively low topographic conditions along broad valley floors.

SPATIAL CHARACTERISTICS

Spatial Summary:

Size:

Heterogeneity:

Adjacent Ecological System Comments:

Other Comments:

SOURCES

References: Barbour and Billings 1988, Comer et al. 2003

Version: 05 Mar 2003

Stakeholders: Midwest, Southeast, West

Concept Author: S. Menard and K. Kindscher

LeadResp: Midwest

CES303.671 Western Great Plains Sandhill Shrubland

Primary Division: Western Great Plains (303)

Land Cover Class: Shrubland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Concept Summary: This system is found mostly in south-central areas of the Western Great Plains Division ranging from the Nebraska Sandhill region south to central Texas, although some examples may reach as far north as the Badlands of South Dakota. The climate is semi-arid to arid for much of the region in which this system occurs. This system is found on somewhat excessively to excessively well-drained, deep sandy soils that are often associated with dune systems and ancient floodplains. In some areas, this system may actually occur as a result of overgrazing in Western Great Plains Tallgrass Prairie (CES303.673) or Western Great Plains Sand Prairie (CES303.670). This system is characterized by a sparse to moderately dense woody layer dominated by *Artemisia filifolia*. Associated species can vary with geography, amount and season of precipitation, disturbance and soil texture. Several graminoid species such as *Andropogon hallii*, *Schizachyrium scoparium*, *Sporobolus cryptandrus*, *Calamovilfa gigantea*, *Hesperostipa comata*, and *Bouteloua* spp. can be connected with this system. Other shrub species may also be present including *Yucca glauca*, *Prosopis glandulosa*, *Rhus trilobata*, and *Prunus angustifolia*. In the southern range of this system, *Quercus havardii* may also be present and represents one succession pathway that develops over time following a disturbance. *Quercus havardii* is able to resprout following a fire and thus may persist for long periods of time once established. Fire and grazing are the most important dynamic processes for this type, although drought stress can impact this system significantly in some areas. Overgrazing can lead to decreasing dominance of some of the grass species such as *Andropogon hallii*, *Calamovilfa gigantea*, and *Schizachyrium scoparium*.

Comments: This system may overlap in concept with Crosstimbers Southern Xeric Sandhill (CES205.897).

DISTRIBUTION

Range: This system is found primarily within the south-central areas of the Western Great Plains Division ranging from the Nebraska Sandhills south into central Texas. However, examples of this system can be found as far north as the Badlands in South Dakota.

Divisions: 303:C

TNC Ecoregions: 26:C, 27:C, 28:C, 33:C

Subnations: CO, KS, NE, OK, TX?

CONCEPT

Associations:

- *Artemisia filifolia* / *Andropogon hallii* Shrubland (CEGL001459, G3?)
- *Artemisia filifolia* / *Bouteloua (curtipendula, gracilis)* Shrubland (CEGL002176, GNR)
- *Artemisia filifolia* / *Calamovilfa longifolia* Shrubland (CEGL002177, G2G3)
- *Artemisia filifolia* / *Schizachyrium scoparium* - *Andropogon hallii* Shrubland (CEGL002178, GNR)
- *Artemisia filifolia* / *Sporobolus cryptandrus* Shrubland (CEGL002179, GNR)
- *Artemisia filifolia* - *Rhus trilobata* Shrubland (NEW, GNR)
- *Prunus angustifolia* / *Schizachyrium scoparium* Shrubland (CEGL002180, GNA)
- *Quercus havardii* / *Sporobolus cryptandrus* - *Schizachyrium scoparium* Shrubland (CEGL002171, G3)

Alliances:

- *Artemisia filifolia* Shrubland Alliance (A.816)
- *Prunus angustifolia* Shrubland Alliance (A.1884)

- *Quercus havardii* Shrubland Alliance (A.780)

Environment: This system is found primarily in semi-arid to arid areas of the Western Great Plains Division. It occurs on somewhat excessively to excessively well-drained and deep sandy soils. This system is often found associated with dune systems and/or ancient floodplains but may occur in soils derived from sandstone residuum.

Vegetation: This system is distinguished by a sparse to a moderately dense shrub layer dominated by *Artemisia filifolia*. Graminoid species such as *Andropogon hallii*, *Schizachyrium scoparium*, *Sporobolus cryptandrus*, *Calamovilfa gigantea*, *Hesperostipa comata*, and *Bouteloua* spp. can also be found within this system. Other shrub species such as *Yucca glauca*, *Rhus trilobata*, and *Prunus angustifolia* may be present. *Quercus havardii* and *Prosopis glandulosa* may also be present in the southern extent of this system.

Dynamics: Fire and grazing constitute the most important processes impacting this system. Burning shrublands reduces cover of *Artemisia filifolia* for several years resulting in grassland patches that form a mosaic pattern with shrublands. Composition of grasslands depends on precipitation and management. Drought stress can also influence this system in some areas.

SPATIAL CHARACTERISTICS

Spatial Summary:

Size:

Heterogeneity:

Adjacent Ecological System Comments:

Other Comments:

SOURCES

References: Comer et al. 2003, Ramaley 1939b, Sims et al. 1976, Tolstead 1942

Version: 11 Nov 2003

Stakeholders: Midwest, Southeast, West

Concept Author: S. Menard and K. Kindscher

LeadResp: Midwest

CES303.659 Central Mixedgrass Prairie

Primary Division: Western Great Plains (303)

Land Cover Class: Herbaceous

Spatial Scale & Pattern: Matrix

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Concept Summary: This mixedgrass prairie system ranges from South Dakota to northern Texas and is bordered by the shortgrass prairie on the western edge and the tallgrass prairie to the east. The loessal regions in west-central Kansas and central Nebraska, the Red Hills region of south-central Kansas and northern Oklahoma are all located within this system. Because of its proximity to other ecoregions, this system contains elements from both shortgrass and tallgrass prairies, which combine to form the mixedgrass prairie ecological system throughout its range. The distribution, species richness and productivity of plant species within the mixedgrass ecological system is controlled primarily by environmental conditions, in particular soil moisture and topography. Grazing and fire are important dynamic processes in this system. The relative dominance of the various grass and forb species within different associations in the system also can strongly depend on the degree of natural or human disturbance. This system can contain grass species such as *Bouteloua curtipendula*, *Schizachyrium scoparium*, *Andropogon gerardii*, *Hesperostipa comata*, *Sporobolus heterolepis*, and *Bouteloua gracilis*, although the majority of the associations within the region are dominated by *Pascopyrum smithii* or *Schizachyrium scoparium*. Numerous forb and sedge species (*Carex* spp.) can also occur within the mixedgrass system in the Western Great Plains. Although forbs do not always significantly contribute to the canopy, they can be very important. Some dominant forb species include *Ambrosia psilostachya*, *Echinacea angustifolia*, and *Lygodesmia juncea*. Oak species such as *Quercus macrocarpa* can occur also in areas protected from fire due to topographic position. This can cause an almost oak savanna situation in certain areas, although fire suppression may allow for a more closed canopy and expansion of bur oak beyond those sheltered areas. In those situations, further information will be needed to determine if those larger areas with a more closed canopy of bur oak should be considered part of Western Great Plains Dry Bur Oak Forest and Woodland (CES303.667). Likewise, within the mixedgrass system, small seeps may occur, especially during the wettest years. Although these are not considered a separate system, the suppression of fire within the region has enabled the invasion of both exotics and some shrub species such as *Juniperus virginiana* and also allowed for the establishment of *Pinus ponderosa* in some northern areas.

DISTRIBUTION

Range: This system is found throughout the central and southern areas of the Western Great Plains ranging from southern South Dakota into northern Texas.

Divisions: 303:C

TNC Ecoregions: 27:P, 28:P, 29:C, 32:C, 33:C, 37:P

Subnations: CO, KS, NE, OK, SD, TX

CONCEPT

Associations:

- *Artemisia tridentata* ssp. *wyomingensis* / Mixed Grasses Shrub Herbaceous Vegetation (CEGL001534, G5)
- Blacktailed Prairie Dog Town Grassland Complex (CECX005703, G4)
- *Cornus drummondii* - (*Rhus glabra*, *Prunus* spp.) Shrubland (CEGL005219, GNA)
- *Cynodon dactylon* Herbaceous Vegetation (CEGL004701, GNA)
- *Hesperostipa comata* - *Bouteloua gracilis* - *Carex filifolia* Herbaceous Vegetation (CEGL002037, G5)
- *Hesperostipa comata* - *Carex filifolia* Herbaceous Vegetation (CEGL001700, G4)
- *Hesperostipa comata* - *Carex inops* ssp. *heliophila* Herbaceous Vegetation (CEGL001701, G4)

- *Hesperostipa comata* Colorado Front Range Herbaceous Vegetation (CEGL001702, G1G2)
- *Hesperostipa curtisetata* - *Elymus lanceolatus* Herbaceous Vegetation (CEGL002253, GNR)
- *Juniperus virginiana* var. *virginiana* / *Schizachyrium scoparium* - *Bouteloua curtipendula* Great Plains Herbaceous Vegetation (CEGL004066, G2)
- *Juniperus virginiana* var. *virginiana* / *Schizachyrium scoparium* Forest (CEGL003628, GNA)
- *Krascheninnikovia lanata* / *Bouteloua gracilis* Dwarf-shrub Herbaceous Vegetation (CEGL001321, G4)
- *Panicum obtusum* Herbaceous Vegetation (NEW GNR)
- *Pascopyrum smithii* - *Bouteloua gracilis* Herbaceous Vegetation (CEGL001578, G5)
- *Pascopyrum smithii* - *Hesperostipa comata* Central Mixedgrass Herbaceous Vegetation (CEGL002034, G4)
- *Pascopyrum smithii* Herbaceous Vegetation (CEGL001577, G3G5Q)
- *Pleuraphis mutica* - *Buchloe dactyloides* Herbaceous Vegetation (CEGL002272, G4?)
- *Poa palustris* Herbaceous Vegetation (CEGL001659, GNA)
- *Poa pratensis* - (*Pascopyrum smithii*) Semi-natural Herbaceous Vegetation (CEGL005265, GNA)
- *Quercus macrocarpa* / Mixedgrass Loam Wooded Herbaceous Vegetation (CEGL002163, G1Q)
- *Quercus macrocarpa* / Mixedgrass Sand Wooded Herbaceous Vegetation (CEGL002162, G1)
- *Quercus macrocarpa* / Mixedgrass Shale Wooded Herbaceous Vegetation (CEGL002164, G1Q)
- *Sarcobatus vermiculatus* / *Sporobolus airoides* Sparse Vegetation (CEGL001368, G3?)
- *Schizachyrium scoparium* - *Bouteloua (curtipendula, gracilis)* - *Carex filifolia* Herbaceous Vegetation (CEGL001681, G3G4)
- *Schizachyrium scoparium* - *Bouteloua curtipendula* - *Bouteloua gracilis* Central Plains Herbaceous Vegetation (CEGL002246, G2G4)
- *Schizachyrium scoparium* - *Bouteloua curtipendula* - *Nassella leucotricha* Herbaceous Vegetation (CEGL004070, GNR)
- *Schizachyrium scoparium* - *Bouteloua curtipendula* Chalkflat Herbaceous Vegetation (CEGL002247, G2)
- *Schizachyrium scoparium* - *Bouteloua curtipendula* Loess Mixedgrass Herbaceous Vegetation (CEGL002036, G3?)
- *Schizachyrium scoparium* - *Bouteloua curtipendula* Red Hills Herbaceous Vegetation (CEGL002248, G2Q)
- *Schizachyrium scoparium* - *Bouteloua curtipendula* Western Great Plains Herbaceous Vegetation (CEGL001594, G3)
- *Schizachyrium scoparium* - *Lesquerella gordonii* - *Castilleja purpurea* var. *citrina* Herbaceous Vegetation (CEGL002252, G2?)
- *Yucca glauca* / *Calamovilfa longifolia* Shrub Herbaceous Vegetation (CEGL002675, G4)

Alliances:

- *Artemisia tridentata* ssp. *wyomingensis* Shrub Herbaceous Alliance (A.1527)
- *Cornus drummondii* Shrubland Alliance (A.3558)
- *Cynodon dactylon* Herbaceous Alliance (A.1279)
- *Hesperostipa comata* - *Bouteloua gracilis* Herbaceous Alliance (A.1234)
- *Hesperostipa curtisetata* - *Elymus lanceolatus* Herbaceous Alliance (A.3523)
- *Juniperus virginiana* Forest Alliance (A.137)
- *Krascheninnikovia lanata* Dwarf-shrub Herbaceous Alliance (A.1565)
- *Pascopyrum smithii* Herbaceous Alliance (A.1232)
- *Pleuraphis mutica* Herbaceous Alliance (A.1249)
- *Poa palustris* Semi-natural Seasonally Flooded Herbaceous Alliance (A.1409)
- *Poa pratensis* Semi-natural Herbaceous Alliance (A.3562)
- *Quercus macrocarpa* Wooded Medium-Tall Herbaceous Alliance (A.1505)
- *Sarcobatus vermiculatus* Intermittently Flooded Sparsely Vegetated Alliance (A.1877)
- *Schizachyrium scoparium* - *Bouteloua curtipendula* Herbaceous Alliance (A.1225)
- *Yucca glauca* Shrub Herbaceous Alliance (A.1540)

Environment: Differences in topography and soil characteristics also occur across the range of this system. It is often characterized by rolling to extremely hilly landscapes with soils developed from loess, shale, limestone or sandstone parent material. Mollisol soils are most prevalent and range from silt loams and silty clay loams with sandy loams possible on the western edge of the

range. The Red Hills region of Kansas and Oklahoma, which contains examples of this system, contains somewhat unique soil characteristics and has developed from a diversity of sources including red shale, red clay, sandy shale, siltstone, or sandstone. These soils have developed a characteristic reddish color from the primary material. These soils can consist of silt, loam, or clay and can have textures ranging from a fine sandy loam to a more clayey surface.

Vegetation: This system contains elements from both Western Great Plains Shortgrass Prairie (CES303.672) and Western Great Plains Tallgrass Prairie (CES303.673). This system typically contains grass species such as *Bouteloua curtipendula*, *Schizachyrium scoparium*, *Andropogon gerardii*, *Hesperostipa comata*, *Sporobolus heterolepis*, and *Bouteloua gracilis*, although the majority of the associations within the region are dominated by *Pascopyrum smithii* or *Schizachyrium scoparium*. Isolated patches of *Quercus macrocarpa* also can occur.

Dynamics: Fire and grazing are the primary processes occurring within the system. The diversity in this mixedgrass system likely reflects both the short- and long-term responses of the vegetation to these often concurrent disturbance regimes. Fire suppression and overgrazing can lead to the invasion of this system by woody species such as *Juniperus virginiana* and *Pinus ponderosa*. Likewise, fire suppression may lead to a more closed canopy of bur oak.

SPATIAL CHARACTERISTICS

Spatial Summary:

Size:

Heterogeneity:

Adjacent Ecological System Comments:

Other Comments:

SOURCES

References: Barbour and Billings 1988, Comer et al. 2003, Ricketts et al. 1999, Weaver and Albertson 1956, Weaver and Bruner 1948

Version: 05 Mar 2003

Stakeholders: Midwest, Southeast, West

Concept Author: S. Menard and K. Kindscher

LeadResp: Midwest

CES303.670 Western Great Plains Sand Prairie

Primary Division: Western Great Plains (303)

Land Cover Class: Herbaceous

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Concept Summary: The sand prairies constitute a very unique system within the Western Great Plains. These sand prairies are often considered part of the tallgrass regions in the Western Great Plains, but can contain elements from both Western Great Plains Shortgrass Prairie (CES303.672) and Central Mixedgrass Prairie (CES303.659). The largest expanse of sand prairies (approximately 5 million ha) can be found in the Sandhills of north-central Nebraska and southwestern South Dakota. These areas are relatively intact. The primary use of this system has been grazing (not cultivation), and areas such as the Nebraska Sandhills can experience less degeneration than other prairie systems. Although greater than 90% of the Sandhills region is privately owned, the known fragility of the soils and the cautions used by ranchers to avoid poor grazing practices have allowed for fewer significant changes in the vegetation of the Sandhills compared to other grassland systems. The distribution, species richness and productivity of plant species within the sand prairie ecological system is controlled primarily by environmental conditions, in particular the temporal and spatial distribution of soil moisture and topography. Soils in the sand prairies can be relatively undeveloped and are highly permeable. Soil texture and drainage along with a species' rooting morphology, photosynthetic physiology, and mechanisms to avoid transpiration loss are highly important in determining the composition and distribution of communities/associations within the sand prairies. Another important aspect of soils in the sand prairies is their susceptibility to wind erosion. Blowouts and sand draws are some of the unique wind-driven disturbances in the sand prairies, particularly the Nebraska Sandhills, which can profoundly impact vegetation composition and succession within this system. Graminoid species dominate the sand prairies, although relative dominance can change due to impacts of wind disturbance. *Andropogon hallii* and *Calamovilfa longifolia* are the most common species, but other grass and forb species such as *Hesperostipa comata*, *Carex inops* ssp. *heliophila*, and *Panicum virgatum* may be present. Patches of *Quercus havardii* can also occur within this system in the southern Great Plains. Fire and grazing constitute the other major dynamic processes that can influence this system.

DISTRIBUTION

Range: This system is found throughout the Western Great Plains Division. The largest and most intact example of this system is found within the Sandhills region of Nebraska and South Dakota.

Divisions: 303:C

TNC Ecoregions: 26:C, 27:C, 28:C, 33:C, 34:C

Subnations: CO, KS, MT, ND, NE, NM?, OK, SD, TX?, WY

CONCEPT

Associations:

- *Andropogon gerardii* - *Panicum virgatum* Sandhills Herbaceous Vegetation (CEGL002023, G3?)
- *Andropogon hallii* - *Calamovilfa gigantea* Herbaceous Vegetation (CEGL004016, G2G3)
- *Andropogon hallii* - *Calamovilfa longifolia* Herbaceous Vegetation (CEGL001467, G4G5)
- *Andropogon hallii* - *Carex inops* ssp. *heliophila* Herbaceous Vegetation (CEGL001466, G3)
- *Artemisia cana* ssp. *cana* / *Calamovilfa longifolia* Shrub Herbaceous Vegetation (CEGL001555, G3Q)
- *Artemisia cana* ssp. *cana* / *Hesperostipa comata* Shrub Herbaceous Vegetation (CEGL001553, G3)
- *Betula occidentalis* - *Juniperus horizontalis* / *Calamovilfa longifolia* Shrubland (CEGL002184, GNR)

- *Calamovilfa longifolia* - *Carex inops* ssp. *heliophila* Herbaceous Vegetation (CEGL001471, G3)
- *Calamovilfa longifolia* - *Hesperostipa comata* Herbaceous Vegetation (CEGL001473, G3)
- *Carex interior* - *Eleocharis elliptica* - *Thelypteris palustris* Herbaceous Vegetation (CEGL002390, G1G2)
- *Quercus havardii* / *Sporobolus cryptandrus* - *Schizachyrium scoparium* Shrubland (CEGL002171, G3)
- *Schizachyrium scoparium* - *Aristida basiramea* - *Sporobolus cryptandrus* - *Eragrostis trichodes* Herbaceous Vegetation (CEGL005221, GNR)
- *Yucca glauca* / *Calamovilfa longifolia* Shrub Herbaceous Vegetation (CEGL002675, G4)

Alliances:

- *Andropogon gerardii* - (*Calamagrostis canadensis*, *Panicum virgatum*) Herbaceous Alliance (A.1191)
- *Andropogon hallii* Herbaceous Alliance (A.1193)
- *Artemisia cana* ssp. *cana* Shrub Herbaceous Alliance (A.2554)
- *Betula occidentalis* Shrubland Alliance (A.914)
- *Calamovilfa longifolia* Herbaceous Alliance (A.1201)
- *Carex pellita* - (*Carex nebrascensis*) - *Schoenoplectus* spp. Saturated Herbaceous Alliance (A.1466)
- *Quercus havardii* Shrubland Alliance (A.780)
- *Schizachyrium scoparium* - (*Sporobolus cryptandrus*) Herbaceous Alliance (A.1224)
- *Yucca glauca* Shrub Herbaceous Alliance (A.1540)

Environment: This tallgrass system is found primarily on sandy and sandy loam soils that can be relatively undeveloped and highly permeable as compared to Western Great Plains Tallgrass Prairie (CES303.673), which occurs on deeper loams. This system is usually found in areas with a rolling topography and can occur on ridges, midslopes and/or lowland areas within a region. It often occurs on moving sand dunes, especially within the Sandhill region of Nebraska and South Dakota.

Vegetation: This system is distinguished by the dominance of *Andropogon hallii* and *Calamovilfa longifolia*. Other species such as *Hesperostipa comata*, *Carex inops* ssp. *heliophila*, and *Panicum virgatum* may be present. In the southern range of this system, patches of *Quercus havardii* can also occur. *Penstemon haydenii* is endemic to the sand prairie system and of special conservation concern because of its probable decline due to grazing and fire suppression.

Dynamics: The distribution, species richness and productivity of plant species within the sand prairie ecological system is controlled primarily by environmental conditions, in particular the temporal and spatial distribution of soil moisture and topography. Another important aspect of this system is its susceptibility to wind erosion. Blowouts and sand draws are some of the unique wind-driven disturbances in the sand prairies, particularly the Nebraska Sandhills, which can profoundly impact vegetation composition and succession within this system. Fire and grazing constitute the other major disturbances that can influence this system. Overgrazing, fire and trampling that leads to the removal of vegetation within those areas susceptible to blowouts can either instigate a blowout or perpetuate one already occurring. Overgrazing can also lead to significant erosion.

SPATIAL CHARACTERISTICS

Spatial Summary:

Size:

Heterogeneity:

Adjacent Ecological System Comments:

Other Comments:

SOURCES

References: Barbour and Billings 1988, Comer et al. 2003, Tolstead 1942

Version: 05 Mar 2003 **Stakeholders:** Midwest, Southeast, West

Concept Author: S. Menard and K. Kindscher **LeadResp:** Midwest

CES303.672 Western Great Plains Shortgrass Prairie

Primary Division: Western Great Plains (303)

Land Cover Class: Herbaceous

Spatial Scale & Pattern: Matrix

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Concept Summary: This system is found primarily in the western half of the Western Great Plains Division in the rainshadow of the Rocky Mountains and ranges from the Nebraska Panhandle south into Texas and New Mexico, although grazing-impacted examples may reach as far north as southern Canada where it grades into Northwestern Great Plains Mixedgrass Prairie (CES303.674). This system occurs primarily on flat to rolling uplands with loamy, ustic soils ranging from sandy to clayey. In much of its range, this system forms the matrix system with *Bouteloua gracilis* dominating this system. Associated graminoids may include *Aristida purpurea*, *Bouteloua curtipendula*, *Bouteloua hirsuta*, *Buchloe dactyloides*, *Hesperostipa comata*, *Koeleria macrantha* (= *Koeleria cristata*), *Pascopyrum smithii* (= *Agropyron smithii*), *Pleuraphis jamesii*, *Sporobolus airoides*, and *Sporobolus cryptandrus*. Although mid-height grass species may be present, especially on more mesic land positions and soils, they are secondary in importance to the sod-forming short grasses. Sandy soils have higher cover of *Hesperostipa comata*, *Sporobolus cryptandrus*, and *Yucca elata*. Scattered shrub and dwarf-dwarf species such as *Artemisia filifolia*, *Artemisia frigida*, *Artemisia tridentata*, *Atriplex canescens*, *Eriogonum effusum*, *Gutierrezia sarothrae*, and *Lycium pallida* may also be present. Also, because this system spans a wide range, there can be some differences in the relative dominance of some species from north to south and from east to west. Large-scale processes such as climate, fire and grazing influence this system. High variation in amount and timing of annual precipitation impacts the relative cover of cool- and warm-season herbaceous species.

In contrast to other prairie systems, fire is less important, especially in the western range of this system, because the often dry and xeric climate conditions can decrease the fuel load and thus the relative fire frequency within the system. However, historically, fires that did occur were often very expansive. Currently, fire suppression and more extensive grazing in the region have likely decreased the fire frequency even more, and it is unlikely that these processes could occur at a natural scale. A large part of the range for this system (especially in the east and near rivers) has been converted to agriculture. Areas of the central and western range have been impacted by the unsuccessful attempts to develop dryland cultivation during the Dust Bowl of the 1930s. The short grasses that dominate this system are extremely drought- and grazing-tolerant. These species evolved with drought and large herbivores and, because of their stature, are relatively resistant to overgrazing. This system in combination with the associated wetland systems represents one of the richest areas for mammals and birds. Endemic bird species to the shortgrass system may constitute one of the fastest declining bird populations.

DISTRIBUTION

Range: This system is found primarily in the western half of the Western Great Plains Division east of the Rocky Mountains and ranges from the Nebraska Panhandle south into the panhandles of Oklahoma and Texas and New Mexico, although some examples may reach as far north as southern Canada where it grades into Northwestern Great Plains Mixedgrass Prairie (CES303.674).

Divisions: 303:C

TNC Ecoregions: 26:P, 27:C, 28:C, 33:P

Subnations: CO, KS, NE, NM, OK, TX, WY

CONCEPT

Associations:

- *Aristida purpurea* Herbaceous Vegetation (CEGL005800, GNR)
- Blacktailed Prairie Dog Town Grassland Complex (CECX005703, G4)
- *Bouteloua curtipendula* - *Bouteloua (eriopoda, gracilis)* Herbaceous Vegetation (CEGL002250, G4)
- *Bouteloua eriopoda* - *Bouteloua gracilis* Herbaceous Vegetation (CEGL001748, G2)
- *Bouteloua eriopoda* - *Bouteloua hirsuta* Herbaceous Vegetation (CEGL001749, G2)
- *Bouteloua gracilis* - *Bouteloua curtipendula* Herbaceous Vegetation (CEGL001754, G5)
- *Bouteloua gracilis* - *Bouteloua hirsuta* Herbaceous Vegetation (CEGL001755, G3G4)
- *Bouteloua gracilis* - *Buchloe dactyloides* - *Pleuraphis jamesii* Herbaceous Vegetation (CEGL002271, GNR)
- *Bouteloua gracilis* - *Buchloe dactyloides* Herbaceous Vegetation (CEGL001756, G4)
- *Bouteloua gracilis* - *Buchloe dactyloides* Xeric Soil Herbaceous Vegetation (CEGL002270, G3G5)
- *Bouteloua gracilis* - *Pleuraphis jamesii* Herbaceous Vegetation (CEGL001759, G2G4)
- *Bouteloua gracilis* Herbaceous Vegetation (CEGL001760, G4Q)
- *Bouteloua hirsuta* - *Bouteloua curtipendula* Herbaceous Vegetation (CEGL001764, G4)
- *Bouteloua hirsuta* Herbaceous Vegetation [Placeholder] (CEGL002673, GNR)
- *Gutierrezia sarotrhae* – *Yucca glauca* Dwarf-shrubland (NEW, GNR)
- *Hesperostipa neomexicana* Mixed Prairie Herbaceous Vegetation (CEGL001711, GU)
- *Sporobolus airoides* Southern Plains Herbaceous Vegetation (CEGL001685, G3Q)
- *Yucca glauca* / *Calamovilfa longifolia* Shrub Herbaceous Vegetation (CEGL002675, G4)

Alliances:

- *Aristida purpurea* Herbaceous Alliance (A.2570)
- *Bouteloua curtipendula* Herbaceous Alliance (A.1244)
- *Bouteloua eriopoda* Herbaceous Alliance (A.1284)
- *Bouteloua gracilis* Herbaceous Alliance (A.1282)
- *Bouteloua hirsuta* Herbaceous Alliance (A.1285)
- *Hesperostipa neomexicana* Herbaceous Alliance (A.1272)
- *Sporobolus airoides* Herbaceous Alliance (A.1267)
- *Yucca glauca* Shrub Herbaceous Alliance (A.1540)

Environment: Climate is continental with mean annual precipitation generally about 300 mm ranging to 500 mm to the south in Texas. Most of the annual precipitation occurs during the growing season as thunderstorms. Precipitation events are mostly <10 cm with occasional larger events.

This system is located on primarily flat to rolling uplands. Soils typically are loamy and ustic and range from sandy to clayey.

Vegetation: This system spans a wide range and thus there can be some differences in the relative dominance of some species from north to south and from east to west. This system is primarily dominated by *Bouteloua gracilis* throughout its range with various associated graminoid species depending on precipitation, soils and management. Associated graminoids may include *Achnatherum hymenoides*, *Aristida purpurea*, *Bouteloua curtipendula*, *Bouteloua hirsuta*, *Buchloe dactyloides*, *Carex filifolia*, *Hesperostipa comata*, *Koeleria macrantha* (= *Koeleria cristata*), *Muhlenbergia torreyana*, *Pascopyrum smithii* (= *Agropyron smithii*), *Pleuraphis jamesii*, *Sporobolus airoides*, and *Sporobolus cryptandrus*. Although mid-height grass species may be present especially on more mesic land positions and soils, they are secondary in importance to the sod-forming short grasses. Sandy soils have higher cover of *Hesperostipa comata*, *Sporobolus cryptandrus*, and *Yucca elata*. Scattered shrub and dwarf-dwarf species such as *Artemisia filifolia*, *Artemisia frigida*, *Artemisia tridentata*, *Atriplex*

canescens, *Eriogonum effusum*, *Gutierrezia sarothrae*, and *Lycium pallida* may also be present. High annual variation in amount and timing of precipitation impacts relative cover of herbaceous species. Cover of cool-season grasses is dependant on winter and early spring precipitation.

Dynamics: Climate, fire and grazing constitute the primary processes impacting this system. Drought-tolerant shortgrass species have root systems that extend up near the soil surface where they can utilize low precipitation events (Sala and Lauenroth 1982). Fire is less important in this system compared to other Western Great Plains prairie systems, especially in the western portion of its range. Previous comments in the literature citing *Opuntia* spp. increasing with overgrazing may not be borne out by more recent research (R. Rondeau pers. comm.). Conversion to agriculture and pastureland with subsequent irrigation has degraded and extirpated this system in some areas of its range.

SPATIAL CHARACTERISTICS

Spatial Summary:

Size:

Heterogeneity:

Adjacent Ecological System Comments: Some examples may reach as far north as southern Canada where it grades into Northwestern Great Plains Mixedgrass Prairie (CES303.674).

Other Comments:

SOURCES

References: Barbour and Billings 1988, Comer et al. 2003, Dick-Peddie 1993, Lauenroth and Milchunas 1992, Milchunas et al. 1989, Ricketts et al. 1999, Rondeau pers. comm., Sala and Lauenroth 1982

Version: 11 Nov 2003

Stakeholders: Midwest, Southeast, West

Concept Author: S. Menard and K. Kindscher

LeadResp: Midwest

CES303.678 Western Great Plains Floodplain

Primary Division: Western Great Plains (303)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Linear

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Concept Summary: This system is found in the floodplains of medium and large rivers of the Western Great Plains. Alluvial soils and periodic, intermediate flooding (every 5-25 years) typify this system. Dominant communities within this system range from floodplain forests to wet meadows to gravel/sand flats; however, they are linked by underlying soils and the flooding regime. Dominant species include *Populus deltoides* and *Salix* spp. Grass cover underneath the trees is an important part of this system and is a mix of tallgrass species, including *Panicum virgatum* and *Andropogon gerardii*. *Tamarix* spp. and less desirable grasses and forbs can invade degraded areas within the floodplains, especially in the western portion of the province. These areas are often subjected to heavy grazing and/or agriculture and can be heavily degraded. Another factor is that groundwater depletion and lack of fire have created additional species changes. In most cases, the majority of the wet meadow and prairie communities may be extremely degraded or extirpated from the system.

Comments: Need to review if there needs to be another split of this system into a Central Great Plains Floodplain system and a Southern Great Plains floodplain system. Will need to review in conjunction with Northwestern Great Plains Floodplain (CES303.676).

DISTRIBUTION

Range: This system is found along major river floodplains in the southern and central portions of the Western Great Plains division.

Divisions: 205:C, 303:C

TNC Ecoregions: 27:C, 28:C, 29:P, 32:C, 33:C, 37:C

Subnations: CO, KS, NE, OK, SD, TX

CONCEPT

Associations:

- *Baccharis salicina* Shrubland (NEW GNR)
- *Carex nebrascensis* Herbaceous Vegetation (CEGL001813, G4)
- *Ericameria nauseosa* / *Pseudoroegneria spicata* Shrubland (CEGL001330, G3Q)
- *Juglans microcarpa* - *Brickellia laciniata* / *Indigofera lindheimeriana* Edwards Plateau Shrubland (CEGL004932, G2?)
- *Justicia americana* - *Bacopa monnieri* Edwards Plateau Herbaceous Vegetation (CEGL004926, G3)
- *Panicum virgatum* - *Andropogon glomeratus* - *Cladium mariscus* ssp. *jamaicense* Herbaceous Vegetation (CEGL004928, G2G3)
- *Panicum virgatum* – *Pascopyrum smithii* Southern Herbaceous Vegetation (NEW GNR)
- *Platanus occidentalis* - (*Salix nigra*) / *Juglans microcarpa* - *Baccharis salicifolia* Woodland (CEGL004930, G2G3)
- *Platanus occidentalis* - *Juglans major* Woodland (CEGL004929, G2?)
- *Platanus occidentalis* - *Salix nigra* Forest (CEGL002093, G5?)
- *Populus deltoides* (ssp. *wislizeni*, ssp. *monilifera*) / *Salix exigua* Woodland (CEGL002685, G3)
- *Populus deltoides* - (*Salix amygdaloides*) / *Salix (exigua, interior)* Woodland (CEGL000659, G3G4)
- *Populus deltoides* - *Salix nigra* Woodland (CEGL004919, G3G4Q)
- *Populus deltoides* - *Ulmus americana* - *Celtis laevigata* Forest (CEGL002096, G3)
- *Populus deltoides* / *Carex pellita* Woodland (CEGL002649, G2)
- *Populus deltoides* / *Distichlis spicata* Woodland (CEGL000939, G2)
- *Populus deltoides* / *Muhlenbergia asperifolia* Forest (CEGL000678, G3)

- *Populus deltoides* / *Panicum virgatum* - *Schizachyrium scoparium* Woodland (CEGL001454, G2)
- Riverine Gravel Flats Great Plains Sparse Vegetation (CEGL005223, GNR)
- Riverine Sand Flats - Bars Sparse Vegetation (CEGL002049, G4G5)
- *Salix exigua* Temporarily Flooded Shrubland (CEGL001197, G5)
- *Salix exigua* / Mesic Graminoids Shrubland (CEGL001203, G5)
- *Salix nigra* Forest (CEGL002103, G4)
- *Schoenoplectus acutus* - *Typha latifolia* - (*Schoenoplectus tabernaemontani*) Sandhills Herbaceous Vegetation (CEGL002030, G4)
- *Schoenoplectus pungens* – *Distichlis spicata* Herbaceous Vegetation (CEGL005988, G4)
- *Schoenoplectus pungens* - *Suaeda calceoliformis* Alkaline Herbaceous Vegetation (CEGL002040, G3G4)
- *Schoenoplectus tabernaemontani* - *Typha* spp. - (*Sparganium* spp., *Juncus* spp.) Herbaceous Vegetation (CEGL002026, G4G5)
- *Spartina pectinata* - *Eleocharis* spp. - *Carex* spp. Herbaceous Vegetation (CEGL002223, G2G4)
- *Sporobolus airoides* Southern Plains Herbaceous Vegetation (CEGL001685, G3Q)
- *Symphoricarpos occidentalis* Shrubland (CEGL001131, G4G5)
- *Tamarisk* spp. Temporarily Flooded Shrubland (CEGL003114, GNR)
- *Taxodium distichum* - *Platanus occidentalis* Edwards Plateau Forest (CEGL002104, G2)
- *Typha* (*angustifolia*, *domingensis*, *latifolia*) - *Schoenoplectus americanus* Herbaceous Vegetation (CEGL002032, G3G4)
- *Typha* (*latifolia*, *angustifolia*) Western Herbaceous Vegetation (CEGL002010, G5)
- *Ulmus* (*americana*, *rubra*) - *Quercus muehlenbergii* Forest (CEGL002091, GNR)
- *Ulmus americana* - *Celtis* (*laevigata*, *occidentalis*) - *Fraxinus pennsylvanica* Forest (CEGL002090, G3?)
- *Ulmus crassifolia* - *Celtis laevigata* / *Ilex decidua* / *Elymus virginicus* Forest (CEGL008468, G3?)

Alliances:

- *Baccharis salicina* Temporarily Flooded Shrubland Alliance (NEW)
- *Carex nebrascensis* Seasonally Flooded Herbaceous Alliance (A.1417)
- *Celtis laevigata* - *Ulmus crassifolia* Temporarily Flooded Forest Alliance (A.283)
- *Ericameria nauseosa* Shrubland Alliance (A.835)
- *Fraxinus pennsylvanica* - *Ulmus americana* - *Celtis* (*occidentalis*, *laevigata*) Temporarily Flooded Forest Alliance (A.286)
- *Juglans microcarpa* Temporarily Flooded Shrubland Alliance (A.945)
- *Justicia americana* Temporarily Flooded Herbaceous Alliance (A.1657)
- *Panicum virgatum* Temporarily Flooded Herbaceous Alliance (A.1343)
- *Pascopyrum smithii* Temporarily Flooded Herbaceous Alliance (A.1354)
- *Platanus occidentalis* - (*Fraxinus pennsylvanica*, *Celtis laevigata*, *Acer saccharinum*) Temporarily Flooded Forest Alliance (A.288)
- *Platanus occidentalis* - *Juglans* (*major*, *microcarpa*) Temporarily Flooded Woodland Alliance (A.2018)
- *Populus deltoides* Temporarily Flooded Forest Alliance (A.290)
- *Populus deltoides* Temporarily Flooded Woodland Alliance (A.636)
- *Populus deltoides* ssp. *wislizeni* Temporarily Flooded Forest Alliance (A.312)
- *Salix* (*exigua*, *interior*) Temporarily Flooded Shrubland Alliance (A.947)
- *Salix nigra* Temporarily Flooded Forest Alliance (A.297)
- *Schoenoplectus pungens* Semipermanently Flooded Herbaceous Alliance (A.1433)
- *Spartina pectinata* Temporarily Flooded Herbaceous Alliance (A.1347)
- *Sporobolus airoides* Herbaceous Alliance (A.1267)
- *Tamarisk* spp. Semi-Natural Temporarily Flooded Shrubland (A.842)
- *Symphoricarpos occidentalis* Temporarily Flooded Shrubland Alliance (A.961)
- *Taxodium distichum* - (*Platanus occidentalis*) Temporarily Flooded Forest Alliance (A.298)
- *Typha* (*angustifolia*, *latifolia*) - (*Schoenoplectus* spp.) Semipermanently Flooded Herbaceous Alliance (A.1436)
- *Typha* spp. - (*Schoenoplectus* spp., *Juncus* spp.) Seasonally Flooded Herbaceous Alliance (A.1394)
- Cobble/Gravel Shore Sparsely Vegetated Alliance (A.1850)
- Sand Flats Temporarily Flooded Sparsely Vegetated Alliance (A.1864)

Environment: This system is found primarily along floodplains of medium and large rivers. Soils are primarily alluvial and range from sandy to dense clays.

Vegetation: Dominant woody species occurring within this system include *Populus deltoides* and *Salix* spp. Understory species constitute an important component of this system and include a mixture of tallgrass prairie species such as including *Panicum virgatum* and *Andropogon gerardii*. Sparsely vegetated areas such as gravel and sand flats are also included within this system.

Dynamics: Periodic and intermediate flooding (i.e., every 5-25 years) constitutes the major process influencing this system. Grazing and conversion to agriculture can significantly impact this system and can lead to the degradation or extirpation of the majority of prairie and wet meadow communities from this system.

SPATIAL CHARACTERISTICS

Spatial Summary:

Size:

Heterogeneity:

Adjacent Ecological System Comments:

Other Comments:

SOURCES

References: Comer et al. 2003, Lauver et al. 1999, Steinauer and Rolfsmeier 2000

Version: 05 Mar 2003

Stakeholders: Midwest, Southeast, West

Concept Author: S. Menard and K. Kindscher

LeadResp: Midwest

CES303.680 Western Great Plains Wooded Draw and Ravine

Primary Division: Western Great Plains (303)

Land Cover Class: Mixed Upland and Wetland

Spatial Scale & Pattern: Linear

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland

Concept Summary: This system is typically found associated with permanent or ephemeral streams and small rivers and may occur on steep northern slopes or within canyon bottoms that do not experience periodic flooding, although soil moisture and topography allow greater than normal moisture conditions compared to the surrounding areas. *Fraxinus* spp. and *Ulmus rubra* and *Ulmus americana* typically dominate this system, although in some areas of the western Great Plains steppe province, *Juniperus* spp. can dominate the canopy. In south-central portions of the Great Plains, *Quercus macrocarpa* can also be present. This system was often subjected to heavy grazing and trampling by both domestic animals and wildlife and can be heavily degraded in some areas. In addition, exotic species such as *Ulmus pumila* and *Elaeagnus angustifolia* can invade these systems.

Comments: More information from the broader division and from the Rocky Mountain division will be needed to determine if those areas dominated by ash and elm should be separated from areas dominated by *Juniperus scopulorum*. Those areas dominated by *Juniperus* are typically found in the Badlands and the western portions of North Dakota and Nebraska, and should probably be described based on data from the Great Plains Steppe or Rocky Mountain division. However, *Juniperus* can occur in stands with elm and ash in Nebraska and North Dakota.

DISTRIBUTION

Range: This system is found throughout the Western Great Plains Division.

Divisions: 205:P, 303:C

TNC Ecoregions: 26:C, 27:C, 28:P, 33:C, 34:C, 37:C

Subnations: CO, KS, MT, ND, NE, OK, SD, TX

CONCEPT

Associations:

- *Carex nebrascensis* Herbaceous Vegetation (CEGL001813, G4)
- *Cornus drummondii* - (*Rhus glabra*, *Prunus* spp.) Shrubland (CEGL005219, GNA)
- *Cornus drummondii* - *Amorpha fruticosa* - *Cornus sericea* Shrubland (CEGL005220, G4?)
- *Cornus sericea* - *Salix (bebbiana, discolor, petiolaris)* / *Calamagrostis stricta* Shrubland (CEGL002187, G3G4)
- *Cornus sericea* Shrubland (CEGL001165, G4Q)
- *Crataegus douglasii* - (*Crataegus chrysocarpa*) Shrubland (CEGL001093, G2Q)
- *Crataegus succulenta* Shrubland [Provisional] (CEGL001097, G3G4Q)
- *Fraxinus pennsylvanica* - (*Ulmus americana*) / *Symphoricarpos occidentalis* Forest (CEGL002088, G4?)
- *Fraxinus pennsylvanica* - *Ulmus americana* / *Prunus virginiana* Woodland (CEGL000643, G2G3)
- *Fraxinus pennsylvanica* - *Ulmus americana* / *Symphoricarpos occidentalis* Forest (CEGL002082, G3G5)
- *Fraxinus pennsylvanica* - *Ulmus* spp. - *Celtis occidentalis* Forest (CEGL002014, G3G5)
- *Fraxinus pennsylvanica* / *Prunus virginiana* Forest (CEGL000642, G3?)
- *Juniperus scopulorum* / *Piptatherum micranthum* Woodland (CEGL000747, G3G4)
- *Juniperus scopulorum* / *Pseudoroegneria spicata* Woodland (CEGL000748, G4)
- *Juniperus scopulorum* / *Schizachyrium scoparium* Woodland (CEGL000750, G2)
- *Juniperus scopulorum* Woodland (CEGL003550, GNR)
- *Populus deltoides* - *Fraxinus pennsylvanica* Forest (CEGL000658, G2G3)
- *Populus deltoides* / *Carex pellita* Woodland (CEGL002649, G2)
- *Populus deltoides* / *Juniperus scopulorum* Woodland (CEGL002152, G1G2)
- *Populus deltoides* / *Pascopyrum smithii* Woodland (CEGL002680, G3)

- *Populus deltoides* / *Symphoricarpos occidentalis* Woodland (CEGL000660, G2G3)
- *Prunus virginiana* - (*Prunus americana*) Shrubland (CEGL001108, G4Q)
- *Quercus macrocarpa* / *Prunus virginiana* - *Symphoricarpos occidentalis* Woodland (CEGL002138, G3G4)
- *Rosa woodsii* Shrubland (CEGL001126, G5)
- *Shepherdia argentea* Shrubland (CEGL001128, G3G4)
- *Symphoricarpos occidentalis* Shrubland (CEGL001131, G4G5)

Alliances:

- *Carex nebrascensis* Seasonally Flooded Herbaceous Alliance (A.1417)
- *Cornus drummondii* Shrubland Alliance (A.3558)
- *Cornus sericea* - *Salix* spp. Seasonally Flooded Shrubland Alliance (A.989)
- *Cornus sericea* Temporarily Flooded Shrubland Alliance (A.968)
- *Crataegus (douglasii, succulenta)* Temporarily Flooded Shrubland Alliance (A.954)
- *Fraxinus pennsylvanica* - (*Ulmus americana*) Forest Alliance (A.259)
- *Fraxinus pennsylvanica* - (*Ulmus americana*) Temporarily Flooded Forest Alliance (A.308)
- *Fraxinus pennsylvanica* - (*Ulmus americana*) Woodland Alliance (A.629)
- *Fraxinus pennsylvanica* - *Ulmus americana* - *Celtis (occidentalis, laevigata)* Temporarily Flooded Forest Alliance (A.286)
- *Juniperus scopulorum* Woodland Alliance (A.506)
- *Populus deltoides* Temporarily Flooded Forest Alliance (A.290)
- *Populus deltoides* Temporarily Flooded Woodland Alliance (A.636)
- *Prunus virginiana* Shrubland Alliance (A.919)
- *Quercus macrocarpa* Woodland Alliance (A.620)
- *Rosa woodsii* Temporarily Flooded Shrubland Alliance (A.959)
- *Shepherdia argentea* Temporarily Flooded Shrubland Alliance (A.960)
- *Symphoricarpos occidentalis* Temporarily Flooded Shrubland Alliance (A.961)

Environment: This system is associated with permanent or ephemeral streams and small rivers. It also can occur on steep northern slopes or within canyon bottoms that do not experience periodic flooding. Soils are primarily wet to mesic, and more dissected topography allows for greater than normal moisture conditions. This system is most often associated with smaller rivers and/or temporary streams.

Vegetation: Species composition of this system can vary across the range of this system. *Fraxinus* spp. and *Ulmus* spp. typically dominate this system. In some western areas of the Great Plains Division, *Juniperus* spp. can dominate, and in the south-central portion of the division, *Quercus macrocarpa* can also be important. Exotic species such as *Ulmus pumila* and *Elaeagnus angustifolia* can be present in degraded examples of this system.

Dynamics: Fire can influence this system, however, grazing is the most prevalent dynamic process influencing this system. Overgrazing can heavily degrade this system and allow for the invasion of exotic species.

SPATIAL CHARACTERISTICS

Spatial Summary:

Size:

Heterogeneity:

Adjacent Ecological System Comments:

Other Comments:

SOURCES

References: Comer et al. 2003

Version: 05 Mar 2003 **Stakeholders:** Midwest, Southeast, West

Concept Author: S. Menard and K. Kindscher **LeadResp:** Midwest

CES303.664 Southwestern Great Plains Canyon

Primary Division: Western Great Plains (303)

Land Cover Class: Barren

Spatial Scale & Pattern: Small patch, Large patch

Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland

Concept Summary: This system occurs in both perennial- and intermittent-stream canyons of the southwestern Great Plains. Soils can range from deep loams to alluvial to sandy. The mosaic of soil types which have developed from sandstone, limestone, basalt, and shale parent materials create a complex mosaic of grasslands, shrublands, and woodlands within the canyon system (Shaw et al. 1989). Although the system combines many elements from Southern Rocky Mountain Juniper Savanna and Woodland (CES306.834), Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822), Western Great Plains Shortgrass Prairie (CES303.672), and other shrublands, the varied geology, diverse soil types, and topographic dynamics together form a distinct ecological system characteristic of the canyons and dissected mesas of the southwestern Great Plains.

Vegetation varies both regionally and locally depending on latitude, aspect, slope position and substrate and can range from riparian vegetation to xeric or mesic woodlands and shrublands. Rock outcrops with sparse vegetation are also common. Open to moderately dense pinyon-juniper woodlands occupy most of the canyonland slopes. Scattered *Pinus edulis* may occur within these community types but are never dominant. Woodlands may be floristically similar to and intergrade with Southern Rocky Mountain Juniper Savanna and Woodland (CES306.834) but are distributed along rocky outcrops, canyon slopes, and mesas. *Juniperus monosperma* is the most common tree species and forms extensive woodlands with a grassy understory of *Bouteloua eriopoda*, *Bouteloua gracilis*, *Bouteloua hirsuta*, *Bouteloua curtipendula*, and *Pleuraphis jamesii*, or sometimes with an open shrub layer dominated by *Cercocarpus montanus*. In Kansas, *Juniperus virginiana* can become more dominant and replace *Juniperus monosperma*. Isolated patches of *Pinus ponderosa* or *Populus tremuloides* are found in some locations. Shrublands occur on canyon bottoms, in narrow side canyons, and integrate with woodlands on upper slopes. A mosaic of shrub species is characteristic of canyon walls and slopes and varies with substrate and moisture availability. Common species include *Artemisia bigelovii*, *Cercocarpus montanus*, *Rhus trilobata*, *Ribes* spp., *Prosopis glandulosa* (in Texas), *Ptelea trifoliata*, *Philadelphus microphyllus*, and *Yucca glauca*. *Frankenia jamesii* and *Glossopetalon spinescens* var. *meionandrum* form a community restricted to gypsiferous and calciferous soils. Canyon floors often support a degraded shrubby grassland of *Ericameria nauseosa* and *Opuntia imbricata* with a grassy understory.

Because of the varied topography, relatively permanent water along streambeds and southern location, these canyonlands have a rich herpetofauna (Mackessy 1998). This system provides good habitat for a number of snake species that are otherwise uncommon in the Central Shortgrass Prairie ecoregion. Occasional seeps and springs of the canyon walls provide habitat for rare ferns.

DISTRIBUTION

Range: This system occurs in dry canyons and mesas in the southwestern portion of the Western Great Plains, ranging from Palo Duro Canyon on the Red River in the Texas Panhandle north to Purgatoire and Apishipa canyons, tributaries of the Arkansas River.

Divisions: 303:C

TNC Ecoregions: 27:C, 28:C

Subnations: CO, KS, OK, TX

CONCEPT

Associations:

- *Artemisia bigelovii* / *Achnatherum hymenoides* Shrubland (CEGL000990, G3Q)
- *Cercocarpus montanus* - *Rhus trilobata* / *Andropogon gerardii* Shrubland (CEGL002912, G2G3)
- *Cercocarpus montanus* / *Achnatherum scribneri* Shrubland (CEGL002913, G3)
- *Cercocarpus montanus* / *Bouteloua curtipendula* Shrubland (CEGL001086, G5)
- *Cercocarpus montanus* / *Hesperostipa comata* Shrubland (CEGL001092, G2)
- *Cercocarpus montanus* / *Hesperostipa neomexicana* Shrubland (CEGL002911, G2G3)
- *Dalea formosa* – *Mimosa borealis* Dwarf-shrubland (NEW GNR)
- *Juniperus monosperma* / *Bouteloua curtipendula* Woodland (CEGL000708, G5)
- *Juniperus monosperma* / *Bouteloua eriopoda* Woodland (CEGL000709, GNR)
- *Juniperus monosperma* / *Bouteloua gracilis* Woodland (CEGL000710, G5)
- *Juniperus monosperma* / *Cercocarpus montanus* - *Ribes cereum* Woodland (CEGL000714, GU)
- *Juniperus monosperma* / *Cercocarpus montanus* Woodland (CEGL000713, GNR)
- *Juniperus monosperma* / *Hesperostipa neomexicana* Woodland (CEGL000722, G4)
- *Krascheninnikovia lanata* Dwarf-shrubland (NEW GNR)
- *Quercus gambelii* / *Symphoricarpos oreophilus* Shrubland (CEGL001117, G5)
- *Rhus trilobata*/ *Bouteloua curtipendula* – *Schizachyrium scoparium* Shrubland (NEW GNR)
- *Rhus trilobata* Rocky Mountain Shrub Herbaceous Vegetation (CEGL002910, G2)

Alliances:

- *Artemisia bigelovii* Shrubland Alliance (A.1103)
- *Cercocarpus montanus* Shrubland Alliance (A.896)
- *Dalea formosa* – *Mimosa borealis* Dwarf-shrubland Alliance (NEW)
- *Juniperus monosperma* Woodland Alliance (A.504)
- *Krascheninnikovia lanata* Dwarf-shrubland Alliance (A.1104)
- *Quercus gambelii* Shrubland Alliance (A.920)
- *Rhus trilobata* Shrub Herbaceous Alliance (A.1537)
- *Rhus trilobata* Shrubland Alliance (NEW)

SPATIAL CHARACTERISTICS

Spatial Summary:

Size:

Heterogeneity:

Adjacent Ecological System Comments: This system can grade into in areas dominated by *Pinus* spp.

Other Comments:

SOURCES

References: CONHP 1999, Comer et al. 2003, Mackessy 1998, Shaw et al. 1989

Version: 27 May 2004

Stakeholders: Midwest, Southeast, West

Concept Author: K. Decker, K. Schulz, S. Menard and K. Kindscher

LeadResp: Midwest

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Appendix 2
Fuel Models

Lake Meredith National Recreation Area
&
Alibates Flint Quarries National Monument

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Lake Meredith National Recreation Area - Fuel Models

Background

Currently, fire managers use fuels maps, generated by assigning fuel model numbers to vegetation types. These maps are used with various fire behavior software programs to predict fire size, rate of spread, intensity and severity for both the prescription of fire and the suppression of wildfire.

Anderson's guide classifies fuels into four groups: grass, shrubs, timber, and slash. Fuel models only consider the fuel stratum most likely to carry the surface fire (i.e., grass, shrub, timber, or slash). The difference between the four groups is related to fuel loading and fuel size class distributions. At Lake Meredith the following fuel models occur and are used by the fire management office:

Fuel Model 1 (grass model)

Description: Fire is spread through the fine, very porous, and continuous herbaceous fuels (cured grass and associated material) that have cured or are nearly cured. Very little shrub or timber is present, generally less than one-third of the area. Fuel bed depth is average of 1 foot (i.e., grass layer is approximately 1 foot tall).

Park examples:

Sporobolus cryptandrus- *Aristida purpurea* Herbaceous Vegetation

Bouteloua curtipendula- *Aristida purpurea* Herbaceous Vegetation

Pascopyrum smithii Herbaceous Vegetation

Fuel Model 2 (grass model)

Description: Fire is spread through the fine herbaceous fuels, either curing or dead. These are surface fires where the herbaceous material, in addition to litter and dead-down stemwood from the open shrub or timber overstory, contributes to fire intensity. Open shrub or timber lands that cover one-third to two-thirds of the area generally fit this model. Fuel bed depth is approximately 1 foot.

Park examples:

Juniperus monosperma / *Rhus trilobata* / *Schizachyrium scoparium* Woodland

Juniperus monosperma / *Dalea formosa* / *Bouteloua curtipendula* Woodland

Prosopis glandulosa/ grass Woodland or Shrubland

Baccharis salicina / *Schizachyrium scoparium* – *Panicum virgatum* Shrubland

Artemisia filifolia / *Andropogon gerardii* – *Bouteloua curtipendula* Shrubland

Fuel Model 3 (grass model)

Description: Fires in this fuel model are the most intense of the grass group and display high rates of spread under the influence of wind. Stands are tall (averaging 3 feet), but considerable

variation may occur. Approximately one-third or more of the stand is considered dead or cured and maintains the fire. Average fuel bed depth is 2.5 feet.

Park examples:

Phragmites australis Herbaceous Vegetation

Typha domingensis Herbaceous Vegetation

Fuel Model 4 (shrub model)

Description: Fire intensity and fast-spreading fires involve the foliage and live and dead fine woody material in the crowns of a nearly continuous secondary overstory. Stands of mature shrubs are usually 6 or more feet tall.

Park examples:

Tamarix spp. Shrubland

Salix exigua Shrubland

Fuel Model 9 (timber model)

Description: This fuel model is not very abundant at Lake Meredith at this point in time. Fires run through the surface litter of both conifer and hardwood stands. Concentrations of dead-down woody material will contribute to possible torching out of trees, spotting, and crowning. Average fuel bed depth is 0.2 feet.

Park examples:

Populus deltoides / *Vitis acerifolia* Forest

Dense *Populus deltoides* forest stands with little grass or shrub understory

For further understanding of fuel models read through the fuel model description handbook (Anderson's) and refer to the photographs-keep in mind the photos represent only a few possible field situations. The species depicted in the photos may be different than those present in your plot.

Instructions for assigning fuel model(s) on the data sheet

1. For each plot, surveyors will assign a fuel model (1-13) from Anderson's (1982) field guide. If the surveyor is between more than one fuel model, assign two fuel models and explain your reasoning behind your choices. Do not assign more than two fuel models to a vegetation type. Also, you are not limited to the specified fuel models (1-4, 9) others may exist in the park. If no fuel model fits for a particular area simply right unknown and make the necessary comments.

2. For each fuel model assigned, decide if the fuel loading is lower, normal or higher than what is described in the descriptions. Factors that may contribute to a higher or lower loading as compared to fuel model descriptions include:

- density of primary or secondary fuel layers (grass, shrub, timber)
- height of primary fuel layer (grass, shrub, timber)

3. Finally, make any comments that may help explain the area more. Comments might address the continuity of fuels, the variation of fuel bed depths compared to the fuel model descriptions, the reasoning between two fuel models etc.

Example of Fuel Model data sheet:

Fuel Model (1-13)	Fuel Loading (L, N, or H)	Comments-How does this area differ from the description in Anderson's
1	Lower	This may be a lower fuel model since the grasses present are not continuous (approximately 70% percent herbaceous vegetation cover, grass dominated, <i>Bouteloua curtipendula</i> dominant grass).

Fuel Model (1-13)	Fuel Loading (L, N, or H)	Comments-How does this area differ from the description in Anderson's
2	Normal	n/a

Fuel Model (1-13)	Fuel Loading (L, N, or H)	Comments-How does this area differ from the description in Anderson's
1 or 2	Higher or Lower	The area may be a high fuel model 1 or a lower fuel model 2. Not sure if there is enough shrub cover, shrub litter and dead-down wood for a fuel model 2.

Appendix 3
Map Accuracy Assessment using Fuzzy Accuracy Analysis

Lake Meredith National Recreation Area
&
Alibates Flint Quarries National Monument

Introduction

As part of the standards for the USGS/NPS National Vegetation Mapping, it is required that an accuracy assessment be conducted of the thematic accuracy of the vegetation map. This provides a measure of how well the map polygons match the vegetation on the ground. The recommended standard for overall accuracy should not be less than 80%. The program recognizes that this standard can be very difficult to meet. One method of data analysis that takes into account that map units rarely have discrete boundaries is a fuzzy accuracy assessment.

Methods

The need for an alternative to the standard binary approach of accuracy assessment was recognized some time ago. Gopal and Woodcock (1994) described the first fuzzy accuracy assessment approach that is commonly used today. This type of analysis allows for degrees of membership to a particular class. That is, we are allowed to recognize that a particular class may be considered wrong using a strict binary approach but with the fuzzy analysis that class may be mostly correct. This does provide a much better representation of the continuity present in the real world and still allows us to map using discrete classes.

The use of “fuzzy” techniques to describe the accuracy of thematic maps is a useful if somewhat ambiguous tool. While the word fuzzy implies inexactness, a formal fuzzy assessment introduces standards for the computation of accuracy in the case of map units that do not have discrete boundaries. Now one is forced to interpret the thematic accuracy of a product from multiple perspectives and a number of caveats. There is no “one” figure to use as an estimate for either overall or individual map unit accuracies. It is now standard to couch the results in statistical parlance of confidence intervals and sample sizes. Its use in many thematic products today originates from the recognition that the binary approach of either “right” or “wrong” belies the true nature of most map units and even the view from the person or persons providing the “reference” data.

The great utility of a fuzzy approach is the acknowledgement of degrees of correctness. Only occasionally do map units have discrete boundaries; more often they can be seen grading into one another over distances ranging from a few to hundreds of meters. The necessity of drawing discrete lines representing non-discrete entities requires other than a binary approach.

The standard approach to assigning fuzzy membership to a class is to review each of the AA plots and assign a fuzzy level to that plot. Fuzzy level designations are shown in Table 1.

Table 1. Fuzzy set accuracy ranks (Gopal and Woodcock, 1994).

Fuzzy Class	Description
1	Absolutely Wrong: This answer is absolutely unacceptable. Very Wrong.
2	Understandable but Wrong: Not a good answer. There is something about the site that makes the answer understandable but there is clearly a better answer. This answer would pose a problem for the users of the map.
3	Reasonable or Acceptable Answer: Maybe not the best possible answer but it is acceptable: this answer does not pose a problem to the user if it is seen on the map. Correct
4	Good Answer: Would be happy to find this answer given on the map. Very Right
5	Absolutely Right: No doubt about the match. Perfect.

The result of this fuzzy designation then allowed us to evaluate each fuzzy level using the standard binary approach. That is, we developed a contingency table for fuzzy levels 5, 4 and 3. Because we are only interested in the fuzzy levels that allow for varying degrees of membership and still be considered correct we ignored fuzzy levels 2 and 1 which are always considered to be mismatches.

To facilitate this analysis it was necessary to create one table that included all the information necessary for a multiple contingency table analysis. A screen shot of this table is shown in Figure . The table has several columns. The first column is generated by the GIS software and may be ignored for analysis purposes. The second column is the unique plot id for each AA point. Column three is the map unit assigned to the AA point. After each AA point was collected it was assigned to a vegetation association and subsequently to a map unit. The number in column three is the equivalent of the map unit code. This column becomes the “reference” point when applied to a binary analysis such as described in the binary approach above. Columns four and five are the UTM coordinates for each AA point. Column six is the fuzzy designation applied to each plot. The designation of a fuzzy code is a lengthy process and made more difficult by its subjective nature. To provide some objectivity to the fuzzy membership we developed some on the fly rules for evaluating the plots and the subsequent fuzzy designation. The rules are rough in that they do not evaluate every single possible permutation of species occurrence, density, canopy etc. An example of this process is as follows:

If an AA plot is designated as map unit 8 (Honey Locust) and the vegetation map shows map unit 2 (Cottonwood/Mesic Grass) then the initial binary accuracy assessment would indicate that this was wrong. Consensus was reached on each designation before moving on to the next AA plot.

FID_1	PLOT	AAMU	X	Y	FUZZCODE	NOTES	FUZZ5	FUZZ4	FUZZ3	VEGCODE
1	491	5094	400	440068	4490531	4 mix zone Krum with SABR	400	13	13	13
2	493	5097	13	439930	4490454	5 r from 400	13	13	13	13
3	193	201	13	441538	4490274	5	13	13	13	13
4	194	202	13	439811	4490269	5 r from 400	13	13	13	13
5	487	509	22	449696	4488143	4 Codominant with PIEN ABLA	22	38	38	38
6	106	113	400	444022	4488057	5 r from 222 - tree in shrub layer	400	400	400	400
7	414	476	7	445159	4487757	5	7	7	7	7
8	499	5108	120	442118	4486963	4	120	13	13	13
9	492	5096	120	441953	4487314	3	120	120	13	13
10	417	481	13	446734	4487344	5	13	13	13	13
11	148	136	400	441469	4487253	5	400	400	400	400
12	169	167	1	451477	4486680	5	1	1	1	1
13	130	1160	22	442120	4486624	3 Adjacent to moist area - polygon appears to be on higher ground thus drier	22	22	190	190
14	73	109	400	448995	4486505	5	400	400	400	400
15	497	5106	400	450813	4486093	3 Very mixed area KRUM - SABR	400	400	13	13
16	489	5092	120	441556	4485763	3	120	120	13	13
17	486	5089	13	449341	4485818	5	13	13	13	13
18	494	5098	400	449310	4485929	2 Polygon missing arc?	400	400	400	13
19	495	5100	13	449256	4485856	5	13	13	13	13
20	113	1138	1	447595	4486048	2	1	1	1	120
21	419	483	13	441116	4485956	5	13	13	13	13
22	234	248	120	434426	4485847	5 r from 13	120	120	120	120
23	418	482	13	446816	4485715	5	13	13	13	13
24	125	1152	13	435442	4485646	4 Plot in wrong polygon - rip. shrub inclusion	13	120	120	120
25	224	235	13	437974	4485480	4	13	6	6	6
26	409	488	7	440718	4484112	5	22	22	22	22
27	122	1149	23	434720	4485200	2	23	23	23	190
28	221	232	13	440956	4485086	4	13	6	6	6
29	128	1157	23	439516	4484834	2	23	23	23	190
30	449	5037	120	437555	4482986	5 r from 13	120	120	120	120
31	455	5050	120	437960	4479907	5	120	120	120	120
32	429	497	23	454217	4483529	5	23	23	23	23
33	424	489	164	454347	4483628	4	164	18	18	18
34	430	499	22	437902	4483378	4 Codominant T2 with PIEN ABLA	22	23	23	23
35	150	139	400	448163	4483389	5	400	400	400	400
36	452	5043	120	432165	4482936	5 Reservoir drawdown area - mapped correct	120	120	120	120
37	457	5053	120	430175	4480808	5	120	120	120	120
38	461	5059	120	432284	4482792	5 Reservoir drawdown area - mapped correct	120	120	120	120
39	103	1125	121	454884	4483111	3	121	121	14	14
40	170	169	1	450645	4483013	5 Confusing position - classific	1	1	1	1
41	415	478	7	441869	4482176	5	7	7	7	7
42	137	119	400	450135	4482817	5	400	400	400	400
43	489	5057	120	429955	4482060	5	120	120	120	120
44	413	475	1	449294	4482441	2	1	1	1	7
45	420	484	13	440572	4482071	5	13	13	13	13
46	167	165	1	441746	4482133	5	1	1	1	1
47	0	1	162	457760	4482244	5	162	162	162	162

Figure 1. Example of fuzzy re-designation for the creation of contingency tables.

All plots that received a “correct” designation during the initial binary assessment received a fuzzy membership 5. All other plots were then selected for other fuzzy membership designations.

To evaluate fuzzy levels 4 and 3 using a contingency table we recalculated the reference layer (AA Plot) to be equal to the predicted layer (digital polygon map) depending upon the fuzzy level. To do this we created three additional columns in the AA table. These are columns “fuzz5, fuzz4 and fuzz3”. Evaluation of fuzzy level 5 is identical to the initial binary accuracy assessment as described above. The designation of values in the fuzz4 and fuzz3 columns is as follows. If a plot received a fuzzy designation of 4 then all levels at and below 4 were calculated to equal the polygon code. This column was then used as the “reference” layer in the contingency table. These would show up as “correct” in the contingency table for fuzzy level 4. However, at fuzz5 this would still show up as wrong which is what we would expect for the very stringent class membership at fuzzy level 5. When we calculate the contingency table for fuzzy level 3 this AA plot would show up as correct because it received a fuzzy code of 4 and therefore it follows logically that it must also be correct at fuzzy level 3. Adjacent to the fuzz5, fuzz4 and fuzz3 columns is the “vegcode” which is the code for the predicted value (polygon layer). Also in this table is a column for the original AA code assigned to each AA plot (“AAMU” – accuracy assessment Map Unit). This column is identical to the fuzz5

column and is duplicated for the sake of clarity. The “fuzzcode” column is the fuzzy designation for each plot arrived at by plot evaluation by the authors. The contingency tables are presented in the following “Results” section.

Results

We performed a fuzzy accuracy assessment on the digital thematic map for LAMR. Only vegetated map units were sampled. Table describes the 5 fuzzy classes used during this analysis. This concept and class descriptions was first described by Gopal and Woodcock (Gopel and Woodcock 1994) using fuzzy set theory described by (Zadeh 1965). In addition, fuzzy accuracy assessment is discussed in the NBS/NPS Vegetation Mapping Program “Accuracy Assessment Procedures” (1994, sections 6.3 and 7.4). A fuzzy class was only analyzed using a contingency table for the top three fuzzy classes that are considered “correct”. The overall map accuracies for each of the fuzzy classes are outlined in Table 2 and include a 90% confidence interval and Kappa statistic. The contingency table detailed results are shown in Table 3, Table 4, and Table 5, for fuzzy classes 5, 4 and 3 respectively. Each map unit is analyzed in terms of its individual accuracy for omission and commission (producer’s error and user’s error respectively) for three levels of fuzzy accuracy and includes a 90% confidence interval. A summary table of all map unit accuracies for both omission and commission for all fuzzy levels is shown in Table 6.

Comparison of mean overall and omission/commission accuracies between fuzzy levels:

Predictably, overall map accuracy increases as one relaxes requirements for individual map unit membership. Table shows the increasing overall accuracy from fuzzy level 5 to fuzzy level 3. We also include a Kappa statistic as a metric of the overall accuracy. This statistic assumes that a certain number of correct classifications will occur by chance. Therefore, the Kappa statistic penalizes the overall map accuracy. The mean error for omission and commission also increase as one relaxes map unit membership requirement.

Table 2. Overall map accuracies for each fuzzy class.

Fuzzy Class	Overall Map Accuracy	Standard Deviation (90% - two tailed)	Overall Map Accuracy (Kappa)
5	62.9	4.9	59.9
4	72.4	4.5	70.3
3	85.5	3.6	84.4

Table 3. Contingency table for fuzzy accuracy assessment level 5.

Reference (Accuracy Assessment Field Data)																		Fuzzy 5	Sum	%Correct	Commiss sion Error	+/- (90% Conf. Interval)
	1	2	3	4	5	6	8	10	11	12	13	14	15	16	17	18						
Predictive Data (Polygon Map Data)	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2	1	5.0	0.0%	10.0%		
	2	0	18	0	0	0	1	0	0	0	0	0	4	0	0	0	0	23.0	78.3%	16.3%		
	3	0	7	11	0	0	0	0	0	1	0	0	1	0	0	0	0	20.0	55.0%	20.8%		
	4	0	0	0	5	0	0	1	0	0	0	0	0	0	0	9	1	16.0	31.3%	22.2%		
	5	0	0	2	0	3	0	1	0	0	0	0	0	0	1	0	1	8.0	37.5%	34.4%		
	6	0	0	0	0	0	6	0	0	0	0	0	11	0	0	0	0	17.0	35.3%	22.0%		
	8	0	0	0	0	0	0	9	0	0	0	0	0	0	1	0	3	13.0	69.2%	24.9%		
	10	0	0	0	0	0	1	0	2	0	0	0	0	1	0	0	0	4.0	50.0%	53.6%		
	11	0	0	0	0	1	1	0	0	17	0	0	0	2	1	0	0	22.0	77.3%	17.0%		
	12	0	0	0	0	0	0	0	0	0	11	0	0	0	0	0	3	14.0	78.6%	21.6%		
	13	0	0	0	0	0	0	2	0	0	0	5	0	0	0	17	0	24.0	20.8%	15.7%		
	14	0	0	0	0	0	1	0	1	0	0	0	22	0	0	0	0	24.0	91.7%	11.4%		
	15	0	0	0	0	0	0	0	0	0	0	2	2	25	0	1	0	30.0	83.3%	12.9%		
	16	0	1	0	0	0	1	0	6	6	0	0	0	0	11	0	0	25.0	44.0%	18.3%		
	17	0	0	1	1	0	0	0	0	0	0	0	0	0	0	20	0	22.0	90.9%	12.4%		
	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	13	16.0	81.3%	19.2%		
	Sum	0	26	14	6	4	11	15	9	24	11	7	43	28	11	59	15	Total Correct = 178				
	% Accurate	0.0%	69.2%	78.6%	83.3%	75.0%	54.5%	60.0%	22.2%	70.8%	100.0%	71.4%	51.2%	89.3%	100.0%	33.9%	86.7%	Total Samples = 283				
+/- (90% Conf. Interval)	0.0%	16.8%	21.6%	33.4%	48.1%	29.2%	24.1%	28.4%	17.3%	4.5%	35.2%	13.7%	11.4%	4.5%	11.0%	17.8%						
OVERALL TOTAL ACCURACY = 62.9% OVERALL KAPPA INDEX = 59.9% OVERALL 90% UPPER AND LOWER CONFIDENCE INTERVAL: 58.0% and 67.8%																						
Producers Accuracy (Omission Error)																						
Confidence Interval is 90% two-sided limit																						

Table 4. Contingency table for fuzzy accuracy assessment level 4.

Reference (Accuracy Assessment Field Data)																		Fuzzy 4	Sum	%Correct	Commiss ion Error	+/- (90% Conf. Interval)
	1	2	3	4	5	6	8	10	11	12	13	14	15	16	17	18						
Predictive Data (Polygon Map Data)	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	1	5.0	20.0%	39.4%	
	2	0	22	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	23.0	95.7%	9.2%	
	3	0	3	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20.0	85.0%	15.6%	
	4	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	8	1	16.0	43.8%	23.5%	
	5	0	0	2	0	4	0	1	0	0	0	0	0	0	0	0	1	0	8.0	50.0%	35.3%	
	6	0	0	0	0	0	6	0	0	0	0	0	11	0	0	0	0	0	17.0	35.3%	22.0%	
	8	0	0	0	0	0	0	11	0	0	0	0	0	1	0	1	0	0	13.0	84.6%	20.3%	
	10	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	4.0	100.0%	12.5%	
	11	0	0	0	0	1	0	0	0	18	0	0	2	1	0	0	0	0	22.0	81.8%	15.8%	
	12	0	0	0	0	0	0	0	0	0	12	0	0	0	0	0	2	0	14.0	85.7%	19.0%	
	13	0	0	0	0	0	0	1	0	0	0	8	0	0	0	15	0	0	24.0	33.3%	17.9%	
	14	0	0	0	0	0	0	0	1	0	0	0	23	0	0	0	0	0	24.0	95.8%	8.8%	
	15	0	0	0	0	0	0	0	0	0	0	2	2	25	0	1	0	0	30.0	83.3%	12.9%	
	16	0	1	0	0	0	1	0	6	5	0	0	0	0	12	0	0	0	25.0	48.0%	18.4%	
	17	0	0	1	0	0	0	0	0	0	0	0	0	0	0	21	0	0	22.0	95.5%	9.6%	
	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	14	0	16.0	87.5%	16.7%	
	Sum	1	26	20	7	5	8	14	11	23	12	10	38	27	12	53	16					
	% Accurate	100.0%	84.6%	85.0%	100.0%	80.0%	75.0%	78.6%	36.4%	78.3%	100.0%	80.0%	60.5%	92.6%	100.0%	39.6%	87.5%	Total Correct = 205 Total Samples = 283				
+/- (90% Conf. Interval)	50.0%	13.6%	15.6%	7.1%	39.4%	31.4%	21.6%	28.4%	16.3%	4.2%	25.8%	14.4%	10.1%	4.2%	12.0%	16.7%						
OVERALL TOTAL ACCURACY = 72.4% OVERALL KAPPA INDEX = 70.3% OVERALL 90% UPPER AND LOWER CONFIDENCE INTERVAL: 67.9% and 76.9%																						
Producers Accuracy (Omission Error)																						
Confidence Interval is 90% two-sided limit																						

Table 5. Contingency table for fuzzy accuracy assessment level 3.

Reference (Accuracy Assessment Field Data)																		Fuzzy 3	Sum	%Correct	Commis sion Error	+/- (90% Conf. Interval)
	1	2	3	4	5	6	8	10	11	12	13	14	15	16	17	18						
Predictive Data (Polygon Map Data)	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	5.0	80.0%	39.4%		
	2	0	22	0	0	0	1	0	0	0	0	0	0	0	0	0	0	23.0	95.7%	9.2%		
	3	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	20.0	100.0%	2.5%		
	4	0	0	0	13	0	0	0	0	0	0	0	0	0	0	2	1	16.0	81.3%	19.2%		
	5	0	0	0	0	7	0	0	0	0	0	0	0	0	0	1	0	8.0	87.5%	25.5%		
	6	0	0	0	0	0	10	0	0	0	0	0	7	0	0	0	0	17.0	58.8%	22.6%		
	8	0	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0	13.0	100.0%	3.8%		
	10	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	4.0	100.0%	12.5%		
	11	0	0	0	0	1	0	0	0	19	0	0	2	0	0	0	0	22.0	86.4%	14.3%		
	12	0	0	0	0	0	0	0	0	0	12	0	0	0	0	2	0	14.0	85.7%	19.0%		
	13	0	0	0	0	0	0	0	0	0	0	15	0	0	0	9	0	24.0	62.5%	18.3%		
	14	0	0	0	0	0	0	0	0	0	0	0	24	0	0	0	0	24.0	100.0%	2.1%		
	15	0	0	0	0	0	0	0	0	0	0	2	0	27	0	1	0	30.0	90.0%	10.7%		
	16	0	1	0	0	0	1	0	6	2	0	0	0	0	15	0	0	25.0	60.0%	18.1%		
	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	0	22.0	100.0%	2.3%		
	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	15	16.0	93.8%	13.1%		
	Sum	4	23	20	13	8	12	13	10	21	12	17	33	27	15	39	16	Total Correct = 242		Total		
	% Accurate	100.0%	95.7%	100.0%	100.0%	87.5%	83.3%	100.0%	40.0%	90.5%	100.0%	88.2%	72.7%	100.0%	100.0%	56.4%	93.8%	Samples = 283				
+/- (90% Conf. Interval)	12.5%	9.2%	2.5%	3.8%	25.5%	21.9%	3.8%	30.5%	12.9%	4.2%	15.8%	14.3%	1.9%	3.3%	14.3%	13.1%						
OVERALL TOTAL ACCURACY = 85.5% OVERALL KAPPA INDEX = 84.4% OVERALL 90% UPPER AND LOWER CONFIDENCE INTERVAL: 89.1% and 81.9%																						
Producers Accuracy (Omission Error)																						
Confidence Interval is 90% two-sided limit																						
Users Accuracy (Commission Error)																						

Table 6. Map unit accuracies for omission and commission errors at all fuzzy levels (only vegetated polygons).

VEG CODE	Map Unit Name	Fuzzy 5		Fuzzy 4		Fuzzy 3	
		Users' accuracy	Producers' accuracy	Users' accuracy	Producers' accuracy	Users' accuracy	Producers' accuracy
1	One-Seed Juniper	n/a	n/a	20.0	100.0	80.0	100.0
2	Cottonwood / Mesic Grass	78.3	69.2	95.7	84.6	95.7	95.7
3	Cottonwood / Hackberry / Soapberry	55.0	78.5	85.0	85.0	100.0	100.0
4	Sand Sage / Sideoats-Blue Grama Shrubland	31.3	43.8	46.7	100.0	81.3	100.0
5	Sand Sage / Skunkbush Sumac Shrubland	37.5	75.0	50.0	80.0	87.5	87.5
6	Willow Baccharis Shrubland	35.3	54.5	35.3	75.0	58.8	83.3
8	Honey Mesquite Shrubland	69.2	69.2	84.6	78.6	100.0	100.0
10	Sandbar Willow Shrubland	50.0	22.2	100.0	36.4	100.0	40.0
11	Tamarisk Shrubland	77.3	70.8	81.8	78.3	86.4	90.5
12	Gypsum Outcrops Sparse Herbaceous Vegetation	78.6	100.0	85.7	100.0	85.7	100.0
13	Blue Grama-Buffalograss Herbaceous Vegetation	20.8	71.4	33.3	80.0	62.5	88.2
14	Perennial Bottomland Herbaceous Vegetation Complex	91.7	51.2	95.8	60.5	100.0	72.7
15	Perennial Bottomland/Upper Terrace/Valley Floor HV Complex	83.3	89.3	83.3	92.6	90.0	100.0
16	Semipermanently Flooded herbaceous Vegetation Complex	40.0	100.0	48.0	100.0	60.0	100.0
17	Upland Slopes/Rolling Hills Herbaceous Vegetation Complex	90.9	35.1	95.5	39.6	100.0	56.4
18	Steep Slope Vegetation Complex	81.2	92.9	87.5	87.5	93.8	93.8
MEAN		57.8%	66.4%	70.3%	79.9%	86.3%	88.0%

Appendix 4
Map Unit Descriptions

Lake Meredith National Recreation Area
&
Alibates Flint Quarries National Monument

Lake Meredith National Recreation Area & Alibates Flint Quarries National Monument

Map Unit Descriptions

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Lake Meredith National Recreation Area - Map Units

This section describes the map units for the Lake Meredith National Recreation Area Vegetation Mapping Project. Its purpose is to:

- Describe the vegetation of each map unit
- Provide a ground photo image for each map unit;
- Describe the link between each map unit and the U.S. National Vegetation Classification (USNVC)

The map units for LAMR include those derived from NVCS association level classifications for the vegetation within the mapping boundary. The vegetation described in this section reflects the classification designed specifically for this project. Brief descriptions of all other map units are included at the end of this document.

Summary of Map Units

There are 35 map units describing the land cover in and around Lake Meredith National Recreation Area. These include both vegetated and non-vegetated areas. Within the Park there are 17,417 hectares. The Park and the buffer make up 35,806 hectares.

1 – One Seeded Juniper / Sideoats Grama Woodland

NVC ASSOCIATION

<i>Juniperus monosperma</i> / <i>Bouteloua curtipendula</i> Woodland
--

Map Unit Description

This map unit occurs sparsely and is found primarily on moderate to steep slopes on terrain that is at the high end of drainages off of the Canadian River or on steep slopes overlooking the Canadian River bottomland. The community is more prone to occur in the Triassic sandstone geologic formations and in the accompanying gravelly hills. The soils are generally shallow with moderate amounts of small rocks or gravel throughout the profile. Larger boulders may also be present on the steeper slopes.

Elevations range from 3,000 to 3,200 ft with a mean at 3,125 ft. Polygon sizes range from less than 0.1 to 14 ha with a mean of about 3 ha. Aspects range from west to northeast. The most extensive area of this community is found just outside of the Park on the LX Ranch, just to the west of Chicken Creek. There are small “pockets” of this juniper community along the steep slopes mainly in the area from Bonita Creek to McBride Canyon.

One Seeded Juniper / Sideoats Grama Woodland - Ground Photo



2 – Cottonwood with Mesic Grass

NVC ASSOCIATION (ALLIANCE)

<i>Populus deltoides</i> / <i>Panicum virgatum</i> – <i>Schizachyrium scoparium</i> Woodland
--

<i>Populus deltoides</i> / <i>Pascopyrum smithii</i> – <i>Panicum virgatum</i> Woodland

Map Unit Description

Two vegetation associations make up this map unit. It can be described as open cottonwood woodland with perennial grass understory. A shrub layer, if present, is poorly developed with cover values usually less than 10%. Scattered *Rhus trilobata*, *Baccharis salicina* (willow baccharis), *Amorpha fruticosa* (desert false indigo), *Prunus gracilis* (sand plum), and shrubby *Celtis laevigata* (netleaf hackberry) occur but can be locally dense. The understory vegetation is composed primarily of either warm season tall grass species, including *Panicum virgatum* (switchgrass), *Schizachyrium scoparium* (little bluestem), *Elymus canadensis* (Canada wildrye), *Sorghastrum nutans* (Indiangrass), and *Sporobolus compositus* (tall dropseed), or cool season perennial grasses, mainly *Pascopyrum smithii* (western wheatgrass), depending on which association. Grass cover typically ranges from 45 to 60% with some variation resulting from the shade pattern of the cottonwood. Forbs are not prevalent making up only 5 to 15% of the total canopy cover. This community occurs throughout LAMR. Large areas occur in the Rosita Flats area on the east end of the park. It can also be found in the floodplain of many of the tributary creeks of the Canadian River.

Elevations range little from 2,800 to 3,000 ft with a mean at 2,963 ft. Slopes are all relatively flat and therefore have no measurable aspect. Soils are sandy in the Cottonwood / Western Wheatgrass association while the Cottonwood / Switchgrass – Little Bluestem association has deep soils ranging from fine sandy loams to silty clay.

Cottonwood with Mesic Grass - Ground Photos



3 – Cottonwood / Hackberry - Soapberry Woodland

NVC ASSOCIATION

<i>Populus deltoides</i> / <i>Celtis laevigata</i> – <i>Sapindus saponaria</i> Woodland

Map Unit Description

This map unit occurs in dry riparian areas at the edge of the floodplain, usually at a slightly higher elevation than the floodplain bottom. The underground stream flow that is present in the river floodplain is not present in these slightly higher sites. Any groundwater present is usually found at a greater depth.

This community exhibits a complex physiognomy with wide variation in the cover of the three dominant species. Typically there are a few scattered tall cottonwood with a secondary canopy of smaller soapberry and hackberry. The hackberry often occur as solitary trees or in small groves. The soapberry frequently occur as small groves under the open canopy of scattered tall cottonwoods. Occasionally, this community occurs with a total absence of cottonwood. Shrubs, including *Prunus gracilis* (sand plum) and *Rhus trilobata* (skunkbush) with occasional *Artemisia filifolia* (sand sage), are nearly always present but are seldom abundant. The herbaceous stratum has moderate cover but can be quite variable depending on the degree of shading. Common species include the mid and tall grasses such as *Panicum virgatum* (switchgrass), *Pascopyrum smithii* (western wheatgrass), *Sporobolus cryptandrus* (sand dropseed), *Aristida purpurea* (purple threeawn), *Andropogon hallii* (sand bluestem), and *Bouteloua curtipendula* (sideoats grama).

Elevations range from 2,900 to 3,000 ft. with a mean of 2,980 ft. This map class is typically found on flat to occasional gently sloping terrain. Therefore slopes are also usually without measurable aspect. It is not uncommon to find representatives of this community along the upper edge of riparian areas along tributary creeks to the Canadian River. This community is quite prevalent and can be found in the McBride Canyon, Plum Creek, Turkey Creek and Mullinaw Creek areas. Soils are sandy alluvium.

Cottonwood / Hackberry - Soapberry Woodland - Ground Photos



5 – Sand Sage / Grama Grass Shrubland

NVC ASSOCIATION

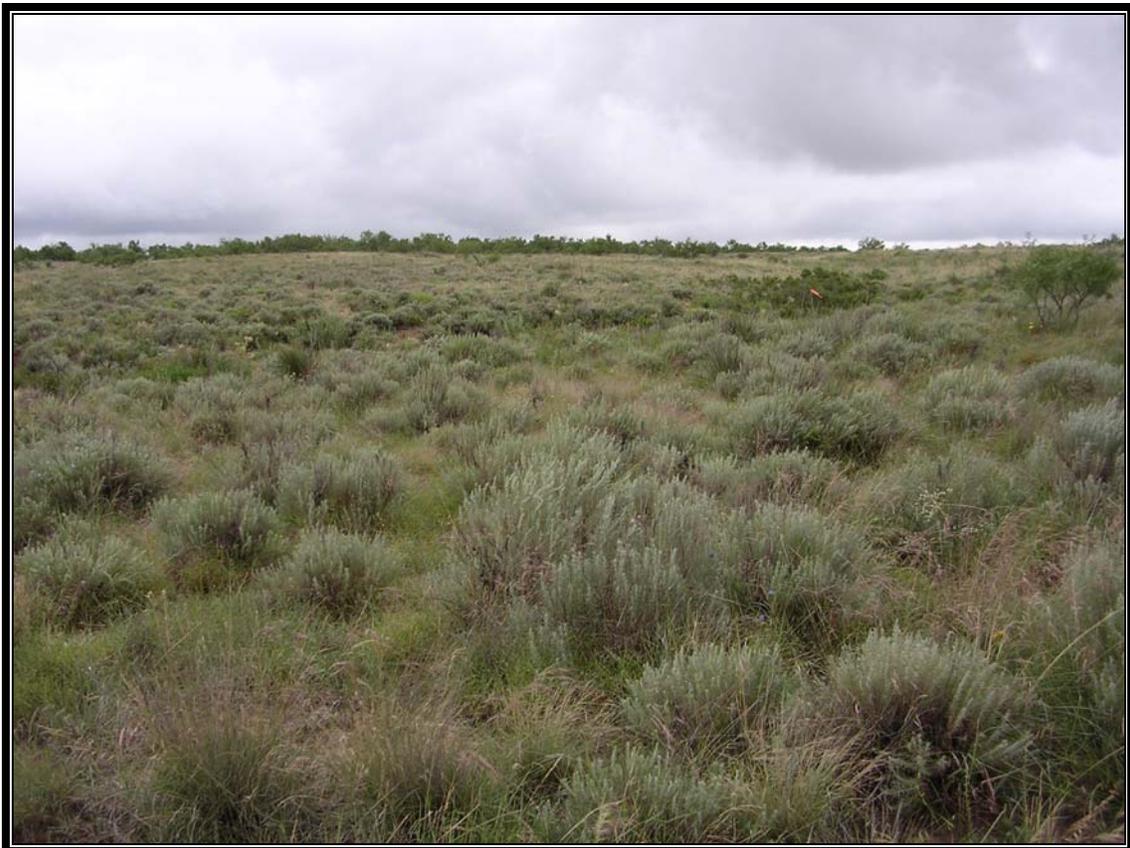
<i>Artemisia filifolia</i> / <i>Bouteloua (curtipendula, gracilis)</i> Shrubland
--

Map Unit Description

This community occurs on sandy rolling upland hills. *Artemisia filifolia* (sand sage) dominates this community with an average canopy cover of 20-25%. Shrubs vary from 1 to 1.5 m in height. Scattered to frequent *Prosopis glandulosa* (honey mesquite) are present as shrubs and trees up to 2.5 m in height, and scattered plants of *Yucca glauca* (*soapweed yucca*) are common. The ground layer is dominated by short to mid grasses, including *Bouteloua gracilis* (blue grama) and *Bouteloua curtipendula* (sideoats grama). Lesser amounts of *Sporobolus cryptandrus* (sand dropseed), *Aristida purpurea* (purple threeawn) and *Buchloe dactyloides* (buffalograss) are common. Forbs are generally limited with *Ambrosia psilostachya* (Cuman ragweed) and *Gaillardia pulchella* (firewheel) being the major species.

This community is gently to moderately sloping with a mean slope of 4 degrees. Aspects tend toward the north-northwest-west. However, this community can be found on all aspects. This Map Unit occurs throughout the Recreation Area with concentrations northeast of Sanford Dam as well as in the area around McBride Canyon and Mullinaw Creek. Elevations range from 2900 ft. to 3100 ft. with a mean of 3000 ft.

Sand Sage / Grama Grass Shrubland - Ground Photos



6 – Willow Baccharis Shrubland

NVC ASSOCIATION
<i>Baccharis salicina</i> Shrubland

Map Unit Description

This community is dominated by shrubs with *Baccharis salicina* (willow baccharis) being the dominant shrub. Typically, willow baccharis is a short shrub but can occasionally reach a height of 2 m. Taller shrubs, especially *Tamarix* spp. (salt cedar) and *Salix* spp. (willow) are often present. Occasional *Populus deltoides* (cottonwood) are scattered throughout this community. The density of willow baccharis is usually dense to moderately dense and in places is difficult to walk through. There are areas of grass but the density is variable depending on the degree of shading and the competition from shrubs. The most common grass species are *Phragmites australis* (common reedgrass), *Panicum virgatum* (switchgrass), and *Muhlenbergia asperifolia* (scratchgrass). Forbs are infrequent. Since communities of the floodplain are often mixed, Willow Baccharis is commonly interspersed with *Tamarix* spp communities, *Salix* spp. associations as well as with communities of *Andropogon hallii* (sand bluestem) and other tall grass species.

Willow baccharis communities occur consistently at around 2900 ft. elevation. The terrain is almost always level with no measurable aspect. The soils are alluvial sandy loams or silt loams with occasional sandier pockets. These areas are occasionally to frequently flooded for short periods of time. This community is found at various locations in the Lake Meredith National Recreation Area but is restricted to the river floodplain upstream from the lake. The area around Mullinaw Crossing has a significant presence of this community as does the area downstream from the mouth of Bonita Creek.

Willow Baccharis Shrubland - Ground Photos



7 – Mountain Mahogany Shrubland

NVC ASSOCIATION
<i>Cercocarpus montanus</i> Shrubland

Map Unit Description

This upland community, Mountain Mahogany occurs on dry, rocky hilltops and escarpments. *Cercocarpus montanus* (mountain mahogany) dominates this shrubland community, however, another shrub, *Dalea formosa* (feather dalea), is also common. Total vegetation cover is low with the vegetation often confined to small areas of soil accumulation and in fissures in the rock cover. Common forbs include *Tetaneuris scaposa* (stemmy four-nerve daisy), *Eriogonum longifolium* (longleaf buckwheat), *Krameria lanceolata* (*trailing krameria*), *Zinnia grandiflora* (Rocky Mountain zinnia), and *Hedyotis nigricans* (diamondflowers). *Aristida purpurea* var. *wrightii* (Wright's threeawn) and *Bouteloua curtipendula* (sideoats grama) are the common grasses.

Mountain Mahogany Shrubland has been found in only one location of the Park, approximately 0.5 mile south of the Alibates Ranger Station, off of Cas Johnson Road on an escarpment and a separate hilltop. Slopes range from 25 to 50% and the soils are weathered Permian redbed material, loamy in texture. The surface can be described as talus with large and small rocks, forming a cover of 30 to 45%. The rocks are dolomite that has broken away from a layer at the top of the slopes.

Mountain Mahogany Shrubland - Ground Photo



8 – Honey Mesquite Shrubland

NVC ASSOCIATION (ALLIANCE)

<i>Prosopis glandulosa</i> / <i>Bouteloua curtipendula</i> Shrubland
--

<i>Prosopis glandulosa</i> / <i>Bouteloua gracilis</i> Shrubland
--

Map Unit Description

This map unit is composed of two NVC associations: Mesquite / Sideoats Grama Shrubland and Mesquite / Blue Grama Shrubland. *Prosopis glandulosa* (honey mesquite) is the dominant shrub with lesser amounts of *Yucca glauca* (soapweed yucca) and *Gutierrezia sarothrae* (broom snakeweed) sometimes present. Canopy cover is usually around 25%. In some cases, the mesquite canopy may be less than 20% which makes this map unit a borderline grassland community. The mesquite may vary in size from 1.5 to 3.0 meters and be a single stemmed or multistemmed plant. Typically there is a good cover of perennial grasses, consisting of *Bouteloua curtipendula* (sideoats grama) or *Bouteloua gracilis* (blue grama). *Sporobolus cryptandrus* (sand dropseed) is commonly present but rarely abundant. Forb cover is typically less than 10% and is variable and highly dependent on spring moisture. Common forbs include: *Tetraneuris scaposa* (stemmy four-nerve daisy), *Chaetopappa ericoides* (rose heath), *Sphaeralcea coccinea* (scarlet globemallow), *Ratibida columnaris* (upright prairie coneflower), *Thelesperma filifolia* (stiff greenthread), and *Amphiachyris dracunculoides* (prairie broomweed).

Soils in this map unit are moderately deep, and calcareous or deep and medium to fine textured. The location on the landscape includes gently sloping upper slopes or high nearly level areas, as well as on the lower gently sloping areas at the base of cliffs adjacent to grasslands.

Honey Mesquite Shrubland - Ground Photo



10 – Sandbar Willow Temporarily Flooded Shrubland

NVC ASSOCIATION

<i>Salix exigua</i> Temporarily Flooded Shrubland

Map Unit Description

This map unit occurs in places where there is a permanent and stable ground water source, such as along the main river channel or in areas where there is an underground source of water. This community is dominated by *Salix exigua* (Sandbar or Coyote Willow). Sandbar willow may be either a tall or short shrub with an average height of 1.5 to 2.0 meters. It usually occurs in small and localized stands. It can form thick stands with an almost closed canopy or it can be more sparse. *Tamarix ramosissima* (tamarisk) and *Baccharis salicina* (willow baccharis) are often present and sometimes in substantial density. *Panicum virgatum* (switchgrass) and *Phragmites australis* (common reedgrass) are often present as individual plants. Also, *Populus deltoides* (cottonwood) may be present as seedlings or small saplings. The dense stands of willow do not allow a great number of other species to persist.

This community is common at Lake Meredith NRA along the Canadian River streambed. Soil types include alluvial sand, silt, clay and gravel. This community occurs in narrow bands adjacent to the streambed or further up away from the river in the floodplain where there is an underground water source, as it requires soil that is continually wet.

Sandbar Willow Temporarily Flooded Shrubland - Ground Photo



11 - Tamarisk spp. Shrubland

NVC ASSOCIATION

<i>Tamarix</i> spp. Temporarily Flooded Shrubland

Map Unit Description

This community is dominated by *Tamarix* spp. (tamarisk or salt cedar). It can occur in almost pure stands that range in height from short shrubs to as tall as 4 meters. It often occurs in bands that follow old stream terraces. Quite frequently there are few understory plants. This is due in part to the density of the salt cedar as well as the accumulation of salt in the soil around the plants as the salt-accumulating leaves fall to the ground. Both inhibit the establishment of other species. Stand size varies from quite small, 0.1 acre to quite large (over 300 acres) with a mean size of 11 acres. The characteristics of this community vary considerably from dense established thickets to newly established rather sparse sites in areas that are influenced by the water fluctuations of the reservoir drawdown area. Sometimes this community is found mixed with *Baccharis salicina* (willow baccharis), another competitive high water use shrub. Where understory grasses are present, they are likely to be *Distichlis spicata* (Inland Saltgrass), *Muhlenbergia asperifolia* (scratchgrass) or *Phragmites australis* (common reedgrass).

Tamarisk shrubland require deep soils, commonly thin sandy loam soil over alluvial deposits of sand, gravel or cobbles. LAMR has an active program for salt cedar removal which results in significant variation in this map unit. After mechanical or chemical removal, tamarisk frequently re-sprouts adding to the variation in age and density of stands found at Lake Meredith. Although salt cedar is an invasive species, introduced from the Mediterranean, it is considered to be naturalized and self-sustaining.

Tamarisk spp. Shrubland - Ground Photo



12 - Gypsum Outcrops Sparse Herbaceous Vegetation

NVC ASSOCIATION

<i>Sporobolus cryptandrus</i> – <i>Schizachyrium scoparium</i> – <i>Bouteloua curtipendula</i> Herbaceous Vegetation

This community occurs on gypsiferous soils located on small hills, ridges, and ledges within the Permian Redbed geology. This community is sparsely vegetated with vegetation decreasing as the gypsum content increases. The number of species is limited. The most commonly occurring grasses are *Sporobolus cryptandrus* (sand dropseed), *Bouteloua curtipendula* (sideoats grama), *Schizachyrium scoparium* (little bluestem), *Erioneuron jamesii* (galleta), and *Aristida wrightii* (Wright threeawn). The more common forbs include *Calylophus serrulata* (shrubby evening primrose), *Oenothera macrocarpa* (bigfruit even-primrose), *Phacelia integrifolia* (gypsum phacelia), *Mentzelia strictissima* (grassland blazingstar), *Eriogonum jamesii* (James' buckwheat), *Haploesthes greggii* (false broomweed), and *Hymenopappus flavescens* (collegeflower). A few scattered shrubs may occur: *Dalea formosa* (feather dalea), *Yucca glauca* (soapweed yucca), and *Rhus trilobata* (skunkbush). Cacti are occasionally present especially *Echinocereus reichenbachii* (lace hedgehog cactus) and *Opuntia macrorhiza* (twistspine pricklypear). The total vegetation decreases on dryer south and west facing slopes. Some sites are almost pure gypsum and these are almost barren of any vegetation.

This map unit is found in the Plum Creek and Big Canyon areas of LAMR. While it is not extensive throughout LAMR, it is common on the Permian Redbed geology.

Gypsum Outcrops Sparse Herbaceous Vegetation - Ground Photos



13 – Blue Grama- Buffalograss Herbaceous Vegetation

NVC ASSOCIATION
<i>Bouteloua gracilis</i> – <i>Buchloe dactyloides</i> Herbaceous Vegetation

Map Unit Description

This map unit is an upland grassland dominated by short grass species, *Bouteloua gracilis* (blue grama) and lesser amounts of *Buchloe dactyloides* (buffalograss). Very small amounts of other grasses may be present, *Sporobolus cryptandrus* (sand dropseed), *Panicum obtusum* (vine mesquite), *Pascopyrum smithii* (western wheatgrass), *Muhlenbergia arenicola* (sand muhly), and *Eragrostis curtipedicillata* (gummy lovegrass). Forbs are relatively sparse with the most common species being *Sphaeralcea coccinea* (globemallow), *Thelesperma filifolia* (stiff greenthread), *Amphiachyris dracunculoides* (prairie broomreed), and *Ratibida columnaris* (upright prairie coneflower). Shrubs are limited in this community with *Prosopis glandulosa* (Honey Mesquite) being the most common.

Soils are colluvial, deep, and fine textured. Typically, this map unit is found at the highest landscape position on uplands that are nearly level to gently sloping terrain. This community is not common on LAMR because the park is located in the Canadian River Canyon and does not include the higher elevation uplands. It is found in the Bugbee Shores area, south of the town. There are also some areas on the Palo Duro Ranch, adjacent to the recreation area between McBride Canyon and Cas Johnson Road.

Blue Grama- Buffalograss Herbaceous Vegetation - Ground Photos



14 – Perennial Bottomland Herbaceous Vegetation

NVC ASSOCIATION (ALLIANCE)
<i>Andropogon hallii</i> – <i>Calamovilfa gigantea</i> Herbaceous Vegetation
<i>Andropogon hallii</i> – <i>Schizachyrium scoparium</i> – <i>Panicum virgatum</i> – <i>Sorghastrum nutans</i> Herbaceous Vegetation
<i>Panicum virgatum</i> – <i>Pascopyrum smithii</i> Herbaceous Vegetation
<i>Phragmites australis</i> Western North America Temperate Semi-Natural Herbaceous Vegetation

Map Unit Description

This map complex encompasses all of the grasslands that occur in the Canadian River floodplain. These tall grass associations occupy the small dunes along the streambed, as well as the first stream terraces. The terrain is nearly level to slightly undulating. These associations are subject to occasional flooding and the deposition of debris from time to time. The grass cover may vary from sparse for those associations that occupy the sandy alluvium at the edge of the river streambed, Sand Bluestem – Giant Sandreed Herbaceous Vegetation to more production and good grass cover, Sand Bluestem – Little Bluestem – Switchgrass – Indiangrass Herbaceous and Switchgrass – Western Wheatgrass Herbaceous Vegetation. Common Reedgrass Western North America Temperate Semi-Natural Herbaceous Vegetation occurs in narrow bands immediately adjacent to the stream channel and scattered throughout the river floodplain. It seems to be dependent on a particular ground water regime in which the water table is close to the soil surface.

For detailed descriptions of these NVC Associations, see the NatureServe section: Descriptions of the Vegetation Associations of Lake Meredith NRA.

Perennial Bottomland Herbaceous Vegetation - Ground Photos



Perennial Bottomland Herbaceous Vegetation - Ground Photos



15 – Perennial Bottomland / Upper Terrace / Valley Floor Herbaceous Vegetation

NVC ASSOCIATION (ALLIANCE)
<i>Andropogon hallii</i> – <i>Schizachyrium scoparium</i> – <i>Hesperostipa comata</i> Herbaceous Vegetation
<i>Bouteloua curtipendula</i> – <i>Bouteloua (gracilis, eriopoda)</i> Herbaceous Vegetation
<i>Panicum obtusum</i> Herbaceous Vegetation
<i>Pascopyrum smithii</i> Herbaceous Vegetation
<i>Sporobolus airoides</i> Southern Plains Herbaceous Vegetation
<i>Phragmites australis</i> Western North America Temperate Semi-Natural Herbaceous Vegetation

Map Unit Description

This map complex encompasses the grasslands that occupy the upper floodplain terraces of the Canadian River, the valley floors and floodplains of the major contributing streams and tributary canyons and the transition zones between the riparian and upland grasslands. As a group, these associations may represent the characteristics of both riparian and upland. Alkali Sacaton Southern Plains Herbaceous Vegetation occurs on nearly level terrain with deep moderate to moderately fine textured soils with a high degree of alkalinity. It usually occupies broad colluvial fans or benches just outside of the main river floodplain, but it may be found in the outer reaches of the floodplain also. Western Wheatgrass Herbaceous Vegetation is found in broad, open valley floors that receive overflow from the surrounding areas and also in riparian areas with deep moderate textured soils with scattered trees. Vine Mesquite occurs on broad, moderately sloping overflow sites along major drainages. Sideoats Grama – Grama (Blue, Black) Herbaceous Vegetation and Sand Bluestem – Little Bluestem – Needle-and-Thread both occupy upland areas and the transition areas between floodplain and upland. Common Reedgrass Western North American Temperate Semi-Natural Herbaceous Vegetation is included in this map class due to its habit of occurring throughout the river floodplain.

**Perennial Bottomland / Upper Terrace / Valley Floor Herb. Veg. –
Ground Photos**



**Perennial Bottomland / Upper Terrace / Valley Floor Herb. Veg. –
Ground Photos**



16 – Semipermanently Flooded Herbaceous Vegetation Complex

NVC ASSOCIATION (ALLIANCE)
<i>Typha latifolia</i> – <i>Schoenoplectus (americanus, validus)</i> Herbaceous Vegetation
<i>Phragmites australis</i> Western North America Temperate Semi-Natural Herbaceous Vegetation

Map Unit Description

This map complex consists of two NVC alliances. Cattail, Softstem Bulrush, and Threesquare Bulrush Herbaceous Vegetation alliance occurs in areas that are wet from underground streamflow and periodic flooding. While the cattails may occupy large areas especially at the upper end of the lake, the bulrush are found in small patches on the banks of standing water or margins of ponds. Common Reedgrass Western North American Temperate Semi-Natural Herbaceous Vegetation alliance occupies floodplain areas where the water table is close to the soil surface. It often occurs in narrow monotypic stands along the active river channel as well as scattered in with other grasses of the floodplain.

The soils of this map complex are typical sandy to silty alluvium that are found on the generally flat alluvial floodplain.

At Lake Meredith, the growth of cattails in the upper end of the lake is strongly influenced by the water regime. In times of extended drought, cattails may die off over vast areas, only to return when the area water is replenished. This dynamic nature is seen in the pattern of live cattails, large areas of dead plant material and mud flats visible on the aerial photography. This map complex occurs throughout the project area, most often in very small stands.

Semipermanently Flooded Herbaceous Vegetation Complex
Ground Photos:



17 – Upland Slopes/Rolling Hills Herbaceous Vegetation Complex

NVC ASSOCIATION (ALLIANCE)
<i>Bouteloua curtipendula</i> – <i>Bouteloua (gracilis, eriopoda)</i> Herbaceous Vegetation
<i>Cercocarpus montanus</i> Shrubland
<i>Dalea formosa</i> – <i>Mimosa</i> Shrubland
<i>Gutierrezia sarothrae</i> – <i>Yucca glauca</i> Dwarf-Shrubland
<i>Krascheninnikovia lanata</i> Dwarf-Shrubland
<i>Schizachyrium scoparium</i> – <i>Bouteloua curtipendula</i> Herbaceous Vegetation

Map Unit Description

This map complex is composed of a varied mix of vegetation associations including grassland, dwarf shrubland and shrubland communities. All of the common shrub species share some of the characteristics of xeromorphic species: small leaves, spines, low growth form or short for the range of height of that particular species. These associations tend to be at least moderately sparse with low biomass and litter production with a droughty appearance. The vegetation communities in this complex generally do not form a solid cover. As a result, cryptogamic crust is commonly visible in the open areas. The photo signature of this complex can range from smooth to somewhat textured even though there are shrubs present. It is likely that the xeromorphic growth form contributes to the lack of stippling that is commonly seen in the photo signature of shrub associations. In the landscape, this map complex is situated on the rolling hills as well as on the edges of escarpments, shallow ridges, footslopes and hilltops. The soils will vary from very shallow upland soils, less than 4 inches in depth, with high rock content and exposed bedrock to a medium textured soil including loams, silt loams and fine sandy loams where the little bluestem – sideoats grama grasslands occur and even some moderately deep calcareous and loamy soils. The slope varies from rolling to fairly steep.

Upland Slopes/Rolling Hills Herbaceous Vegetation Complex
Ground Photos:



Upland Slopes/Rolling Hills Herbaceous Vegetation Complex
Ground Photos:



18 – Steep slope Vegetation Complex

NVC ASSOCIATION (ALLIANCE)

<i>Rhus trilobata</i> / <i>Bouteloua curtipendula</i> - <i>Schizachyrium scoparium</i> HV

<i>Schizachyrium scoparium</i> – <i>Bouteloua curtipendula</i> HV

Map Unit Description

This map unit is composed of two NVC associations: Skunkbush Sumac / Sideoats Grama – Little Bluestem Shrubland and Little Bluestem – Sideoats Grama Herbaceous Vegetation. This complex occupies the steep talus slopes that line the Canadian River floodplain corridor. Slopes are steep, ranging from 25 to 50%. The skunkbush sumac / sideoats grama shrubland association is likely to be found on the more mesic eastern and northern exposure slopes. The little bluestem – sideoats grama is more common on the drier south and west-facing slopes. Both associations can exhibit greater productivity than might be expected given the steepness of the terrain. Large and small pieces of dolomite that have broken off of a layer at the top of the slope and tumbled downhill are common. Within the grassland association, more mesic aspects favor the dominance of little bluestem over sideoats grama.

Rhus trilobata (skunkbush sumac) is the dominant shrub and there are lesser amounts of *Dalea formosa* (feather dalea), *Mimosa borealis* (fragrant mimosa), *Ptelea trifoliata* (wafer ash), occasional shrubby *Celtis laevigata* (hackberry) and a few isolated *Juniperus monosperma* (one seed juniper). *Artemisia ludoviciana* (white sage) is a very common forb species, whose gray green color can be seen on the slopes from a distance. Other common forbs include *Calylophus serrulata* (yellow sundrops), *Chaetopappa ericoides* (rose heath), *Tetranneuris scaposa* (stemmy four-nerve daisy) and *Eriogonum longifolium* (longleaf buckwheat).

Soils in this map unit range from weathered Permian redbed material, loamy in texture to medium textured loams, silt loams, and fine sandy loams. The location on the landscape is restricted to the steep talus slopes that line the Canadian River floodplain corridor as well as some of these steep slopes overlooking the larger tributary creeks. This community is found throughout much of the project area. Specific examples are the northeast facing slope in McBride Canyon and the paved road leading to the Alibates Ranger Station.

Steep slope Vegetation Complex - Ground Photo



Other Map Units

Vegetated Map Units not addressed by the NVC and/or not sampled for accuracy:

Reservoir Drawdown (20) Areas of lake shoreline and sandy terraces on the edge of the reservoir pool that are subject to fluctuating lake levels and rain events. Due to the continual ecological flux and manmade nature of the environment, this vegetated community was mapped but not classified by the NVCS. Common species among many include such marsh or riparian species as *Typha domingensis*, *Phragmites australis*, *Distichlis spicata*, and *Populus deltoides* seedlings. (Nesom and O'Kennon 2005)

Weedy Forbs (21) Numerous non native species of plants flourish at LAMR and ALFL. Specifically, *Kochia scoparia* and *Salsola kali* can become difficult to control. These weed blooms were mapped when visible on the aerial photographs. However, due to their transient nature, a consistent or all-inclusive mapping of weedy forbs is not within the scope of the NVC mapping program. Large areas of weedy forb growth may be discernable on the aerial photos depending on the timing of the growth spurt and the date of photo acquisition. Nevertheless, we included this map unit because we felt that it provided valuable information.

Miscellaneous Cottonwood – Cottonwood Alliance (see Appendix 1 for more detailed description) (22). This alliance is fairly common within the park although most of the *Populus* communities are included in associations. There is a good example of this alliance located at the mouth of Bonita Creek and at the mouth of Chicken Creek. It can also be found at lower Plum Creek.

The tree canopy is usually over 50% and the understory is heavily shaded. There are almost no other tree species present and a large variation in the shrub strata. In general, *Salix exigua*, *Amorpha fruticosa*, *Baccharis salicina*, and occasional *Rhus trilobata* are the main shrubs present. There are few forbs and grasses present except in localized situations. Grass species found are usually shade tolerant species such as *Tridens flavus*, *Pascopyrum smithii*, and *Elymus canadensis*. *Vitis rupestris* is often found in abundance.

Western Soapberry Woodland (24) Small clonal mottes of *Sapindus saponaria* occur on a scattered basis around LAMR and near ALFL. Although Western Soapberry is a member of the Eastern Cottonwood – Sugarberry / Soapberry Woodland Association, these ½ to 5 acre sites appear distinct.

Disturbed ORV (37) Map unit created for the disturbed portions of the Rosita Creek area, both in the sandy bottomland and along the cliff walls and nearby hills where off-road vehicle traffic has dissected the landscape with so many roads that it is meaningless to map as a vegetated map unit.

Non -Vegetated Map Units based on Anderson (1976):

Transportation (25) All paved and major dirt roads were delineated and attributed as transportation.

Oil/Gas Development (26) The oil and gas wells located throughout the Park lands and buffer were mapped and attributed separately from other forms of urban or build-up land.

Mixed Urban or Built-up Land (27) Park facilities, including buildings, camp grounds and dam structures, as well as all other buildings were included in this map class.

Cropland and Pasture (28) Parcels of land used for agricultural purposes or for pasturing of livestock.

Perennial Streams (30) Active channel of the Canadian River

Intermittent Streams (31) active channel of any of the tributaries of the Canadian River

Reservoirs (32)

Stock ponds (33) includes small earthen dams created to store water for livestock

Strip Mines, Quarries, and Borrow Areas (34)

Includes active quarries and large borrow areas created during the construction of Lake Meredith.

Sandy Areas (35)

River sandbars, major sand or gravel bars occurring in the Canadian River or within larger intermittent or perennial tributary streams. If any appreciable vegetation was detected, these areas were mapped as Perennial Bottomland Grassland Complex.

Open Water (36) most commonly associated with the semi-permanently flooded herbaceous vegetation.

Bare Exposed Rock (38) Areas of dolomite outcrops, specifically along the edge of the drawdown area.