APPENDIX F

Biological Survey Report

BIOLOGICAL SURVEY REPORT

FOR CONSTRUCTION, OPERATION, AND MAINTENANCE OF TACTICAL INFRASTRUCTURE USBP DEL RIO SECTOR, TEXAS

Prepared for

U.S. Department of Homeland Security
Customs and Border Protection
U.S. Border Patrol
Del Rio Sector, Texas

Prepared by

Solutions Today for a Sustainable Tomorrow

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ABBREVIATIONS AND ACRONYMS

°F	degrees Fahrenheit
BMP	Best Management Practice
BSR	Biological Survey Report
CBP	U.S. Customs and Border Protection
CFR	Code of Federal Regulations
CWA	Clean Water Act
e²M	engineering-environmental Management
ESP	Environmental Stewardship Plan
FE	Federally Endangered
FEMA	Federal Emergency Management Agency
FT	Federally Threatened
GIS	Geography Information Systems
GPS	Global Positioning Systems
IBWC	International Boundary and Water Commission
JV	Joint Venture
MJD	Multi-Jurisdictional Dataset
NWI	National Wetlands Inventory
NWR	National Wildlife Refuge
POE	port of entry
RGJV	Rio Grande Joint Venture
ROE	right-of-entry
SE	State Endangered
ST	State Threatened
TPWD	Texas Parks and Wildlife Department
TXNDD	Texas Natural Diversity Database
USACE	U.S. Army Corps of Engineers
USBP	U.S. Border Patrol
USC	United States Code
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UTM	Universal Transverse Mercator

BIOLOGICAL SURVEY REPORT
FOR
CONSTRUCTION, OPERATION, AND MAINTENANCE OF TACTICAL INFRASTRUCTURE
U.S. BORDER PATROL DEL RIO SECTOR, TEXAS

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1. Introduction

This Biological Survey Report (BSR) synthesizes information collected from a variety of literature sources and field surveys to describe the biological resources within the project corridor, provides support information from the Project region, allows evaluation of the potential impacts of the Project on those biological resources within the Project Environmental Stewardship Plan (ESP), and provides the basis for recommendations for avoidance or reduction of those impacts using mitigation including best management practices (BMP). Information was gathered from publicly available literature, data provided by relevant land management agencies, review of aerial photography and U.S. Geological Survey (USGS) topographic maps, data from the State of Texas, data from NatureServe, the National Wetlands Inventory (NWI), and corridor field surveys conducted in November 2007 and January 2008. The BSR was prepared as an independent document that is an appendix to the ESP developed for this Project.

In general, the project corridor encompasses approximately 4 miles in length and approximately 139 acres. Approximately 112 acres of nonnative and native vegetation providing wildlife habitat and approximately 27 acres that support land use in the form of fallow and irrigated agriculture, urban and residential development, roads, and open water occur in the project corridor. Staging areas occur on approximately 8.3 acres in the project vicinity; 6 percent (approximately 0.5 acres) of the staging area surfaces are composed of existing roads and trails.

Herbaceous vegetation (grasslands, forblands, emergent wetlands) comprises approximately 31 percent of the project corridor or a total of approximately 34.6 acres. Shrublands (dwarf, short, and tall) compose approximately 55 percent of the project corridor or a total of 61.1 acres. Forests and woodlands compose approximately 15 percent of the project corridor or 16.4 acres total cover. Staging area vegetation (approximately 7.8 acres) is composed of 82 percent nonnative grassland and forbland, 4 percent shrubland, and 10 percent woodland and forest habitats. The vegetation represents a combination of mostly nonnative grasses that have become established in dense stands on floodplains and gravel pits, in pastures, and as forest and woodland understory; shrublands that are invading herbaceous vegetation stands or occur on gravelly upland substrates; and woodlands invading pastures and riparian woodlands and forests.

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2. Project Description

U.S. Customs and Border Protection (CBP) plans to construct, maintain, and operate tactical infrastructure consisting of primary pedestrian fence and associated access roads, patrol roads, lights, and other tools along the U.S./Mexico international border in the U.S. Border Patrol (USBP) Del Rio Sector, Texas. The locations of tactical infrastructure are based on a USBP Del Rio Sector assessment of local operational requirements where it will assist USBP agents in reducing illegal cross-border activities. Tactical infrastructure will be constructed in two sections along the international border (**Table 2-1**). The individual tactical infrastructure sections range from 0.8 to 2.3 miles in length.

Table 2-1. Tactical Infrastructure Sections, Del Rio Sector

Section Number	USBP Station	General Location	Length of Section (miles)
M-1	Del Rio	Del Rio, Texas	2.3
M-2A	Eagle Pass	Eagle Pass, Texas	0.8
		Total	**3.1**

The following discussion provides a general description of each section considered. The Project alignment was developed through coordination with Federal and state agencies to identify an alignment for the infrastructure that will meet current operational requirements with fewer environmental effects.

In Del Rio, the Project will parallel the U.S. Section of the International Boundary and Water Commission (IBWC) floodplain. The Project will be located outside the IBWC floodway but inside the Federal Emergency Management Agency (FEMA) 100-year floodplain. The Project also includes removing giant reed (*Arundo donax*) and other brush in a 150-foot-wide corridor and constructing an access and patrol road along the entire length of the primary pedestrian fence section, south of the primary pedestrian fence.

The tactical infrastructure will affect approximately a 150-foot-wide corridor along Section M-1. This corridor will include primary pedestrian fences, access roads, and patrol roads. In addition, a 150-foot-wide corridor will be maintained free of giant reed (to the extent practical) along Section M-1. This corridor will include giant reed removal from 100 feet south to 50 feet north of the primary pedestrian fence.

In Eagle Pass, Section M-2A, the Project will generally parallel the bank of the Rio Grande. Section M-2A will connect to a previously evaluated and approved primary pedestrian fence section, Section M-2B, which is addressed in an existing National Environmental Policy Act document. Approximately 0.5 miles of

Section M-2A will be a 15- to 18-foot-high concrete retaining wall and the remaining length will be aesthetic fencing. The Project also includes improving patrol roads along the entire length of the primary pedestrian fence sections and managing giant reed growth.

The tactical infrastructure will affect approximately a 60-foot-wide corridor along Section M-2A. This corridor will include a primary pedestrian fence, concrete retaining wall, improvement of the existing access and patrol roads, and lights.

3. Survey Methods and Limitations

To provide flexibility in placment of tactical infrastructure within the project corridor, and to ensure consideration of potential impacts due to construction, patrol, and maintenance, surveys were conducted in an area extending 150 feet north and 150 feet south of the alignment. The surveys also extended at least 0.5 miles past the ends of each section. The areas thus defined are referred to hereafter as the "survey corridor" or "project corridor."

Intuitive controlled investigations of the survey corridor were conducted by employees of engineering-environmental Management, Inc. (e^2M): James Von Loh (senior ecologist), Valerie Whalon (staff biologist), Karen Stackpole (staff biologist), Shannon Cauley (wetlands ecologist), and Gena Jannsen of Jannsen Biological (a subcontractor to e^2M and a U.S. Fish and Wildlife Service [USFWS]-approved botanist in Texas, specifically for Tamaulipan brushland/south Texas brush country). The November 2007 and January 2008 surveys examined the project corridor beginning on 5 November 2007 and 30 January 2008. Necessary to access properties were rights-of-entry (ROEs) approvals and CBP escort.

Due to the timeframe for acquiring field information, e^2M assigned senior ecologists and biologists familiar with vegetation and wildlife habitat classification and mapping protocols, and field sampling methods to intuitively examine the landscape and project corridor for the four-mile length. Further, senior e^2M natural resources staff teamed with a USFWS-approved and experienced South Texas botanist to ensure accurate identification of plant species and competent surveys for rare plants and potential habitat. The surveys were controlled, in that ROE were approved for a 150-foot corridor width, and survey crews were accompanied by USBP agents who served as guides, shared knowledge of wildlife sightings and other pertinent information, contacted landowners, if necessary, and ensured surveyor safety while in the field. Investigations included observed plant and wildlife species lists by fence section; an assessment of habitat and surveys for rare plant and wildlife species; landscape photography points; observation points recording dominant species; location, cover, and environmental conditions; photographic documentation; determination of potential wetlands for future research; and general note-taking of natural resources and other reporting needs.

Biologists walked the project corridor for each tactical infrastructure section where approved ROE was obtained. They conducted reconnaissance-level surveys on areas of land use (urban areas) and examined in detail areas containing unique species compositions or habitat that might be conducive to sensitive species (e.g., grasslands, shrublands, woodlands, forests, wetlands, water bodies). Observation data (Universal Transverse Mercator [UTM] coordinates, photographs, field notes, environmental information, vegetation structure, and plant community composition) were recorded at regular intervals along the corridor where vegetation occurred as homogenous stands and also

where plant communities presented substantial shifts in species composition. These data were used to generate a vegetation classification and map to inform delineation of habitat types, analyses of potential sensitive species occurrences, and analyses of potential Project impacts on biological resources (**Attachment A**). Vegetation type and land use maps are included as a digital file in this BSR. Although no protocol surveys were conducted, botanists and wildlife biologists specifically examined habitats to determine the presence of state- and Federal-listed species (**Table 3-1**). Descriptions of the federally listed species are provided in **Attachment B**.

Table 3-1. Federal- and State-Listed Species Potentially Occurring in the Project Area

Common Name	Scientific Name	County	Federal Status	State Status
Plants				
Texas snowbells	*Styrax texana*	VV	**E**	**E**
Tobusch fishhook cactus	*Ancistrocactus tobuschii*	VV	**E**	**E**
Mussels				
Texas hornshell (clam)	*Popenaias popeii*	VV	**C**	
Fish				
Blotched gambusia	*Gambusia senilis*	VV		**T**
Blue sucker	*Cycleptus elongates*	M		**T**
Conchos pupfish	*Cyprinodon eximius*	VV		**T**
Devils River minnow	*Dionda diabolic*	VV	**T**	**T**
Fish (continued)				
Pecos pupfish	*Cyprinodon pecosensis*	VV		**T**
Proserpine shiner	*Cyprinella Proserpina*	M		**T**
Rio Grande darter	*Etheostoma graham*	M		**T**
Rio Grande silvery minnow	*Hybognathus amarus*	M	**E**	**E**
Amphibians				
South Texas siren (Large form)	*Siren sp. 1*	M		**T**
Reptiles				
Indigo snake	*Drymarchon corais*	M		**T**
Reticulate collared lizard	*Crotaphytus reticulatus*	M		**T**
Texas horned lizard	*Phrynosoma cornutum*	M		**T**
Texas tortoise	*Gopherus berlandieri*	M		**T**
Trans-Pecos black-headed snake	*Tantilla cucullata*	VV		**T**

Common Name	Scientific Name	County	Federal Status	State Status
Birds				
American peregrine falcon	*Falco peregrines anatum*	M	**DL**	**E**
Arctic peregrine falcon	*Falco peregrines tundrius*	M	**DL**	**T**
Interior least tern	*Sterna antillarum athalassos*	M, VV	**E**	**E**
Black-capped vireo	*Vireo atricapilla*	VV	**E**	**E**
Brown pelican	*Pelecanus occidentalis*	VV	**E**	
Common black hawk	*Buteogallus anthracinus*	VV		**T**
Peregrine flacon	*Falco peregrines*	M	**DL**	**ET**
Zone-tailed hawk	*Buteo albonotatus*	VV		**T**
Mammals				
Gulf Coast jaguarundi	*Herpailurus yaguarondi*	M	**E**	**E**
Gray wolf	*Canis lupus*	M	**E**	**E**
Black bear	*Ursus americanus*	M	**T/SA;NL**	**T**
White-nosed coati	*Nasus narica*	M		**T**
Ocelot	*Leopardus pardalis*	M	**E**	**E**

Sources: TPWD 2007, USFWS 2007

Notes: E = Endangered; DL = Delisted; NL = Not Listed; SA = Similar Appearance to a Threatened or Endangered Species; T = Threatened; C = Species for which USFWS has on file enough substantial information to warrant listing as threatened or endangered. M = Maverick County (Section M-2A); VV = Val Verde County (Section M-1)

Texas Department of Wildlife and Parks; Texas Natural Diversity Database

The Texas Natural Diversity Database (TXNDD) was established in 1983 and is the Texas Parks and Wildlife Department's (TPWD) most comprehensive source of information related to rare, threatened, and endangered animals, plants, exemplary natural communities, and other significant features. While these data are continually updated, there are gaps in coverage and species information due to lack of access to land for inventory, data from many sources, and a lack of staff and resources to collect and process data for all rare and significant resources. To request information from the TXNDD, please refer to <*http://www.tpwd.state.tx.us/landwater/land/maps/gis/ris/endangered_species.phtml*>.

For the project corridor, TXNDD was used to assist with the evaluation of environmental impacts of the sections under consideration. The interpretation and extrapolation of the data included consideration of (1) data gaps occur because of lack of access to private land, (2) the restriction of data extraction from only public information sources, (3) species and geographic coverage focused on the most rare species and ecosystems, and (4) the lack of precise

locality data in many secondary sources. Because of the small proportion of public land versus private land in Texas, the TXNDD does not include a representative inventory of rare resources in the state. However, it is based on the best data available to TPWD in terms of rare species locations and distributions and use of qualified biologists to provide onsite inventory and evaluation.

County lists of rare species were acquired from TPWD and these were consolidated into **Table 3-1**. The county lists include species of conservation concern in Texas. In general, species that appear on county lists do not all share the same probability of occurrence within a county, e.g., some species are migrants or wintering residents and a few species might be historic or considered extirpated within a county.

4. Environmental Setting

The project area climate is semi-arid continental (NOAA 2007) and has been further described as subtropical steppe within the modified marine climatic type, meaning that summers are long and hot and winters are short, dry, and mild (Larkin and Bomar 1983, Bailey 1995). The marine climate forms in response to the predominant onshore flow of tropical maritime air from the Gulf of Mexico. Onshore air flow is modified by a decrease in moisture content from east to west and by intermittent seasonal intrusions of continental air.

Temperatures in Del Rio occur in an average range of lows from 39 degrees Fahrenheit (°F) (January) to 74 °F (July) to an average range of highs from 62 °F (January) to 96 °F (July). The average annual precipitation is 18 inches, and approximately 80 percent occurs as showers and thunderstorms from the late spring through early fall seasons. The area experiences a long growing season of approximately 300 days. The evaporation rate during the summer season is high, and the average relative humidity is 44 percent, measured in the afternoon.

The vegetation of the Rio Grande Delta of southern Texas has generally been classified under the Dry Domain, Tropical/Subtropical Steppe Division by Bailey (1995). The project area is more finely classified as the Southwestern Plateau and Plains Dry Steppe and Shrub Province. The TPWD (TPWD 2007) provides discussion and describes vegetation geography to biotic provinces and natural regions using topographic features, climate, vegetation types, and terrestrial vertebrates. This system places the project area in the Tamaulipan Biotic Province, South Texas Brush Country (Rio Grande Basin) Natural Region, and the Level III Ecoregions of the Southern Texas Plains.

Occurring within the Lower Rio Grande Valley of southern Texas and northern Mexico, Tamaulipan Brushland represents a unique ecosystem (USFWS 1988). The characteristic natural vegetation is dense and thorny, and plant species distribution can be correlated with geologic formations. The Rio Grande floodplain supports tall and dense riparian forest, woodland, shrubland, and herbaceous vegetation, while the xeric upland areas support mostly spiny shrubs, short-stature trees, and dense nonnative grasslands. Between the 1920s and 1980s, more than 95 percent of the native brushland and 90 percent of the riparian vegetation had been converted to agriculture and urban land use (USFWS 1988). In 1988, it was estimated that 98 percent of the lush, subtropical region of the Rio Grande Delta had been cleared of native vegetation in the United States and a large but unknown percentage cleared in Mexico.

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5. Biological Resources

5.1 Vegetation Classification

The USFWS (1988) recognized 11 biotic communities in the Lower Rio Grande Valley using a combination of plant species dominance, wildlife use, topography, hydrology, and geology. Sections M-1 and M-2A lie within the Chihuahuan Thorn Forest biotic community, as described by USFWS ecologists. Chihuahuan Thorn Forest is a desert shrub community characterized by upland and riparian components, e.g., sotol, catclaw mimosa, blackbrush acacia shrublands and black willow, Montezuma baldcypress, Texas ebony, and honey mesquite riparian woodlands and forests.

NatureServe (2007) has defined ecological systems to represent recurring groups of biological communities that are found in similar physical environments and are influenced by similar dynamic ecological processes such as fire or flooding. Ecological systems represent classification units that are readily identifiable by conservation and resource managers in the field. The ensuing vegetation description for the project area was prepared in the framework of ecological systems that include the following:

1. Tamaulipan Floodplain Ecological System (CES301.990)
2. Tamaulipan Mesquite Upland Scrub Ecological System (CES301.984)
3. Tamaulipan Mixed Deciduous Thornscrub Ecological System (CES301.983)
4. Tamaulipan Savanna Grassland Ecological System (CES301.985)
5. North American Arid West Emergent Marsh Vegetation Alliances and Associations (CES300.729).

A brief description of each plant community observed within the sections is provided herein; they are distinguished using the NatureServe Vegetation Alliance level of classification or an approximation. To the extent possible, each community is illustrated and supported by representative ground photographs and foliar cover information for dominant species. Some vegetation patches and stands are introduced nonnative species and do not readily fit into a recognized vegetation alliance or ecological system predominantly designed for native vegetation; they are discussed at the end of this section.

5.1.1 Tamaulipan Floodplain Ecological System (CES301.990)

Sugarberry Riparian Woodland

Sugarberry riparian woodland stands have persisted as rare, narrow bands on the outer floodplain margin of the Rio Grande and the banks of its tributaries within Sections M-1 and M-2A (see **Figure 5-1**). Canopy cover for the mature sugarberry trees (10–15 meters tall) was approximately 10–20 percent. Honey

mesquite trees were commonly present and often codominant in the canopy layer and provided 10–15 percent cover. In one stand a subcanopy layer of granjeno, retama, and honey mesquite, 2–5 meters tall, provided approximately 15–20 percent cover. The herbaceous layer provided low to moderate cover, up to 30 percent, and included Bermuda grass, cowpen daisy, and the vine old man's beard. Another stand that had become established around seeps and a small pond included 15 percent cover each by sugarberry and black willow trees 15–20 meters tall (see also discussions under Black Willow Woodland and Emergent Wetlands types). Giant reed and Bermuda grass were codominant at this site, each provided 15–25 percent cover.

Figure 5-1. Photographs of Representative Sugarberry Habitat

Black Willow Woodland

Small stands of black willow trees mixed with a variety of other riparian trees (typically sugarberry and Mexican sabal palms) and shrubs occurred on the eastern portion of Section M-1 where seeps and springs emerged to the ground surface and ponds occurred (see **Figure 5-2**). Small pools of standing water supported elephant ears, swamp lily, arrow-weed, and small duckweed, which are described more completely under the Emergent Wetlands type. Black willow trees to 15 meters tall provided 5–15 percent cover in the canopy layer and were codominant with sugarberry, eastern cottonwood, and Mexican sabal palm that together provided approximately 20–40 percent cover. Nonnative Chinese tallow trees occurred in one stand. The common tall shrub or graminoid was giant reed or carrizo, which contributed up to 25 percent cover in these stands.

Figure 5-2. Photographs of Representative Black Willow Habitat

Giant Reed Herbaceous Vegetation

Giant reed or Carrizo occurred in dense stands 5–10 meters tall and provided cover of 40–95 percent. Stands had become established on saturated soils of Rio Grande floodplain terraces, floodplains of tributary drainages, pond edges, and ditchbanks in Sections M-1 and M-2A (see **Figure 5-3**). Understory vegetation was typically excluded due to shading, however, scattered emergent trees occurred, including sugarberry and honey mesquite to 20 meters tall. Bermuda grass was a common associate in openings along the margins of giant reed stands, providing 2–5 percent cover, and the trees sugarberry, honey mesquite, and white mulberry, 10–20 meters tall, each provided up to 5 percent cover in sampled stands. The tall shrubs Chinaberry and huisache each provided 3 percent cover in one stand within a shallow arroyo. Giant reed was identified for removal from Section M-2A under another project because it served as an effective hiding place for illegal border-crossers; however, it will not be necessary to remove the scattered native trees and shrubs that had become established within the giant reed.

Figure 5-3. Photographs of Representative Giant Reed Habitat

5.1.2 Tamaulipan Mesquite Upland Scrub Ecological System (CES301.984)

Granjeno Woodland and Shrubland

Granjeno or spiny hackberry formed stands of moderate-stature trees to 15 meters tall or was a dominant understory component in the subcanopy or tall shrub layers, 5–10 meters tall in Sections M-1 and M-2A. In representative stands granjeno cover was 20–60 percent (see **Figure 5-4**). Associated emergent and canopy trees provided low cover, up to 12 percent, and included honey mesquite and sugarberry. Retama tall shrubs provided 2 percent cover in one stand. The herbaceous layer provided low cover, 5–15 percent where canopy openings occurred, and included Bermuda grass and switchgrass.

Figure 5-4. Photographs of Representative Granjeno Habitat

Honey Mesquite Woodland

Honey mesquite woodlands with small trees 5–15 meters tall were sampled in Sections M-1 and M-2A, where they occurred in linear strips growing from bedrock exposures at the edge of the first or second Rio Grande floodplain terrace and where they re-invaded pastures. In the canopy layer, honey mesquite cover was 25–30 percent (see **Figure 5-5**). Associated canopy tree species when present included huisache and in one stand athel tamarisk, which provided low cover of 1–15 percent. The tall and short shrub layers provided low cover, 3–20 percent, and included granjeno, Texas prickly pear, and honey mesquite saplings. The herbaceous layer contributed low to moderate cover of 7–45 percent and was dominated by Bermuda grass, buffelgrass, switchgrass, and cowpen daisy. Honey mesquite trees and tall shrubs were common invaders of former and current pastureland planted to Bermuda grass.

Figure 5-5. Photographs of Representative Honey Mesquite Woodland Habitat

5.1.3 Tamaulipan Mixed Deciduous Thornscrub Ecological System (CES301.983)

Honey Mesquite Shrubland

Honey mesquite tall shrubs were distributed throughout Sections M-1 and M-2A sections and recently had become re-established in nonnative Bermuda grass pastures (over the past 10 years). Honey mesquite 2–5 meters in height in the tall shrub layer typically provided up to 15 percent cover in shrub herbaceous stands (see **Figure 5-6**). The herbaceous layer was dominated by nonnative Bermuda grass, which provided up to 80 percent cover.

Figure 5-6. Photographs of Representative Honey Mesquite Shrub Herbaceous Vegetation Habitat

Huisache Woodland

Huisache is distributed throughout Sections M-1 and M-2A, occurring as tall shrubs in the understory of woodlands and rarely as short-stature woodlands along drainages and fencerows, where re-establishment within or around nonnative Bermuda grass pastures had occurred over several years. Huisache trees ranged up to 15 meters tall and provided up to 25 percent cover in one stand along Cienegas Creek (see **Figure 5-7**). The canopy tree honey mesquite provided 5 percent cover in the sampled stand, and the tall shrub giant reed provided moderate cover (30 percent). The herbaceous layer was dominated by nonnative Bermuda grass, which provided 15 percent cover. Sparse cover, up to 2 percent, by bushy bluestem occurred on steep banks in the Cienegas Creek stand.

Figure 5-7. Photographs of Representative Huisache Woodland Habitat

5.1.4 Tamaulipan Savanna Grassland Ecological System (CES301.985)

Retama Shrubland

Retama had invaded grassland habitat along an access road to Cienegas Creek, forming tall shrublands. Where retama had become established the tall shrub provided moderate cover, up to 35 percent within Section M-1 (see **Figure 5-8**). Texas prickly-pear cactus provided 3 percent cover in the short shrub layer of the sampled stand, and lanceleaf sumac provided sparse cover. The herbaceous layer in this type was relatively monotypic and dominated by the nonnative Bermuda grass, which provided up to 45 percent cover. The forbs cowpen daisy, stinking gourd, and common horehound provided sparse cover.

Figure 5-8. Photographs of Representative Retama Habitat

5.1.5 North-American Arid West Emergent Marsh Vegetation Alliances and Associations (CES300.729)

Emergent Wetlands

Small patches of emergent wetlands occurred within Sections M-1 and M-2A and were typically sampled as herbaceous components of larger woodland vegetation stands (see **Figure 5-9**). Emergent wetland patches occupied shallow ponds, stream banks, resaca margins, saturated soils, and seeps. Observed in particular were narrow-leaved cattail, elephant-ear, swamp lily, arrow-head, flat sedge, small duckweed, pickerelweed, and algae. In the backwaters of Cienegas Creek, the emergent wetland species water-pennywort, Indian swampweed, and water lettuce occurred.


Figure 5-9. Photographs of Representative Emergent Wetland Habitat

5.1.6 Nonnative Herbaceous Vegetation Alliances and Associations

Bermuda Grass Semi-Natural Herbaceous Vegetation

A large stand of Bermuda grass had become established in a historic pasture or corral in the vicinity of the port of entry (POE) in Section M-1 and has apparently not been grazed for more than a year (see **Figure 5-10**). The POE stand was regularly mown and resembled a large lawn. Typical stands/pastures of this nonnative rhizomatous grass in the vicinity of Del Rio and Eagle Pass had become invaded by honey mesquite, huisache, and retama tall shrubs and trees and are described above under the woodland and shrubland types. On one stand adjacent to a homestead, Bermuda grass provided 90 percent cover. Associated species that individually provided 2–5 percent cover included old man's beard vines and honey mesquite shrubs and the forbs annual sunflower, cocklebur, and spiny aster.


Figure 5-10. Photographs of Representative Bermuda Grass Habitat

Russian-thistle Semi-Natural Herbaceous Vegetation

One large area that appearred to be used as a former agricultural field occupied the terrace north of the Rio Grande in Section M-2A near Eagle Pass and predominantly supported the nonnative annual forb Russian-thistle. This floodplain second-terrace was elevated above the Rio Grande first terrace by approximately 15 meters. The fine-textured soils sealed following precipitation to create shallow ponded water, as indicated by mud cracks. Russian-thistle tumbleweeds, providing up to 45 percent cover, dominated this disturbed site (see **Figure 5-11**), along with low cover of the nonnative grasses buffelgrass (4 percent cover), switchgrass (2 percent cover), and giant reed (2 percent cover). Low cover, up to 5 percent, was provided by the native forb annual sunflower. The site had several small access roads up to 4 meters wide traversing it and was apparently under planning to be developed into single family dwellings in future years.

Figure 5-11. Photographs of Representative Russian-thistle Habitat

5.2 Plant Species Identified

A list of plant species prepared during the field surveys and including wetlands indicator status and the tactical infrastructure section in which each species was identified is provided in **Table 5-1**. The number of taxa identified during the fall surveys was 74.

Table 5-1. Plant Species Observed in Del Rio Sector Sections M-1 and M-2A

Section		Scientific Name/Common Name	Wetland Indictor Status
M-1	M-2A		
	X	*Acacia berlandieri*/Guajillo	—
X	X	*Acacia farnesiana*/Huisache	—
	X	*Acacia rigidula*/Chaparro Prieto	—
	X	*Agave americana*/Century Plant	—
X	X	*Aloysia gratissima*/Whitebrush	—
X		*Ambrosia cumanensis*/Perennial Ragweed	—
	X	*Ambrosia trifida*/Giant Ragweed	FAC
X		*Ampelopsis arborea*/Peppervine	FAC
X		*Andropogon glomeratus*/Bushy Bluestem	—
X	X	*Arundo donax*/Giant Reed, Carrizo	FAC+
X	X	*Aster spinosus (Leucosyris spinosa)*/Mexican Devil-weed	FACW-
X	X	*Baccharis neglecta*/Jara Dulce, Roosevelt Weed	FAC
X		*Bothriochloa laguroides*/Silver Bluestem	—
X		*Callirhoe involucrata*/Winecup	—
X		*Calyptocarpus vialis*/Straggler Daisy	FAC
X		*Campsis radicans*/Trumpet Creeper	FAC
X		*Capsicum annuum*/Chilipiquin	—
	X	*Castela erecta*/Amargosa, Goatbush	—
	X	*Castela texana*/Amargosa	—
X	X	*Celtis laevigata*/Palo Blanco, Texas Sugarberry	FAC
X	X	*Celtis laevigata* var. *reticulata*/Palo Blanco, Netleaf Hackberry	UPL
X	X	*Celtis pallida*/Granjeno, Spiny Hackberry	—
X		*Cissus incisa (Cissus trifoliata)*/Hierba del Buey, Ivy Treebine, Possum Grape	FACU-
X	X	*Clematis drummondii*/Barbas de Chivato, Old Man's Beard	—
X		*Colocasia esculenta*/Elephant Ears, Coco Yam	OBL
	X	*Condalia spathulata*/Costilla, Knifeleaf Condalia	—

Section		Scientific Name/Common Name	Wetland Indictor Status
M-1	M-2A		
X		*Crinum americanum*/Swamp Lily	OBL
X		*Cucurbita foetidissima*/Stinking Gourd	—
X	X	*Cynodon dactylon*/Pato de Gallo, Bermuda Grass	FACU+
X		*Cyperus tenuis*/Flat Sedge	—
X		*Datura inoxia*/Indian Apple	—
	X	*Ehretia anacua*/Anacua	—
	X	*Guaiacum angustifolium*/Guayacan, Soap-bush, Ironwood	—
X	X	*Gutierrezia sarothrae/*Broom Snakeweed	—
X	X	*Helianthus annuus*/Annual Sunflower	FAC
X		*Hydrocotyle umbellata/*Water-pennywort	OBL
X		*Hygrophila polysperma*/Indian Swampweed	OBL
	X	*Lantana camara*/Lantana	FACU
X		*Lantana urticoides/*Texas Lantana	—
X		*Lemna minuta/*Small Duckweed	OBL
X		*Leucophyllum frutescens*/Cenizo, Purple Sage	—
X		*Marrubium vulgare/*Common Horehound	FACW-
X	X	*Melia azedarach/*Paraiso, Chinaberry-tree	—
X	X	*Morus alba/*Mulberry	FACU*
X	X	*Nicotiana glauca/*Tree Tobacco	FAC
X	X	*Opuntia engelmannii*/Nopal, Texas Prickly Pear	—
X	X	*Panicum virginatum*/Switchgrass	—
X	X	*Parkinsonia aculeata*/Retama	FACW-
X	X	*Pennisetum ciliare (Cenchrus ciliaris)*/Buffelgrass	—
	X	*Phoradendron tomentosum*/Mistletoe	—
X		*Phytolacca americana*/Pokeweed	FAC-
X		*Pistia stratiotes*/Water Lettuce	OBL
X		*Platanus occidentalis*/Sycamore	FAC+
X		*Pontederia cordata*/Pickerelweed	OBL
X		*Populus deltoides*/Eastern Cottonwood	FAC

Section		Scientific Name/Common Name	Wetland Indictor Status
M-1	M-2A		
X	X	*Prosopis glandulosa*/Mesquite, Honey Mesquite	—
X		*Rhus lanceolata*/Flameleaf (Lanceleaf) Sumac	—
X		*Rivina humilis*/Coralito, Pigeonberry	—
X		*Sabal mexicana*/Palm	—
X		*Sagittaria longiloba*/Arrow-head	OBL
X	X	*Salix nigra*/Sauz, Black Willow	FACW+
X	X	*Salsola australis*/Russian-thistle	FACU
X		*Sapium sebiferum*/Chinese Tallow Tree	—
X		*Sida abutifolia*/Spreading Sida	—
X		*Solanum elaeagnifolium*/Trompillo, Silverleaf Nightshade	—
X	X	*Sorghum halepense*/Johnsongrass	FACU
X	X	*Sphaeralcea angustifolia*/Globe-mallow	—
X		*Talinum angustissimum*/Flame Flower	—
X	X	*Tamarix aphylla*/Athel Tamarisk, Saltcedar	FACW
X	X	*Typha domingensis*/Tule, Narrow-leaf Cattail	OBL
X	X	*Verbesina encelioides*/Cowpen Daisy	FAC
X		*Xanthium strumarium*/Cocklebur	FAC-
	X	*Ziziphus obtusifolia*/Clepe, Lotebush	—
61	40	Total number of species in each section	
33	18	Total number of FACW- to OBL species per section	

Note: Wetland Indicator Status (NRCS 2007): Facultative Upland (FACU) – usually occurs in non-wetlands, but occasionally found in wetlands; Facultative (FAC) – equally likely to occur in wetlands or nonwetlands; Facultative Wetland (FACW) – usually occurs in wetlands but occasionally found in nonwetlands; Obligate Wetland (OBL) – occurs almost always under natural conditions in wetlands; Upland (UPL) – Occurs in wetlands in another region, but occurs almost always (estimated probability 99%) under natural conditions in non-wetlands in the regions specified; (*) = tentative assignments based on limited information, (-) = less frequently found in wetlands).

5.3 Fence Section Characteristics and Description of Habitat Quality

A general description of the habitat quality as it relates to rare plant species and the landscape characteristics of each section are provided below.

5.3.1 Section M-1

County:	Val Verde
Potential Listed Plant Species:	*Sclerocactus brevihamatus* ssp. *tobuschii (*formerly *Ancistrocactus tobuschii)* Tobusch fishhook cactus (FE, SE) *Styrax platanifolius* spp. *texanus* (formerly *Styrax texana*) Texas snowbells (FE, SE)
Listed Plants Observed:	None
Suitable Listed Plant Habitat Present:	No
If so, Habitat Quality:	NA

Section M-1 consists of multiple privately owned tracts of land, many with active cattle grazing and other activities. Although generally the species assemblage remains consistent from tract to tract, varying stages of succession or regrowth are evident. Southeast of the POE is a residential street that parallels the project corridor and is bounded immediately to the south by a mesic wetland area consisting of springs, shallow pools, and ponds.

The northernmost boundary of this section begins at Cienegas Creek and traverses relatively mature mesquite-hackberry woodland. Some areas of this woodland are dense enough to create a dark understory with mostly leaf litter and very little understory vegetation. Woody tree species along this area are hackberry, sugarberry, spiny hackberry, mesquite, huisache, retama, flameleaf (or lanceleaf) sumac, and one sycamore tree. Other species encountered were lantana, common horehound, chilipiquin, pokeweed, jimson weed, pigeonberry, cocklebur, stinking gourd, cowpen daisy, Bermuda grass, and buffelgrass. With the exception of the sumac and the sycamore, this same species assemblage (in varying stages of succession or regrowth) continued southeastward to the POE. There was also one large stand of giant reed in the section.

Southeast of the POE, the project corridor crosses between a line of residences and a wetland. This wetland area consists of springs, seeps, pools, and ponds, which extend within approximately 100 feet of several homes. Woody species observed were cottonwood, black willow, mesquite, tree tobacco, Chinese tallow, Chinaberry, hackberry, sugarberry, mulberry, retama, and huisache. Herbaceous plants along the mesic zone were cattails, giant reed, water-pennywort, flatsedge, swamp lily, hygrophila, small duckweed, water lettuce, pickerelweed, arrowhead, elephant ears, and straggler daisy. The southernmost ponds or impoundments were surrounded by Bermuda grass, cattails, retama, and huisache.

There was no suitable habitat for the endangered Tobusch fishhook cactus or the endangered Texas snowbells along this section.

5.3.2 Section M-2A

County:	Maverick
Potential Listed Plant Species:	None
Listed Plants Observed:	None
Suitable Listed Plant Habitat Present:	No
If so, Habitat Quality:	NA

Section M-2A consists of mostly a dense stand of giant reed along the riverside, with a thin ridge (higher in elevation) of brush just to the east, and highly disturbed open tracts or residential areas just beyond and to the east of the ridge line. The unpaved access road used for border patrol consists of very fine, powdery soil. The dense giant reed stand contains the occasional tree tobacco, Roosevelt weed, and retama, along with abundant Bermuda grass. The ridge line consists of brushy species such as mesquite, guayacan, whitebrush, and spiny hackberry, with scattered prickly pear throughout. The highly disturbed tracts along the northern extent of this section are dominated by Russian-thistle and broom snake weed, along with areas of globe mallow, buffelgrass, and switchgrass.

5.4 Wetlands and Waters of the United States

Wetlands and waters of the United States can be confusing terms and are defined here for the convenience of document users. The U.S. Army Corps of Engineers (USACE) has jurisdiction to protect wetlands under Section 404 of the Clean Water Act using the following definition:

> *. . . areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions (33 Code of Federal Regulations [CFR] 328.3[b]). Wetlands generally include swamps, marshes, bogs, and similar areas.*

Wetlands have three diagnostic characteristics that include (1) more than 50 percent of the dominant species present must be classified as obligate, facultative wetland, or facultative; (2) the soils must be classified as hydric; and (3) the area is either permanently or seasonally inundated (Environmental Laboratory 1987).

Waters of the United States are defined under 33 *United States Code* (U.S.C.) 1344, as follows:

a. The term “waters of the United States” means

   1. All waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide;
   2. All interstate waters including interstate wetlands;
   3. All other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation or destruction of which could affect interstate or foreign commerce including any such waters:
      i. Which are or could be used by interstate or foreign travelers for recreational or other purposes; or
      ii. From which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or
      iii. Which are used or could be used for industrial purpose by industries in interstate commerce;
   4. All impoundments of waters otherwise defined as waters of the United States under the definition;
   5. Tributaries of waters identified in paragraphs (a)(1)-(4) of this section;
   6. The territorial seas;
   7. Wetlands adjacent to waters (other than waters that are themselves wetlands) identified in paragraphs (a)(1)-(6) of this section.

      Waste treatment systems, including treatment ponds or lagoons designed to meet the requirements of the Clean Water Act (CWA) (other than cooling ponds as defined in 40 CFR 123.11(m) which also meet the criteria of this definition) are not waters of the United States.
   8. Waters of the United States do not include prior converted cropland. Notwithstanding the determination of an area's status as prior converted cropland by any other Federal agency, for the purposes of the CWA, the final authority regarding CWA jurisdiction remains with the EPA.

b. The term "wetlands" means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

c. The term "adjacent" means bordering, contiguous, or neighboring. Wetlands separated from other waters of the United States by man-made dikes or barriers, natural river berms, beach dunes and the like are "adjacent wetlands."

d. The term "high tide line" means the line of intersection of the land with the water's surface at the maximum height reached by a rising tide. The high tide line may be determined, in the absence of actual data, by a line of oil or scum along shore objects, a more or less continuous deposit of fine shell or debris on the foreshore or berm, other physical markings or characteristics, vegetation lines, tidal gages, or other suitable means that delineate the general height reached by a rising tide. The line encompasses spring high tides and other high tides that occur with periodic frequency but does not include storm surges in which there is a departure from the normal or predicted reach of the tide due to the piling up of water against a coast by strong winds such as those accompanying a hurricane or other intense storm.

e. The term "ordinary high water mark" means that line on the shore established by the fluctuations of water and indicated by physical characteristics such as clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas.

The term “tidal waters” means those waters that rise and fall in a predictable and measurable rhythm or cycle due to the gravitational pulls of the moon and sun. Tidal waters end where the rise and fall of the water surface can no longer be practically measured in a predictable rhythm due to masking by hydrologic, wind, or other effects.

5.4.1 Field Evaluation Summary

Observations and initial identification of potential wetlands and waters of the United States were recorded and reported to wetlands ecologists during the November 2007 field inventory. During January 2008, wetland ecology teams sampled nine potential and known wetland sites to determine the wetlands classification and boundary, determination of jurisdictional status (jurisdictional determination form), record physical site data (wetland data observation form), and acquire on-the-ground photographs. The teams assessed wetlands and waters of the United States within a 150-foot-wide corridor for the length of the Project. Additionally, construction staging areas were assessed for wetlands and waters of the United States in conjunction with the corridor analyses. In general, wetlands of the project corridor have become established in seeps and springs, rivers and creeks, canals and ditches, ponds, and arroyos.

5.4.2 Wetlands Vegetation Summary

Wetlands delineated within the Del Rio Sector included forest, woodland, shrubland, and herbaceous types. The characteristic species for each wetlands type sampled and delineated in the field are presented below by stand physiognomy.

Forest and Woodland

- Acacia – Honey Mesquite Riparian Woodland
- Black Willow – Sugarberry/Giant Reed Riparian Woodland
- Sugarberry/Giant Reed Riparian Woodland

Shrubland

- Roosevelt Weed – Honey Mesquite/Giant Reed Shrubland

Herbaceous

- Giant Reed Herbaceous Vegetation

5.4.3 Wetlands Soil Summary

Soils supporting wetlands and waters of the United States within the Lower Rio Grande Valley included (1) Lagloria very fine sandy loam, 1 to 3 percent slopes, (2) Rio Grande soils, frequently flooded; (3) Rio Grande silt loam, occasionally flooded, and (4) Zalla, frequently flooded. The common soil textures of these Rio Grande floodplain sites are coarse silt and sandy. The matrix color of the A horizon for Del Rio Sector wetland soils was consistently a light brown hue (10YR) with the value ranging from 3 to 6 and the chroma ranging from 1 to 4. Wetland soils under long-term standing water or soils saturated by the groundwater table exhibited gleying and a few exhibited mottling. The mottles were typically a light brown hue (10YR) or less commonly a brown hue (7.5YR) with values of 4 and chromas ranging from 3 to 6.

5.5 Noxious Weeds and Invasive Nonnative Species

The State of Texas maintains a noxious weed definition, species list, and control districts under a legislative determination (TDA 2008). The legislature has determined that: (1) noxious weeds are present in this state to a degree that poses a threat to agriculture and is deleterious to the proper use of soil and other natural resources, and (2) reclamation of land from noxious weeds is a public right and duty in the interest of conservation and development of the natural resources of the state (Chapter 388, Acts 1981, Sixty-seventh Legislature). Under Chapter 388 of this act “a weed or plant is considered to be a noxious weed if declared to be a noxious weed by: (1) a law of this state, or (2) the department acting under the authority of Chapter 61 if this code or any other law of this state.” This Act is administered by the Texas Department of Agriculture under Title 4, Part 1, Chapter 19, Subchapter T: Noxious and Invasive Plants.

The act and other legislation provide a list of noxious weed species present and managed within Texas (see **Table 5-4**). Additionally, TPWD has listed the water lettuce, observed in Section M-1 in this survey, as a prohibited exotic species. The Web site Texasinvasives.org, provides a list of 137 plant species considered

to be nonnative invasives or noxious weeds within Texas, 9 of which occur within the project corridor and are listed in **Table 5-4**.

Table 5-4. Noxious Weed List for the Project Corridor

Common Name	Scientific Name	Fence Sections Observed
Giant Reed; Carrizo[1,2]	*Arundo donax*	M-1, M-2A
Bermuda Grass[2]	*Cynodon dactylon*	M-1, M-2A
Common Horehound[2]	*Marrubium vulgare*	M-1
China-berry Tree[2]	*Melia azedarach*	M-1, M-2A
Tree Tobacco[2]	*Nicotiana glauca*	M-1, M-2A
Buffelgrass[2]	*Pennisetum ciliare*	M-1, M-2A
Water Lettuce[1,2]	*Pistia stratioides*	M-1
Russian-thistle[2]	*Salsola tragus*	M-1, M-2A
Johnsongrass[2]	*Sorghum halepense*	M-1, M-2A
Athel Tamarisk[1,2]	*Tamarix aphylla*	M-1, M-2A
Guineagrass[2]	*Urochloa maxima*	M-1, M-2A

Source: Texasinvasives.org 2007
Notes: [1] = Noxious, [2] = Nonnative Invasive

In general, nonnative noxious and invasive plant species represent a serious management concern, and their inventory, monitoring, and control is expensive for land managers. Within the project corridor, 14 species of nonnative plants have been identified and 3 of these species (i.e., giant reed, water lettuce, athel tamarisk) are considered noxious in Texas. Nonnative species usually lower the value of wildlife habitat and compete with agricultural crops resulting in lower forage value and production. Once inventoried, methods commonly used to control nonnative species include biological, mechanical, and chemical. Controls must be ongoing to be effective in reducing, but only rarely eliminating, nonnative plant species.

5.6 Wildlife and Wildlife Habitat

5.6.1 Introduction

The landscape surrounding the Del Rio Sector is unique in that it is located at the convergence of the Rio Grande Plain, Edward's plateau, and the Trans-pecos ecoregions. The southern extent of the Del Rio sector is located at the northwestern edge of the Rio Grande Plain, also known as the southern Texas brush country, or Tamaulipan brushland. The northern portion of the Del Rio

Sector is within the southwestern edge of the Edward's Plateau and is near the eastern edge of the Trans-pecos. Though the delineated boundaries of these ecoregions are all within close proximity to the Del Rio project area, the ecological systems found within the Del Rio Sector project area are more indicative of the Rio Grande Plain than the former or latter. Eleven communities have been cross checked against the National Vegetation Classification System at the ecological system level (NatureServe 2007) where four ecological systems have been described by vegetation alliances and plant associations observed during field studies.

There is a diverse array of wildlife species due to the ecotonal habitat diversity at the landscape scale. Much of the vegetation in the Del Rio area has been cleared or altered, however, National Wildlife Refuges (NWRs), state parks and wildlife areas, properties purchased for conservation by nonprofit organizations, and some private holdings, are important links in the efforts to protect the biodiversity and related economics of the region.

5.7 Wildlife Observed

Table 5-5 below lists wildlife observed during the field surveys.

Table 5-5. Wildlife Observed During Natural Resources Surveys November 5 and 6, 2007

Common Name	Scientific Name	Species Status	M-1	M-2A
Insects				
Cloudless sulfur	*Phoebis sennae eubule*	C	X	
Monarch butterfly	*Danaus plexippus*	C	X	
Painted lady butterfly	*Vanessa cardui*	C	X	
Amphibians				
Bullfrog	*Rana catesbiena*	C	X	
Rio Grande leopard frog	*Rana berlandieri*	C	X	
Reptiles				
Indigo snake	*Drymarchon corais*	ST	X	
Birds				
Baltimore oriole	*Icterus galbula*	C	X	X
Barn swallow	*Riparia riparia*	C		X
Black-bellied whistling duck	*Dendrocygna autumnalis*	C	X	
Bufflehead	*Bucephala albeola*	C	X	

Common Name	Scientific Name	Species Status	M-1	M-2A
Couch's kingbird	*Tyrannus couchii*	C	X	X
Double-crested cormorant	*Phalacrocorax auritus*	C	X	
Gadwall	*Anas strepera*	C	X	
Great egret	*Ardea alba*	C		X
Great-tailed grackle	*Quiscalus mexicanus*	C	X	X
Inca dove	*Columbina inca*	C		X
Kingfisher	*Megaceryle* sp.	C	X	
Mallard	*Anas platyrhynchos*	C	X	
Mourning dove	*Zenaida aurtia*	C	X	
Northern cardinal	*Cardinalis cardinalis*	C	X	
Northern shoveler	*Anas clypeata*	C	X	
Red-shouldered hawk	*Buteo lineatus*	C	X	
Says phoebe	*Sayornis saya*	C		X
Scissor-tailed flycatcher	*Tyrannus forticatus*	C		X
Sparrow	*Spizella* sp.	C	X	X
Vermilion flycatcher	*Pyrocephalus rubinus*	C		X
Wild turkey	*Meleagris gallopavo*	C	X	
Mammals				
Raccoon	*Procyon lotor*	C		X

Notes:
C = Common
ST = State threatened

Table 5-6. Wildlife Habitat Types Observed in the Mapping Corridor

Wildlife Habitat Type Observed	Acreage by Section Numbers		Total Acreage of Wildlife Habitats
	M-1 Impact Corridor	M-2A Impact Corridor	
Herbaceous Vegetation			
Bermuda Grass Herbaceous Vegetation	21.903	0.228	22.131
Giant Reed Shrubland/Herbaceous Vegetation	11.9633	0.528	12.491
Russian-thistle Herbaceous Vegetation	---	0.001	0.001
Shrubland			
Honey Mesquite Woodland/Shrubland	59.793	0.263	60.056
Ratama Shrubland	1.022	---	1.022
Woodland and Forest			
Black Willow Woodland	0.203	---	0.203
Granjeno Woodland/Shrubland	3.278	---	3.278
Huisache Woodland/Shrubland	0.572	---	0.572
Sugarberry - Honey Mesquite Woodland	11.132	1.193	12.325
Open Water			
Open Water Pond/Lake	2.671	---	2.671
Land Use			
Facilities (e.g., Buildings, Driveways, Landscape)	7.880	---	7.880
Private Residences	2.963	---	2.963
Roads and Trails	11.088	2.259	13.347
Total	**134.468**	**4.471**	**138.939**

5.7.1 Wildlife and Habitat Overview

The project corridor supports diverse populations and individuals of vertebrate and invertebrate wildlife species (see **Attachment D**, and unique-to-common native and nonnative wildlife habitats, described as vegetation alliances, plant associations, and land use types (see **Section 5.1**). **Table 5-5** lists wildlife observed during the field surveys. The table can provide a general indication of species richness in each section. Along the international border, climate, geology, soils, land forms, geography, precipitation, and plant communities combine to provide excellent habitat diversity. Recent estimates concur that only

a small percentage of the native landscape remains within the Del Rio Sector and its associated terraces and uplands, where it is generally distributed as discontinuous vegetation patches and stands.

Vegetation and wildlife diversity within these native habitat fragments and nonnative stands totals more than 1,200 species of plants, approximately 600 species of vertebrates (including approximately 400 bird species), and 150 species of butterflies. Within the Del Rio project corridor, the broad habitat types available to resident and migrating wildlife species include herbaceous vegetation, shrubland, woodland and forest, agriculture, water bodies, and residential and urban landscapes. Most of the available wildlife habitat has become established on Rio Grande alluvium. This section provides a brief summary of wildlife habitats observed and sampled in 2007 (see **Table 5-6**) during ESP preparation, categorized as follows:

1. Herbaceous Vegetation: This class of wildlife habitat includes annual and perennial species of grasses, forbs, and graminoids, which typically are characterized by no less than 15 percent cover by shrubs or trees. Stands of herbaceous vegetation range from less than 0.5 meters up to 10.0 meters tall and range from low to dense in terms of cover. Herbaceous wildlife habitat occurs within the entire length of the project corridor.

a. *Grasslands.* Bermuda grass stands are common along the project corridor, reaching 90 percent cover in areas. Old man's beard vines, honey mesquite shrubs, and the forbs annual sunflower, cocklebur, and spiny aster contributed between 2 percent and 5 percent cover in the Bermuda grass communities observed. Occurring as pastures for grazing livestock, grass hay fields, woodland and shrubland clearings, and on the banks of the IBWC levee, these nonnative grassland habitats typically have low floristic species diversity, provide thick mats of litter as ground cover, and occur as moderate to dense stands in terms of foliar cover. Wildlife species such as the fulvous harvest mouse, blue spiny lizard, and Rio Grande leopard frog (when wetlands or water bodies are nearby) can commonly be found in Bermuda grass grasslands. Raccoons, skunks, and coyotes are also commonly found in the dense grassland habitat. Species of dove and the northern bobwhite often forage for seeds within and raptors including the Harris' and red-tailed hawks, northern harrier, and American kestrel hunt extensively over grassland habitat. Ground nesting birds, including the eastern meadowlark and lark bunting, rely on grasslands for forage, escape cover, nesting, and brood rearing.

b. *Forblands*. One forb-dominated community was identified on the second-terrace floodplain north of the Rio Grande in Section M-2A near Eagle Pass. Russian-thistle provides up to 45 percent cover at the site, intermixed with the Russian thistle in this community are the nonnative grasses buffelgrass (4 percent cover), switchgrass (2

percent cover), and giant reed (2 percent cover). Low cover, up to 5 percent, is provided by the native forb annual sunflower. Russian-thistle is a minor component (less than 10 percent) in mule deer diets. It is an important prairie dog food and pronghorn show high preference for the summer growth in years of high precipitation. Russian-thistle seeds are eaten by at least eight species of granivorous birds, including scaled and Gambel's quail. Small mammals also consume the seeds.

c. *Emergent Wetlands.* Small patches of emergent wetlands occur within Sections M-1 and M-2A. Emergent wetland patches occupy shallow ponds, stream banks, resaca margins, saturated soils, and seeps. Observed in particular are narrow-leaved cattail, elephant-ear, swamp lily, arrow-head, flat sedge, small duckweed, pickerelweed, and algae. In the backwaters of Cienegas Creek, the emergent wetland species water-pennywort, Indian swampweed, and water lettuce occur. Emergent wetlands can be tall, from 2 meters–10 meters in height and dense, providing habitat for birds, mammals, reptiles, and many invertebrates. Avian species that use emergent wetlands for roosting, nesting and brood rearing, foraging, and as escape cover include the red-winged and Brewer's blackbirds, barn and tree swallows, common yellowthroat, and purple gallinule. Vermillion and scissor-tailed flycatchers forage over emergent wetland stands. Adjacent shallow water, when present, is used by wading birds including herons and waterfowl particularly the American coot. Emergent wetlands provide important basking habitat for Texas spiny softshell turtle and the Rio Grande cooter and important escape cover and breeding habitat for the Rio Grande leopard frog.

2. Shrublands: This habitat class is somewhat rare within the project corridor, occupying approximately 39 acres. The characteristic shrubs range from 2 meters–10 meters tall and include mule's fat, honey mesquite, and a variety of upland thornscrub species. Shrublands provide sparse to dense cover and are more common on the ridges and hills of the western Project terminus.

   a. *Short Shrublands.* Honey mesquite shrubs are distributed throughout Sections M-1 and M-2A sections and recently have become re-established in nonnative Bermuda grass pastures over the past 10 years. Honey mesquite 2–5 meters in height in the tall shrub layer typically provides up to 15 percent cover in shrub herbaceous stands. The herbaceous layer in these shrublands is dominated by nonnative Bermuda grass, which provides up to 80 percent cover. Laredo striped whiptail, prairie racerunner, and Texas horned lizard are common to abundant in short shrub stands using them for foraging, breeding, resting, and as escape cover. Birds that commonly forage, breed, rest, and use short shrub habitats as escape cover include ruby-crowned kinglet, pyrrhuloxia,

cactus wren, species of doves, and the greater roadrunner. Raptors, including the turkey and black vultures and Chihuahuan raven commonly hunt over short shrub habitats. Cottontail rabbits and coyotes commonly use short-shrub habitats for home ranges.

b. *Tall Shrublands*. Where retama has become established, the tall shrub provides moderate cover, up to 35 percent within Section M-1. Texas prickly-pear cactus provides 3 percent cover in the short shrub layer of the sampled stand, and lanceleaf sumac provides sparse cover. The herbaceous layer in this type is relatively monotypic and dominated by the nonnative Bermuda grass, which provides up to 45 percent cover. The forbs cowpen daisy, stinking gourd, and common horehound provide sparse cover. Stands of tall shrubs occur predominantly along the margins of the Rio Grande floodplain on second or third terraces or in topographic depressions. Characterized by retama, granjeno, mule's fat, and honey mesquite tall shrubs from 4 meters–10 meters tall, this habitat type ranges from moderate to dense in terms of foliar cover. Tall shrubs provide important perching, breeding, nesting, brood rearing, and escape cover for a variety of birds including species of doves, bobwhite quail, northern mockingbird, Couch's kingbird, and species of flycatchers. Mammals commonly use tall shrub habitats for resting, foraging, and as part of home ranges and include javelina, bobcat, coyote, gray fox, raccoon, cottontails, and the fulvous harvest mouse.

3. Woodlands and Forests: Open to closed-canopy stands of trees occupy approximately 276 acres throughout the length of the project corridor. Diverse riparian forests occupy the first terrace of the Rio Grande and woodlands more commonly occur on higher river terraces, in fencerows, and as restoration plantings in old agricultural fields. Woodlands typically provide moderate canopy cover and range between 5 and 15 meters tall; dense stands of nonnative grasses, particularly buffelgrass and switchgrass almost always dominate the woodland understory. Forest stands range between 10 and 25 meters tall, provide dense canopy cover, and often have subcanopy and tall shrub layers, which enhance the wildlife habitat value.

   a. *Upland.* Granjeno or spiny hackberry forms stands of moderate-stature trees to 15 meters tall or is a dominant understory component in the subcanopy or tall shrub layers, 5–10 meters tall in Sections M-1 and M-2A. In representative stands granjeno cover is 20–60 percent. Associated emergent and canopy trees provide low cover, up to 12 percent, and include honey mesquite and sugarberry. Retama tall shrubs provide 2 percent cover in one stand. The herbaceous layer provides low cover, 5–15 percent where canopy openings occur, and include Bermuda grass and switchgrass. Invaluable to wildlife; fruit for birds, raccoons, deer,

and jackrabbits; leaves and branches browsed by wildlife and livestock; a variety of butterfly caterpillars feed on leaves; good honey plant; cover, nest sites.

b. *Floodplain High Terraces.* Honey mesquite woodlands with small trees 5–15 meters tall were sampled in Sections M-1 and M-2A, where they occur in linear strips growing from bedrock exposures at the edge of the first or second Rio Grande floodplain terrace and where they have re-invaded pastures. In the canopy layer, honey mesquite cover is 25–30 percent. Associated canopy tree species when present include huisache and in one stand athel tamarisk, which provides low cover of 1–15 percent. The tall and short shrub layers provide low cover, 3–20 percent, and include granjeno, Texas prickly pear, and honey mesquite saplings. The herbaceous layer contributes low to moderate cover of 7–45 percent and is dominated by Bermuda grass, buffelgrass, switchgrass, and cowpen daisy. Honey mesquite trees and tall shrubs are common invaders of former and current pastureland planted to Bermuda grass. While adult mesquite plants are not palatable and are not browsed by mammals (with the possible exception of new regrowth sprouts), they provide cover for many. In addition, many species of insects are dependent on mesquite, including the cutworm (*Melipotis* spp.), the twig girdler (*Oncideris* spp.), and Bruchid beetles (Ansley 1997).

c. *Floodplain Low Terraces*. Sugarberry riparian woodland stands have persisted as rare, narrow bands on the outer floodplain margin of the Rio Grande, the banks of its tributaries, and around seeps and small ponds within Sections M-1 and M-2A. Canopy cover for the mature sugarberry trees (10–15 meters tall) is approximately 10–20 percent. Honey mesquite trees are commonly present and often codominant in the canopy layer and provided 10–15 percent cover. Other flora identified within the sugarberry riparian woodland stands are the trees granjeno, retama, and black willow. The herbaceous layer provides up to 30 percent cover, and includes cowpen daisy, old man's beard (vine), Bermuda grass, and giant reed. Numerous avifauna use the floodplain forest habitat for foraging, breeding, nesting, brood rearing, perching, and escape cover, including the plain chachalaca, green jay, hooded oriole, northern rough-winged swallow, golden-fronted woodpecker, northern mockingbird, blue-gray gnatcatcher, groove-billed ani, and Carolina wren. Raptors, including hawks, falcons, and vultures perch in the large riparian trees and forage in their vicinity. Mammal use is typically high in these areas. Javelinas, raccoon, cottontails, ground squirrels, skunk, coyote, and bobcat commonly utilize the lower floodplain terraces for cover, foraging and hunting. High diversity of invertebrates also occur within these floodplain forests.

d. *Wooded Wetlands.* Small stands of black willow trees mixed with a variety of other riparian trees (typically sugarberry and Mexican sabal palms) and shrubs occur on the eastern portion of Section M-1 where seeps and springs emerge to the ground surface and ponds occur. Small pools of standing water support elephant ears, swamp lily, arrow-weed, and small duckweed, which are described more completely under the Emergent Wetlands type. Black willow trees to 15 meters tall provide 5–15 percent cover in the canopy layer and are codominant with sugarberry, eastern cottonwood, and Mexican sabal palm that together provide approximately 20–40 percent cover. The common tall shrub or graminoid is giant reed or carrizo, which contributes up to 25 percent cover in these stands. Small wooded wetland stands provide dense foliar cover that provides perching, breeding/nesting/brood rearing sites, and escape cover for species of flycatchers, blackbirds, and doves, in particular and also the northern mockingbird, great kiskadee, and the rare western yellow-billed cuckoo. Mammals, including the javelina and raccoon, prefer these often moist wooded wetlands habitats.

4. Open Water: Though occupying a small fraction of the area within the project corridor, open-water habitats are species-rich in terms of wildlife use. Of the avian species observed during the field research for the ESP, seven species are waterfowl, wading birds, or shorebirds. Water bodies occur as flowing habitats including the Rio Grande, canals, and ditches and as still habitats including lakes and ponds. The bottom substrate is typically sand and fine sediments in the Rio Grande and fine sediments and mud in canals, ditches, and standing water bodies.

   a. *Rivers, Creeks, and Canals.* Flowing open-water habitat includes the Rio Grande, a few tributary creeks, streams, arroyos, and more commonly irrigation canals and ditches. Waterfowl species that commonly use flowing open water to rest and forage include the black-bellied whistling duck and American coot and wading birds such as white ibis, herons, and lesser yellowlegs. Fish, reptiles, and amphibians were less frequently observed in the flowing open water habitats and included the Texas cichlid, Texas spiny softshell turtle, Rio Grande chirping frog, and Rio Grande leopard frog.

   b. *Lakes and Ponds.* Lakes and ponds have formed in resacas, gravel pits, and topographic lows and provide still-water habitat in a variety of depths. The wetland and riparian vegetation surrounding the shoreline and the size of the water body can dictate the species using still open water, which include the American avocet, black-necked stilt, anhinga, pied-billed grebe, American white pelican, ringed kingfisher, great blue heron, and egrets, which feed on a variety of aquatic and wetland vertebrates and invertebrates. The

Rio Grande cooter and Rio Grande leopard frog commonly occur in the small lake and pond habitats.

c. *Land Use.* Large acreages in the project corridor are maintained on a regular basis, ranging from nearly daily maintenance in urban areas to seasonal/annual maintenance on agricultural lands. Even though subject to disturbance, these habitats are important to many species of resident and migratory wildlife for all life stages ranging from movement corridors to hiding and breeding sites to important foraging sites.

d. *Irrigated Agriculture.* Fields actively used to grow crops typically included sorghum, sugarcane, corn, and truck crops such as tomatoes and broccoli. The fields under production provide valuable hiding cover, dispersal corridors, roosts, forage, and some nesting habitat. Many individuals of a variety of wildlife species including toads, snakes, harvest mice, cotton rats, and passerine birds can be displaced to surrounding habitats or killed when crops are harvested by mechanical means, leaves are burned from sugarcane stalks, and the ground is tilled post-harvest. Open agricultural fields are commonly used for hunting by the American kestrel. Cattle egrets often occur in pastures, away from water sources, where they prey on invertebrates exposed by the hooves of cattle, or when a field is being tilled.

e. *Fallow Agriculture.* Fields under seasonal rest often contain waste grain or support annual forbs and grasses that produce quantities of seed used by foraging wildlife. Seeds present on fallow fields attracted the cottontail rabbit and species of doves, blackbirds, meadowlarks, cowbirds, European starlings, quail, ducks, and geese. Turkey vultures, ravens, and other raptor species roosted on the ground in fallow agricultural fields.

f. *Residential and Urban Development.* A myriad of habitats and food and water sources are present within residential and urban areas including landscaping, open fields, structures related to buildings and other urban infrastructure, pastures, corrals, and backyard feeding stations for domestic pets and birds. Domestic pets, particularly cats, can kill individuals of small mammals and birds within urban and adjacent rural areas. Wildlife species that use residential and urban habitats regularly include raccoons, skunks, house mice, Norwegian rats, European starlings, house sparrows and finches, mockingbirds, rock doves, mourning doves, and grackles.

g. *Highways, Roads, and Trails.* Wildlife species use established transportation corridors to move and disperse rapidly across the landscape. As a result, low to moderately high death rates can be experienced depending on adjacent habitat importance to wildlife,

population levels, and design speed and safety features of transportation corridors. Wildlife that forage on carrion or are omnivorous, including the turkey vulture, black vulture, crested caracara, raccoon, and coyote, can benefit from the presence of road-killed animals. Transportation structures such as bridges can provide hiding and roosting cover for species including owls or nesting sites for swallows and rock doves.

5.8 Species Groups and Habitat Affinity

5.8.1 Mammals

The three ecoregions with the highest mammal diversity in Texas (Trans-pecos, Edward's Plateau, South Texas Plains) all converge in the general area of the Del Rio Sector. These regions demonstrate a strong positive correlation between landscape heterogeneity and mammal diversity (NSRL 1997). More than 80 species of mammals are found in the Del Rio area (see **Attachment D** for a complete mammal list of the Del Rio area).

Two federally listed mammals are documented to inhabit the counties encompassing the Del Rio Sector (NSRL 1997). The federally endangered ocelot historically occupied much of the brush-dominated habitats in the central, eastern, and southern portions of Texas. This habitat now occurs as patches and small stands within their historic range. The southernmost county encompassing the Del Rio Sector is included in the current range of the ocelot. The ocelot requires dense forest or shrubland habitats with very high canopy cover (NSRL 1997). The federally threatened white-nosed coati has also been sighted in Maverick County. White-nosed coatis occupy many different types of habitat, from tropical lowlands to dry, high-altitude forests. (Marceau 2001)

5.8.2 Birds

Approximately 400 avian species, including neotropical migratory birds, shorebirds, raptors, and waterfowl, can occur in the Del Rio area (**Attachment D**).

More than 800 species of birds spend all or part of their lives in the United States as they migrate from summer breeding grounds in the north to winter in warmer climates of the south, including Latin America (USFWS 2002). Because migratory birds depend on habitats across many political boundaries, a coordinated conservation effort has been established internationally, with the USFWS being the principal Federal authority in the United States. Large numbers of birds migrate seasonally through or overwinter in the area surrounding Del Rio, using natural, managed, and agricultural habitats for forage, roosting, and cover. The rivers and other topographic features can serve as leading lines to guide raptors and neotropical migrants during migration. Of

special interest is the resident population of the federally endangered interior least tern found at Lake Amistad.

Migratory birds are also economically important, e.g., birders recreate in many areas to identify migrant species and some hunters focus on migrating waterfowl, including species of ducks and geese. Organizations such as Ducks Unlimited use donations to protect and restore wetlands and associated riparian and upland systems used by migrating waterfowl and shorebirds, primarily. Avian habitats in the Del Rio area, including wetlands and riparian resources, are a priority for conservation and management organizations and agencies, including TPWD, USFWS (partnership programs and wildlife refuges), Natural Resources Conservation Service (Wetlands Reserve and Environmental Quality Incentives [EQUIP] programs), and private and nonprofit land managers.

The primary function of lands managed under the NWR System is to provide habitat for waterfowl and shorebirds in addition to other wildlife-related benefits. Federal agencies in general are responsible to protect migratory birds under Executive Order 13186, *Responsibilities of Federal Agencies To Protect Migratory Birds*. This executive order states that migratory birds are of great ecological and economical value to the United States and to other countries. They contribute to biological diversity and bring tremendous enjoyment to those who study, watch, feed, or hunt them and the critical importance of this shared resource has been recognized through ratification of international, bilateral conventions for migratory bird conservation. A list of all migratory birds included under this executive order is available under 50 *Code of Federal Regulations* (CFR) 10.13; a focused list for species occurring in the project corridor is presented in **Attachment D**.

In general, the Del Rio area represents important and unique habitat for migrant bird species, largely a result of geography, diverse and unique plant communities, and protected lands. This region represents an important bird observation area due to the diversity of habitats and the uniqueness of the birds that occur, more than 200 avian species have been recorded from the Lake Amistad Recreational Area alone. The range of open water, wetlands, riparian, playa, grassland, shrubland, woodland and forest, and agricultural land provide habitats for migrating birds. Migrant birds breed in tundra, northern forest, grasslands, subtropical scrub forest, and all suitable habitats north of the international border. In the absence of stopover habitat, migration will be difficult to likely impossible for bird species that require places to rest, feed, and avoid predators.

The Del Rio area is a migratory crossroad for individuals and flocks of hawks, shorebirds, waterfowl and other waterbirds, hummingbirds, and songbirds. The combination of high species diversity; several rare, threatened, and endangered species; large concentrations of wintering birds; several endemic subspecies; and an important migratory pathway results in the Rio Grande Plain being an important avian region for North America.

Many state and federally listed birds are found in the ecoregions adjacent to the Del Rio sector project area. The Federally listed endangered birds found in the area are the aplomado falcon, black-capped vireo, Eskimo curlew, brown pelican, interior least tern, golden-cheeked warbler, and the whooping crane. The federally listed threatened bird is the piping plover. The birds found in the area that are listed as threatened in the State of Texas are the gray hawk, white-tailed hawk, zone-tailed hawk, common black-hawk, swallow-tailed kite, bald eagle, reddish egret, piping plover, wood stork, sooty tern, tropical parula, white-faced ibis, northern beardless-tyrannulet, and rose-throated becard.

5.8.3 Herpetiles

More than 200 species of reptiles and amphibians occur in Texas (see **Attachment D** for a more complete list of herpetile species in the Del Rio area). The counties encompassing the Del Rio Sector are home to 7 species of frogs, 5 species of toads, and 2 species of amphibians. One of these species, the South Texas siren, is listed as a threatened species in the State of Texas. Reptiles are very common in the arid landscape surrounding Del Rio. Forty-four snake species, 22 species of lizard, and 7 species of turtle are found in the Del Rio area. Of these, the indigo snake, reticulated collared lizard, Texas horned lizard and the Trans-Pecos black-headed snake are listed as threatened in the State of Texas.

5.8.4 Invertebrates

With more than 100 species of butterflies recorded within the Del Rio area, this region supports a diverse butterfly fauna (see **Attachment D** for lists of butterflies). A big attraction for nature lovers at Lake Amistad is the fall Monarch butterfly migration. Year after year, thousands of Monarchs roost in the same few trees as they head to their wintering grounds in Mexico. Other common butterflies in the area are the American snout, bordered patch, checkered white, empress Leilia, giant swallowtail, gulf fritillary, and the large orange sulphur.

5.9 Prehistoric Humans, Spanish Settlement, and Current Land Conservation

The history of the Lower Pecos River Region begins far before the U.S. Military's early camps and outposts and goes far beyond the beginning days of the Southern Pacific Railroad. The first visitors to the canyons in the Del Rio area arrived some 12,000 years ago following herds of large ice-age animals that grazed the grassy upland plateaus and ventured deep into the canyons for water. And although the people might be gone, they've left a legacy of their lifeways in the artifacts and rock art that grace the canyon walls of Amistad National Recreational Area (NPS 2008). With 250-plus known sites within a 100-square-mile area, the region has one of the densest concentrations of Archaic rock art in the new world, comparable in significance to sites in Europe, Australia, and Baja California.

At the time of first recorded European contact with the indigenous people of southern Texas, the Coahuiltecas and other hunter/gatherer Indian tribes resided in the Rio Grande floodplain and its adjacent uplands (USFWS 2001). The floodplain habitat was likely densely forested with palmetto, sabal palm, sugarberry, Texas ebony, and anaqua trees. The Rio Grande carried larger volumes of water more consistently and was subject to seasonal and periodic overbank flooding that distributed sediments and nutrients across the floodplain. The adjacent uplands were thought to be mixtures of thorn scrub and extensive grasslands or prairies.

In 1749, Spanish colonists became established in the Rio Grande Valley under the leadership of José de Escandón who founded the first settlement, Camargo. The Spanish settlers introduced domestic herd animals, e.g., cattle, horses, goats, sheep, and pigs, and they began to clear, plow, and cultivate agricultural plots and small fields within the floodplain. As a result, native humans and sensitive wildlife species, including the bear and jaguar, dispersed to other habitats or were killed by settlers. Soon afterward, the Spanish government awarded land grants for homesteading in the region of south Texas. Additional European settlers arrived in large numbers in south Texas between 1820–1870, resulting in nearly immediate changes in the landscape and associated plant communities/wildlife habitat. The suppression of fire by European settlers, combined with heavy livestock grazing contributed to the development of the current thorn woodlands common throughout southern Texas.

Today many agencies and conservation groups are working together with the common goal of restoring and preserving some of the natural systems that once dominated the landscape in the Rio Grande Plains. A good example of this effort is the Texas Wildlife Action Plan, initiated by the TPWD (TPWD 2008).

5.10 Habitat Monitoring and Management

It is important that land managers understand basic ecological principles of plant succession, plant growth, food chains, water, and mineral and soil nutritive cycles as they affect range, wildlife, and grazing management. Additionally, the basic needs and preferences of the livestock and wildlife species being managed should be well-researched and documented. It is equally important to manage for a high level of plant succession and quality wildlife habitat using the basic tools of grazing, rest, fire, hunting, animal impact, disturbance, and technology. Management using these principles results in high-quality habitat for wildlife and can result in more stable conditions during stress periods such as droughts and during the winter season.

An essential component to good management is basic information on the potential outcomes of alternative decisions. Monitoring is a way to gain information on the states and trends of varied attributes of a resource. The information collected through properly designed monitoring protocols allows the

collective knowledge of scientists and land managers to be applied to the many difficult questions that are involved in habitat management.

Quality habitats are the key to sustaining wildlife populations. Habitat biologists typically monitor several components when assessing wildlife habitats, including (1) diversity of shrub or brush species, (2) browsing pressure, (3) amount of herbaceous cover, (4) water distribution, (5) stocking rates and grazing systems for livestock, (6) deer and other large mammal density, and (7) the use of supplemental forage. This information is then interpreted and used in the process of determining whether management goals are being met and can provide guidance into what changes need to be initiated, if any. Low-quality wildlife habitats generally lack good shrub or brush diversity, have sparse grass and forb cover, and the shrubs often have a hedged appearance or browse line. Healthy wildlife habitats are characterized by moderate to high plant species diversity, vegetation structural diversity (grasses and forbs, low-growing shrubs, trees), and moderate to high ground cover.

Wildlife biologists and private landowners implement habitat enhancement techniques or management tools to mimic some of the natural processes that probably occurred prior to European settlement in south Texas. Important to managing natural resources is to use a holistic approach, where several techniques are typically applied to develop and maintain healthy ecosystems. Single species typically deserve less attention, while the system in which they occur requires more attention. During the late 1940s, Aldo Leopold expressed five basic wildlife habitat management tools: axe, cow, plow, fire, and gun, that if used properly in combination will enhance or possibly restore habitats and key species indigenous to the south Texas Brush Country.

5.11 Habitat Restoration

Ecosystem management is a relatively new paradigm of thought concerning how to best approach the task of restoring and conserving natural systems at the landscape scale. At its core, it involves collaborative partnerships between varied stakeholders and interested parties. Collaborative partnerships can be an important tool in assembling stakeholders to mobilize for affecting change at the regional scale of wildlife habitat stewardship as well as increase the knowledge base for understanding the scope and variables involved in the management process.

Many such partnershops have been and are being developed by the TPWD. One such partnership acting in the Del Rio area is the Rio Grande Joint Venture (RGJV). A Joint Venture (JV) is a regional, self-directed partnership of government agencies and nongovernmental organizations as well as individuals. JVs deliver science-based conservation, and work in support of national and international bird conservation plans. JVs are directed by a Management Board made up of partner representatives. JV Partners are dedicated to the conservation of habitats within their region. There are many levels for

participation, ranging from membership on the Management Board to participation with technical teams and working groups. The goal of the RGJV is to restore and preserve the important bird habitats of the Chihuahuan Desert and the Tamaulipan Brushlands (TPWD 2006).

5.12 Urban Wildlife Habitat

More than 80 percent of the Texas population resides in urban areas and the six largest cities together total more than 30 percent of the state's population. In south Texas towns and cities, the top three sounds that people prefer are natural sounds: birds singing, wind in the trees, and gently moving water. As such, there are many extrinsic values attached to "natural" landscapes in urban areas. Proximity to natural areas increases property values, employee satisfaction has been shown to be higher when natural open space is created for daily access onto corporate properties, and it has also been shown that hospital patients heal faster when there are views of natural landscapes outside their windows.

Many programs have been initiated by TPWD to provide guidance and support to Texas urban citizens who are interested in creating and preserving wildlife habitat in their own neighborhoods. Some examples of outreach programs provided are the Texas Master Naturalist Program, the Texas Wildscapes Program, and varied Wildlife Education Programs. The TPWD has also assigned wildlife biologists to work in each of the largest urban areas in Texas. The duties of urban wildlife biologists include providing opportunities for urban residents to reconnect with natural or semi-natural systems, presenting educational programs for urbanites on a variety of habitat/wildlife issues, serving as technical advisors on multi-agency conservation planning initiatives, and assisting landowners with habitat restoration or enhancement projects.

6. Rare Species Data

To ensure the most recent data were acquired for rare species analyses, e²M requested Element Occurrence Data from NatureServe Central Databases in Arlington, Virginia, through a referral from the USFWS (NatureServe and e²M 2007a). The data fields requested and geographic scope of this request were as follows:

1. Location and habitat data for endangered, threatened, and candidate species provided in list form by the USFWS and supplemented with online information from the TPWD and information from the NatureServe database.
2. The USFWS requested that all rare species occurring within 25 miles of the international border with Mexico be considered in this data search. Data were therefore requested for the South Texas counties of Brewster, Cameron, Culberson, Dimmitt, Edwards, El Paso, Hidalgo, Hudspeth, Jeff Davis, Jim Hogg, Kinney, Maverick, Pecos, Presidio, Starr, Terrell, Val Verde, Webb, Willacy, Zapata, and Zavala.
3. Data were requested to be delivered electronically in the form of Geographic Information Systems (GIS) layers depicting population polygons or point locations and Excel tables for species lists/tabular data and narratives of habitat and natural history information.

To protect sensitive data, a license agreement between NatureServe and e²M was signed in 2007. Data covered under the LA reside in a Multi-Jurisdictional Dataset (MJD), which includes all precise species location data for species that are federally listed (listed endangered, listed threatened, or candidate) or are listed under the State of Texas endangered species legislation. Additionally, the license agreement describes a 25-mile occurrence corridor north of the international border between the United States and Mexico as the licensed dataset for this Project. Data and text fields delivered by NatureServe under the license agreement included life history, threats, trends and management recommendations, classification status, confidence extent, county name, element information, U.S. Federal Information Processing Standard code, first observation date, global information, habitat types for animals, observation dates, location information, subnational information, survey information, and species status information.

The license agreement provides guidelines which stipulate external use of the data:

1. “Named” Locations: species names linked with locations cannot be displayed at a scale of less than 1:100,000 or the precise species location must be randomized within a USGS topographic quadrangle.

2. "Blind" Locations: when species names are not linked with locations specific locations can be displayed, except when the species records are flagged "sensitive" or if they can be identified easily by geographic attributes at a particular location.
3. Exceptions: the only allowable exception to the guidelines occurs when data are obtained from a source independent from NatureServe and the member programs.

7. Project Database and Interactive GIS

A Microsoft Access database was developed to serve as a centralized storage system for data collected during biological field surveys. The database data entry form closely mimics the field form utilized to record ecological information within the project corridor (**Attachment A**).

During field surveys, UTM coordinates were collected with Global Positioning Systems (GPS) receivers to locate observation points, photo-documentation points, and wetlands. The GPS data were post-processed and incorporated into feature classes for use in GIS. Additional data collected in the field were manually entered into the Microsoft Access database.

The information stored in the database was also linked to an interactive GIS. The interactive file, or published map document, can be viewed with ESRI's ArcReader. The datasets collected and included in the published map are biological survey areas, observation points, NWI wetlands, e^2M delineated wetlands, plant communities, wildlife habitats, wildlife areas and refuges, land use, and aerial photography. The observation points are interactively hyperlinked with ground photographs acquired in the field.

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8. List of Preparers

Domenick Alario
B.A. Geography
Years of Experience: 2

Shannon Cauley
B.S. Geology
USACE Certified Wetland Delineator
Years of Experience: 23

Brent Eastty
B.S. Biology
Years of Experience: 6

Stuart Gottlieb
B.A. Geography
GIS Professional Certificate
Years of Experience: 5

Shawn Gravatt
M.S. Environmental Studies
B.S. Earth Science and Geography
Years of Experience: 10

Brian Hoppy
B.S. Biology
Certified Environmental Manager
Years of Experience: 17

Gena Jannsen
M.S. Biology
B.S. Geography
Years of Experience: 17

Ronald E. Lamb
M.S. Environmental Science
M.A. Political Science/International Economics
B.A. Political Science
Years of Experience: 22

Cheryl Myers
A.A.S. Nursing
Years of Experience: 17

Cheryl Schmidt, Ph.D.
Ph.D. Biology
M.S. Biology
B.S. Biology
Years of Experience: 22

Sarah Spratlen
Masters of Engineering
Years of Experience: 5

Karen Stackpole
M.S. Environmental Science and Education
B.S. Biology
Years of Experience: 9

Jim Von Loh
M.S. Biology
B.S. Biology
Years of Experience: 32

Lauri Watson
B.S. Environmental Science
Years of Experience: 5

Valerie Whalon
M.S. Fisheries Science
B.S. Marine Science
Years of Experience: 15

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9. References

Ansley 1997 — R.J. Ansley, J.A. Huddle and B.A. Kramp. U.S. Forest Service. Texas Agricultural Experiment Station. Available online at <*http://texnat.tamu.edu/symposia/sculptor/8.htm*>.

Bailey 1995 — Bailey, Robert F. 1995. *Ecoregions of the United States.* U.S. Forest Service. Available online at: <*http://www.fs.fed.us/colorimagemap/images/300.html*>.

Correll 1970 — Correll, Donavan S., and Marshall C. Johnston. 1970. *Manual of the Vascular Plants of Texas.* Texas Research Foundation. Renner, TX.

Environmental Laboratory 1987 — Environmental Laboratory. 1987. "Corps of Engineers Wetlands Delineation Manual, "Technical Report Y-87-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS., NTIS No. AD A176 912.

Larkin and Bomar, 1983 — Larkin, Thomas J., and George W. Bomar. 1983. *Climatic Atlas of Texas.* Texas Department of Water Resources. Austin, TX.

Marceau 2001 — Marceau, J. 2001. "Nasua narica", *Animal Diversity Web*. Available online at <*http://animaldiversity.ummz.umich.edu/site/accounts/information/Nasua_narica.html*>.

NSRL 1997 — Natural Science Research Laboratory (NSRL). 1997. *Notes on Ocelot Life History*. Available online at: <*http://www.nsrl.ttu.edu/*>.

NatureServe 2007 — NatureServe Explorer. 2007. *Ecological System Comprehensive Reports.* Available online at: <*http://www.natureserve.org/explorer*>.

NOAA 2007 — National Oceanic and Atmospheric Administration. 2007. Del Rio Val Verde Airport Weather Station. Available online at: *http://www4.ncdc.noaa.gov/*.

NRCS 2007 — U.S. Department of Agriculture, Natural Resources Conservation Service. 2007. PLANTS Database. Available online at: <*http://plants.usda.gov/*>.

TDA 2008 — Texas Department of Agriculture. 2008. Texas Agriculture Code: Title 4, Part 1, Chapter 19, Subchapter T – Noxious and Invasive Plants. Available online: <*http://tlo2.tlc.state.tx.us/statutes/ag.toc.htm*>. Accessed 23. February 2008.

TPWD 2006	Texas Parks and Wildlife Division (TPWD). 2006. Rio Grande Joint Venture. Available online at: <*http://www.tpwd.state.tx.us*>.
TPWD 2007	TPWD. 2007. State of Texas Threatened and Endangered Species. Available on-line at: <*http://www.tpwd.state.tx.us/huntwild/wild/species/endang/regulations/texas/index.phtml*>. Accessed 15 November 2007.
TPWD 2008	TPWD. 2008. The Vegetation Types of Texas. Available online at: *http://www.tpwd.state.tx.us/publications*.
Texasinvasives.org 2007	Texasinvasives.org. 2007. *Plant Database*. Available online: <*http://www.texasinvasives.org/Invasives_Database/Invasives.html*>. Accessed 23 February 2007.
USFWS 1988	U.S. Fish and Wildlife Service (USFWS). 1988. *Tamaulipan Brushland of the Lower Rio Grande Valley of South Texas: Description, Human Impacts, and Management Options.* Biological Report 88(36). S. E. Jahradoerfer and D. M. Leslie, Jr. Washington, D.C.
USFWS 2001	USFWS. 2001. "Lower Rio Grande Valley National Wildlife Refuge." Last updated 21 December 2001. Available online: <*http://www.fws.gov/southwest/refuges/texas/lrgv.html#Birds*>. Accessed 9 October 2007.
USFWS 2002	USFWS. 2002. 50 CFR 10.13, List of Migratory Birds. Available online: <*http://www.fws.gov/info/*>. Accessed 24 February 2008.
USFWS 2007	USFWS, Southwest Region. 2007. List titled "For Customs and Border Protection, Federally Listed as Threatened and Endangered Species Potentially Occurring Within 25 Miles of the Border."

ATTACHMENT A

OBSERVATION POINT FORMS AND INSTRUCTIONAL MANUAL

OBSERVATION SURVEY FORM

SURVEY AND SITE INFORMATION

Point Code: TX __ __ __ Quad name: _____ BPU Code: _____ Aerial Photo #: _____

Type of Observation (Please Circle One): VEG/OBS OTHER (Specify) _____

Site Name _____

Survey Date _____ Surveyors _____ Size of Area: _____

GPS file name _____ Field UTM X _____ m E Field UTM Y _____ m N

☐ Coordinates from USGS Quad Map (if checked enter coordinates under GPS comments)

Datum NAD 83 Zone: _____ GPS Unit: _____ PDOP: _____ 3D Differential? Y / N

GPS Comments: Error: +/- _____m

Camera Name and Model: _____

Roll #	Frame #	Photographer	Direction/Comments

ENVIRONMENTAL DESCRIPTION

Elevation _____ m / f t From: GPS / Map (circle one) | Slope _____ Aspect _____

Topographic Position:

Landform: | Geology:

Cowardin System
___ Upland ___ Palustrine

Hydrology
___ Unknown
___ Permanently Flooded ___ Seasonally Flooded ___ Temporarily Flooded
___ Semipermanently Flooded ___ Saturated ___ Intermittently Flooded

Environmental Comments:

Unvegetated Surface: *(please use cover scale below)*
___ Bare soil ___ Small rocks (0.2-10cm) ___ Wood (>1cm) ___ Other (describe) _____
___ Bedrock ___ Large rocks (>10cm) ___ Litter / duff
___ Sand (0.1-2mm)

VEGETATION DESCRIPTION

Leaf phenology (of dominant stratum)	Leaf Type (of dominant stratum)	Physiognomic Class	Cover scale for strata and unvegetated surfaces:
Trees and Shrubs ___Evergreen ___Cold-deciduous ___Mixed evergreen-cold-deciduous Herbs ___Annual ___Perennial	___Broad-leaved ___Needle-leaved ___Microphyllous ___Graminoid ___Forb ___Pteridophyte ___Non-vascular ___Mixed (describe)	___Forest ___Woodland ___Shrubland ___Wooded Shrubland ___Dwarf Shrubland ___Shrub Herbaceous ___Herbaceous ___Nonvascular ___Sparsely Vegetated ___Wooded herbaceous	01 = 0 – 10% 02 = 10 – 25% 03 = 25 – 60% 04 = 60 – 100%

OBSERVATION SURVEY FORM

Provisional Community Name:_____ Plot Code: TX __ __ __

	Stratum Height Class	Stratum Cover Class	Dominant Species (mark Diagnostic species with *)	% Cover
T1 Emergent				
T2 Canopy				
T3 Sub-canopy				
S1 Tall shrub (> 2 m)				
S2 Short Shrub (< 2 m)				
S3 Dwarf Shrub (< 0.5 m)				
H Herbaceous				
N Non-vascular				

Height Scale for strata:

01 = < 0.5 m	06 = 10-15m
02 = 0.5-1 m	07 = 15-20m
03 = 1-2 m	08 = 20-35 m
04 = 2-5 m	09 = 35-50 m
05 = 5-10 m	10 = >50 m

Cover scale for strata and unvegetated surfaces:

01	= 0 – 10%
02	= 10 – 25%
03	= 25 – 60%
04	= 60 – 100%

Vegetation Characterization in Texas
OBSERVATION POINT MANUAL - 2007

This document is intended to assist you in collecting observation point data in Texas during the 2007 field season. Detailed, field-by-field instructions for data collection are provided.

VEGETATION DATA COLLECTION INSTRUCTIONS

LOCATING AN OBSERVATION POINT

You will locate sampling points based on homogenous or unique aerial photo signatures and by using site maps, topographic maps, handheld GPS receivers, and/or aerial photos.

- Topography (Topo) maps are useful in identifying the landscape through which you will be navigating, and in determining the elevation of a site.
- Aerial photos aid in navigating through the landscape, and are essential in determining where to sample to inform photo-interpreters (this will be explained in more detail). **Please** record the vegetation, and its condition, that you walk through and sample on the photo or accompanying digital orthophoto. Feel free to write comments regarding unique features as well.

Along the way... look around. Context is everything – you will have a much better sense of how your sample sites represent the landscape if you are always in analysis mode. Keep in mind that the goal of this field work and field work being conducted for vegetation classification is to sample **all** the different vegetation and geologic types that occur at the site.

Special Features... in the process of locating observation points you will encounter unique features or vegetative stands too small to sample, record their coordinates using the GPS receiver and note them on aerial photos and maps. These UTM coordinates may be added to the final production map as "Special Features. Locations of significant weed occurrences (highly invasive species that pose a big threat) and large areas of infestation may also be documented as they may represent a "semi-natural" vegetation type.

OBSERVATION POINT FORM INSTRUCTIONS – 2007

The primary role of Observation Point forms is to inform aerial photo interpretation; a secondary role is to help fill out plant association descriptions and provide distribution information for writing local descriptions of plant associations. They are representative of large and homogenous aerial photo signatures, unusual signatures, confusing signatures, and signatures that are slightly different due to shifts in dominant/understory species composition. The same vegetation type should be sampled where it occurs on different geology, where slope aspect leads to changes in density, and where effects due to fire, landslide, etc. have occurred.

- **IDENTIFIERS / LOCATORS SECTION**

Observation Point Code
This is a unique identifier you give each sample plot using the format "TX.XXX". **Please record the observation point code on both sides of the form in the provided field.**

Quad Name
Record the **full name** of the 7.5-minute quadrangle, such as "The Knoll".

1

Aerial Photo Number
The photo number is in the upper right hand corner of the photo in the format FLIGHTLINE-FRAME #. Record this number on the form. Locate your observation point on the Mylar overlay of the photo, and mark your location with a dot in a circle and the observation point number. *Again, please draw and comment on the photo overlay regarding the vegetation of the plot and the surroundings.*

County
This field will be completed in the office as part of processing the GPS data.

State
TX

Site Name
This is best determined from a topographic or site map. Select a nearby feature that is an obvious waypoint, such as the name of a canyon, lava flow, etc. This name does not need to be unique. If you sample a number of observation points in a small area, you can use the same site name for all of them.

Survey Date
Date the plot was sampled. Please use this format: Month - Day - Year.

Surveyors
List the last names of the field team members present.

GPS File Name - this is the name you give to the waypoint when you mark the observation point location in your GPS receiver. When logging an observation point, the file name would be "TX" and the number (e.g., TX101 for point #101). Mark the aerial photo with a dot with a circle around it and the observation point number, "TX101.

Datum
ALWAYS check datum settings on your GPS unit at the beginning of each day. It should **always** be NAD83. This information is **CRITICAL** for correctly applying your waypoints to the final vegetation map. If it is anything other than NAD83, **please, please, please** record this on the form. This step will keep your work from being wasted.

UTM Zone
This value is recorded from the GPS unit read-out.

Field UTM X, Field UTM Y
Record the UTM easting and northing you saved as a waypoint in your GPS receiver. Please double-check to make sure that the easting is six digits and the northing is seven digits. If recorded incorrectly, your plot will show up in Venezuela or the middle of Wyoming.

In mountainous or deep canyon country it is often difficult to obtain UTM coordinates from a GPS receiver (your unit has to be able to receive at least three or four satellites). If you are unable to obtain UTM coordinates in the observation point, or if the PDOP is greater than 8 (or EPE is greater than ±50m), first try to acquire a signal from a higher point outside (but still close to) the site. If that fails, you will need to estimate the UTM coordinates from the topo map, and manually enter these UTMs into the GPS unit.

Use a map which is in NAD83 if at all possible, since the project standard is the NAD83 datum. However, you may need to use USGS 7.5 minute maps, which use the NAD27 datum, note this.

GPS Unit:
Record the name and model of the GPS receiver being used to record data for the observation point. If a GPS unit was not used to determine UTMs record 'none' here and be sure to complete the 'GPS Comments' field below.

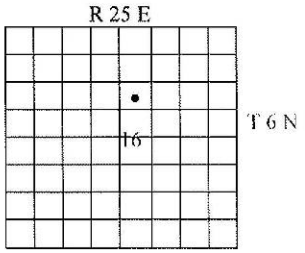
2

GPS Error
Note the PDOP (or "Estimated Position Error" (EPE), if you're using a Garmin unit) displayed on your GPS unit. The lower the number, the more accurate your reading.

3D Differential?
Circle Y or N accordingly. 3D differential is obtained when your GPS unit can "see" a satellite that does nothing but correct the tiny errors in the positioning or clocks of other GPS satellites. This satellite broadcasts a real-time differential correction so that your location coordinates are as accurate as possible. It is in geosynchronous orbit in the southern sky, so if you can see the southern sky, you will generally be able to obtain 3D differential. This system is known as the Wide-Area Augmentation System, or WAAS. The Garmin and Trimble units have a field in their setup pages for turning WAAS on or off. Please make sure that WAAS is **always** on.

GPS Comments:
VERY IMPORTANT: If you resorted to estimating the observation point location UTMs on the topo map, note that in this field. If you're usual GPS croaked and you had to borrow an old Magellan from a friend, note that. Also, if you left the site to obtain a reading from a high point, record that here, along with the compass bearing and distance of the GPS location from the observation point site (unless you used the offset function on the Trimble GeoXM- in that case, enter "point offset.")

Directions to Observation Point
Give precise directions to the observation point beginning with a landmark (e.g., a named point on the topo map, a major highway, marked trailhead) readily locatable on a 7.5 minute topo map as the starting point. Use clear sentences that will be understandable to someone who is unfamiliar with the area and has only your directions to follow. Give distances and use compass directions. Be aware of the ambiguity of words like "above", "near", beyond", "on the back side of", "past". Again, using the GPS unit to give distances can be very helpful. If observation point locations lack major landmark features as guides, use township, range and sections from the topo maps. If there are no features within a reasonable distance of your site and writing directions is taking an inordinately long time, you can use a TRS description to the nearest quarter-quarter-quarter section. The TRS for the plot in the section below is "NW4SW4NE4 Sec. 16, T 6 N, R 25 E".



Photos Taken?
Circle Y or N accordingly for observation point photos.

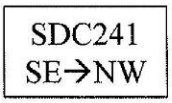
Camera Name and Model
Circle or enter the name and model of your camera

Photos: Type/Roll Number/Frame Number/Photographer/Direction and Comments
For each photo taken at the observation point record the following: *Photo type:* indicate whether photo is a 'stand' or 'landscape' photo. *Photo number*: record photo number. *Photographer*: record last name of person taking photograph.

3

Directions/Comments: record the direction the photos were taken from and towards (eg. SE→NW) and any other comments to clarify contents of the photo (especially landscape/scenery photos).

Taking photographs
Take one representative digital photo of each observation point. The purpose is to obtain a good representation of the vegetation, not individual species. Try to include a little sky (about 10%) for perspective. Use a chalkboard to record the observation point number and the direction the photo is taken. Thus, for observation point 241, the board in the photo taken from the SE edge, facing NW, will read "SDC241, SE→NW". Take the photograph looking across the contour if site occupies a steep slope. In addition, you will need to keep a photograph log for all photos not taken on observation points.



- **ENVIRONMENTAL DESCRIPTION SECTION**

Elevation
Take this measurement from the GPS receiver, in meters. Specify on the data sheet whether the measurement is in feet or meters, and whether your elevation source was the GPS unit or the topo map.

Slope
Measure the slope in degrees using a clinometer. The degree scale is the left-hand scale as you look through the clinometer. If the slope varies, estimate an average. If the observation point is on rolling microtopography, enter "variable." Describe these further under the Environmental Comments section.

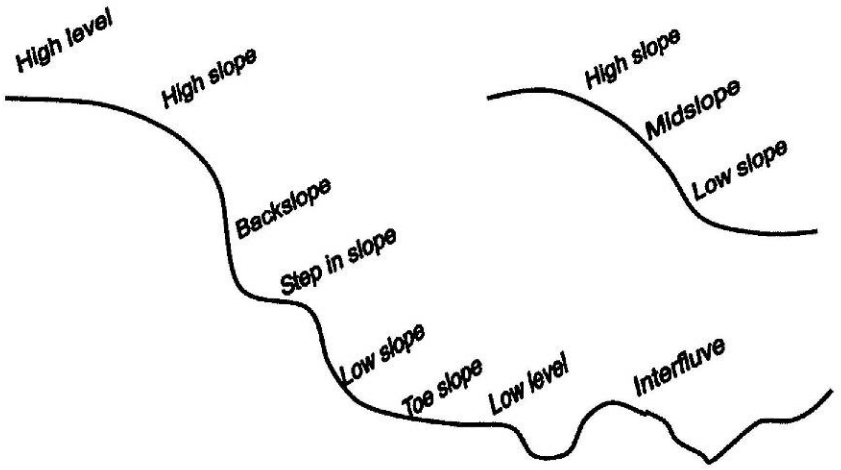
Aspect
Measure the site aspect in degrees using a compass (set for local magnetic declination). If the slope is flat, enter "n/a" for aspect. If the site wraps around different aspects on a slope, enter "variable" and describe further under the Environmental Comments section.

Topographic Position
This is the position of the observation point on its related landform. Determining this requires you to think of the landform in cross-section, which is roughly diagramed below. You **must** use the terms listed below:

Interfluve (crest, summit, ridge). Linear top of ridge, hill, or mountain; the elevated area between two drainages that sheds water to the drainages.
High slope (shoulder slope, upper slope, convex creep slope). The uppermost inclined surface at the top of a slope. Includes the transition zone from backslope to summit. Surface is dominantly convex in profile and erosional in origin.
High level (mesa, summit). Level top of a plateau.
Midslope (transportational midslope). Intermediate slope position.
Backslope (dipslope). Subset of midslopes that are steep, linear, and may include cliff segments.
Step in slope (ledge, terracette). Nearly level shelf interrupting a steep slope, rock wall, or cliff face.
Lowslope (lower slope, foot slope, colluvial footslope). Inner gently inclined surface at the base of a slope. Surface profile is generally concave and a transition between midslope or backslope, and toeslope.
Toeslope (alluvial toeslope). Outermost gently inclined surface at base of a slope. In profile, usually gentle, linear and characterized by alluvial deposition.
Low level (terrace). Valley floor or shoreline representing the former position of an alluvial plain, or lake.

4

TOPOGRAPHIC POSITION



Landform

Enter the landform(s) that describes the site where the plot was sampled. Referring to the topo map for the landscape context may help you decide what landform(s) to choose. Note that the landform choices may describe different scales, or that a landform feature can be described by more than one term. For example, your plot may be on a ledge on the rim of a canyon. A suggested list of landforms and definitions is provided in **APPENDIX 1.**

Note: *The topographic position selected above should relate to the scale of the landform chosen here.*

Surficial Geology

Note the geologic substrate where the plant community occurs. The geology map should help, but if you can't tell the geology at all or you do not have the geology map with you at the plot, put a general description (e.g., coarse sandstone, green shale, aeolian sands, or obscured by soils).

Cowardin System

The majority of the plots you'll be conducting will be "Uplands". Any wetland plots will be in the Palustrine category. This includes riparian stands. They are all fed by groundwater and support vascular plant communities.

> **Palustrine:** All nontidal wetlands dominated by trees, shrubs, persistent emergent species, emergent mosses, or lichens. This category also includes wetlands lacking such vegetation but with all of the following characteristics: (1) area less than 8 ha; (2) lacking an active wave-formed or bedrock boundary; (3) water depth in the deepest part of the basin less than 2 m (6.6 ft) at low water; and (4) ocean-derived salinities less than 0.5 parts per thousand.

Hydrology

This field will mostly be completed if you are in a wetland, however, some areas considered uplands may be subject to intermittent flooding. Select from the following definitions (from Cowardin et al. 1979):

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Permanently flooded. Water covers the land surface at all times of the year in all years.
Semipermanently flooded. Surface water persists throughout growing season in most years except during periods of drought. Land surface is normally saturated when water level drops below soil surface.
Seasonally flooded. Surface water is present for extended periods during the growing season, but is absent by the end of the growing season in most years. The water table after flooding ceases is very variable, extending from saturated to a water table well below the ground surface.
Saturated. Surface water is seldom present, but substrate is saturated to surface for extended periods during the growing season.
Temporarily flooded. Surface water present for brief periods during growing season, but water table usually lies well below soil surface. Often characterizes flood-plain wetlands.
Intermittently flooded. Substrate is usually exposed, but surface water can be present for variable periods without detectable seasonal periodicity. Inundation is not predictable to a given season and is dependent upon highly localized rain storms. This modifier was developed for use in the arid West for water regimes of playa lakes, intermittent streams, and dry washes but can be used in other parts of the U.S. where appropriate. This modifier can be applied to both wetland and non-wetland situations.
Unknown. The water regime of the area is not known. The unit is labeled a non-tidal wetland.

Environmental Comments
Enter any additional noteworthy comments on the environmental setting and its effect on the vegetation. Examples include: "stunted trees due to shallow soils", "vegetation only where pockets of soil occur", or "large colluvial boulders and small rocks litter surface of soil". This field can also be used to describe site history such as fire events. This is an extremely important field for crews to document so please take the time to do a thorough job. Information from this field will be used to prepare local descriptions of the plant community and for photo interpretation.

Ground Cover
Estimate the approximate percentage of the *total* surface area covered by each category. The sum of all fields should equal 100%. A helpful hint in making ocular estimates is that in a 0.5-hectare (1.24-acre) observation point, one 7 x 7m square is equal to 1%. The sum of the cover values should equal 100%. *Notes*: Estimating lichens, dark cyanobacteria and moss also take an extra step in visualization. Also note that it is possible to have bare soil and sand in a plot if sand has blown in, or to have sand on the surface of the site. If a category is present but covers less than 1% (> 0.5%) of the ground, enter a "T" on the line next to it. If a category is present but covers a tiny bit (<0.5%) of ground, enter "t".

Animal Use Evidence
Comment on any evidence of use of the site by non-domestic animals (i.e., tracks, scat, burrows, etc.) and domestic animal use (grazing) under the Environmental Comments.

Natural and Anthropogenic Disturbance
Comment on any evidence of natural or anthropogenic disturbance and specify the source, severity and effects on the vegetation. Common disturbances on sites include gullies, colluvial deposition of rocks on slopes flash flooding and sometimes old tin cans from cowboys or miners. Notes on livestock grazing and other disturbances you may encounter in the buffer include off-road vehicle use, fire, and mass-wasting are valuable. Enter disturbance comments under the Environmental Comments

Other Comments
Record any other comments. What is the extent of the community you sampled? Describe the landscape context of the community. Describe the adjacent plant communities and their relationship to the plot. Are there any other landscape features or processes influencing this community? Is there an important species that occurs in the stand but is not within your plot? Is there a large amount of a dead plant material in the plot? Record these under the Environmental Comments field.

Unvegetated Surface
This field is an ocular estimate of ground cover. Because there is no designated sample size for areas surveyed as Observation Points, you will have to estimate percent covers for whatever size the documented area encompasses. For this estimate, you must use the cover classes listed in the bottom right hand corner of the data sheet. If an unvegetated surface category is not present in your observation point area (e.g., water is very uncommon in the sampling units), leave the corresponding line blank.

- **VEGETATION DESCRIPTION SECTION**

Leaf Phenology
Select the best description for the leaf phenology of the **dominant** stratum. The dominant stratum is the tallest stratum that contains at least 10% cover. Leave blank for non-vascular plots.

Evergreen. Greater than 75% of the total woody cover is never without green foliage. (Some tricky examples: most *Artemisia* and all *Chrysothamnus*)
Cold deciduous. Greater than 75% of the total woody cover sheds its foliage in connection with an unfavorable season mainly characterized by winter frost.
Mixed evergreen - cold deciduous. Evergreen and deciduous species are mixed within the type and generally contribute 25-75% of the total woody cover.
Perennial. Herbaceous vegetation composed of more than 50% perennial species.
Annual. Herbaceous vegetation composed of more than 50% annual species.

Leaf Type
Select the best description for the leaf form of the dominant stratum. The dominant stratum is the uppermost stratum that contains at least 10% total plot coverage. Within that dominant stratum, the species that makes up greater than 50% of cover defines the leaf type.

Broad-leaved. Woody vegetation that is primarily broad-leaved (Sagebrush, oak, California lilac).
Needle-leaved. Woody vegetation that is primarily needle-leaved (Juniper, pine, spruce, fir, hemlock).
Microphyllous. Woody cover that is primarily microphyllous (*Ephedra*).
Graminoid. Herbaceous vegetation composed of more than 50 percent graminoid species (grasses, sedges, rushes, etc).
Forb (broad-leaf-herbaceous). Herbaceous vegetation composed of more than 50% broad-leaf forb species (*Phlox, Astragalus, Lupinus, Thalictrum, Erigeron,* etc).
Pteridophyte. Herbaceous vegetation composed of more than 50 percent ferns or fern allies (scouring rushes).
Non-vascular. Dominated by lichens or mosses.
Mixed. As with leaf phenology, the dominant stratum may be composed approximately equally of species with several different leaf types. Describe the mix briefly or circle leaf types that apply.

Physiognomic Class
This represents what you see when you are standing in the plot looking across at the vegetation. The following definitions can be used as guidelines. For example, areas with scattered pines and junipers may not fit the cover classes below but they would best be described as a woodland.

Forest. Trees with their crowns overlapping (generally forming 60-100% cover).
Woodland. Open stands of trees with crowns not usually touching (generally forming 10-60% cover). Canopy tree cover may be less than 10% in cases where it exceeds shrub, dwarf-shrub, herb, and nonvascular cover, respectively.
Shrubland. Shrubs generally greater than 0.5 m tall with individuals or clumps overlapping to not touching (generally forming more than 25% cover, trees generally less than 10% cover). Shrub cover may be less than 25% where it exceeds tree, dwarf-shrub, herb, and nonvascular cover, respectively. Vegetation composed of woody vines is included this class.
Wooded Shrubland
Trees forming approximately equal cover with a shrub component.

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Dwarf-shrubland. Low-growing shrubs usually under 0.5 m tall. Individuals or clumps overlapping to not touching (generally forming more than 25% cover, trees and tall shrubs generally less than 10% cover). Dwarf-shrub cover may be less than 25% where it exceeds tree, shrub, herb, and nonvascular cover, respectively.
Shrub Herbaceous. Low or taller shrubs forming approximately equal cover with a grass or forb component. Individuals or clumps of shrubs generally not touching and usually forming more than 25% cover; trees less than 10% cover. Spaces between shrubs are generally mostly occupied by grasses and/or forbs.
Wooded Herbaceous. Trees forming approximately equal cover with a grass or forb component.
Herbaceous. Perennial herbs (graminoids or forbs) dominant (generally forming at least 25% cover; trees, shrubs, and dwarf-shrubs generally with less than 10% cover). Herb cover may be less than 25% where it exceeds tree, shrub, dwarf-shrub, and nonvascular cover, respectively.
Nonvascular. Nonvascular cover (bryophytes, lichens, and algae) dominant (generally forming at least 25% cover). Nonvascular perennial vegetation cover may be less than 25%, as long as it exceeds tree, shrub, dwarf-shrub, and herb cover.
Sparsely Vegetated. Abiotic substrate features dominant. Perennial vegetation is scattered to nearly absent and generally restricted to areas of concentrated resources. Total vegetation cover is typically less than 10% and greater than 2%. Badlands, ash fields, lava beds, or sand dunes supporting communities of annual plants should be included in this category, regardless of cover.

Provisional Community Name
Record the dominant species names creating the association which most closely resembles your observation point. Devise the name based on: (1) the dominant species of the dominant strata (including nonvascular) and (2) indicate the physiognomic class (this must match the physiognomic class checked on the back side of the datasheet). For example, if you are in a P-J woodland with only scattered shrubs but a really nice galleta grass layer, you would use a provisional name like "*Pinus edulis – Juniperus osteosperma / Pleuraphis jamesii* Woodland". The provisional name is also a great help to the ecologists who will be using your work to construct a classification. Note: this field should be completed only after the entire plot is completed.

• DOMINANT PLANT SPECIES LIST

Species/Strata Data. The form has been developed for recording information on *species* composition and cover and *strata* cover and height. Species lists (diagnostic species) and cover estimates should be completed first; then cover class and height class estimates for strata should be recorded. Write out the complete species name. The main body of the table is dedicated to recording species names and associated cover estimates. To begin, the observer needs to make a species list for the diagnostic species in the stand and assign each species to the appropriate stratum. The next section provides a brief discussion on assigning species to the appropriate strata, followed by instructions for completing the species level information.

Stratum: Species names will be recorded within the appropriate stratum. It is important that all crew members are consistent in assignment of species to strata throughout this project. Following are some guidelines to use in determining strata. Begin by assessing the strata at your site. Trees are defined as single-stemmed woody plants, generally 5 m in height or greater at maturity and under optimal growing conditions. Shrubs are defined as multiple-stemmed woody plants generally less than 5 m in height at maturity and under optimal growing conditions.

T1 Emergent, T2 Canopy, T3 Subcanopy. A uniform stand of pine or hemlock trees would be a good example of T2"canopy", but where trees are absent you would begin with the shrubs, or herbaceous species if no shrubs are present. If the tree crowns in your plot are mostly touching and similar in height, but a given tree species is much taller that species would be a T1"emergent." Occasionally, you will sample an area where there may be several tall, scattered pines and then shorter scattered junipers. In this case, the pines would be your "canopy" and the junipers would be the "subcanopy". You may also have pines listed in the "subcanopy" layer, if there are a number of short saplings in addition to mature tall trees.

The remaining vegetative strata are (remember to check with plant list for consistency):

S1 Tall Shrub. >2 meters tall. For example, *Sambucus racemosa, Amelanchier utahensis,*and *Cercocarpus ledifolius.*
S2 Short Shrub. <2 meters tall. For example, *Artemisia tridentata,* all *Symphoricarpos* spp.
S3 Dwarf Shrub. <0.5 meters tall. For example, *Artemisia arbuscula.*
H1 Graminoid. All grass species, including *Carex* spp. and *Juncus* spp.
H2 Forb. All forbs. (*Typha* is a forb.)
H3 Fern or Fern Ally. All ferns, including *Equisetum laevigatum.*
H4 Tree Seedlings. Seedlings are trees with vertical stems less than 1.5 m tall, but that may vary by species.
N Nonvascular. This is mainly mosses and lichens.
V Vine/liana. All vine species.
E Epiphyte. All epiphytic species.

Height can be used to define strata, but is not how species should be placed in strata. **Species characteristically belong to one stratum or another** (e.g., quaking aspen and juniper are canopy (T2), Utah serviceberry is a tall shrub (S1), antelope bitterbrush is a short shrub (S2), low sagebrush is a dwarf-shrub (S3), etc.), **EVEN when unusual environmental circumstances dictate that the plants have an unusually tall or unusually short growth form**. So even if the junipers growing in cracks are only 1.5 m tall, as long as they are mature trees, they are placed in the T2 category. About the only rule regarding height should be that the tree layer is (usually) higher than the tall shrub layer, is taller than the short shrub layer, etc.

The second point is to avoid splitting species between strata. If a few willow have been browsed to <1m tall, but most are 2m tall, they all are placed into the tall shrub stratum. There are two exceptions: (1) each height class covers more than 10% of plot, or (2) there is a reproductive layer of seedling shrubs or young trees.

The third point is how to define some of the "borderline/confusing" species. What we want to avoid is some folks calling *Apocynum* a forb and some calling it a dwarf-shrub or short shrub, for example.

Species / Percent Cover Estimates . Once you have identified your strata, list all diagnostic plant species in that strata and complete cover estimates per the following instructions.

1. **Species Name:** Refer to the plant list you have been provided for plant names used in this area. Always record the full scientific name for each species.
2. **Cover Class:** Estimate the aerial / crown cover of **each** species listed, using the cover class codes for the bottom of the page. These classes are as follows:
   01 = 0-10% 02 = 10-25% 03 = 25-60% 04 = 60-100%
3. **% Cover:** Record continuous cover value used to make cover class estimates.

Unknowns. If you can't identify or easily key out the plant at the site, assign a name to it to be recorded on your data sheet. For example, if you know what family it is in or its genus, label it "unknown Asteraceae sp." or "Unk. *Erigeron* sp.". If there is more than one unknown in a family, add a number to the name you give them. If you do not know the family, label the plant "Unknown 1", using consecutive numbers for additional unknowns. Record the cover class and other data for the unknown as you would for any other species. Then, take a sample of the species with as much of the plant as possible, especially intact sexual parts, if present. Place the sample in a plastic baggie, and either label the plant (if you are putting more than one plant in the baggie) or label the baggie with the plot code, the date and the name you gave it on the data form. Plant samples in baggies can be stored in coolers or refrigerators for short periods. If you are not able to key the plant out soon after collecting it, or you intend to keep the sample for the park collection, press the plant and with a label stating the plot or location of its collection (include UTMs if the sample is not from a plot), date, collectors name and name you assigned the plant. Also, thoroughly label any plant specimens collected as proof of plant occurrence for plants not listed on the site plant list.

Strata / Height Class, Cover Class and Diagnostic Species. Once the species list and associated cover data have been completed, the observer should then complete the following fields as specified below.

1. Indicate the average height class of the stratum in the first column, using the Height Scale at the bottom of the form. The height scale for this project is as follows:
2.

01 = <0.5 m	03 = 1- 2 m	05 = 5 – 10 m	07 = 15-20 m	09 = 35 – 50 m
02 = 0.5 – 1 m	04 = 2-5 m	06 = 10-15 m	08 = 20-35 m	10 = > 50 m

3. Enter the average percent cover class of the whole stratum in the second column, using the Cover Scale at the bottom of the form (same cover scale as for species above).
4. '*' – This Column is used to indicate which species in the strata are particularly abundant.

Record information on ***dominant species only***. There is one column that corresponds to the "Stratum" column in this table:

1. **Height.** Use the number code that best describes the heights of all plant species within a given stratum. The number codes are listed in the bottom left-hand corner of the data sheet.
2. **Cover Class.** For this ocular estimation you are looking at the aerial cover of **all** plants within a given stratum. Use the cover class codes listed in the bottom right hand corner of the data sheet and presented below.

Cover Classes	
01	0 – 10%
02	10 – 25%
03	25 - 60%
04	60 – 100%

3. **Dominant Species (Mark species that characterize the stand with a *).** List the plant species using the full scientific name. You may find that there are not enough lines, in which case you can write in the blank area under the stratum name and number codes.
4. **% Cover.** Estimate the percent aerial cover (T-100%) for each diagnostic plant species.

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APPENDIX 1: Landform Glossary (http://soils.usda.gov/technical/handbook/contents/part629glossary1.html)

alluvial cone - A semi-conical type of alluvial fan with very steep slopes; it is higher, narrower, and steeper (e.g., > 40% slopes) than a fan, and composed of coarser, and thicker layers of material deposited by a combination of alluvial episodes and to a much lesser degree, landslides (e.g., debris flow). Compare - alluvial fan, talus cone.

alluvial fan - A low, outspread mass of loose materials and/or rock material, commonly with gentle slopes, shaped like an open fan or a segment of a cone, deposited by a stream (best expressed in semiarid regions) at the place where it issues from a narrow mountain or upland valley; or where a tributary stream is near or at its junction with the main stream. It is steepest near its apex which points upstream and slopes gently and convexly outward (downstream) with a gradual decrease in gradient.

alluvial flat (a) (colloquial: western US) A nearly level, graded, alluvial surface in bolsons and semi-bolsons which commonly does not manifest traceable channels, terraces or floodplain levels. Compare - flood-plain step, terrace, valley flat. (b) **(not preferred)** A general term for a small flood plain bordering a river, on which alluvium is deposited during floods.

alluvial plain - (a) A large assemblage of fluvial landforms (braided streams, terraces, etc.,) that form low gradient, regional ramps along the flanks of mountains and extend great distances from their sources (e.g., High Plains of North America. SW (b) (not recommended, use flood plain.) An general, informal term for a broad flood plain or a low-gradient delta. Compare - alluvial flat.

alluvial plain remnant - An erosional remnant of an alluvial plain which retains the surface form and alluvial deposits of its origin but was not emplaced by, and commonly does not grade to a present-day stream or drainage network. Compare - alluvial plain, erosional remnant, paleoterrace.

alluvial terrace - (not preferred) refer to stream terrace.

alluvium - Unconsolidated, clastic material subaerially deposited by running water, including gravel, sand, silt, clay, and various mixtures of these. Compare - colluvium, slope alluvium.

anticline - (a) A unit of folded strata that is convex upward and whose core contains the stratigraphically oldest rocks, and occurs at the earth's surface. In a single anticline, beds forming the opposing limbs of the fold dip away from its axial plane. Compare - monocline, syncline, fold. (b) A fold, at any depth, generally convex upward whose core contains the stratigraphically older rocks.

arroyo - (colloquial: southwest A.) The channel of a flat-floored, ephemeral stream, commonly with very steep to vertical banks cut in unconsolidated material; sometimes called a wash. It is usually dry but can be transformed into a temporary watercourse or short-lived torrent after heavy rain within the watershed. Where arroyos intersect zones of ground-water discharge, they are more properly classed as intermittent stream channels.

artificial levee - An artificial embankment constructed along the bank of a watercourse or an arm of the sea, to protect land from inundation or to confine streamflow to its channel.

backslope - The hillslope profile position that forms the steepest and generally linear, middle portion of the slope. In profile, backslopes are commonly bounded by a convex shoulder above and a concave footslope below. They may or may not include cliff segments (i.e. free faces). Backslopes are commonly erosional forms produced by mass movement, colluvial action, and running water. Compare - summit, shoulder, footslope, toeslope.

backswamp - A flood-plain landform. Extensive, marshy or swampy, depressed areas of flood plains between natural levees and valley sides or terraces. Compare - valley flat.

badlands - A landscape which is intricately dissected and characterized by a very fine drainage network with high drainage densities and short, steep slopes with narrow interfluves. Badlands develop on surfaces with little or no vegetative cover, overlying unconsolidated or poorly cemented materials (clays, silts, or in some cases sandstones) sometimes with soluble minerals such as gypsum or halite.

bajada - (colloquial: southwestern US.) A broad, gently inclined, alluvial piedmont slope extending from the base of a mountain range out into a basin and formed by the lateral coalescence of a series of alluvial fans. Typically it has a broadly undulating transverse profile, parallel to the mountain front, resulting from the convexities of component fans. The term is generally restricted to constructional slopes of intermontane basins. Synonym - coalescent fan piedmont. Compare - colluvial apron.

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ballena - (colloquial: western US.) A fan remnant having a distinctively-rounded surface of fan alluvium. The ballena's broadly-rounded shoulders meet from either side to form a narrow summit and merge smoothly with concave sideslopes and then concave, short pediments which form smoothly-rounded drainageways between adjacent ballenas. A partial ballena is a fan remnant large enough to retain some relict fan surface on a remnant summit. Compare - fan remnant.

ballon - (colloquial: western US). A rounded, dome-shaped hill, formed by erosion or uplift.

bar - A general term for a ridge-like accumulation of sand, gravel, or other alluvial material formed in the channel, along the banks, or at the mouth of a stream where a decrease in velocity induces deposition; e.g. a channel bar or a meander bar. A generic term for any of various elongate offshore ridges, banks, or mounds of sand, gravel, or other unconsolidated material submerged at least at high tide, and built up by the action of waves or currents, especially at the mouth of a river or estuary, or at a slight distance offshore from the beach.

barchan dune - A crescent-shaped dune with tips extending leeward (downwind), making this side concave and the windward (upwind) side convex. Barchan dunes tend to be arranged in chains extending in the dominant wind direction. Compare - parabolic dune.

base slope - A geomorphic component of hills consisting of the concave to linear slope (perpendicular to the contour) which, regardless of the lateral shape is an area that forms an apron or wedge at the bottom of a hillside dominated by colluvial and slope wash processes and sediments (e.g., colluvium and slope alluvium). Distal base slope sediments commonly grade to, or interfinger with, alluvial fills, or gradually thin to form pedisediment over residuum. Compare - head slope, side slope, nose slope, interfluve, free face.

basin - (a) Drainage basin; (b) A low area in the Earth's crust, of tectonic origin, in which sediments have accumulated. (c) (colloquial: western US) A general term for the nearly level to gently sloping, bottom surface of an intermontane basin (bolson). Landforms include playas, broad alluvial flats containing ephemeral drainageways, and relict alluvial and lacustrine surfaces that rarely, if ever, are subject to flooding. Where through-drainage systems are well developed, flood plains are dominant and lake plains are absent or of limited extent. Basin floors grade mountainward to distal parts of piedmont slopes.

basin floor - A general term for the nearly level, lower-most part of intermontane basins (i.e. bolsons, semi-bolsons). The floor includes all of the alluvial, eolian, and erosional landforms below the piedmont slope. Compare - basin, piedmont slope.

basin-floor remnant - (colloquial: western US) A flat erosional remnant of any former landform of a basin floor that has been dissected following the incision of an axial stream.

bench - (not preferred) refer to structural bench.

beveled base - The lower portion of a canyon wall or escarpment marked by a sharp reduction in slope gradient from the precipitous cliff above, and characteristically composed of thinly mantled colluvium (e.g. < 1 m) and / or carapaced with a thin surficial mantle of large rock fragments from above, which overly residuum of less resistant rock (e.g., shale) whose thin strata intermittently outcrop at the surface; a zone of erosion and transport common in the canyonlands of the semi-arid, southwestern US. Compare - talus slope.

blowout - A saucer-, cup-, or trough-shaped depression formed by wind erosion on a preexisting dune or other sand deposit, especially in an area of shifting sand, loose soil, or where protective vegetation is disturbed or destroyed; the adjoining accumulation of sand derived from the depression, where recognizable, is commonly included. Commonly small, some blowouts may be large (kilometers in diameter). Compare - deflation basin.

bluff - (a) A high bank or bold headland, with a broad, precipitous, sometimes rounded cliff face overlooking a plain or body of water, especially on the outside of a stream meander; ex. a river bluff. (b) (not preferred) use cliff. Any cliff with a steep, broad face.

bolson - (colloquial: western US.) A landscape term for an internally drained (closed) intermontane basin into which drainages from surrounding mountains converge inward toward a central depression. Bolsons are often tectonically depressed areas and, according to Peterson, include alluvial flat, alluvial plain, beach plain, barrier beach, lake plain, sand sheets, dunes, and playa. The piedmont slope includes slopes of erosional origin adjoining the mountain front (pediments) and complex construction surfaces (fans). A semi-bolson is an externally drained (open) bolson. Synonym - intermontane basin.

borrow pit - An excavated area from which earthy material has been removed typically for construction purposes offsite; also called barrow pit.

bottomland - (not recommended) use flood plain. An obsolete, informal term loosely applied to varying portions of a flood plain.

box canyon - a) A narrow gorge or canyon containing an intermittent stream following a zigzag course, characterized by high, steep rock walls and typically closed upstream by a similar wall, giving the impression, as viewed from its bottom, of being surrounded or "boxed in" by almost vertical walls. b) A steep-walled canyon heading against a cliff a dead-end canyon.

braided stream - A channel or stream with multiple channels that interweave as a result of repeated bifurcation and convergence of flow around inter-channel bars, resembling (in plan view) the strands of a complex braid. Braiding is generally confined to broad, shallow streams of low sinuosity, high bedload, non-cohesive bank material, and a steep gradient. At bank-full discharge, braided streams have steeper slopes and shallower, broader, and less stable channel cross sections than meandering streams. Compare - meandering channel, flood-plain landforms.

break - (slopes) An abrupt change or inflection in a slope or profile. Compare - knickpoint, shoulder, escarpment. (geomorphology) A marked variation of topography, or a tract of land distinct from adjacent land, or an irregular or rough piece of ground. Compare - breaks.

breaks - (colloquial: western US) A landscape or large tract of steep, rough or broken land dissected by ravines and gullies and marks a sudden change in topography as from an elevated plain to lower hilly terrain, or a line of irregular cliffs at the edge of a mesa or a river (e.g., the Missouri River breaks).

butte - An isolated, generally flat-topped hill or mountain with relatively steep slopes and talus or precipitous cliffs and characterized by summit width that is less than the height of bounding escarpments, commonly topped by a caprock of resistant material and representing an erosion remnant carved from flat-lying rocks. Compare - mesa, plateau, cuesta.

caldera - A large, more or less circular depression, formed by explosion and/or collapse, which surrounds a volcanic vent or vents, and whose diameter is many times greater than that of the included vent, or vents. Compare - crater.

canyon - A long, deep, narrow, very steep-sided valley cut primarily in bedrock with high and precipitous walls in an area of high local relief (e.g., mountain or high plateau terrain), often with a perennial stream at the bottom; similar to but larger than a gorge. Compare - gorge, box canyon, slot canyon.

canyon bench - One of a series of relatively narrow, flat landforms occurring along a canyon wall and caused by differential erosion of alternating strong and weak horizontal strata; a type of structural bench.

canyonlands - A deeply and extensively dissected landscape composed predominantly of relatively narrow, steep-walled valleys with small flood plains or valley floors; commonly with considerable outcrops of hard bedrock on steep slopes, ledges, or cliffs, and with broader summits or interfluves than found in badlands. Sideslopes exhibit extensive erosion, active back-wearing, and relatively sparse vegetation.

channel - (a) The hollow bed where a natural body of surface water flows or may flow. The deepest or central part of the bed of a stream, containing the main current and occupied more or less continuously by water. (b) (colloquial: western US.) The bed of a single or braided watercourse that commonly is barren of vegetation and is formed of modern alluvium. Channels may be enclosed by banks or splayed across and slightly mounded above a fan surface and include bars and mounds of cobbles and stones. (c) Small, trough-like, arcuate or sinuous channels separated by small bars or ridges, caused by fluvial processes; common to flood plains and young alluvial terraces; a constituent part of *bar and channel* topography.

cinder cone - A conical hill formed by the accumulation of cinders and other pyroclastics, normally basaltic or andesitic composition. Slopes generally exceed 20 percent.

cliff - Any high, very steep to perpendicular or overhanging face of rock or earth; a precipice. Compare - bluff.

climbing dune - A dune formed by the piling-up of sand by wind against a cliff or mountain slope; very common in arid regions with substantial local relief and strong winds. Compare - sand ramp.

closed depression - A generic name for an enclosed area that has no surface drainage outlet and from which water escapes only by evaporation or subsurface drainage; an area of low ground indicated on a topographic map by a hachured contour line forming a closed loop. Compare - open basin.

collapse sinkhole - A type of sinkhole that is formed by collapse of a cave within the underlying soluble bedrock (e.g., limestone, gypsum, salt). Compare - solution sinkhole.

colluvium - Unconsolidated, unsorted material being transported or deposited on sideslopes and/or at the base of slopes by mass movement (e.g. direct gravitational action) and by local, unconcentrated runoff. Compare - alluvium, slope alluvium, scree, talus, mass movement.

complex landslide - A category of mass movement processes, associated sediments (complex landslide deposit) or resultant landforms characterized by a composite of several mass movement processes none of which dominates or leaves a prevailing landform. Numerous types of complex landslides can be specified by naming the constituent processes evident (e.g. a complex earth spread - earth flow landslide). Compare - fall, topple, slide, lateral spread, flow, landslide.

crest - (a) The commonly linear, narrow top of a ridge, hill, or mountain. It is appropriately applied to elevated areas where retreating backslopes are converging such that these high areas are almost exclusively composed of convex shoulders; (b) (not preferred) Sometimes used as an alternative for the hillslope component *summit*. Compare - summit (*part b*), saddle.

cuesta - An asymmetric, homoclinal ridge capped by resistant rock layers of slight to moderate dip (commonly less than 15 percent); produced by differential erosion of interbedded resistant and weak rocks. A cuesta has a long, gentle slope on one side (dip slope), that roughly parallels the inclined beds, and on the other side has a relatively short and steep or cliff-like slope (scarp) that cuts through the tilted rocks. Compare - hogback, mesa, dipslope, scarp slope, cuesta valley.

cuesta valley - A low relief, low angle, asymmetrical depression which lies parallel to the strike of underlying strata; a type of strike valley. It's formed by the differential erosion of weaker strata interbedded with more resistant bedrock. It may or may not contain a local drainage network and commonly lies above and is not connected to the regional drainage system. Compare - cuesta, valley, trough, hanging valley.

debris fall - The process, associated sediments (debris fall deposit) or resultant landform characterized by a rapid type of *fall* involving the relatively free, downslope movement or collapse of detached, unconsolidated material which falls freely through the air (lacks an underlying slip face); sediments have substantial proportions of both fine earth and coarse fragments; common along undercut stream banks. Compare - rock fall, soil fall, landslide.

debris flow - The process, associated sediments (debris flow deposit) or landform resulting from a very rapid type of *flow* dominated by a sudden downslope movement of a mass of rock, soil, and mud (more than 50% of the particles are > 2mm), and whether saturated or comparatively dry, behaves much as a viscous fluid when moving. Compare - lahar, mudflow, landslide.

deflation basin - A topographic basin excavated and maintained by wind erosion which removes unconsolidated material and commonly leaves a rim of resistant material surrounding the depression. Unlike a blowout, a deflation basin does not include adjacent deposits derived from the basin. Compare - blowout.

depression - Any relatively sunken part of the Earth's surface; especially a low-lying area surrounded by higher ground. A closed depression has no natural outlet for surface drainage (e.g. a sinkhole). An open depression has a natural outlet for surface drainage. Compare - closed depression, open depression.

desert pavement - A natural, residual concentration or layer of wind-polished, closely packed gravel, boulders, and other rock fragments, mantling a desert surface. It is formed where wind action and sheetwash have removed all smaller particles or where coarse fragments have migrated upward through sediments to the surface. It usually protects the underlying, finer-grained material from further deflation. The coarse fragments commonly are cemented by mineral matter. Compare - erosion pavement, stone line.

dike - A tabular igneous intrusion that cuts across the bedding or foliation of the country rock. Compare – sill.

dip - A geomorphic component (characteristic piece) of flat plains (e.g., lake plain, low coastal plain, low-relief till plain) consisting of a shallow and typically closed depression that tends to be an area of focused groundwater recharge but not a permanent water body and that lies slightly lower and is wetter than the adjacent talf, and favors the accumulation of fine sediments and organic materials.

ditch - An open and usually unpaved (unlined), channel or trench excavated to convey water for drainage (removal) or irrigation (addition) to or from a landscape; smaller than a canal; some ditches are modified natural waterways.

divide - (a) The line of separation; (b) The summit area, or narrow tract of higher ground that constitutes the watershed boundary between two adjacent drainage basins; it divides the surface waters that flow naturally in one direction from those that flow in the opposite direction. Compare – interfluve.

dome - (a) An uplift or anticlinal structure, either circular or elliptical in outline, in which the rocks dip gently away in all directions. A dome may be small (e.g. a salt dome) or many kilometers in diameter. (b) A smoothly rounded landform of rock mass such as a rock-capped mountain summit, that roughly resembles the dome of a building. (e.g. the rounded granite peaks of Yosemite, CA).

drainageway - (a) A general term for a course or channel along which water moves in draining an area. (b) a term restricted to relatively small, roughly linear or arcuate depressions that move concentrated water at some time, and either lack a defined channel (e.g. head slope, swale) or have a small, defined channel (e.g. low order streams).

draw - A small, natural watercourse cut in unconsolidated materials, generally more open with a broader floor and more gently sloping sides than an arroyo, ravine or gulch, and whose present stream channel may appear inadequate to have cut the drainageway that it occupies.

dune - A low mound, ridge, bank or hill of loose, windblown, subaerially deposited granular material (generally sand), either barren and capable of movement from place to place, or covered and stabilized with vegetation, but retaining its characteristic shape. (See barchan dune, parabolic dune, parna dune, shrub-coppice dune, seif dune, transverse dune).

dune field - An assemblage of moving and/or stabilized dunes, together with sand plains, interdune areas, and the ponds, lakes, or swamps produced by the blocking of steams by the sand. See dune lake.

earthflow - The process, associated sediments (earthflow deposit) or resultant landforms characterized by slow to rapid types of flow dominated by downslope movement of soil, rock, and mud (more than 50% of the particles are < 2 mm), and whether saturated or comparatively dry, behaves as a viscous fluid when moving. Compare - debris flow (coarser, less fluid), mudflow (finer, more fluid).

eolian deposit - Sand, silt or clay-sized clastic material transported and deposited primarily by wind, commonly in the form of a dune or a sheet of sand or loess. Conventionally, primary volcanic deposits (e.g. tephra) are handled separately. Compare - loess, parna, beach sands.

eolian sands - Sand-sized, clastic material transported and deposited primarily by wind, commonly in the form of a dune or a sand sheet. Compare - beach sands.

ephemeral stream - Generally a small stream, or upper reach of a stream, that flows only in direct response to precipitation. It receives no protracted water supply from melting snow or other sources and its channel is above the water table at all times. Compare - arroyo, intermittent stream, perennial stream.

eroded fan remnant - All, or a portion of an alluvial fan that is much more extensively eroded and dissected than a fan remnant; sometimes called an *erosional fan remnant*. It consists primarily of a) eroded and highly dissected sides (*eroded fan-remnant sideslopes*) dominated by hillslope positions (shoulder, backslope, etc.), and b) to a lesser extent an intact, relatively planar, relict alluvial fan "summit" area best described as a tread.

eroded fan-remnant sideslope - A rough or broken margin of an *eroded fan remnant* highly dissected by ravines and gullies that can be just a fringe or make up a large part of an eroded alluvial fan; its bounding escarpments (risers), originally formed by inset channels, have become highly dissected and irregular such that terrace components (tread and riser) have been consumed or modified and replaced by hillslope positions and components (shoulder, backslope, footslope, etc.); sometimes referred to as *fan remnant sideslopes*. Compare - eroded fan remnant.

escarpment - A continuous, steep slope or cliff produced by erosion or faulting and that topographically interrupts or breaks the general continuity of more gently sloping land surfaces . The term is most commonly applied to cliffs produced by differential erosion. Synonym = scarp.

falling dune - An accumulation of sand that is formed as sand is blown off a mesa top or over a cliff face or steep slope, forming a solid wall, sloping at the angle of repose of dry sand, or a fan extending downward from a re-entrant in the mesa wall. Compare - climbing dune, sand ramp.

fan - (a) A gently sloping, fan-shaped mass of detritus forming a section of a low-angle cone commonly at a place where there is a notable decrease in gradient; specifically an alluvial fan (not preferred – use alluvial fan). Compare - alluvial fan, alluvial cone. (b) A fan-shaped mass of congealed lava that formed on a steep slope by the continually changing direction of flow.

fan apron - A sheet-like mantle of relatively young alluvium and soils covering part of an older fan piedmont (and occasionally alluvial fan) surface, commonly thicker and further down slope (e.g., mid-fan or mid-fan piedmont) than a fan collar. It somewhere

buries an older soil that can be traced to the edge of the fan apron where the older soil emerges as the land surface, or relict soil. No buried soils should occur within a fan-apron mantle itself. Compare - fan collar.

fan collar - A landform comprised of a thin, short, relatively young mantle of alluvium along the very upper margin (near the proximal end or apex) of a major alluvial fan. The young mantle somewhere buries an older soil that can be traced to the edge of the collar where the older soil emerges at the land surface as a relict soil. Compare - fan apron.

fan remnant - A general term for landforms that are the remaining parts of older fan-landforms, such as alluvial fans, fan aprons, inset fans, and fan skirts, that either have been dissected (erosional fan-remnants) or partially buried (nonburied fan-remnants). An erosional fan remnant must have a relatively flat summit that is a relict fan-surface. A nonburied fan-remnant is a relict surface in its entirety. Compare - eroded fan remnant, ballena.

fan skirt - The zone of smooth, laterally-coalescing, small alluvial fans that issue from gullies cut into the fan piedmont of a basin or that are coalescing extensions of the inset fans of the fan piedmont, and that merge with the basin floor at their toeslopes. These are generally younger fans which onlap older fan surfaces.

fault-line scarp - (a) A steep slope or cliff formed by differential erosion along a fault line, as by the more rapid erosion of soft rock on the side of a fault as compared to that of more resistant rock on the other side; e.g. the east face of the Sierra Nevada in California. (b) (not recommended) A fault scarp that has been modified by erosion. This usage is not recommended because the scarp is usually not located on the fault line.

fen - Waterlogged, spongy ground containing alkaline decaying vegetation, characterized by reeds, that develops into peat. It sometimes occurs in sinkholes of karst regions. Compare - bog, marsh, swamp.

finger ridge - One in a group of small, tertiary spur ridges that form crudely palmate extensions of erosional remnants along the flanks or nose of larger ridges. Compare - ballena, rib.

flat - (a) (adjective) Said of an area characterized by a continuous surface or stretch of land that is smooth, even, or horizontal, or nearly so, and that lacks any significant curvature, slope, elevations, or depressions. (b) (noun) An informal, generic term for a level or nearly level surface or small area of land marked by little or no local relief. Compare - mud flat. (c) (not recommended) A nearly level region that visibly displays less relief than its surroundings.

flood plain - The nearly level plain that borders a stream and is subject to inundation under flood-stage conditions unless protected artificially. It is usually a constructional landform built of sediment deposited during overflow and lateral migration of the streams.

foothills - A steeply sloping upland composed of hills with relief of 30 up to 300 meters and fringes a mountain range or high-plateau escarpment. Compare - hill, mountain, plateau. SW &

footslope - The hillslope profile position that forms the concave surface at the base of a hillslope. It is a transition zone between upslope sites of erosion and transport (shoulder, backslope) and downslope sites of deposition (toeslope). Compare - summit, shoulder, backslope, and toeslope.

free face - A geomorphic component of hills and mountains consisting of an outcrop of bare rock that sheds rock fragments and other sediments to, and commonly stands more steeply than the angle of repose of, the colluvial slope immediately below; most commonly found on shoulder and backslope positions, and can comprise part or all of a nose slope or side slope. Compare - interfluve, crest, nose slope, side slope, head slope, base slope.

gorge - (a) A narrow, deep valley with nearly vertical, rocky walls, smaller than a canyon, and more steep-sided than a ravine; especially a restricted, steep-walled part of a canyon. (b) A narrow defile or passage between hills or mountains.

graben - An elongate trough or basin bounded on both sides by high-angle, normal faults that dip towards the interior of the trough. It is a structural form that may or may not be geomorphically expressed as a rift valley. Compare - horst.

gravel pit - A depression, ditch or pit excavated to furnish gravel for roads or other construction purposes; a type of borrow pit.

ground soil - Any soil at the present-day land surface and actively undergoing pedogenesis,

gulch - (colloquial: western US.; not preferred - refer to ravine) A small stream channel, narrow and steep-sided in cross section, and larger than a gully, cut in unconsolidated materials. General synonym - ravine. Compare - arroyo, draw, gully, wash.

gully - A small channel with steep sides caused by erosion and cut in unconsolidated materials by concentrated but intermittent flow of water usually during and immediately following heavy rains or ice / snow melt. A gully generally is an obstacle to wheeled vehicles and too deep (e.g., > 0.5 m) to be obliterated by ordinary tillage; (a rill is of lesser depth and can be smoothed over by ordinary tillage). Compare - rill, ravine, arroyo, swale, draw.

hanging valley - A tributary valley whose floor at the lower end is notably higher than the floor of the main valley in the area of junction.

head slope - A geomorphic component of hills consisting of a laterally concave area of a hillside, especially at the head of a drainageway, resulting in converging overland water flow (e.g. sheet wash); head slopes are dominated by colluvium and slope wash sediments (e.g., slope alluvium); contour lines form concave curves. Slope complexity (downslope shape) can range from simple to complex. Headslopes are comparatively moister portions of hillslopes and tend to accumulate sediments (e.g., cummulic profiles) where they are not directly contributing materials to channel flow. Compare - side slope, nose slope, free face, interfluve, crest, base slope.

headwall - A steep slope at the head of a valley; e.g. the rock cliff at the back of a cirque. Compare - cirque headwall.

high hill - A generic name for an elevated, generally rounded land surface with high local relief, rising between 90 meters (approx. 300 ft.) to as much as 300 m (approx. 1000 ft.) above surrounding lowlands. Compare - low hill, hill, hillock.

hill - A generic term for an elevated area of the land surface, rising at least 30 m (100 ft.) to as much as 300 meters (approx. 1000 ft.) above surrounding lowlands, usually with a nominal summit area relative to bounding slopes, a well-defined, rounded outline and slopes that generally exceed 15 percent. A hill can occur as a single, isolated mass or in a group. A hill can be further specified based on the magnitude of local relief: *low hill* (30 - 90 m) or *high hill* (90 - 300 m). Informal distinctions between a hill and a mountain are often arbitrary and dependent on local convention. Compare - hillock, plateau, mountain, foothills, hills.

hillock - A generic name for a small, low hill, generally between 3 - 30 m in height and slopes between 5 and 50% (e.g., bigger than a mound but smaller than a hill); commonly considered a microfeature. Compare - mound, hill.

hillslope - A generic term for the steeper part of a hill between its summit and the drainage line, valley flat, or depression floor at the base of the hill. Compare - mountain slope.

hogback - A sharp-crested, symmetric (homoclinal) ridge formed by highly tilted resistant rock layers; produced by differential erosion of interlayered resistant and weak rocks with dips greater than about 25 degrees (45 percent). Compare - cuesta.

hoodoo - A bizarrely shaped column, pinnacle, or pillar of rock produced by differential weathering or erosion in a region of sporadically heavy rainfall. Formation is facilitated by joints and layers of varying hardness. Compare - earth pillar.

horst - An elongate block that is bounded on both sides by normal faults that dip away from the interior of the horst. It is a structural form and may or may not be expressed geomorphically.

hummock - (a) (not preferred - see hillock). An imprecise, general term for a rounded or conical mound or other small elevation. (b) (not preferred) A slight rise of ground above a level surface.

impact crater - a) A generally circular or elliptical depression formed by hypervelocity impact of an experimental projectile or ordinance into earthy or rock material. Compare - caldera, crater, meteorite crater. SW; b) (not recommended - use meteorite crater) A generally circular crater formed by the impact of an interplanetary body (projectile) on a planetary surface.

inset fan - (colloquial; western US) The flood plain of an ephemeral stream that is confined between fan remnants, ballenas, basin-floor remnants, or closely-opposed fan toeslopes of a basin.

interdune - The relatively flat surface, whether sand-free or sand-covered, between dunes. GG

interfluve - A landform composed of the relatively undissected upland or ridge between two adjacent valleys containing streams flowing in the same general direction. An elevated area between two drainageways that sheds water to those drainageways. Compare - divide.

intermittent stream - A stream, or reach of a stream, that does not flow year-round (commonly dry for 3 or more months out of 12) and whose channel is generally below the local water table; it flows only when it receives a) base flow (i.e. solely during wet periods),

or b) ground-water discharge or protracted contributions from melting snow or other erratic surface and shallow subsurface sources. Compare - ephemeral stream.

island - (a) Land completely surrounded by water; (b) An elevated area of land surrounded by swamp, or marsh, or isolated at high water or during floods. Compare - barrier island.

knob - (a) A rounded eminence, a small hill or mountain; especially a prominent or isolated hill with steep sides, commonly found in the Southern United States. (b) A peak or other projection from the top of a hill or mountain. Also, a boulder or group of boulders or an area of resistant rocks protruding from the side of a hill or mountain. Compare - stack.

knoll - A small, low, rounded hill rising above adjacent landforms.

lake - An inland body of permanent standing water, fresh or saline, occupying a depression, generally of appreciable size (larger than a pond) and too deep to permit vegetation (excluding subaqueous vegetation) to take not completely across the expanse of water.

lakebed - (a) The flat to gently undulating ground underlain or composed of fine-grained sediments deposited in a former lake. (b) The bottom of a lake; a lake basin.

lakeshore - The narrow strip of land in contact with or bordering a lake; especially a beach.

landslide - A general, encompassing term for most types of mass movement landforms and processes involving the downslope transport and outward deposition of soil and rock materials, caused by gravitational forces and which may or may not involve saturated materials. Names of landslide types generally reflect the dominant process and/or the resultant landform. The main operational categories of mass movement are *fall* (rockfall, soil fall, topple), *slide* (rotational landslide, block glide, debris slide, lateral spread), *flow* [rock fragment flow (especially rockfall avalanche), debris avalanche, debris flow (e.g., lahar), earthflow, (creep, mudflow)], and *complex landslides*. Compare - solifluction.

ledge - (a) A narrow shelf or projection of rock, much longer than wide, formed on a rock wall or cliff face, as along a coast by differential wave action on softer rocks; erosion is by combined biological and chemical weathering. (b) A rocky outcrop; solid rock. (c) A shelf-like quarry exposure or natural rock outcrop. Compare - structural bench.

levee - An artificial or natural embankment built along the margin of a watercourse or an arm of the sea, to protect land from inundation or to confine streamflow to its channel. Compare artificial levee, natural levee.

longitudinal dune - A long, narrow sand dune, usually symmetrical in cross profile, oriented parallel to the prevailing wind direction ; it is wider and steeper on the windward side but tapers to a point on the lee side. It commonly forms behind an obstacle in an area where sand is abundant and the wind is strong and constant. Such dunes can be a few meters high and up to 100 km long. Compare - seif dune, transverse dune.

low hill - A generic name for an elevated, generally rounded land surface with low local relief, rising between 30 meters (100 ft.) to as much as 90 m (approx. 300 ft.) above surrounding lowlands. Compare - high hill, hill, hillock.

lowland - (a) A generic, imprecise term for low-lying land or an extensive region of low-lying land, especially near a coast and including the extended plains or country lying not far above tide level. (b) (not preferred) A generic, imprecise term for a landscape of low, comparatively level ground of a region or local area, in contrast with the adjacent higher country. (c) (not recommended - use valley, bolson, etc.) A generic term for a large valley. Compare - upland.

marsh - Periodically wet or continually flooded areas with the surface not deeply submerged. Covered dominantly with sedges, cattails, rushes, or other hydrophytic plants. Compare - salt marsh, swamp, bog, fen.

meander belt - The zone within which migration of a meandering channel occurs; the flood-plain area included between two imaginary lines drawn tangential to the outer bends of active channel loops. Landform components of the meander-belt surface are produced by a combination of gradual (lateral and down-valley) migration of meander loops and avulsive channel shifts causing abrupt cut-offs of loop segments. Landforms flanking the sinuous stream channel include: point bars, abandoned meanders, meander scrolls, oxbow lakes, natural levees, and flood-plain splays. Meander belts may not exhibit prominent natural levee or splay forms. Flood plains of broad valleys may contain one or more abandoned meander belts in addition to the zone flanking the active stream channel.

meander scar - (a) A crescent-shaped, concave or linear mark on the face of a bluff or valley wall, produced by the lateral erosion of a meandering stream which impinged upon and undercut the bluff; if it's no longer adjacent to the modern stream channel it indicates an

abandoned route of the stream; (b) (not recommended - refer to oxbow) An abandoned meander, commonly filled in by deposition and vegetation, but still discernable.

meander scroll - (a) One of a series of long, parallel, close fitting, crescent-shaped ridges and troughs formed along the inner bank of a stream meander as the channel migrated laterally down-valley and toward the outer bank. Compare - meander belt, point bar. (b) (not recommended; refer to oxbow lake) - A small, elongate lake on a flood plain in a well-defined part of an abandoned stream channel.

mesa - A broad, nearly flat-topped, and usually isolated landmass bounded by steep slopes or precipitous cliff and capped by layers of resistant, nearly horizontal, rocky summit width greater than the height of bounding escarpments. (Colloquial: western US; not preferred) Also used to designate broad structural benches and alluvial terraces that occupy intermediate levels in stepped sequences of platforms bordering canyons and valleys. Compare - butte, plateau, cuesta.

monocline - (a) A unit of folded strata that dips from the horizontal in one direction only, is not part of an anticline or syncline, and occurs at the earth's surface.. This structure is typically present in plateau areas where nearly flat strata locally assume steep dips caused by differential vertical movements without faulting. Compare - anticline, syncline, fold. (b) - A local steepening in an otherwise uniform gentle dip.

mountain - A generic term for an elevated area of the land surface, rising more than 300 meters above surrounding lowlands, usually with a nominal summit area relative to bounding slopes and generally with steep sides (greater than 25 percent slope) with or without considerable bare-rock exposed. A mountain can occur as a single, isolated mass or in a group forming a chain or range. Mountains are primarily formed by tectonic activity and/or volcanic action and secondarily by differential erosion. Compare - hill, hillock, plateau, foothills, mountains.

natural levee - A long, broad low ridge or embankment of sand and coarse silt, built by a stream on its flood plain and along both sides of its channel, especially in time of flood when water overflowing the normal banks is forced to deposit the coarsest part of its load. It has a gentle slope away from the river and toward the surrounding floodplain, and its highest elevation is closest to the river bank. Compare - levee, artificial levee, meander belt.

open depression - A generic name for any enclosed or low area that has a surface drainage outlet whereby surface water can leave the enclosure; an area of lower ground indicated on a topographic map by contour lines forming an incomplete loop or basin indicating at least one surface exit. Compare - closed basin.

overbank deposit - Fine-grained sediments (silt and clay) deposited from suspension on a flood plain by floodwaters that cannot be contained within the stream channel.

overflow stream channel - A watercourse that is generally dry but conducts flood waters that have overflowed the banks of a river, commonly from large storms or annual meltwater.

oxbow - A closely looping stream meander having an extreme curvature such that only a neck of land is left between the two parts of the stream. (colloquial: northeastern A.) the land enclosed, or partly enclosed, within an oxbow. Compare - meander belt, oxbow lake, bayou.

oxbow lake - The crescent-shaped, often ephemeral body of standing water situated by the side of a stream in the abandoned channel (oxbow) of a meander after the stream formed a neck cutoff and the ends of the original bend were silted up. Compare - meander belt, oxbow.

parabolic dune - A sand dune with a long, scoop-shaped form, convex in the downwind direction so that its horns point upwind, whose ground plan, when perfectly developed, approximates the form of a parabola.

peak - Sharp or rugged upward extension of a ridge chain, usually at the junction of two or more ridges; the prominent highest point of a summit area.

pediment - A gently sloping erosional surface at the foot of a receding hill or mountain slope. The surface may be essentially bare, exposing earth material that extends beneath adjacent uplands; or it may be thinly mantled with alluvium and colluvium, ultimately in transit from upland front to basin or valley lowland. In hill-foot slope terrain the mantle is designated "pedisediment." The term has been used in several geomorphic contexts: Pediments may be classed with respect to (a) landscape positions, for example, intermontane-basin piedmont or valley-border footslope surfaces (respectively, apron and terrace pediments); (b) type of material eroded, bedrock or regolith; or (c) combinations of the above. Compare - Piedmont slope.

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perennial stream - A stream or reach of a stream that flows continuously throughout the year and whose surface is generally lower than the water table adjacent to the region adjoining the stream. Compare - Ephemeral stream, Intermittent stream.

piedmont - (adjective) Lying or formed at the base of a mountain or mountain range; e.g., a piedmont terrace or a piedmont pediment. (noun) An area, plain, slope, glacier, or other feature at the base of a mountain; e.g., a foothill or a bajada. In the United States, the Piedmont is a low plateau extending from New Jersey to Alabama and lying east of the Appalachian Mountains.

piedmont slope - (colloquial - western US) The dominant gentle slope at the foot of a mountain; generally used in terms of intermontane-basin terrain in arid to subhumid regions. Main components include: (a) An erosional surface on bedrock adjacent to the receding mountain front (pediment, rock pediment); (b) A constructional surface comprising individual alluvial fans and interfan valleys, also near the mountain front; and (c) A distal complex of coalescent fans (bajada), and alluvial slopes without fan form. Piedmont slopes grade to basin-floor depressions with alluvial and temporary lake plains or to surfaces associated with through drainage (e.g., axial streams). Compare - bolson, fan piedmont.

plain - A general term referring to any flat, lowland area, large or small, at a low elevation. Specifically, any extensive region of comparatively smooth and level gently undulating land. A plain has few or no prominent hills or valleys but sometimes has considerable slope, and usually occurs at low elevation relative to surrounding areas. Where dissected, remnants of a plain can form the local uplands. A plain may be forested or bare of trees and may be formed by deposition or erosion. Compare - lowland, plateau.

plateau - A comparatively flat area of great extent and elevation; specifically an extensive land region considerably elevated (more than 100 meters) above adjacent lower-lying terrain, and is commonly limited on at least one side by an abrupt descent, has a flat or nearly level surface. A comparatively large part of a plateau surface is near summit level. Compare - hill, foothill, mountain, mesa, plain.

playa - The usually dry and nearly level lake plain that occupies the lowest parts of closed depressions, such as those occurring on intermontane basin floors. Temporary flooding occurs primarily in response to precipitation-runoff events. Playa deposits are fine grained and may or may not have high water table and saline conditions.

point bar - One of a series of low, arcuate ridges of sand and gravel developed on the inside of a growing meander by the slow addition of individual accretions accompanying migration of the channel toward the outer bank. Compare - meander scroll.

pond - (a) A natural body of standing fresh water occupying a small surface depression, usually smaller than a lake and larger than a pool. (b) A small artificial body of water, used as a source of water. Compare - salt pond.

pool - A small, natural body of standing water, usually fresh; e.g. a stagnant body of water in a marsh, or a transient puddle in a depression following a rain.

quarry - Excavation areas, open to the sky, usually for the extraction of stone.

ravine - A small stream channel; narrow, steep-sided, commonly V-shaped in cross section and larger than a gully, cut in unconsolidated materials. General synonym (not preferred) - gulch. Compare - arroyo, draw, gully.

reef - (a) A ridge-like or mound-like structure, layered or massive, built by sedentary calcareous organisms, especially corals, and consisting mostly of their remains; it is wave-resistant and stands above the surrounding contemporaneously deposited sediment. Also, such a structure built in the geologic past and now enclosed in rock, commonly of differing lithology. (b) A mass or ridge of rocks, especially coral and sometimes sand, gravel, or shells, rising above the surrounding sea or lake bottom to or nearly to the surface, and dangerous to navigation; specifically such a feature at 10 fathoms (18.3 m) or less, formerly 6 fathoms (11 m).

ridge - A long, narrow elevation of the land, usually sharp crested with steep sides and forming an extended upland between valleys. The term is used in areas of both hill and mountain relief.

rill - A very small channel with steep sides caused by erosion and cut in unconsolidated materials by concentrated but intermittent flow of water, usually during and immediately following moderate rains or after ice/snow melt. Generally, a rill is not an obstacle to wheeled vehicles and is shallow enough to be obliterated by ordinary tillage. Compare - gully.

rim - The border, margin, edge, or face of a landform, such as the curved brim surrounding the top part of a crater or caldera; specifically the rimrock of a plateau or canyon.

rise - (refer to lake plain) (a) A general term for a slight increase in slope and elevation of the land surface, usually with a broad summit and gently sloping sides. (b) same as (a) but the term is restricted to microfeatures in areas of very low relief such as lake plains or coastal plains.

river - (a) A general term for a natural, freshwater surface stream of considerable volume and generally with a permanent base flow, moving in a defined channel toward a larger river, lake, or sea. (b) (not recommended: colloquial - New England, US) A small watercourse which elsewhere in the US is known as a *creek*. Compare - stream.

river valley - an elongate depression of the Earth's surface; carved by a river during the course of it's development. Compare - valley side, valley floor.

rockfall - The process, associated sediments (rockfall deposit) or resultant landform characterized by a very rapid type of *fall* dominated by downslope movement of detached rock bodies which fall freely through the air or by leaps and bounds (lacks an underlying slip face); also spelled rock fall. Compare - debris fall, soil fall, landslide.

rock pediment - An erosion surface of low relief, cut directly into and across bedrock and composed of either bare rock or thinly veneered pedisediment or residuum (e.g. < 1.5 m) over bedrock; it occurs along the flanks of mountain fronts, or at the base of mountains or high hills. Its surface grades to the backwearing mountain slopes or hillslopes above, and generally grades down to and merges with a lower-lying alluvial plain, piedmont slope or valley floor below.

rotational slide - The process, associated sediments (rotational landslide deposit) or resultant landforms characterized by an extremely slow to moderately rapid type of slide, composed of comparatively dry and largely soil-rock materials, portions of which remain largely intact and in which movement occurs along a well-defined, concave shear surface and resulting in a backward rotation of the displaced mass. The landform may be single, successive (repeated up and down slope), or multiple (as the number of slide components increase). Compare - rotational debris slide, rotational earth slide, rotational rock slide, translational slide, lateral spread, landslide.

rubble - An accumulation of loose angular rock fragments, commonly overlying outcropping rock; the unconsolidated equivalent of a breccia. Compare - scree, talus.

saddle - A low point on a ridge or interfluve, generally a divide (pass, col) between the heads of streams flowing in opposite directions. Compare - summit, crest.

sandhills - A region of semi-stabilized sand dunes or sandy hills, either covered with vegetation or bare, as in north-central Nebraska and the midlands of the Carolinas.

sand plain - (a) A sand-covered plain which may originate by deflation of sand dunes, and who's lower limit of erosion is governed by the ground-water level. Also spelled *sandplain*. (b) (not preferred - refer to *sandy* outwash plain) A small outwash plain composed chiefly of sand deposited by meltwater streams flowing from a glacier.

sand ramp - A sand sheet blown up onto the lower slopes of a bedrock hill or mountain and forming an inclined plane, sometimes filling small mountain-side valleys and even crossing low passes. Compare - climbing dune, sand sheet.

sand sheet - A large, irregularly shaped, commonly thin, surficial mantle of eolian sand, lacking the discernible slip faces that are common on dunes.

scarp - An escarpment, cliff, or steep slope of some extent along the margin of a plateau, mesa, terrace, or structural bench. A scarp may be of any height. Compare - escarpment.

scarp slope - The relatively steeper face of a cuesta, facing in a direction opposite to the dip of the strata. Compare - dip slope.

scree - A collective term for an accumulation of coarse rock debris or a sheet of coarse debris mantling a slope. Scree is not a synonym of talus, as scree includes loose, coarse fragment material on slopes without cliffs. Compare - talus, colluvium, mass movement.

scree slope - A portion of a hillside or mountainslope mantled by scree and lacking an up-slope rockfall source (i.e. cliff). Compare - talus slope, scree, talus.

seep - (noun) An area, generally small, where water or oil percolates slowly to the land surface. For water, it may be considered as a seepage spring, but it is used by some for flows too small to be considered as springs.

shoulder - The hillslope profile position that forms the convex, erosional surface near the top of a hillslope. If present, it comprises the transition zone from summit to backslope. Compare - summit, crest, backslope, footslope, and toeslope.

shrub-coppice dune - A small, streamlined dune that forms around brush and clump vegetation.

side slope - A laterally planar area of a hillside, resulting in predominantly parallel overland water flow (e.g., sheet wash); contour lines generally form straight lines. Side slopes are dominated by colluvium and slope wash sediments. Slope complexity (downslope shape) can range from simple to complex. Compare - head slope, nose slope, free face, interfluve, crest, base slope. The slope bounding a drainageway and lying between the drainageway and the adjacent interfluve. It is generally linear along the slope width.

slide - (a) Mass movement processes, associated sediments (slide deposit) or resultant landforms (e.g., rotational, translational, and snow slide) characterized by a failure of earth, snow, or rock under shear stress along one or several surfaces that are either visible or may reasonably be inferred. The moving mass may or may not be greatly deformed, and movement may be rotational (rotational slide) or planar (translational slide). A slide can result from lateral erosion, lateral pressure, weight of overlying material, accumulation of moisture, earthquakes, expansion owing to freeze-thaw of water in cracks, regional tilting, undermining, fire, and human agencies. Compare -fall, topple, lateral spread, flow, complex landslide. (b) The track of bare rock or furrowed earth left by a slide. (c) The mass of material moved by or deposited by a slide.

slip face - The steeply sloping surface of a dune, standing at or near the angle of repose of loose sand, and advancing downwind by a succession of slides wherever that angle is exceeded.

slope - (also called slope gradient or gradient) The inclination of the land surface from the horizontal. Percent slope is the vertical distance divided by the horizontal distance, then multiplied by 100.

slope alluvium - Sediment gradually transported down mountain or hill slopes primarily by non-channel alluvial processes (i.e., slope wash processes) and characterized by particle sorting. Lateral particle sorting is evident on long slopes. In a profile sequence, sediments may be distinguished by differences in size and/or specific gravity of coarse fragments and may be separated by stone lines. Sorting of pebbles or cobbles and burnished peds distinguish these materials from unsorted colluvial deposits. Compare - colluvium, slope wash.

slope wash - A collective term for non-fluvial, incipient alluvial *processes* (e.g. overland flow, minor rills) that detach, transport, and deposit sediments down hill and mountain slopes. Related sediments (*slope alluvium*) exhibit nominal sorting or rounding of particles, peds, etc., and lateral sorting downslope on long slopes; stratification is crude and intermittent and readily destroyed by pedoturbation and frost action. Also called *slope wash processes*. Compare - slope alluvium, colluvium, valley-side alluvium.

slot canyon - A long, narrow, deep and tortuous channel or drainageway with sheer rock walls eroded into sandstone or other sedimentary rocks, especially in the semi-arid western US (e.g. Colorado Plateau); subject to flash flood events; depth to width ratios exceed 10:1 over most of its length and can approach 100:1; commonly containing unique ecological communities distinct from the adjacent, drier uplands.

strath terrace - A type of stream terrace, formed as an erosional surface cut on bedrock and thinly mantled with stream deposits (alluvium).

stream - (a) A body of running water that moves under gravity to progressively lower levels, in a relatively narrow but clearly defined channel on the ground surface, in a subterranean cavern, or beneath or in a glacier. It is a mixture of water and dissolved, suspended, or entrained matter. (b) A term used in quantitative geomorphology interchangeably with channel. Compare - river.

stream terrace - One or a series of platforms in a stream valley, flanking and more or less parallel to the stream channel, originally formed near the level of the stream, and representing the remnants of an abandoned flood plain, stream bed, or valley floor produced during a former state of fluvial erosion or deposition (i.e., currently very rarely or never floods; inactive cut and fill and/or scour and fill processes). Erosional surfaces cut into bedrock and thinly mantled with stream deposits (alluvium) are called "strath terraces." Remnants of constructional valley floors thickly mantled with alluvium are called alluvial terraces. Compare - alluvial terrace, flood-plain step, strath terrace, terrace.

strike valley - A subsequent valley eroded in, and developed parallel to the strike of, underlying weak strata; such as a cuesta; a valley that often, but not necessarily contains a strike valley.

structural bench - A platform-like, nearly level to gently inclined erosional surface developed on resistant strata in areas where valleys are cut in alternating strong and weak layers with an essentially horizontal attitude. Structural benches are bedrock controlled,

and in contrast to stream terraces, have no geomorphic implication of former, partial erosion cycles and base-level controls, nor do they represent a stage of flood-plain development following an episode of valley trenching. Compare - pediment, ledge; see scarp.

summit - (a) The topographically highest position of a hillslope profile with a nearly level (planar or only slightly convex) surface. Compare - shoulder, backslope, footslope, and toeslope, crest. (b) A general term for the top, or highest area of a landform such as a hill, mountain, or tableland. It usually refers to a high interfluve area of relatively gentle slope that is flanked by steeper slopes, e.g., mountain fronts or tableland escarpments.

swale - (a) A shallow, open depression in unconsolidated materials which lacks a defined channel but can funnel overland or subsurface flow into a drainageway. Soils in swales tend to be more moist and thicker (cummulic) compared to surrounding soils. (b) A small, shallow, typically closed depression in an undulating ground moraine formed by uneven glacial deposition; Compare - swell-and-swale topography. (c) (not preferred; refer to interdune) A long, narrow, generally shallow, trough-like depression between two beach ridges, and aligned roughly parallel to the coastline.

syncline - (a) A unit of folded strata that is concave upward whose core contains the stratigraphically younger rocks, and occurs at the earth's surface. In a single syncline, beds forming the opposing limbs of the fold dip toward its axial plane. Compare - monocline, syncline, fold. (b) A fold, at any depth, generally concave upward whose core contains the stratigraphically younger rocks.

tableland - A term for a broad upland with an extensive, nearly level or undulating summit area and steep side slopes descending to surrounding lowlands. Compare - plateau, mesa, cuesta.

talus - Rock fragments of any size or shape (usually coarse and angular) derived from and lying at the base of a cliff or very steep rock slope. The accumulated mass of loose broken rock formed chiefly by falling, rolling, or sliding. Compare - talus slope, colluvium, mass movement, scree.

talus cone - A small, steep, cone-shaped landform at the base of a cliff or escarpment, that heads in a relatively small declivity or ravine, and composed of poorly sorted rock and soil debris that has accumulated primarily by episodic rockfall or, to a lesser degree, by slope wash. Not to be confused with an *alluvial cone*; a similar feature but of fluvial origin, composed of better stratified and more sorted material, and that tapers up into a more extensive drainageway. Compare - alluvial cone, beveled base, talus slope.

talus slope - a portion of a hillslope or mountainslope mantled by talus and lying below a rockfall source (e.g. cliff). Compare - scree slope, scree, talus. Compare - beveled base.

tank - (colloquial: southwestern US) A natural depression or cavity in impervious rocks in which water collects and remains for the greater part of the year.

terrace - A step-like surface, bordering a valley floor or shoreline, that represents the former position of a flood plain, or lake or sea shore. The term is usually applied to both the relatively flat summit surface (tread), cut or built by stream or wave action, and the steeper slope (scarp, riser), descending to a lower base level. Compare - stream terrace, flood-plain step. Practically, terraces are considered to be generally flat alluvial areas above the 100 yr. flood stage.

terracettes - Small, irregular step-like forms on steep hillslopes, especially in pasture, formed by creep or erosion of surficial materials that may be induced or enhanced by trampling of livestock such as sheep or cattle. Synonyms (not preferred) - catstep, sheep or cattle track.

toeslope - The hillslope position that forms the gently inclined surface at the base of a hillslope. Toeslopes in profile are commonly gentle and linear, and are constructional surfaces forming the lower part of a hill-slope continuum that grades to valley or closed-depression floors. Compare - summit, shoulder, backslope, footslope, valley floor.

translational slide - A category of mass movement processes, associated sediments (translational slide deposit) or resultant landforms characterized by the extremely slow to moderately rapid downslope displacement of comparatively dry soil-rock material on a surface (slip face) that is roughly parallel to the general ground surface, in contrast to falls, topples, and rotational slides. The term includes such diverse *slide* types as translational debris slides, translational earth slide, translational rock slide, block glides, and slab or flake slides. Compare - rotational slide, slide, landslide.

transverse dune - A very asymmetric sand dune elongated perpendicular to the prevailing wind direction, having a gentle windward slope and a steep leeward slope standing at or near the angle of repose of sand; it generally forms in areas of sparse vegetation. Compare - longitudinal dune.

valley - An elongate, relatively large, externally drained depression of the Earth's surface that is primarily developed by stream erosion or glacial activity. Compare - basin.

valley floor - A general term for the nearly level to gently sloping, lowest surface of a valley. Landforms include axial stream channels, the flood plain, flood-plain steps, and, in some areas, low terrace surfaces. Compare - flood-plain landforms, meander, braided channel, valley side.

valley side - The sloping to very steep surfaces between the valley floor and summits of adjacent uplands. Well-defined, steep valley sides have been termed valley walls (not recommended). Note: Scale, relief, and perspective may require use of closely related terms such as hill slope or mountain slope.

wash (dry wash) - (colloquial: western US.) The broad, flat- floored channel of an ephemeral stream, commonly with very steep to vertical banks cut in alluvium. Note: When channels reach intersect zones of ground-water discharge they are more properly classed as "intermittent stream" channels. Synonym - arroyo. Compare - gully.

zibar - A small, low-relief sand dune that lacks discernible slip faces and commonly occurs on sand sheets, in interdune areas, or in corridors between larger dunes. Zibar spacing can range from 50-400 m with local relief < 10 m. Unlike coppice dunes, zibars are unrelated to deposition around vegetation. Generally dominated by coarse sand. Compare - dune, coppice dune.

CONSIDERATIONS FOR PLANNING

Planning for the day:

1. Safety and sustenance: Plenty of food, water, first-aid kit, raingear, sunscreen.
2. Field communications:
   a. Develop a plan with team-mate for check-in time.
   b. Does park staff know the area in which you will be working?
3. Make sure you have the right maps and photos.
4. Check your GPS receiver (Datum set to NAD83? WAAS on? Needs new batteries?).
5. Plan the day's mission before departing using a) USGS quads, b) aerial photos, c) Park/BLM/FS maps.
6. Considerations for mission planning:
   a. Plan travel based on topography, best access routes, density and complexity of vegetation (more time for forest and woodland sites, less for herbaceous and shrub).
   b. Plan data collection based on priority needs; new types get higher priority.
   c. Communicate to make sure you aren't duplicating effort when unnecessary.

Planning for the Week (do this on the first day of the trip)

1. Do you have all appropriate maps, photos?
2. Develop a reasonable estimate of the number of plots for each team broken up by day and based on an estimate of individual team's travel logistics for the week.
3. Develop plan of attack for the week to capture all essential associations in the work area.
4. Balance points two and three above with the expected work schedule of the teams and ensure adequate time-off and reduce over-time concerns.
5. Do you have all necessary information and backups for the week's planning? E.g., blank field forms, film, plenty of batteries.

Wrapup

1. Clean, recharge and repair equipment.
2. Hold brief meeting to discuss data collection issues, things that came up during the day/week, and plan for next days activities.
3. Edit field forms and file them systematically.
4. Re-file the aerial photos and maps.
5. Download flashcards.
6. Key unknown plants.
7. Enter edited data into database.

Communicate among teams / Topics for wrap-up meetings.

1. What were your questions about the sites visited daily/weekly?
2. Do you have any questions about the forms or fields?
3. What was accomplished, what was not accomplished?
4. Pass on developments and questions, e.g., were there problems with interpreting the aerial photos, or are there personnel issues, problems in consistency in interpreting the forms, or with park-related logistics?

Materials Checklist

- Site research permit
- Topo maps
- Site maps for general navigation
- Digital orthophoto for easy reference
- Geology map
- Aerial photos
- Compass with adjustable declination
- Clinometer
- GPS receiver
- Plenty of AA batteries for GPS receivers, walkie talkies, etc.
- Radio or walkie talkie and/or cell phone
- Digital camera and flash cards
- Baggies for temporary storage of unknown plants, and masking tape for labeling
- Plant press & paper
- Plant Keys / Flora(s)
- Pens / sharpies
- Forms: observation point
- Clipboard/forms holder
- Pens, pencils, pencil lead, slate board, chalk, and chalkboard eraser
- Most recent version of provisional classification of the park
- All ancillary information (cheat sheet, species list, floras, main sampling protocol).
- First aid kit, personal gear (food, water, rain gear, etc.)

ATTACHMENT B

DESCRIPTION OF FEDERALLY LISTED SPECIES

(*IN ALPHABETICAL ORDER BY COMMON NAME*)

Black-Capped Vireo *(Verio atricapilla)*
Val Verde County

The black-capped vireo was listed as a Federally endangered bird on October 6, 1987.

Distribution: They are found through the Edwards Plateau and eastern Trans-Pecos region of Texas.

Natural History:

The black-capped vireo is 4.5 inches long. The male black-capped vireo has a black cap and has red eyes surrounded by white spectacles that are interrupted with black above the eye. The back is olive green, and underparts are mostly white with olive- and yellow-tinged flanks. Wings and back are dark olive to blackish with two pale yellow wingbars. Females and juveniles are similar to males but have a gray cap and a brown iris.

Habitat: Preferred habitat is rangelands with scattered clumps of shrubs separated by open grassland.

Breeding: Black-capped vireos nest in Texas during April through July, and spend the winter on the western coast of Mexico. They build a cup-shaped nest in the fork of a branch 2 to 4 feet above the ground. Nests are usually built in shrubs such as shin oak or sumac. Females lay 3–4 eggs, which hatch in 14–17 days. Both parents incubate the eggs and feed the chicks. Their diet consists of insects. Black-capped vireos have a lifespan of 5–6 years. Males sing to attract mates and defend territories, which are usually 2 to 4 acres. Vireos return year after year to the same area to nest.

Threats: Black-capped vireos are endangered because the low growing woody cover they need for nesting has been cleared or overgrazed by livestock and deer. One of the primary threats to black-capped vireos is the brown-headed cowbird, which lays its eggs in vireo nests and causes vireos to abandon their nest (brood parasitism) (TPWD).

Texas Parks and Wildlife Department on-line fact sheet accessed at:
http://www.tpwd.state.tx.us/huntwild/wild/species/bcv/

Brown Pelican (*Pelecanus occidentalis*)

Val Verde County

The brown pelican was listed as endangered on October 13, 1970.

Distribution: The brown pelican's historical range included the Atlantic and Gulf coasts from South Carolina to Florida and west to Texas. Currently, the brown pelican occurs throughout its historic range but in greatly reduced numbers. Within Texas, numbers dropped drastically from an estimated 5,000 birds in 1918 to less than 100 individuals and only 10 breeding pairs in 1974. According to a 2003 survey, there were 8 colonies and 3,895 active nests in Texas. Today, brown pelicans are found along the Texas coast from Chambers County on the upper coast to Cameron County on the lower coast. Most of the breeding birds nest on Pelican Island in Corpus Christi Bay and Sundown Island near Port O'Connor.

Natural History:

Habitat: The brown pelican is a coastal bird that is rarely seen inland or far out at sea. It feeds in shallow estuarine waters usually less than 40 miles from shore. Pelicans use sand spits, offshore sand bars, and islets for roosting and rest.

Breeding: Egg laying times vary with the location of the brown pelican. In Texas, brown pelican populations nest irregularly, usually beginning in late fall and extending through June. The clutch size averages 2–3, and incubation lasts 28-30 days. The young pelicans leave the nests around 35 days after hatching, fledge around 63 days after hatching, and fly around 71–88 days after hatching. Reproductive success is highly variable and susceptible to disturbance by humans, starvation of young, and/or flooding of nests. In Texas, brown pelicans build their nests on small isolated coastal islands that are safe from predators such as raccoons and coyotes.

Diet: The brown pelican is a piscivore that primarily feeds upon menhaden and mullet in Texas. They spot the fish from above and the dive beak-first into the water to scoop up the fish.

Threats: The brown pelican has undergone several sharp population declines in Texas. The first decline occurred in the 1920–1930s, when local fishermen will kill the birds because of incorrect assumptions that the brown pelican competed with humans for fish. The second sharp decline occurred in the 1960s and 1970s when the brown pelicans ate menhaden tainted with DDT and Endrin, causing a severe decline in reproductive success. Currently, human encroachment and development of the Texas coast provides the most significant threat to brown pelican populations.

Devils River Minnow (*Dionda diaboli*)

Val Verde County

The Devils River minnow was listed as Federally threatened on March 20, 1999.

Distribution: The Devils River minnow is found in channels of fast-flowing, spring-fed waters over gravel substrates. It most often occurs where spring flow enters a stream. Historically, it was known to occur in Del Rio in the Rio Grande. Its last occurrence in the Rio Grande as it flows though Del Rio is not reported.

Natural History: It is a small fish, with adults reaching approximately 2 inches in length. It occurs with other similar minnows and is believed to feed on algae. Little is known about its life history. They spawn from January to August, depositing eggs near the stream bottom. Life expectancy is estimated to be 1 to 2 years.

Threats: The primary threats for this species are habitat loss, water quality degradation, and impacts from nonnative species.

Texas parks and Wildlife Department on-line fact sheet accessed at:
http://www.tpwd.state.tx.us/publications/pwdpubs/media/pwd_bk_w7000_0013_devils_river_minnow.pdf

Gray Wolf (*Canis lupus*)

Maverick County

The Gray wolf was listed as Federally endangered on March 11, 1967.

Distribution: Currently extirpated from Texas.

Description: The gray wolf is a close relative of domestic dogs. Its thick fur ranges in color from creamy white or reddish-brown to shades of gray and black. Gray wolves are the largest species of wolf and can reach 50–90 pounds and 4–5 feet long. Adult males are larger than adult females.

Gray wolves breed once a year. They mate in late winter, and pups are born in the spring. Dens are usually ground burrows excavated in slopes where rocks will function to support the roof of the tunnel and burrow. Both parents and other pack members, if present, will bring food to the young, which average about 5 pups in a litter. The bond between mated wolves is very strong and commonly lasts their lifetime. Gray wolves can live up to 15 years.

Gray wolves are carnivores that prey on large herbivores such as deer and Pronghorn antelope, but they will also eat rabbits, ground squirrels, and mice. The decline of the gray wolf has been attributed mostly to predator control by humans. In the late 1800s and early 1900s, ranchers killed wolves to prevent loss of livestock and wild ungulates such as deer. In those days, even people living in the towns and cities feared wolves and applauded their demise. Predator control was so successful that few individuals remained. Reintroduction efforts of captive-bred individuals have been difficult to initiate due to residual fears for livestock and people, as well as a lack of large, remote tracts of suitable habitat.

Natural History:

Habitat: Gray wolves are found in forests, brushlands, or grasslands where suitable cover and denning sites are available.

Threats: The primary factors behind extirpation of the gray wolf from its range was loss of habitat and widespread hunting, both for sport and to protect livestock.

Texas Parks and Wildlife Department, Gray Wolf Species Profile. 2007. Accessed on-line at: *http://www.tpwd.state.tx.us/huntwild/wild/species/graywolf/*

Gulf Coast Jaguarundi (*Herpailurus yagouaroundi cacomitli*)

Maverick County

The Gulf Coast jaguarundi was listed as endangered on June 14, 1976.

Distribution: Because of the secretive nature of the jaguarundi, little is known about its exact distribution within Texas. The only documented sighting of a jaguarundi in Texas was a road killed specimen found in Cameron County. Jaguarundi still roam Central and South America in greater numbers than seen in the United States (USFWS 1990).

Natural History:

Habitat: The habitat of the jaguarundi is similar to the ocelot's. It is found within the Tamaulipan Biotic Province, which includes several variations of sub-tropical thornscrub brush. Potential habitat includes four different areas of the Lower Rio Grande Valley: Mesquite-Granjeno Parks, Mesquite-Blackbrush Brush, Live Oak Woods/Parks, and Rio Grande Riparian. Jaguarundi prefer dense thornscrub habitats with greater than 95 percent canopy cover. Their minimal home range is about 40 hectares (ha) (USFWS 1990).

Breeding: The jaguarundi mates in November or December, and gestation lasts 9–10 weeks. There may be two litters of 1–4 (average 2) young per year. In Mexico, the young are born between March and August. Little is known of the breeding habits within the United States.

Diet: The jaguarundi is active at night and preys primarily on birds, small rodents, and rabbits.

Threats: The largest threat to jaguarundi populations in the United States is habitat loss and fragmentation in southern Texas. The jaguarundi requires a large hunting area, and appropriate habitat is being lost to development and agriculture. This creates islands of habitat where the jaguarundi cannot migrate from area to area, leaving them vulnerable.

U.S. Fish and Wildlife Service. 1990. *Listed Cats of Texas and Arizona Recovery Plan (With Emphasis on the Ocelot).* U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 131 pp.

Interior Least Tern (*Sterna antillarum athalassos*)

Maverick and Val Verde County

The interior population of the least tern was listed as endangered on June 27, 1985.

Distribution: The historic breeding range of the least tern included the Mississippi and Red Rivers and the Rio Grande. The breeding range extended from Texas to Montana, and from eastern Colorado and New Mexico to southern Indiana. Currently, the least tern maintains breeding grounds on all these river systems, although suitable habitat has dwindled. In Texas, populations have been observed on the Red River system and along the Texas/Oklahoma border as far east as Burkburnett, Texas. Least terns have been observed on three reservoirs (including Amistad Reservoir in Val Verde County) along the Rio Grande and along the Pecos River at the Bitter Lake National Wildlife Refuge, New Mexico (USFWS 1990).

Natural History:

Habitat: Along river systems such as the Rio Grande, least terns nest on sparsely vegetated sand and gravel bars along a wide, unobstructed river channel or salt flats along lake shorelines. Least terns also have been observed to nest on artificial habitats such as sand and gravel pits and dredge islands (USFWS 1990).

Breeding: Least terns reside on the breeding grounds for 4–5 months, arriving from late April to early June. Nests are shallow depressions in open, sandy areas, gravelly patches, or exposed flats. The tern nests in colonies. Clutch size is usually 2–3 eggs, and the eggs are laid by late May. Incubation lasts 20–25 days, and fledging occurs after three weeks. Parental attention continues until migration at the end of the breeding season (USFWS 1990).

Diet: The least tern is a fish eater that hunts in the shallow waters of rivers, streams, and lakes. Fish prey is small-sized and include the following genera: *Fundulus, Notropis, Campostoma, Pimephales, Gambusia, Blonesox, Morone, Dorosoma, Lepomis* and *Carpiodes.* They usually hunt near their nesting sites (USFWS 1990).

Threats: The taming of wild river systems for irrigation, navigation, hydroelectric power, and recreation has altered the river channels that the least tern depends on for breeding grounds. Stabilized river systems eliminate most of the sandbars that terns utilize for breeding grounds by channeling wide, braided rivers into single, narrow navigation channels.

U.S. Fish and Wildlife Service. 1990. *Recovery plan for the interior population of the least tern (Sterna antillarum).* U.S. Fish and Wildlife Service, Twin Cities, Minnesota. 90 pp.

Ocelot (*Leopardus [=Felis] pardalis*)

Maverick County

The ocelot was listed as endangered on March 28, 1972.

Distribution: The ocelot is found from northern Mexico into the southern extremes of Texas and Arizona to northern Argentina, Paraguay, and Uruguay. Little is known of the exact distribution of the ocelot in Texas. Ocelots recorded by trapping or photo documentation include several areas within five counties in Texas: Cameron, Willacy, Kenedy, Jim Wells, and Hidalgo.

Natural History:

Habitat: The habitat of the ocelot is found within the Tamaulipan Biotic Province, which includes several variations of sub-tropical thornscrub brush. Potential habitat includes four different areas of the Lower Rio Grande Valley: Mesquite-Granjeno Parks, Mesquite-Blackbrush Brush, Live Oak Woods/Parks, and Rio Grande Riparian. Ocelots prefer dense thornscrub habitats with greater than 95 percent canopy cover. Their average home range is about 15 km^2 (USFWS 1990).

Breeding: In Texas, the ocelot breeds in late summer, with gestation lasting about 70 days. Births occur in fall and winter, and the litter size is 2–4. Dens are found in caves, hollow trees, thickets, or the spaces between closed buttress roots of large trees (NatureServe). Juveniles appear to travel with their mother even after lactation has ceased, and one study found two young females up to 2 years old with home ranges that significantly overlapped their mother's home range (USFWS 1990).

Diet: The ocelot is active at night and preys primarily on birds, small rodents, and rabbits, but may also eat reptiles, fish, and invertebrates. Other potential prey species include other rodents, opossum, raccoon, javelina, white-tailed deer, skunks, nine-banded armadillo, feral swine, poultry, quail, doves, chachalaca, numerous passerine birds and waterfowl, snakes, and lizards.

Threats: Habitat loss and fragmentation, especially along the Rio Grande, pose a critical threat to the long-term survival of the ocelot. Efforts need to be taken to preserve key habitat and biological corridors necessary for ocelot survival (USFWS 1990).

U.S. Fish and Wildlife Service. 1990. *Listed Cats of Texas and Arizona Recovery Plan (With Emphasis on the Ocelot).* U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 131 pp.

Rio Grande Silvery Minnow (*Hybognathus amarus)*

Maverick County

The Rio Grande silvery minnow was listed as a Federally endangered fish on July 20, 1994.

Distribution: Historically the Rio Grande silvery minnow occurred in the Rio Grande and Pecos River systems in Texas, New Mexico, and Mexico. Its range is currently drastically reduced, and it occurs only in perennial sections of the Rio Grande in New Mexico (NatureServe 2007).

Natural History:

Habitat: This minnow prefers large freshwater streams with slow to moderate current over mud, sand, or gravel bottoms, perennial sections of the Rio Grande, and irrigation canals (Sublette et al. 1990). It spawns probably in still waters over sandy-silt bottoms (Sublette et al. 1990) (NatureServe).

Diet: The diet of the Rio Grande silvery minnow is assumed to be the same as others in the Genus Hybognathus: diatoms, algae, larval insect skins, and plant material scraped from ooze in bottom sediment (Sublette et al. 1990) (NatureServe).

Threats: Survival continues to be threatened by habitat degradation and flow modifications, introduction of nonnative fishes, and lack of adequate refugia during periods of low or no flow (NatureServe).

NatureServe. 2007. Rio Grande Silvery Minnow. Accessed on-line at: *http://www.natureserve.org*

USFWS. 2007. Draft Revised Recovery Plan. *http://ecos.fws.gov/docs/recovery_plan/070118a.pdf*

Texas Hornshell (*Popenaias popeii*)

Val Verde County

The Texas hornshell mollusk is Federally listed as a candidate species—that is, a species for which the USFWS has enough substantial information to warrant listing as threatened or endangered.

Distribution: The Texas hornshell has only been confirmed in Texas in the Laredo area of the Rio Grande. Historically, it occurred in the lower Pecos River of New Mexico, and downstream throughout the lower Rio Grande.

Natural History: The Texas hornshell is a freshwater mussel. The shell has a length to height ratio of 1.8, is anteriorly rounded and narrow, and posteriorly slightly truncated and wider. Adults are filter feeders, whereas juveniles use foot feeding, thereby being suspension feeders that feed on algae and detritus. The Texas hornshell can live up to a maximum of 200 years.

Threats: The primary threat to Texas hornshells and other freshwater mussels is the destruction or modification of the physical conditions of the river. Modifications include impoundments, water diversions, dams, agriculture irrigation, and levees that modify riffle and shoal habitats; alter the natural flow regime of the river; and prevent natural reproductive grounds for the mussel. Increased siltation, contaminants, and salinity caused by agriculture returns to the river and other human activities create unsuitable conditions for the mussel (USFWS 2005).

U.S. Fish and Wildlife Service. *Species Assessment and Listing Priority Assignment Form.* Accessed on-line at: *http://ecos.fws.gov/docs/candforms_pdf/r2/F02M_I01.pdf*

Texas Snowbells (*Styrax texana*)

Val Verde County

The Texas snowbells shrub or small tree was Federally listed as endangered on October 12, 1984.

Distribution: Western Edwards Plateau in Edwards, Real, and Val Verde Counties.

General Description: This shrub or small deciduous tree grows about 5 to 15 feet tall. It has light green leaves that are silver-white underneath. This contrast in colors on the leaves make the plant appear to shimmer when the wind blows. The flowers are clustered at the end of the branch and hang upside down.

Natural History:

Morphology: Flower buds develop in March and open during the third and fourth weeks of April. Flowering peaks during the last week in April. Fruit capsules, containing up to 3 seeds, swell in late July and early August, and split open in late August through September, dropping the shiny brown, pea-sized seeds. The tree is often found growing with Texas ash, sycamore, little walnut, Mexican silktassel, Lacey oak, Texas oak, Mexican-buckeye, Texas mountain laurel, Texas persimmon, guajillo, and Ashe juniper (TPWD 2007).

Habitat: Texas snowbells grow out of crevices on steep limestone bluffs or cliff faces along streams and dry creek beds. They can also grow in the dry gravels of streambeds or on thin soils overlying limestone ledges.

Threats: Texas snowbells are readily eaten by livestock, exotic ungulates, and deer. Over-browsing by these animals is a serious threat to its survival. Young seedlings are often eaten by browsing animals or insects.

Texas parks and Wildlife Department. On-line fact sheet accessed at:
http://www.tpwd.state.tx.us/huntwild/wild/species/snowbell/

Texas A&M Ornamental Gardening. On-line fact sheet access at:
http://aggie-horticulture.tamu.edu/ornamentals/nativeshrubs/styrax percent20texan.htm

Tobusch Fishhook Cactus (*Ancistrocactus tobuschii*)

Val Verde County

The Tobusch fishhook cactus was Federally listed as endangered in November 1979. It was listed as a state of Texas endangered species in April 1983.

Distribution: This cactus is endemic to Edwards Plateau of central Texas and known to occur in eight counties in Texas. As of February 1996, fewer than 50 populations are known in Texas.

General Description: The stem of the cactus is generally one dark green, flattened hemisphere, growing up to 4 inches in diameter and height. The stem is covered with tubercules. The spines are yellowish, and can be red-tipped and turn gray as the cactus ages.

Natural History:

Morphology: The Tobusch fishhook cactus can flower from mid-January to late March. The flowers are clear, bright yellow, and can be a creamy yellow or yellowish-green when first opening.

Habitat: The habitat for the Tobusch fishhook cactus consists of patchy openings scattered within woodlands, shrublands, and grasslands. It tends to occur on shallow, gravelly soil over limestone within openings among live oak-juniper woodlands.

Threats: The conversion of plant communities to improve pastures, overgrazing, and vulnerability due to low population numbers are all threats.

Texas Parks and Wildlife Department. Tobusch Fishhook Cactus. Accessed on-line at:
http://www.tpwd.state.tx.us/publications/pwdpubs/media/pwd_lf_w7000_0019b.pdf

ATTACHMENT C
GIS PRODUCTS

GIS PRODUCTS

GIS Interactive File

Access Database for PF225

GIS Layer: Vegetation Database

Maps Including Vegetation Layer

Field Photographs

ATTACHMENT D

SPECIES LISTS OF DEL RIO SECTOR

Birds of the Del Rio Sector

Scientific Name	Common Name	Natureserve Rankings	State Status	Federal Status
Accipitridae				
Accipiter cooperii	Cooper's Hawk	G5/S4		
Accipiter striatus	Sharp-shinned Hawk	G5/S2		
Aquila chrysaetos	Golden Eagle	G5/S3		
Asturina (Buteo) nitidus	Gray Hawk	G5/S2	T	
Buteo albicaudatus	White-tailed Hawk	G4G5/S4	T	
Buteo albonotatus	Zone-tailed Hawk	G4/S3	T	
Buteo jamaicensis	Red-tailed Hawk	G5/S5		
Buteo lineatus	Red-shouldered Hawk	G5/S4		
Buteo playpterus	Broad-winged Hawk	G5/S3		
Buteo regalis	Ferruginous Hawk	G4/S2		
Buteo swainsoni	Swainson's Hawk	G5/S4		
Buteogallus anthracinus	Common Black-Hawk	G4G5/S2	T	
Circus cyaneus	Northern Harrier	G5/S2		
Elanoides forficatus	Swallow-tailed Kite	G5/S2	T	
Elanus leucurus	White-tailed Kite	G5/S4		
Haliaeetus leucocephalus	Bald Eagle	G5/S3	T	
Ictinia mississippiensis	Mississippi Kite	G5/S4		
Pandion haliaetus	Osprey	G5/S4		
Parabuteo unicinctus	Harris's Hawk	G5/S3		
Alaudidae				
Eremophila alpestris	Horned Lark	G5/S5		
Alcedinidae				
Ceryle (Megaceryle) torquata	Ringed Kingfisher	G5/S3		
Ceryle (Megacryle) alcyon	Belted Kingfisher	G5/S5		
Chloroceryle Americana	Green Kingfisher	G5/S4		
Anatidae				
Aix sponsa	Wood Duck	G5/S4		
Anas acuta	Northern Pintail	G5/S3		
Anas Americana	American Wigeon	G5/S3		
Anas clypeata	Northern Shoveler	G5/S3		
Anas crecca	Green-winged Teal	G5/S2		
Anas cyanoptera	Cinnamon Teal	G5/S3		
Anas discors	Blue-winged Teal	G5/S3		

Scientific Name	Common Name	Natureserve Rankings	State Status	Federal Status
Anas fulvigula	Mottled Duck	G4/S4		
Anas Penelope	Eurasian Wigeon	G5/No TX Record		
Anas platyrhynchos	Mallard	G5/S3		
Anas strepera	Gadwall	G5/S3		
Anser albifrons	Greater White-fronted Goose	G5/S5		
Aythya affinis	Lesser Scaup	G5/S3		
Aythya Americana	Redhead	G5/S3		
Aythya collaris	Ring-necked Duck	G5/No TX Record		
Aythya marila	Greater Scaup	G5/No TX Record		
Aythya valisineria	Canvasback	G5/S4		
Branta Canadensis	Canada Goose	G5/S5		
Bucephala albeola	Bufflehead	G5/No TX Record		
Bucephala clangula	Common Goldeneye	G5/No TX Record		
Chen caerulescens	Snow Goose	G5/S5		
Chen rossii	Ross' Goose	G4/S3		
Clangula hyemalis	Long-tailed Duck	G5/No TX Record		
Cygnus columbianus	Tundra Swan	G5/No TX Record		
Dendrocygna autumnalis	Black-bellied Whistling-Duck	G5/S5		
Dendrocygna bicolor	Fulvous Whistling-Duck	G5/S4		
Lophodytes cucullatus	Hooded Merganser	G5/S3		
Melanitta fusca	White-winged Scoter	G5/No TX Record		
Melanitta perspicillata	Surf Scoter	G5/No TX Record		
Mergus merganser	Common Merganser	G5/No TX Record		
Mergus serrator	Red-breasted Merganser	G5		
Nomonyx dominicus	Masked Duck	G5/S3		
Oxyura jamaicensis	Ruddy Duck	G5/S3		
Anhingidae				
Anhinga anhinga	Anhinga	G5/S4		
Apodidae				
Chaetura pelagica	Chimney Swift	G5/S3		

Scientific Name	Common Name	Natureserve Rankings	State Status	Federal Status
Ardeidae				
Ardea albus	Great Egret	G5/S5		
Ardea herodias	Great Blue Heron	G5/S5		
Botaurus lentiginosus	American Bittern	G4/S3		
Bubulcus ibis	Cattle Egret	G5/Exotic		
Butorides virescens	Green Heron	G5/S5		
Egretta caerula	Little Blue Heron	G5/S5		
Egretta rufescens	Reddish Egret	G4/S3	T	
Egretta thula	Snowy Egret	G5/S5		
Egretta tricolor	Tricolored Heron	G5/S5		
Ixobrychus exilis	Least Bittern	G5/S4		
Nyctanassa violacea	Yellow-crowned Night-Heron	G5/S4		
Nycticorax nycticorax	Black-crowned Night-Heron	G5/S4		
Bombycillidae				
Bombycilla cedrorum	Cedar Waxwing	G5/N5		
Caprimulgidae				
Caprimulgus carolinensis	Chuck-will's-widdow	G5/S3		
Caprimulgus vociferous	Whip-poor-will	G5/S4		
Chordeiles acutipennis	Lesser Nighthawk	G5/S4		
Chordeiles minor	Common Nighthawk	G5/S4		
Phalaenoptilus nuttallii	Common Poorwill	G5/S4		
Cardinalidae				
Cardinalis cardinalis	Northern Cardinal	G5/S5		
Cardinalis sinuatus	Pyrrhuloxia	G5/S4		
Passerina amoena	Lazuli Bunting	G5/S3		
Passerina caerulea	Blue Grosbeak	G5/S4		
Passerina ciris	Painted Bunting	G5/S4		
Passerina cyanea	Indigo Bunting	G5/S5		
Passerina versicolor	Varied Bunting	G5/S4		
Pheucticus ludovicianus	Rose-breasted Grosbeak	G5/S4		
Pheucticus melanocephalus	Black-headed Grosbeak	G5/S4		
Spiza Americana	Dickcissel	G5/S4		
Cathartidae				
Cathartes aura	Turkey Vulture	G5/S5		
Coragyps atratus	Black Vulture	G5/S5		

Scientific Name	Common Name	Natureserve Rankings	State Status	Federal Status
Certhiidae				
Certhia Americana	Brown Creeper	G5/S4		
Charadriidae				
Charadrius alexandrius	Snowy Plover	G4/S3		
Charadrius melodus	Piping Plover	G3/S2	T	T
Charadrius montanus	Mountain Plover	G2/S2		
Charadrius semipalmatus	Semipalmated Plover	G5/S4		
Charadrius vociferous	Killdeer	G5/S5		
Pluvialis dominicus	American Golden-Plover	G5/S3		
Pluvialis squatarola	Black-bellied Plover	G5/S4		
Ciconiidae				
Mycteria Americana	Wood Stork	G4/SH	T	
Columbidae				
Columba livia	Rock Dove	G5/Exotic		
Columbina inca	Inca Dove	G5/S5		
Columbina passerine	Common Ground-Dove	G5/S4		
Columbina talpacoti	Ruddy Ground-Dove	G5/No TX Record		
Leptotila verreauxi	White-tipped Dove	G5/S4		
Streptopelia decaucto	Eurasian Collared-Dove	G5/Exotic		
Zenaida asiatica	White-winged Dove	G5/S5		
Zenaida macroura	Mourning Dove	G5/S5		
Corvidae				
Corvus cryptoleucus	Chihuahuan Raven	G5/S4		
Cyanocitta cristata	Blue Jay	G5/S5		
Cyanocorax yncas	Green Jay	G5/No TX Record		
Cuculidae				
Coccyzus Americanus	Yellow-billed Cuckoo	G5/S4		
Coccyzus erythrophthalmus	Black-billed Cuckoo	G5/S3		
Crotophaga sulcirostris	Groove-billed Ani	G5/S4		
Geococcyx Californianus	Greater Roadrunner	G5/S4		
Emberizidae				
Aimophila botterii	Botteri's Sparrow	G4/S3		
Aimophila cassinii	Cassin's Sparrow	G5/S4		

Scientific Name	Common Name	Natureserve Rankings	State Status	Federal Status
Aimophila ruficeps	Rufous-crowned Sparrow	G5/S4		
Ammodramus bairdi	Baird's Sparrow	G4/S2		
Ammodramus leconteii	Le Conte's Sparrow	G4		
Ammodramus nelsoni	Nelson's Sharp-tailed Sparrow	G5/No TX Record		
Ammodramus savannarum	Grasshopper Sparrow	G5/S3		
Amphispiza bilineata	Black-throated Sparrow	G5/S4		
Arremonops rufivirgatus	Olive Sparrow	G5/S4		
Calamospiza melanocorys	Lark Bunting	G5/S4		
Calcarius ornatus	Chestnut-collared Longspur	G5/S3		
Chondestes grammacus	Lark Sparrow	G5/S4		
Junco hyemalis	Dark-eyed Junco	G5/S5		
Junco phaeonotus	Yellow-eyed Junco	G5		
Melospiza Georgiana	Swamp Sparrow	G5/S4		
Melospiza lincolnii	Lincoln's Sparrow	G5/S5		
Melospiza melodia	Song Sparrow	G5/S5		
Passerculus sandwichensis	Savannah Sparrow	G5/S4		
Passerella iliaca	Fox Sparrow	G5		
Pipilo arcticus	Spotted Towhee	No NS Record		
Pipilo chlorurus	Green-tailed Towhee	G5/S4		
Pipilo erythrophthalmus	Eastern Towhee	G5/S2		
Pipilo fuscus	Canyon Towhee	G5		
Plectrophenax nivalis	Snow Bunting	G5/No TX Record		
Pooecetes gramineus	Vesper Sparrow	G5/S5		
Spizella arborea	American Tree Sparrow	G5/No TX Record		
Spizella atrogularis	Black-chinned Sparrow	G5		
Spizella breweri	Brewer's Sparrow	G5/S4		
Spizella pallida	Clay-colored Sparrow	G5/S4		
Spizella passerine	Chipping Sparrow	G5/S4		
Spizella pusilla	Field Sparrow	G5/S5		
Zonotrichia albicollis	White-throated Sparrow	G5		
Zonotrichia atricapilla	Golden-crowned Sparrow	G5		
Zonotrichia leucophrys	White-crowned Sparrow	G5/S5		

Scientific Name	Common Name	Natureserve Rankings	State Status	Federal Status
Zonotrichia querula	Harris's Sparrow	G5/S4		
Falconidae				
Caracara plancus	Crested Caracara	G5/S4		
Falco columbarius	Merlin	G5/No NS Record		
Falco femoralis	Aplomado Falcon	G4/S1	E	E
Falco mexicanus	Prairie Falcon	G5/S3		
Falco peregrinus	Peregrine Falcon	G4/S3	E, T	
Falco sparverius	American Kestrel	G5/S4		
Fringillidae				
Carduelis flammea	Common Redpoll	G5/No TX Record		
Carduelis pinus	Pine Siskin	G5/S2		
Carduelis psaltria	Lesser Goldfinch	G5/S5		
Carduelis tristis	American Goldfinch	G5/S2		
Carpodacus mexicanus	House Finch	G5/S5		
Carpodacus purpureus	Purple Finch	G5/S4		
Loxia curvirostra	Red Crossbill	G5/S3		
Gaviidae				
Gavia adamsii	Yellow-billed Loon	G4/No Tx Record		
Gavia immer	Common Loon	G5/No Tx Record		
Gavia pacifica	Pacific Loon	G5/No Tx Record		
Gruidae				
Grus Americana	Whooping Crane	G1/S1	E	E
Grus Canadensis	Sandhill Crane	G5/S5		
Hirundinidae				
Hirundo rustica	Barn Swallow	G5/S5		
Petrochelidon fulva	Cave Swallow	G5/S4		
Petrochelidon pyrrhonota	Cliff Swallow	G5/S4		
Progne subis	Purple Martin	G5/S5		
Riparia riparia	Bank Swallow	G5/S2		
Stelgidopteryx serripennis	Northern Rough-winged Swallow	G5		
Tachycineta bicolor	Tree Swallow	G5/S3		
Tachycineta thalassina	Violet-green Swallow	G5/S4		
Icteridae				
Agelaius phoeniceus	Red-winged Blackbird	G5/S5		

Scientific Name	Common Name	Natureserve Rankings	State Status	Federal Status
Dolichonyx oryzivorus	Bobolink	G5/S3		
Euphagus carolinus	Rusty Blackbird	G4/S3		
Euphagus cyanocephalus	Brewer's Blackbird	G5/S5		
Icterus bullockii	Bullock's Oriole	G5/S4		
Icterus cucullatus	Hooded Oriole	G5/S4		
Icterus galbula	Baltimore Oriole	G5/S4		
Icterus graduacauda	Audubon's Oriole	G5/S4		
Icterus gularis	Altamira Oriole	G5/S3		
Icterus parisorum	Scott's Oriole	G5/S3		
Icterus spurious	Orchard Oriole	G5/S4		
Molothrus aeneus	Bronzed Cowbird	G5/S5		
Molothrus ater	Brown-headed Cowbird	G5/S5		
Quiscalus mexicanus	Great-tailed Grackle	G5/S5		
Quiscalus quiscula	Common Grackle	G5/S5		
Sturnella magna	Eastern Meadowlark	G5/S5		
Sturnella neglecta	Western Meadowlark	G5/S5		
Xanthocephalus xanthocephalus	Yellow-headed Blackbird	G5/S3		
Jacanidae				
Jacana spinosa	Northern Jacana	No NS Record		
Laniidae				
Lanius ludovicianus	Loggerhead Shrike	G4/S4		
Laridae				
Chlidonias niger	Black Tern	G4/S3		
Larus argentatus	Herring Gull	G5/S5		
Larus atricilla	Laughing Gull	G5/S5		
Larus Californicus	California Gull	G5/No TX Record		
Larus Delawarensis	Ring-billed Gull	G5/S5		
Larus fuscus	Lesser Black-backed Gull	G5/No TX Record		
Larus hyperboreus	Glaucous Gull	G5/No TX Record		
Larus occidentalis	Western Gull	G5/No TX Record		
Larus Philadelphia	Bonaparte's Gull	G5/S4		
Larus pipixcan	Franklin's Gull	G4G5/S2		
Larus thayeri	Thayer's Gull	G5/No TX Record		

Scientific Name	Common Name	Natureserve Rankings	State Status	Federal Status
Rissa tridactyla	Black-legged Kittiwake	G5/No TX Record		
Rynchops niger	Black Skimmer	G5/S4		
Stercorarius longicaudus	Long-tailed Jaeger	G5/No TX Record		
Stercorarius parasiticus	Parasitic Jaeger	G5/No TX Record		
Sterna antillarum	Interior Least Tern	No NS Record		E
Sterna caspia	Caspian Tern	No NS Record		
Sterna forsteri	Forster's Tern	G5/S5		
Sterna fuscata	Sooty Tern	No NS Record	T	
Sterna hirundo	Common Tern	G5/S1		
Xema sabini	Sabine's Gull	G5/No TX Record		
Mimidae				
Dumetella carolinensis	Gray Catbird	G5/S4		
Mimus polyglottos	Northern Mockingbird	G5/S5		
Oreoscoptes montanus	Sage Thrasher	G5/No NS Record		
Toxostoma curvirostre	Curve-billed Thrasher	G5/S4		
Toxostoma longirostre	Long-billed Thrasher	G5/S4		
Toxostoma rufum	Brown Thrasher	G5/S4		
Motacillidae				
Anthus rubescens	American Pipit	G5/S4		
Anthus spragueii	Sprague's Pipit	G4/No TX Record		
Odontophoridae				
Callipepla squamata	Scaled Quail	G5/S4		
Colinus virginianus	Northern Bobwhite	G5/S4		
Paridae				
Baeolophus atricristatus	Black-crested Titmouse	G5/S5		
Parus (Poecile) carolinensis	Carolina Chickadee	G5/S5		
Parulidae				
Basileuterus rufifrons	Rufous-capped Warbler	No NS Record		
Cardellina rubrifrons	Red-faced Warbler	G5/No TX Record		
Dendroica caerulescens	Black-throated Blue Warbler	G5/S3		
Dendroica castanea	Bay-breasted Warbler	G5/S4		
Dendroica cerulean	Cerulean Warbler	G4/SH		

Scientific Name	Common Name	Natureserve Rankings	State Status	Federal Status
Dendroica chrysoparia	Golden-cheeked Warbler	G2/S2	E	E
Dendroica discolor	Prairie Warbler	G5/S3		
Dendroica dominica	Yellow-throated Warbler	G5/S4		
Dendroica fusca	Blackburnian Warbler	G5/S3		
Dendroica magnolia	Magnolia Warbler	G5/S4		
Dendroica nigrescens	Black-throated Gray Warbler	G5/SH		
Dendroica occidentalis	Hermit Warbler	G4G5/S3		
Dendroica palmarum	Palm Warbler	G5/S3		
Dendroica pensylvanica	Chestnut-sided Warbler	G5/No TX Record		
Dendroica petechia	Yellow Warbler	G5/S2		
Dendroica pinus	Pine Warbler	G5/S5		
Dendroica striata	Blackpoll Warbler	G5/S3		
Dendroica tigrina	Cape May Warbler	G5/S2		
Dendroica townsendi	Townsend's Warbler	G5/S4		
Dendroica virens	Black-throated Green Warbler	G5/S4		
Geothlypis trichas	Common Yellowthroat	G5/S5		
Helmitheros vermivorus	Worm-eating Warbler	G5/S3		
Icteria virens	Yellow-breasted Chat	G5/S5		
Limnothlypis swainsonii	Swainson's Warbler	G4/S3		
Mniotilta varia	Black-and-white Warbler	G5/S4		
Myioborus miniatus	Slate-throated Redstart	No NS Record		
Myioborus pictus	Painted Redstart	G5/S3		
Oporornis formosus	Kentucky Warbler	G5/S3		
Oporornis Philadelphia	Mourning Warbler	G5/S4		
Oporornis tolmiei	MacGillivray's Warbler	G5/S4		
Parula Americana	Northern Parula	G5/S4		
Parula pitiayumi	Tropical Parula	G5/S3	T	
Protonotaria citrea	Prothonotary Warbler	G5/S3		
Seiurus aurocapillus	Ovenbird	G5/S4		
Seiurus motacilla	Louisiana Waterthrush	G5/S3		
Seiurus noveboracensis	Northern Waterthrush	G5/S4		
Setophaga ruticilla	American Redstart	G5/S2		
Vermivora celata	Orange-crowned Warbler	G5/S4		
Vermivora chrysoptera	Golden-winged Warbler	G4/S3		
Vermivora crissalis	Colima Warbler	G3G4/S3		

Scientific Name	Common Name	Natureserve Rankings	State Status	Federal Status
Vermivora peregrine	Tennessee Warbler	G5/S4		
Vermivora pinus	Blue-winged Warbler	G5/S4		
Vermivora ruficapilla	Nashville Warbler	G5/S5		
Vermivora virginiae	Virginia's Warbler	G5/S3		
Wilsonia Canadensis	Canada Warbler	G5/S4		
Wilsonia citrine	Hooded Warbler	G5/S5		
Wilsonia pusilla	Wilson's Warbler	G5/S4		
Passeridae				
Passer domesticus	House Sparrow	G5/Exotic		
Pelecanidae				
Pelecanus erythrorhynchos	American White Pelican	G3/S2		
Pelecanus occidentalis	Brown Pelican	G4/S3	E	E
Phalacrocoracidae				
Phalacrocorax auritus	Double-crested Cormorant	G5/S3		
Phalacrocorax brasilianus	Neotropic Cormorant	G5/S4		
Phasianidae				
Meleagris gallopavo	Wild Turkey	G5/S5		
Picidae				
Colaptes auratus	Northern Flicker	G5/S3		
Melanerpes aurifrons	Golden-fronted Woodpecker	G5/S5		
Melanerpes erythrocephalus	Red-headed Woodpecker	G5/S3		
Melanerpes formicivorus	Acorn Woodpecker	G5/S4		
Picoides pubescens	Downy Woodpecker	G5/S4		
Picoides scalaris	Ladder-backed Woodpecker	G5/S5		
Sphyrapicus nuchalis	Red-naped Sapsucker	G5/S3		
Sphyrapicus varius	Yellow-bellied Sapsucker	G5/No TX Record		
Podicipedidae				
Aechmophorus occidentalis	Western Grebe	G5/S3		
Podiceps auritus	Horned Grebe	G5/No Tx Record		
Podiceps nigricollis	Eared Grebe	G5/S3		
Podilymbus podiceps	Pied-billed Grebe	G5/S5		
Tachybaptus dominicus	Least Grebe	G5/S3		

Scientific Name	Common Name	Natureserve Rankings	State Status	Federal Status
Ptilogonatidae				
Phainopepla nitens	Phainopepla	G5/S4		
Ptilogonys cinereus	Gray Silky-flycatcher	No NS Record		
Rallidae				
Coturnicops noveboracensis	Yellow Rail	G4/No TX Record		
Fulica Americana	American Coot	G5/S4		
Gallinula chloropus	Common Moorhen	G5/S4		
Porphyrio martinica	Purple Gallinule	G5/S4		
Porzana Carolina	Sora	G5/S3		
Rallus elegans	King Rail	G4/S3		
Rallus limicola	Virginia Rail	G5/S3		
Recurvirostridae				
Himantopus mexicanus	Black-necked Stilt	G5/S5		
Recurvirostra Americana	American Avocet	G5/S4		
Regulidae				
Regulus calendula	Ruby-crowned Kinglet	G5/S5		
Regulus satrapa	Golden-crowned Kinglet	G5/No TX Record		
Remizidae				
Auriparus flaviceps	Verdin	G5/S4		
Scolopacidae				
Actitis macularia	Spotted Sandpiper	G5/S3		
Arenaria interpres	Ruddy Turnstone	G5/S5		
Bartramia longicauda	Upland Sandpiper	G5/S3		
Calidris alba	Sanderling	G5/S5		
Calidris alpine	Dunlin	G5/S4		
Calidris bairdii	Baird's Sandpiper	G5/S3		
Calidris canutus	Red Knot	G4/No TX Record		
Calidris fuscicollis	White-rumped Sandpiper	G5/S3		
Calidris himantopus	Stilt Sandpiper	G5/S3		
Calidris mauri	Western Sandpiper	G5/S5		
Calidris melanotos	Pectoral Sandpiper	G5/S4		
Calidris minutilla	Least Sandpiper	G5/S5		
Calidris pusilla	Semipalmated Sandpiper	G5/S5		
Catoptrophorus semipalmatus	Willet	G5/S5		

Scientific Name	Common Name	Natureserve Rankings	State Status	Federal Status
Limnodromus griseus	Short-billed Dowitcher	G5/S3		
Limnodromus scolopaceus	Long-billed Dowitcher	G5/S4		
Limosa fedoa	Marbled Godwit	G5/S4		
Limosa haemastica	Hudsonian Godwit	G4/S2		
Numenius Americanus	Long-billed Curlew	G5/S3		
Numenius borealis	Eskimo Curlew	GH/SH	E	E
Numenius phaeopus	Whimbrel	G5/S4		
Phalaropus fulicarius	Red Phalarope	G5/No TX Record		
Phalaropus tricolor	Wilson's Phalarope	G5/S3		
Phalarupus lobatus	Red-necked Phalarope	G4G5/No TX Record		
Philomachus pugnax	Ruff	G5/No TX Record		
Scolopax minor	American Woodcock	G5/S2		
Tringa flavipes	Lesser Yellowlegs	G5/S5		
Tringa melanoleuca	Greater Yellowlegs	G5/S5		
Tringa solitaria	Solitary Sandpiper	G5/S5		
Sittidae				
Sitta canadensis	Red-breasted Nutchatch	G5/S2		
Strigidae				
Asio flammeus	Short-eared Owl	G5/No TX Record		
Asio otus	Long-eared Owl	G5/S2		
Athene cunicularia	Burrowing Owl	G4/S3		
Bubo virginianus	Great Horned Owl	G5/S5		
Glaucidium brasilianum	Ferruginous Pygmy-Owl	G5/S3		
Micrathene whitneyi	Elf Owl	G5/S4		
Otus asio	Eastern Screech-Owl	G5/S2		
Otus flammeolus	Flammulated Owl	G4/S3		
Strix varia	Barred Owl	G5/S5		
Sturnidae				
Sturnus vulgaris	European Starling	G5/Exotic		
Sylviidae				
Polioptila caerulea	Blue-gray Gnatcatcher	G5/S3		
Polioptila melanura	Black-tailed Gnatcatcher	G5/S4		

Scientific Name	Common Name	Natureserve Rankings	State Status	Federal Status
Thraupidae				
Piranga bidentata	Flame-colored Tanager	No NS Record		
Piranga flava	Hepatic Tanager	G5/S4		
Piranga ludoviciana	Western Tanager	G5/S4		
Piranga olivacea	Scarlet Tanager	G5/S4		
Piranga rubra	Summer Tanager	G5/S5		
Threskiornithidae				
Eudocimus albus	White Ibis	G5/S4		
Platalea ajaja	Roseate Spoonbill	G5/S4		
Plegadis chihi	White-faced Ibis	G5/S4	T	
Plegadis falcinellus	Glossy Ibis	G5/S3		
Trochilidae				
Amazilia violiceps	Violet-crowned Hummingbird	G5/No TX Record		
Amazilia yucatanensis	Buff-bellied Hummingbird	G4/S3		
Archilochus colubris	Ruby-throated Hummingbird	G5/S4		
Archilocus alexandri	Black-chinned Hummingbird	G5/S5		
Calypte anna	Anna's Hummingbird	G5/No TX Record		
Cynanthus latirostris	Broad-billed Hummingbird	G4/SH		
Hylocharis leucotis	White-eared Hummingbird	G5/No TX Record		
Lampornis clemenciae	Blue-throated Hummingbird	G5/S3		
Sealsphorus rufus	Rufous Hummingbird	G5/No TX Record		
Selasphorus platycercus	Broad-tailed Hummingbird	G5/S3		
Troglodytidae				
Campylorhynchus brunneicapillus	Cactus Wren	G5/S4		
Cistothorus palustris	Marsh Wren	G5/S4		
Cistothorus platensis	Sedge Wren	G5/S4		
Salpinctes obsoletus	Rock Wren	G5/S5		
Thryomanes bewickii	Bewick's Wren	G5/S5		
Thryothorus ludovicianus	Carolina Wren	G5/S5		
Troglodytes aedon	House Wren	G5/S2		
Troglodytes troglodytes	Winter Wren	G5/No TX Record		

Scientific Name	Common Name	Natureserve Rankings	State Status	Federal Status
Turdidae				
Catharus fuscescens	Veery	G5/No TX Record		
Catharus guttatus	Hermit Thrush	G5/S4		
Catharus minimus	Gray-cheeked Thrush	G5/S4		
Catharus ustulatus	Swainson's Thrush	G5/S4		
Hylocichla mustelina	Wood Thrush	G5/S4		
Ixoreus naevius	Varied Thrush	G5/No TX Record		
Myadestes townsendi	Townsend's Solitaire	G5/No TX Record		
Sialia currucoides	Mountain Bluebird	G5/S3		
Sialia sialis	Eastern Bluebird	G5/S5		
Turdus migratorius	American Robin	G5/S4		
Turdus rufopalliatus	Rufous-backed Robin	G5/No TX Record		
Tyrannidae				
Camptostoma imberbe	Northern Beardless-Tyrannulet	G5/S3	T	
Contopus cooperi	Olive-sided Flycatcher	G4/S3		
Contopus pertinax	Greater Pewee	G5/No TX Record		
Contopus sordidulus	Western Wood-Pewee	G5/S4		
Contopus virens	Eastern Wood-Pewee	G5/S4		
Empidonax flaviventris	Yellow-bellied Flycatcher	G5/No TX Record		
Empidonax hammondii	Hammond's Flycatcher	G5/S3		
Empidonax minimus	Least Flycatcher	G5/S5		
Empidonax traillii	Willow Flycatcher	G5/S1		
Empidonax virescens	Acadian Flycatcher	G5/S4		
Legatus leucophaius	Piratic Flycatcher	No NS Record		
Myiarchus cineruscens	Ash-throated Flycatcher	G5/S3		
Myiarchus crinitus	Great Crested Flycatcher	G5/S4		
Myiarchus tuberculifer lawrencei	Dusky-capped Flycatcher	G5/No TX Record		
Myiarchus tyrannulus	Brown-crested Flycatcher	G5/S4		
Myiodynastes luteiventris	Sulphur-bellied Flycatcher	G5/No TX Record		
Pachyramphus aglaiae	Rose-throated Becard	G4G5/No Tx Record	T	
Pitangus sulphuratus	Great Kiskadee	G5/S4		
Pyrocephalus rubinus	Vermilion Flycatcher	G5/S4		

Scientific Name	Common Name	Natureserve Rankings	State Status	Federal Status
Sayornis nigricans	Black Phoebe	G5/S4		
Sayornis phoebe	Eastern Phoebe	G5/S4		
Sayornis saya	Say's Phoebe	G5/S4		
Tyrannus couchii	Couch's Kingbird	G5		
Tyrannus forficatus	Scissor-tailed Flycatcher	G5/S3		
Tyrannus melancholicus	Tropical Kingbird	G5/S1		
Tyrannus tyrannus	Eastern Kingbird	G5/S4		
Tyrannus verticalis	Western Kingbird	G5/S3		
Tyrannus vociferans	Cassin's Kingbird	G5/S3		
Vireonidae				
Vireo atricapillus	Black-capped Vireo	G2G3/S2	E	E
Vireo bellii	Bell's Vireo	G5/S3		
Vireo cassini	Cassin's Vireo	G5/No TX Record		
Vireo flavifrons	Yellow-throated Vireo	G5/S4		
Vireo flavoviridis	Yellow-green Vireo	G5/S2		
Vireo gilvus	Warbling Vireo	G5/S3		
Vireo griseus	White-eyed Vireo	G5/S5		
Vireo olivaceus	Red-eyed Vireo	G5/S5		
Vireo philadelphicus	Philadelphia Vireo	G5/S4		
Vireo solitarius	Blue-headed Vireo	G5/No TX Record		

Mammals of the Del Rio Sector Area

Scientific Name	Common Name	Natureserve Rankings	State Status	Federal Status	County
Order Didelphimorphia					
Family Didelphidae (opossums)					
Didelphis virginiana	Virginia Opossum	G5			V,M
Order Xenarthra					
Family Dasypodidae (armadillos)					
Dasypus novemcinctus	Nine-banded Armadillo	G5			V,M
Order Insectivora					
Family Soricidae (shrews)					
Cryptotis parva	Least Shrew	G5			V,M
Notiosorex crawfordi	Desert Shrew	G5			V,M
Order Chiroptera					
Family Mormoopidae (mormoopid bats)					
Mormoops megalophylla	Ghost-faced Bat	G4			V,M
Family Phyllostomidae (leaf-nosed bats)					
Diphylla ecaudata	Hairy-legged Vampire	uk			V
Family Vespertilionidae (vespertilionid bats)					
Plecotus townsendii	Townsend's Big-eared Bat	G4			V
Antrozous pallidus	Pallid Bat	G5			V,M
Lasionycteris noctivagans	Silver-haired Bat	G5			V,M
Lasiurus borealis	Eastern Red Bat	G5			V,M
Lasiurus cinereus	Hoary Bat	G5			V,M
Myotis californicus	California Myotis	G5			V,M
Myotis yumanensis	Yuma Myotis	G5			V,M
Nycticeius humeralis	Evening Bat	G5			V,M
Perimyotis subflavus	Eastern Pipistrelle	G5			V,M
Pipistrellus hesperus	Western Pipistrelle	G5			V,M
Family Molossidae (free-tailed bats)					
Eumops perotis	Western Mastiff Bat	G5			V
Nyctinomops macrotis	Big Free-tailed Bat	G5			V,M
Tadarida brasiliensis	Brazilian Free-tailed Bat	G5			V,M
Order Lagomorpha					
Family Leporidae (hares and rabbits)					
Lepus californicus	Black-tailed Jackrabbit	G5			V,M

Scientific Name	Common Name	Natureserve Rankings	State Status	Federal Status	County
Sylvilagus audubonii	Desert Cottontail	G5			V,M
Sylvilagus floridanus	Eastern Cottontail	G5			V,M
Order Rodentia					
Family Sciuridae (squirrels and allies)					
Ammospermophilus interpres	Texas Antelope Squirrel	G4G5			V
Cynomys ludovicianus	Black-tailed Prairie Dog	G4			V
Sciurus niger	Eastern Fox Squirrel	G5			V,M
Spermophilus mexicanus	Mexican Ground Squirrel	G5			V,M
Spermophilus spilosoma	Spotted Ground Squirrel	G5			V,M
Spermophilus variegatus	Rock Squirrel	G5			V
Family Geomyidae (pocket gophers)					
Cratogeomys castanops	Yellow-faced Pocket Gopher	G5			V,M
Geomys personatus	Texas Pocket Gopher	G4			V,M
Thomomys bottae	Botta's Pocket Gopher	G5			V
Family Heteromyidae (pocket mice and kangaroo rats)					
Chaetodipus hispidus	Hispid Pocket Mouse	G5			V,M
Chaetodipus nelsoni	Nelson's Pocket Mouse	G5			V,M
Chaetodipus penicillatus	Desert Pocket Mouse	G5			V
Dipodomys compactus	Gulf Coast Kangaroo Rat	G4			M
Dipodomys merriami	Merriam's Kangaroo Rat	G5			V,M
Dipodomys ordii	Ord's Kangaroo Rat	G5			V,M
Perognathus merriami	Merriam's Pocket Mouse	G5			V,M
Family Muridae (mice and rats)					
Baiomys taylori	Northern Pygmy Mouse	G4G5			V,M
Mus musculus	house mouse	G5			V,M
Neotoma leucodon	White-toothed Woodrat	G5			V
Neotoma micropus	Southern Plains Woodrat	G5			V,M
Ondatra zibethicus	Common Muskrat	G5			V
Onychomys arenicola	Mearns' Grasshopper Mouse	G4G5			V
Onychomys leucogaster	Northern Grasshopper Mouse	G5			V,M
Peromyscus attwateri	Texas Mouse	G5			V

Scientific Name	Common Name	Natureserve Rankings	State Status	Federal Status	County
Peromyscus eremicus	Cactus Mouse	G5			V,M
Peromyscus leucopus	White-footed Mouse	G5			V,M
Peromyscus maniculatus	Deer Mouse	G5			V,M
Peromyscus pectoralis	White-ankled Mouse	G5			V,M
Rattus norvegicus	Norway Rat	G5			V,M
Rattus rattus	Roof rat	G5			V,M
Reithrodontomys fulvescens	Fulvous Harvest Mouse	G5			V,M
Sigmodon hispidus	Hispid Cotton Rat	G5			V,M
Family Erethizontidae (New World porcupines)					
Erethizon dorsatum	Porcupine	G5			V,M
Family Castoridae (beavers)					
Castor canadensis	American Beaver	G5			V,M
Family Myocastoridae (myocastorids)					
Myocastor coypus	Nutria	G5			V,M
Order Carnivora					
Family Canidae (canids)					
Canis latrans	Coyote	G5			V,M
Urocyon cinereoargenteus	Common Gray Fox	G5			V,M
Vulpes velox	Swift or Kit Fox	G3			V
Vulpes vulpes	Red Fox	G5			V
Family Ursidae (bears)					
Ursus americanus	Black Bear	G5			UK
Family Procyonidae (procyonids)					
Bassariscus astutus	Ringtail	G5			V,M
Nasua narica	White-nosed Coati	G5			V,M
Procyon lotor	Common Raccoon	G5			V,M
Family Mustelidae (mustelids)					
Conepatus mesoleucus	Common Hog-nosed Skunk	uk			V,M
Mephitis mephitis	Striped Skunk	G5			V,M
Mustela frenata	Long-tailed Weasel	G5			V,M
Spilogale gracilis	Western Spotted Skunk	G5			V,M
Taxidea taxus	American Badger	G5			V,M
Family Felidae (cats)					
Felis pardalis	Ocelot	G4		LE	V,M
Lynx rufus	Bobcat	G5			V,M
Puma concolor	Mountain Lion	G5			V,M

Scientific Name	Common Name	Natureserve Rankings	State Status	Federal Status	County
Order Artiodactyla					
Family Suidae (pigs)					
Sus scrofa	feral hog	G5			V,M
Family Dicotylidae (peccaries)					
Pecari tajacu	Collared Peccary	G5			V,M
Family Cervidae (cervids)					
Axis axis	Axis Deer	G4			V,M
Cervus nippon	Sika Deer	G4			V,M
Dama dama	Fallow deer	G5			V,M
Odocoileus virginianus	White-tailed Deer	G5			V,M
Family Bovidae (bovids)					
Ammotragus lervia	barbary sheep	G5			V,M
Antilope cervicapra	blackbrush antilope	G3G4			V,M
Boselaphus tragocamelus	nilgai	G3G4			V,M

Amphibians of the Del Rio Sector Area

Scientific Name	Common Name	Natureserve Rankings	State Status	Federal Status	County
Salamanders					
Ambystomatidae					
Ambystoma tigrinum	Tiger Salamander	G5			V
Plethodontidae					
Eurycea neotenes	Texas Salamander	G1			V
Sirenidae					
Siren intermedia	Lesser Siren	G5			M
Siren sp. 1	South Texas siren (Large form)	No record	T		M
Toads					
Bufonidae					
Bufo debilis	Green Toad	G5			M,V
Bufo fowleri	Fowler's Toad	G5			M,V
Bufo punctatus	Red-spotted Toad	G5			M,V
Bufo valliceps	Gulf Coast Toad	No record			M,V
Microhylidae					
Gastrophryne olivacea	Great Plains Narrowmouth Toad	G5			M,V
Frogs					
Hylidae					
Acris crepitans	Northern Cricket Frog	G5			M,V
Leptodactylidae					
Eleutherodactylus augusti	Barking Frog	G5			V
Eleutherodactylus marnockii	Cliff Chirping Frog	G5			V
Ranidae					
Rana berlandieri	Rio Grande Leopard Frog	G5			M,V
Rana catesbeiana	Bullfrog	G5			M,V
Scaphiopodidae					
Scaphiopus couchii	Couch's Spadefoot	G5			M,V
Spea multiplicata	New Mexico Spadefoot	G5			V

Reptiles of the Del Rio Sector Area

Scientific Name	Common Name	Natureserve Rankings	State Status	Federal Status	County
Turtles					
Emydidae					
Pseudemys gorzugi	Rio Grande River Cooter	G3G4			V
Terrapene ornata	Western Box Turtle	G5			V
Trachemys scripta	Slider	G5			M,V
Kinosternidae					
Kinosternon flavescens	Yellow Mud Turtle	G5			M,V
Testudinidae					
Gopherus berlandieri	Texas Tortoise	G4	T		M,V
Trionychidae					
Apalone mutica	Smooth Softshell	G5			V
Apalone spinifera	Spiny Softshell	G5			M,V
Alligators					
Alligatoridae					
Alligator mississippiensis	American Alligator	G5	SAT		M
Lizards					
Anguidae					
Gerrhonotus infernalis	Texas Alligator Lizard	G4			V
Crotaphytidae					
Crotaphytus collaris	Eastern Collared Lizard	G5			M,V
Crotaphytus reticulatus	Reticulate Collared Lizard	G3	T		M
Gekkonidae					
Coleonyx brevis	Texas Banded Gecko	G5			V
Phrynosomatidae					
Cophosaurus texanus	Greater Earless Lizard	G5			M,V
Holbrookia lacerata	Spot-tailed Earless Lizard	G3G4			M,V
Holbrookia propinqua	Keeled Earless Lizard	G4			M
Phrynosoma cornutum	Texas Horned Lizard	G4G5	T		M,V
Phrynosoma modestum	Round-tailed Horned Lizard	G5			V
Sceloporus serrifer	Blue Spiny Lizard	G5			M
Sceloporus merriami	Canyon Lizard	G4			V
Sceloporus olivaceus	Texas Spiny Lizard	G5			M,V
Sceloporus poinsettii	Crevice Spiny Lizard	G5			V
Sceloporus undulatus	Fence/prairie/plateau Lizard	G5			M,V
Sceloporus variabilis	Rosebelly Lizard	G5			M
Urosaurus ornatus	Tree Lizard	G5			M,V

Scientific Name	Common Name	Natureserve Rankings	State Status	Federal Status	County
Uta stansburiana	Side-blotched Lizard	G5			V
Anolis carolinensis	Green Anole	G5			V
Scincidae					
Eumeces obsoletus	Great Plains Skink	G5			M,V
Eumeces tetragrammus	Four-lined Skink	G5			M,V
Scincella lateralis	Ground Skink	G5			V
Snakes					
Colubridae					
Arizona elegans	Glossy Snake	G5			M,V
Coluber constrictor	Racer	G5			V
Diadophis punctatus	Ring-necked Snake	G5			M,V
Drymarchon melanurus erebennus	Texas Indigo Snake	G5T4	T		M,V
Elaphe bairdi	Baird's Ratsnake	G4			V
Elaphe guttata	Red Cornsnake	G5			M,V
Gyalopion canum	Chihuahuan Hook-nosed Snake	G5			V
Heterodon nasicus	Western Hog-nosed Snake	G5			M,V
Hypsiglena torquata	Nightsnake	G5			M,V
Lampropeltis alterna	Gray-banded Kingsnake	G5			V
Lampropeltis getula	Common Kingsnake	G5			M,V
Lampropeltis triangulum	Milksnake	G5			M,V
Masticophis flagellum	Coachwhip	G5			M,V
Masticophis schotti	Schott's Whipsnake	G5			M
Masticophis taeniatus	Striped Whipsnake	G5			V
Nerodia erythrogaster	Plain-bellied Watersnake	G5			V
Nerodia rhombifer	Diamond-backed Watersnake	G5			M,V
Opheodrys aestivus	Rough Greensnake	G5			M,V
Pituophis catenifer	Gophersnake	G5			M,V
Rhinocheilus lecontei	Long-nosed Snake	G5			M,V
Salvadora grahamiae	Eastern Patch-nosed Snake	G5			M,V
Sonora semiannulata	Groundsnake	G5			M,V
Tantilla cucullata	Trans-Pecos Black-headed Snake	G3	T		V
Tantilla gracilis	Flat-headed Snake	G5			M,V
Tantilla hobartsmithi	Smith's Black-headed Snake	G5			M,V
Tantilla nigriceps	Plains Black-headed Snake	G5			M,V
Thamnophis cyrtopsis	Black-necked Gartersnake	G5			V
Thamnophis marcianus	Checkered Gartersnake	G5			M,V

Scientific Name	Common Name	Natureserve Rankings	State Status	Federal Status	County
Thamnophis proximus	Western Ribbonsnake	G5			M,V
Elapidae					
Micrurus fulvius	Harlequin Coralsnake	G5			M,V
Leptotyphlopidae					
Leptotyphlops dulcis	Texas Threadsnake	G5			M,V
Leptotyphlops humilis	Western Threadsnake	G5			V
Teiidae					
Aspidoscelis gularis	Texas Spotted Whiptail	G5			M,V
Aspidoscelis inornata	Little Striped Whiptail	G5			V
Aspidoscelis laredoensis	Laredo Striped Whiptail	G4			M,V
Aspidoscelis tigris marmorata	Western Marbled Whiptail	G5			V
Aspidoscelis sexlineata	Six-lined Racerunner	G5			M,V
Aspidoscelis tesselata	Common Checkered Whiptail	G5			V
Bogertophis subocularis	Trans-pecos Snake	G4G5			V
Viperidae					
Agkistrodon contortrix	Copperhead	G5			V
Agkistrodon piscivorus	Cottonmouth	G5			M
Crotalus atrox	Western Diamond-backed Rattlesnake	G5			M,V
Crotalus lepidus	Rock Rattlesnake	G5			M,V
Crotalus molossus	Black-tailed Rattlesnake	G5			V

Butterflies of the Del Rio Sector Area

Scientific Name	Common Name	Natureserve Rankings	State Status	Federal Status	County
Skippers (Hesperiidae)					
Grass Skippers (Hesperiinae)					
Amblyscirtes cassus	Cassus Roadside-skipper	G5			V
Amblyscirtes eos	Dotted Roadside-skipper	G5			V
Amblyscirtes nysa	Nysa Roadside-skipper	G5			M,V
Ancyloxypha arene	Tropical Least Skipper	G5			M,V
Ancyloxypha numitor	Common Least Skipper	G5			V
Atalopedes campestris	Sachem	G5			M,V
Copaeodes aurantiaca	Orange Skipperling	G5			M,V
Copaeodes minima	Southern Skipperling	G5			M,V
Hesperia viridis	Green Skipper	G5			M,V
Hylephila phyleus	Fiery Skipper	G5			M,V
Lerema accius	Clouded Skipper	G5			M,V
Lerodea eufala	Eufala Skipper	G5			M,V
Nastra julia	Julia's Skipper	G5			M,V
Panoquina ocola	Ocola Skipper	G5			V
Polites vibex	Whirlabout	G5			M,V
Giant-Skippers (Megathyminae)					
Agathymus mariae	Mary's Giant-skipper	G3G4			V
Agathymus remingtoni valverdiensis	Coahuila Giant Skipper	G4T2T3			V
Megathymus yuccae	Yucca Giant-skipper	G5			V
Spread-wing Skippers (Pyrginae)					
Achalarus toxeus	Coyote Cloudywing	G5			V
Astraptes fulgerator	Two-barred Flasher	No record			V
Celotes nessus	Common Streaky-skipper	G5			M,V
Cogia outis	Outis Skipper	G3G4			V
Erynnis funeralis	Funereal Duskywing	G5			V
Erynnis juvenalis	Juvenal's Duskywing	G5			V
Erynnis meridianus	Meridian Duskywing	G5			M,V
Gesta invisus	False Duskywing	G5			M,V
Pholisora catullus	Common Sootywing	G5			M,V
Pyrgus albescens	White Checkered-skipper	G5			M,V
Pyrgus philetas	Desert Checkered-skipper	G5			M,V
Staphylus ceos	Golden-headed Scallopwing	G5			V

Scientific Name	Common Name	Natureserve Rankings	State Status	Federal Status	County
Systasea pulverulenta	Texas Powdered-skipper	G5			V
Gossamer-wing Butterflies (Lycaenidae)					
Blues (Polyommatinae)					
Brephidium exilis	Western Pygmy-blue	G5			V
Echinargus isola	Reakirt's Blue	G5			M,V
Hemiargus ceraunus	Ceraunus Blue	G5			M
Metalmarks (Riodinidae)					
Apodemia duryi	Mexican Metalmark	G3G4			V
Calephelis nemesis	Fatal Metalmark	G5			M,V
Hairstreaks (Theclinae)					
Atlides halesus	Great Purple Hairstreak	G5			V
Callophrys henrici	Henry's Elfin	G5			V
Calycopis isobeon	Dusky-blue Groundstreak	G5			M,V
Phaeostrymon alcestis	Soapberry Hairstreak	G5			M,V
Satyrium favonius	Oak Hairstreak	G4			M,V
Strymon alea	Lacey's Scrub-hairstreak	G3G4			V
Strymon istapa	Mallow Scrub-hairstreak	G5			V
Strymon melinus	Gray Hairstreak	G5			M,V
Brush-footed Butterflies (Nymphalidae)					
Emperors (Apaturinae)					
Asterocampa celtis	Hackberry Emperor	G5			M,V
Asterocampa clyton	Tawny Emperor	G5			M,V
Asterocampa leilia	Empress Leilia	G5			M,V
Leafwings (Charaxinae)					
Anaea aidea	Tropical Leafwing	No record			V
Anaea andria	Goatweed Leafwing	G5			M,V
Milkweed Butterflies (Danainae)					
Danaus gilippus	Queen	G5			M,V
Danaus plexippus	Monarch	G5		SC	M,V
Longwings (Heliconiinae)					
Agraulis vanillae	Gulf Fritillary	G5			M,V
Euptoieta claudia	Variegated Fritillary	G5			M,V
Heliconius charithonia	Zebra	G5			V
Snouts (Libytheinae)					
Libytheana carinenta	American Snout	G5			M,V
Admirals and Relatives (Limenitidinae)					
Eunica monima	Dingy Purplewing	G5			M,V
Limenitis archippus	Viceroy	G5			M,V

Scientific Name	Common Name	Natureserve Rankings	State Status	Federal Status	County
Marpesia chiron	Many-banded Daggerwing	G5			V
Mestra amymone	Common Mestra	G5			M,V
True Brushfoots (Nymphalinae)					
Anartia jatrophae	White Peacock	G5			M
Anthanassa texana	Texan Crescent	G5			M,V
Chlosyne lacinia	Bordered Patch	G5			M,V
Chlosyne theona	Theona Checkerspot	G5			M,V
Nymphalis antiopa	Mourning Cloak	G5			V
Phyciodes graphica	Graphic Crescent	G5			M
Phyciodes phaon	Phaon Crescent	G5			M,V
Phyciodes picta	Painted Crescent	G5			M
Phyciodes tharos	Pearl Crescent	G5			M
Poladryas minuta	Dotted Checkerspot	G5			V
Polygonia interrogationis	Question Mark	G5			M
Texola elada	Elada Checkerspot	G5			V
Vanessa atalanta	Red Admiral	G5			M,V
Vanessa cardui	Painted Lady	G5			M,V
Vanessa virginiensis	American Lady	G5			V
Parnassians and Swallowtails (Papilionidae)					
Swallowtails (Papilioninae)					
Battus philenor	Pipevine Swallowtail	G5			M,V
Papilio cresphontes	Giant Swallowtail	G5			M,V
Papilio multicaudata	Two-tailed Swallowtail	G5			M,V
Papilio polyxenes	Black Swallowtail	G5			M,V
Papilio thoas	Thoas Swallowtail	No record			V
Whites and Sulphurs (Pieridae)					
Sulphurs (Coliadinae)					
Abaeis nicippe	Sleepy Orange	G5			M,V
Anteos clorinde	White Angled-Sulphur	No record			V
Colias eurytheme	Orange Sulphur	G5			M,V
Eurema mexicana	Mexican Yellow	G5			V
Kricogonia lyside	Lyside Sulphur	G5			M,V
Nathalis iole	Dainty Sulphur	G5			M,V
Phoebis agarithe	Large Orange Sulphur	G5			M,V
Phoebis sennae	Cloudless Sulphur	G5			M
Pyrisitia lisa	Little Yellow	G5			M,V
Zerene cesonia	Southern Dogface	G5			M,V
Whites (Pierinae)					
Pontia protodice	Checkered White	G4			V

Appendix D Tablenotes

Key:

E = Endangered

T = Threatened

SC = Special concern

SAT = Listed endangered or threatened because of similarity of appearance

G1 = NatureServe Ranking; Critically Imperiled

G2 = NatureServe Ranking; Imperiled

G3 = NatureServe Ranking; Vulnerable to Exterpation or Extinction

G4 = NatureServe Ranking; Apparently Secure

G5 = NatureServe Ranking; Demonstratably Widespread, Abundant and Secure

No Record = No record found in NatureServe Database

M= Maverick County (Section M-1)

V= Val Verde County (Section M-2A)

Sources:

http://www.butterfliesandmoths.org/

http://wfscnet.tamu.edu/tcwc/Herps_online/CountyRecords.htm

http://www.tpwd.state.tx.us/publications/pwdpubs/media/pwd_bk_w7000_0809.pdf

http://www.tpwd.state.tx.us/publications/pwdpubs/media/pwd_bk_w7000_1033.pdf

http://www.nsrl.ttu.edu/tmot1/Default.htm

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