National Park Service
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Natural Resource Stewardship and Science

Vegetation Inventory Project

Amistad National Recreation Area

Natural Resource Report NPS/CHDN/NRR—2019/2055



ON THE COVER

View from a Guajillo - Blackbrush - Torrey Yucca Shrubland Plant Community above the Amistad Reservoir.
Photo Credit: Lady Bird Johnson Wildflower Center 2012.

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Executive Summary

Amistad National Recreation Area (AMIS) covers approximately 57,000 acres (23,000 hectares) in south Texas along the United States (U.S.) border with Mexico. Under a joint International Agreement in 1964, the Amistad Dam was constructed at the confluence of the Rio Grande and Devils Rivers impounding the waters and creating the Amistad Reservoir. In 1990, the National Park Service (NPS) was directed to manage the U.S. surface waters and surrounding lands as a national recreation area. The resulting AMIS park unit contains many unique vegetation elements from three converging ecoregions. Together they combine to form various upland and riparian woodland, shrubland, and herbaceous plant communities. Past and present land-use practices such as ranching and development along with natural disturbances from flooding and drought have also influenced the vegetation at AMIS. In 2010 the National Vegetation Inventory Program (NVIP) and the NPS Chihuahuan Desert Inventory and Monitoring Network (CHDN) began a vegetation inventory effort to better understand and document the vegetation diversity at AMIS.

An eight-year, six-phase project was begun in 2010 to complete the inventorying and mapping of the vegetation at AMIS. Phase one, conducted by Cogan Technology, Inc. (CTI), reviewed the existing vegetation data, summarized the previous classification efforts, and created a new sampling plan. In 2012, ecologists affiliated with the Lady Bird Johnson Wildflower Center (LBJWC) used the sampling plan to collect field data at 100 classification plot and two observation point locations. Field data was then entered into the NVIP-specific PLOTS database and reviewed by CHDN staff. In phase three, CTI analyzed the PLOTS data to classify 31 plant associations using the revised U.S. National Vegetation Classification (rUSNVC) standard. During phase four, CTI created 50 map units (37 vegetated and 13 land-use/land-cover types) to produce a detailed digital vegetation map layer. Phase five was the accuracy assessment (AA), where LBJWC field crews collected data at 562 AA points that were stratified by map class and randomly placed throughout the project area. In 2019, CTI completed the project and delivered the final products to the NVIP.

The resulting spatial database and vegetation map layer for AMIS was created from high-resolution 2015 Texas Orthoimagery Program (TOP) imagery and ancillary data. By comparing the signatures on the imagery to the field data, map units were used to delineate the vegetation alliances and associations into homogeneous polygons. The interpreted vegetation polygons were then digitized into a Geographic Information System (GIS) layer that was field-tested, reviewed, and revised. The final AMIS vegetation map was assessed for overall thematic accuracy at 87.0% with a Kappa value of 87.3%.

Products developed for AMIS are described and presented in this report and stored in the accompanying project digital files. Project deliverables include the final AMIS Vegetation Inventory Report, the AMIS Spatial GIS Geodatabase, Digital Field Photos, Metadata, Vegetation Descriptions, and the Field Key to the Vegetation Associations. For a full listing of the AMIS products available to download please visit the National Park Vegetation Inventory Product website.

Acknowledgments

The authors would like to thank Jack Johnson and Sarah Howard at Amistad National Recreation Area for their input and commitment to this project. They oversaw many of the field work efforts including coordinating boat trips, setting-up meetings, arranging research permits, and contacting the surrounding landowners for access permission. On the mapping side, Sarah and her staff also helped review draft maps, provided ground-based verification, and reviewed all draft project materials. Without their assistance, this project would not have been possible.

The folks at the Lady Bird Johnson Wildflower Center were a pleasure to work with. The field data they provided was thorough and detailed. Many of their field forms contained drawings of the vegetation with detailed notes. Minnette Marr was our “go to” person at LBJWC. From finding old reports, relabeling field photos, and providing background materials, Minnette never let us down. Although Dr. Karen Clary retired from the LBJWC before this project was completed, we would still like to acknowledge all the efforts she and her field crews put into the field sampling, report writing, and classification portions of this project. We wish the best for the LBJWC as they continue their efforts to conserve and protect the natural areas of Texas.

Andy Hubbard, Marcia Wilson (retired), Cheryl McIntyre, and Mark Isley at the Chihuahuan Desert Inventory and Monitoring Network provided much support and assistance as this project progressed. Andy also coordinated the peer-review process and along with his staff at the Sonoran Desert Inventory and Monitoring Network helped get the AMIS report published in the Natural Resource Report series. A big thank you also goes to Dr. Hildy Reiser (retired) who was an excellent tour guide and always championed these inventory projects.

Special recognition goes to Dr. Karl Brown and Tammy Cook with the National Park Service Vegetation Inventory Program in Fort Collins, Colorado for prioritizing this project and providing funding. Without their financial support and coordination, this project would not have been possible. You can always count on Karl and Tammy to answer the phone, reply to urgent e-mails, calm your concerns, and provide valuable guidance.

This project was inspired by the enthusiasm of so many people. The authors wish to express their deep-felt appreciation to all those involved for their never-ending patience and perseverance.

Thanks to all that helped this project in so many ways.

Introduction

National Vegetation Inventory Program

The National Vegetation Inventory Program (NVIP) was started as a cooperative effort between the National Park Service (NPS) and the United States Geological Survey (USGS) to classify, describe, and map existing vegetation communities in more than 270 national park units across the United States. The primary objective of the NVIP is to produce high-quality plant community classifications, standardized vegetation maps, and associated data sets. This information fills data gaps and complements a wide variety of resource assessments, park management, and conservation needs. Among its many uses, the NVIP products have helped park managers better identify and conserve plant biodiversity; manage non-native and rare species, monitor insect and disease effects; and provide a baseline to examine wildlife habitat relationships and the effects of wildland fires.

In 1999, the Director of the NPS approved the Natural Resource Challenge to encourage National Parks to focus on the preservation of the nation's natural heritage through science, natural resource inventories, and expanded resource monitoring. The Natural Resource Challenge provided funding for 12 baseline inventories to be completed in each of 270 park units that contain significant natural resources and the NVIP is considered one of these 12 baseline inventories.

The NVIP follows well-established procedures that are compatible with other agencies and organizations. The inventory uses the revised National Vegetation Classification Standard Version 2 (rUSNVC) (FGDC 2008), a system that is integrated with the major scientific efforts in the taxonomic classification of vegetation and is a Federal Geographic Data Committee (FGDC) standard (FGDC 1997 & FGDC 2008). In addition, stringent quality control procedures ensure the reliability of the vegetation data and encourage the use of resulting maps, reports, and databases at multiple scales.

A complete vegetation inventory and mapping project for an NPS unit follows a standard 12-step procedure (NPS 2009) and includes the following products:

- Detailed Vegetation Report
- Digital Vegetation Map
- Vegetation Plot Data
- Accuracy Assessment Data and Analysis
- Dichotomous Vegetation Key
- Photo-interpretation Key

Maps and other spatial data for the NPS units in the Continental U.S. are normally produced in the Universal Transverse Mercator (UTM) projection, the North America Datum (version 1983 = NAD 83), uses meters for map and distance units, and have a nominal 1:24,000-scale with a minimum mapping unit (MMU) of 0.5 hectare (1.2 acres). The vegetation maps must meet both the National Map Accuracy Standards for positional accuracy (TNC and ESRI 1994a & Lea and Curtis 2010) and the minimum map class accuracy goal of 60% percent (NPS 2009) for all vegetation classes.

National Vegetation Classification Standard

In 1994, the NPS formed the NVIP to catalog and map the vegetation within all the 270 NPS units with a natural resource component. Shortly thereafter, the USGS joined this effort and formed a partnership. In the same year, the NVIP also adopted the U.S. National Vegetation Classification (USNVC) (Grossman et al. 1998) as a basis for the *a priori* definition of vegetation units to be inventoried. NatureServe has since revised the USNVC and in 2008, the FGDC formally endorsed the rUSNVC (FGDC 2008).

Use of a standardized vegetation classification system, such as the rUSNVC helps ensure data compatibility throughout the NPS and other agencies (FGDC 2008). A standardized system is critical for a systematic inventory and classification of the nation's biological resources, assists with efficient stewardship, and helps to prioritize conservation efforts. The rUSNVC is being used for vegetation classification and mapping projects throughout the Chihuahuan Desert Inventory and Monitoring Network (CHDN) and all the other 32 NPS inventory and monitoring networks in the U.S. The USNVC has been in existence for over two decades and has evolved from the original classification systems first developed jointly by The Nature Conservancy (TNC), NatureServe, and various other state Natural Heritage Programs (TNC and ESRI 1994a, Grossman et al. 1998).

The rUSNVC is a hierarchical system that allows for vegetation classification at multiple scales (FGDC 2008). There are eight levels with specific criteria set for each level (Table 1). The upper three levels are based on climate and physiognomic characteristics that reflect geographically widespread (global) topographic and edaphic factors. The middle three levels focus largely on broad sets of diagnostic plant species and habitats along regional-to-continental topographic, edaphic, and disturbance gradients. The lower two levels (as in the original USNVC) are the plant alliance and plant association (i.e. plant community) and are distinguished by differences in the local floristic composition (Grossman et al. 1998).

The broader alliances are physiognomically distinct groups (e.g. forests, woodlands, shrublands, herbaceous vegetation, etc.) of plant associations sharing one or more differential or diagnostic species (Mueller-Dombois and Ellenberg 1974). These are commonly the dominant(s) found in the uppermost strata of vegetation. The plant association is the base unit of the classification and following Jennings et al. (2009) is "a vegetation classification unit defined on the basis of a characteristic range of species composition, diagnostic species occurrence, habitat conditions, and physiognomy". In the winter of 2016, the USNVC for the Conterminous United States was formally released. In the spring of 2017, version 2.01 was made available through the USNVC Explorer. Currently work is being done to revise the classification for plant communities found in Alaska, Hawai'i, and for the U.S. territories in the Caribbean and Pacific islands.

Content for the rUSNVC is currently maintained by NatureServe and is being peer reviewed through collaboration with federal agencies and the Ecological Society of America (ESA) (Faber-Langendoen et al. 2009). The content is available to the public and is regularly updated on the NatureServe Explorer website (2018) (http://explorer.natureserve.org/) and on the official USNVC website.

Table 1. Summary of rUSNVC Revised Hierarchy Levels and Criteria for Natural Vegetation.

Hierarchy Level	Description	Criteria
Upper: Physiognomy plays a predominant role.	L1 – Formation Class	Broad combinations of general dominant growth forms that are adapted to basic temperature (energy budget), moisture, and substrate/aquatic conditions.
	L2 – Formation Subclass	Combinations of general dominant and diagnostic growth forms that reflect global macroclimatic factors driven primarily by latitude and continental position, or that reflect overriding substrate/aquatic conditions.
	L3 – Formation	Combinations of dominant and diagnostic growth forms that reflect global macroclimatic factors as modified by altitude, seasonality of precipitation, substrates, and hydrologic conditions.
Middle: Floristics and physiognomy play predominant roles	L4 – Division	Combinations of dominant and diagnostic growth forms and a broad set of diagnostic plant species that reflect biogeographic differences in composition and continental differences in mesoclimate, geology, substrates, hydrology, and disturbance regimes.
	L5 – Macrogroup	Combinations of moderate sets of diagnostic plant species and diagnostic growth forms, that reflect biogeographic differences in composition and sub-continental to regional differences in mesoclimate, geology, substrates, hydrology, and disturbance regimes.
	L6 – Group	Combinations of relatively narrow sets of diagnostic plant species (including dominants and co-dominants), broadly similar composition, and diagnostic growth forms that reflect regional mesoclimate, geology, substrates, hydrology and disturbance regimes.
Lower: Floristics plays a predominant role	L7 – Alliance	Diagnostic species, including some from the dominant growth form or layer, and moderately similar composition that reflect regional to subregional climate, substrates, hydrology, moisture/nutrient factors, and disturbance regimes.
	L8 – Association	Diagnostic species, usually from multiple growth forms or layers, and more narrowly similar composition that reflect topo-edaphic climate, substrates, hydrology, and disturbance regimes.

All rUSNVC associations and alliances (or equivalents) are commonly used for map units or classes in the NVIP to insure compatibility throughout the NPS as well as with other federal and state agencies. Vegetation maps and supporting ecological information based on the rUSNVC allows for efficient comparisons of similar types in other areas and at the same location through time. Referencing the rUSNVC assures that map units are not based on confusing local (common) plant names or site-specific habitats. Future researchers using the vegetation map and data can always reference the rUSNVC descriptions for timely and accurate information on the common species and

habitat characteristics. Having the ability to cross-reference the vegetation map units with the rUSNVC types also allows for efficient comparison to other studies relating to a wide variety of resource assessment, park management, and planning needs.

Chihuahuan Desert Inventory and Monitoring Network

CHDN is composed of seven NPS park units in the desert and mountain landscapes of west Texas and southeastern New Mexico (Figure 1). CHDN park units include AMIS, Big Bend National Park (BIBE), Carlsbad Caverns National Park (CAVE), Fort Davis National Historic Site (FODA), Guadalupe Mountains National Park (GUMO), Rio Grande Wild and Scenic River (RIGR), and White Sands National Monument (WHSA). This network of park units occurs within the 230,000 square-mile Chihuahuan Desert Ecoregion that covers much of Northern Mexico and extends into Southwest Texas and Southern New Mexico. The biota contained in the CHDN park units is diverse and specialized, with many animal and plant species only found in this region of the world.

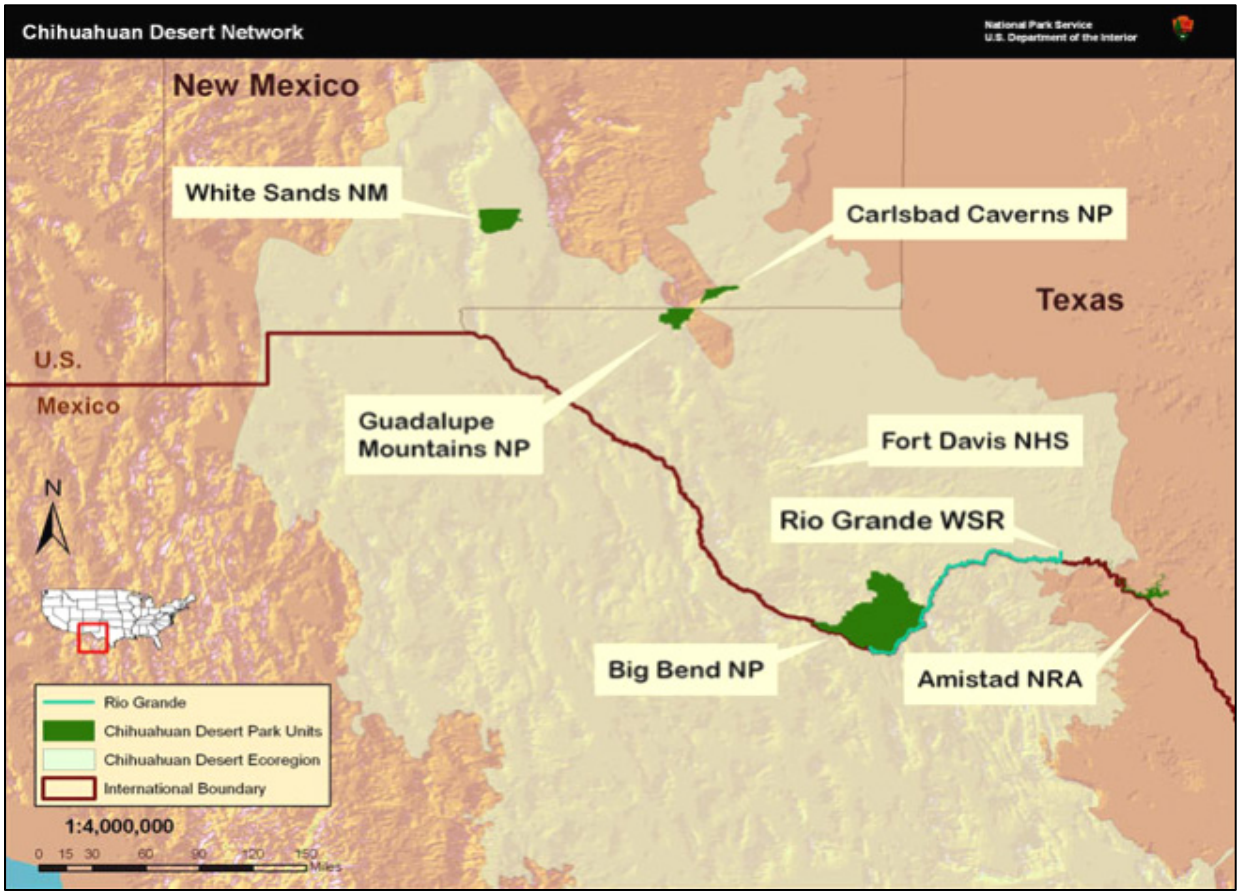


Figure 1. The Chihuahuan Desert Inventory and Monitoring Network Map (NPS/CHDN 2019).

The CHDN was organized to inventory and monitor status and trends for selected natural resources and provide a network organization that facilitates collaboration, information sharing, and economies of scale across all the park units in Chihuahuan ecoregion. The inventory and monitoring information created and collected by this network is used for many purposes including: guiding park-level

management decisions, informing and fostering scientific research, and providing outreach and education to the general public. One goal of the CHDN is to collect and serve data on the dynamic nature and condition of park-managed ecosystems and to provide reference points for comparisons with other management types and possibly with altered environments. The development of a vegetation classification to the vegetation alliance/plant association level and associated GIS map and database for each park is viewed as a high priority in reaching this goal. To help achieve this requirement, the CHDN has collaborated with the NVIP to get all their park units inventoried and mapped. The products presented here, along with those for BIBE and RIGR, represent the last park units to be completed within the CHDN.

For more information about the network please visit the CHDN website and to view examples of other completed NVIP projects in the CHDN please access either the NPS Integrated Resource Management Application Data Store website or the National Park Vegetation Inventory Product website.

Amistad National Recreation Area

The Rio Grande River forms part of the natural boundary between U.S. and Mexico. This large river meanders southeast from the high Rocky and San Juan Mountains through New Mexico and lower Texas before reaching the Gulf of Mexico. The Rio Grande is a critical resource and numerous dams, canals, and other diversions have been built to help allocate its waters. Among the largest is the Amistad Dam created at the confluence of the Rio Grande and Devils Rivers, about 12 miles (19 km) northwest from the town of Del Rio, Texas. Since its creation, Amistad Dam has backed up the Rio Grande, Devils, Pecos, and Rio Conchos Rivers to create the Amistad Reservoir (or Lake Amistad) that has a surface area of roughly 65,000 acres (26,305 ha) with about 33,000 acres (13,355 ha) on the U.S. side of the border.

AMIS gets its name from the Spanish word for “friendship” and the project was started in 1944 under a treaty between U.S. and Mexico to provide flood control, water conservation, irrigation, hydroelectric power, and recreation. Construction of the dam was begun in 1964 and completed in 1969. The International Boundary and Water Commission (IBWC) manages the dam and reservoir (NPS 2006). In 1965, the IBWC assigned the administration of all the lands and the reservoir surface waters to the NPS for recreational purposes. Congress authorized the national recreation area as a unit within the NPS in 1990 to provide for public outdoor recreation and enjoyment of the U.S. portion of the reservoir and to protect the scenic, scientific, cultural, and other values contributing to such enjoyment (NPS 2009).

The AMIS boundary is defined as the reservoir surface and shore area up to the 1,144.3-ft (349 m) elevation contour (above mean sea level) with some additional campgrounds, boat launches, parking lots, and hunting areas above the 1,144.3-ft mark also managed by the NPS. The conservation pool level of the reservoir is maintained at the 1,117-ft (340 km) contour above mean sea level. At this level, the reservoir has a maximum depth of about 217 feet (66 m) (NPS 2006). The resulting area managed by AMIS is about 57,000 acres (23,000 ha) (Figure 2). AMIS occurs entirely in Val Verde County, Texas and shares approximately 83 miles of the international border with the country of Mexico (NPS 2006).

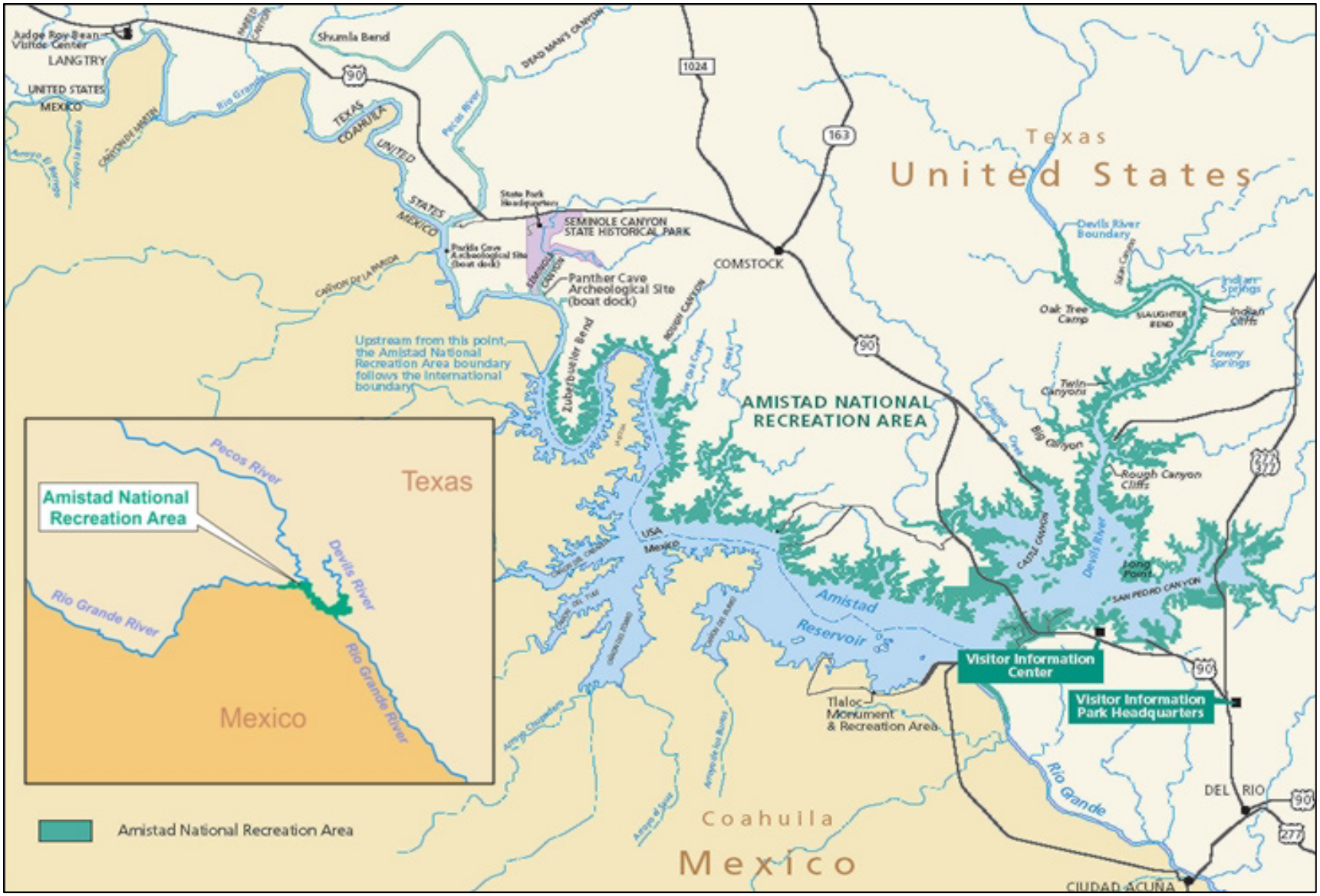


Figure 2. Amistad National Recreation Area Map (NPS and CTI 2019).

The Amistad Reservoir extends approximately 50-75 miles (80-120 km) upriver from the Zuberbueler Bend on the Rio Grande River as it follows the international boundary to the northwest. The AMIS boundary also extends along both sides of the Pecos River to the north about 10-20 miles (16-32 km) and along both side of the Devils River to the north about 10-30 miles (16-52 km). AMIS also continues southeast along the U.S. side of the Rio Grande River about three miles (5 km) below the dam. Most of AMIS is only accessible by boat due to a combination of shoreline cliffs and its proximity to adjacent private lands and Mexico. Numerous private homes, recreational vehicle parks, campgrounds, vacation cabins, housing developments, and utility structures have sprung-up along the AMIS boundary. A network of U.S. Highways (primarily 90 and 277/377) and various state, local, and recreation roads connect these developments to the on-site AMIS facilities.

Natural Setting

AMIS is in south Texas where flat plateaus give way to low ridges, bajada slopes, and rolling hills. Cutting through these are numerous dry washes and arroyos flowing into large drainages with steep-walled canyons. Three major drainage systems consisting of the Rio Grande, Devils, and Pecos Rivers currently flow into AMIS. Historically, this area would have been a large desert basin formed at the confluences of the Rio Grande, Devils, Rio Conchos, and San Pedro Rivers and the Evans and California Creeks with interspersed low hills, washes and floodplains (Poole 2004). Vertical relief varies depending on location but most of the hills and plateaus rise 50-150 feet (15-45 meters) above the surrounding terrain. Elevation within AMIS varies little from a low of 930 ft (283 m) along the Rio Grande River below the dam to a high of 1,224 feet (373 m) in the north. (Poole 2013). Geographically, AMIS is located along the U.S. and Mexican border as defined by the channel of the Rio Grande River. Floodwaters are backed up behind the Amistad Dam to the north past the Slaughter Bend in the Devils River and northwest along the Rio Grande River to the Pecos River confluence. Below the dam, AMIS contains lands bounded by the mid-channel of the Rio Grande River extending to the upper shoreline and river bluffs on the U.S. side (NPS 2006).

Although part of the Chihuahuan Desert, the climate at AMIS is probably best characterized as semi-arid with the area receiving about 18 inches (46 cm) of annual average precipitation. Year to year fluctuations are extreme and droughts are common. Some years may be more desert-like with only a few inches of rain and others can be wet with heavy rainfalls occurring during spring and summer storms. Prevailing winds are mostly from the southeast and originate in the Gulf of Mexico. Mornings at AMIS can be humid and overcast and most afternoons are hot and dry.

Summers are hot with an average of 124 days over 90° Fahrenheit (32° C) and winters are mild. Areas to the west of AMIS transition from a Gulf of Mexico-influenced climate to a true hot and arid Chihuahuan Desert environment (NPS 2018).

AMIS contains many coves, bays, inlets, and small channels that create a rough and rugged shoreline. The upland soils are mainly derived from underlying limestone bedrock and contain various sediments, loams, clays, and gravels. Most upland soils around the reservoir are shallow, rocky, and alkaline. Riparian soils are generally deeper and consist of loams and silts (Golden et. al. 1982). Geological limestone formations are common, occurring as pronounced ridges, cliffs, caves,

overhangs, and other formations. Dramatic examples can be found along the shoreline in the upper Pecos and Devils Rivers.

Vegetation

Centered on the Rio Grande and Pecos River confluence, AMIS occupies an ecological transitional zone between three ecoregions: the Chihuahuan Desert (Trans-Pecos) to the west, the Edwards Plateau (Balconian) to the northeast, and the Tamaulipan (South Texas Plains) to the southeast. Common species forming plant communities include thornscrub species from the Tamaulipan, succulent and cacti species from the Chihuahuan Desert, and various tree species from the Edwards Plateau region (Poole 2004). Occurring within these diverse communities are various insect, mammal, reptile, amphibian, and bird species. The vegetation at AMIS also provides critical seasonal habitat for migrating birds and butterflies (NPS 2018).

The upland areas around the reservoir generally support stable and near climax plant associations consisting of short trees, tall shrubs, mixed short thornscrub, and grass species. The dry climate greatly influences the plant species composition by promoting only those plants that have successfully adapted to living on harsh rocky soils with minimal precipitation. Numerous side drainages that enter the reservoir are more mesic and contain taller and denser shrublands with some tall trees and various riparian species. Unique to AMIS are channels along the Devils and Pecos Rivers that contain scattered oak (*Quercus* spp.) and other mixed tree stands.

The transition between the uplands and riparian zones contain a variety of plant communities dependent on soils, slope, aspect, and elevation considerations. These include sparse vegetation on steep cliffs and grass patches on shallow soils. North and east facing slopes are typically more mesic and have denser vegetation whereas south and west slopes are more arid and less vegetated. The transition zone directly around the reservoir is tied to water level fluctuations and the duration of the flooding events. In the higher and less flooded areas (i.e. formerly inundated sites) large huisache (*Vachellia farnesiana*) and honey mesquite (*Prosopis glandules*) shrublands and woodlands can occur on deeper soils, whereas thin and rocky soils typically have weedy herbaceous species.

Native riparian shrublands and woodlands can be found in the riverine portions of AMIS that are not normally flooded. Long linear patches of willows (*Salix* spp.), honey mesquite, common reed (*Phragmites australis*), and seep-willow (*Baccharis* spp.) are prevalent. Some unique riparian woodlands including stands of American sycamore (*Platanus occidentalis*), Mexican ash (*Fraxinus berlandieriana*), and pecan (*Carya illinoinensis*) occur in the upper reaches of the Pecos, Devils, and Rio Grande Rivers within AMIS. These areas are likely removed from the normal inundation and flooding cycles allowing for more stable vegetation to occur.

Due to the annual fluctuating levels of the reservoir, new successional habitats have been created in the recent or active inundation zone. These lands are regularly flooded for prolonged periods effectively killing the vegetation. Once the waters have receded, the bare shoreline niches often promote the introduction of opportunistic plant species including many non-native and weedy types, especially tamarisk (salt cedar) (*Tamarix ramosissima*), tree tobacco (*Nicotiana glauca*), arundo (giant cane) (*Arundo donax*), Bermuda grass (*Cynodon dactylon*), and various others. These exotic

and invasive species likely consume scarce resources, deplete ground water reserves, displace native species, and ultimately create altered habitats (NPS 2006).

Historically, most of the lands around and within AMIS were used for ranching and farming. Cultural relics leftover from these enterprises such as water tanks and corrals can still be found within the recreation area. Past homesteading activities such as mechanically clearing the woody, native vegetation likely altered the vegetation on these slow-to-recover habitats. Seeding of developed soils with non-native grasses may have also occurred at this time. Past activities along with the current grazing by cattle, horses, sheep, and goats in some of parts of AMIS likely influences the vegetation by replacing deciduous trees, broad-leaved shrubs, grasses and herbaceous vegetation in favor of more thorny shrubs and evergreen trees. Fire suppression may have also led to an increase in woody vegetation (Poole 2004).

Past efforts to characterize the vegetation at AMIS have included a broad characterization by the AMIS staff that recognized three woodland alliances, three shrubland alliances, two herbaceous alliances, and two sparse alliances (Larson 2002). In 2003, a more comprehensive study was conducted that narrowly identified 76 plant communities (Poole 2004). In Poole's study, she concluded that the plant communities at AMIS were influenced by soils, geology, topography, geography, climate, and most importantly anthropogenic disturbances.

In 2010, as part of the planning for this effort, NVIP contracted with CTI to update the vegetation classification list for AMIS (Von Loh and Cogan 2011). The purpose of this exercise was to update the list of AMIS vegetation communities and match them to existing rUSNVC vegetation alliances and associations. This study included both legacy data as well as discussions with researchers and local experts. In summary, the 2011 effort found 82 vegetation alliances and 102 associations that could potentially occur at AMIS. These included 15 forest and woodland alliances (24 associations), 33 shrubland/dwarf-shrubland /shrub herbaceous alliances (53 associations), and 34 herbaceous/sparse alliances (25 associations). Semi-natural vegetation types characterized by nonnative plant species were included in this classification representing 10 vegetation alliances (11 plant associations). Overall the 2011 study found that several ecologic drivers including hydrology, elevation, slope, aspect/slope exposure, precipitation patterns, temperature extremes, topographic position, geology, and soils influenced the distribution of vegetation at AMIS. Chief among these is the impact of the Amistad Dam that controls the annual flows and sediment delivery/removal diminishing the overbank flooding and allowing bank-armoring invasive vegetation to become established.

Based on the previous classification efforts, the vegetation at AMIS can roughly be stratified and modeled across the landscape. The resulting life zones can be a valuable tool for understanding the vegetation diversity and growth patterns. Using the dominant overstory species, the potential plant communities developed for AMIS by both Poole (2004) and Larson (2002) can be summarized from high to low elevation, from drier to more mesic conditions, and grouped by bio-geographical area or life zone (Table 2).

Table 2. General AMIS Life Zones and Dominant Vegetation Types.

General Life Zones	General Vegetation Type and Dominant Species by Life Zone
Dry Uplands	Mixed Thornscrub Shrublands = (Blackbrush, Cenizo, Guajillo, Honey Mesquite) Mixed Upland Grasslands = (Sideoats Grama, Purple Threeawn, Other grasses)
Mesic Uplands	Oak Woodlands = (Graves/Chisos Oak, Texas Live Oak, Vasey Scrub Oak) Mixed Broad-leaved Woodlands = (Sugarberry, Hackberry, and Texas Persimmon
Transition Zone	Sparse Rock Outcrops and Shoreline = (Rocky Cliffs, Bluffs, and Bedrock)
Former Inundation Zone	Shoreline Shrublands and Woodlands = (Huisache and Honey Mesquite) Mixed Transitional Grasslands (Buffel Grass, Beardgrass, Bluestems)
Recent Inundation Zone	Weedy Shrublands = (Rooseveltweed, Tree tobacco, Tamarisk) Early Successional Herbaceous Vegetation = (Bermuda grass, Frogfruit) Submerged Vegetation = (Hydrilla)
Riverine/Riparian Zone	Willow Shrubland and Woodlands = (Goodding and Black Willow Trees) Mixed Deciduous Woodlands = (American Sycamore, Mexican Ash Trees) Weedy Shrublands and Woodlands = (Tamarisk, Tree Tobacco, Rooseveltweed) Riparian Herbaceous Vegetation = (Common Reed, Spikerush, Bulrush) Weedy Riparian Herbaceous Vegetation = (Arundo/Giant Cane, Bermuda Grass)

Using a combination of the life zones, AMIS's existing vegetation data, and ground-based imagery reveals a general vegetative pattern based on elevation and location (Figures 3 and 4). In summary, the AMIS vegetation gradient starts in the dynamic drawdown portions of the reservoir and extends upstream into both larger linear riparian rivers/streams and smaller dry upland drainages. Directly above the riparian corridor/reservoir basin, sparse geologic features are common giving way to large areas of dry rolling hills and low slopes.

The dry uplands at AMIS are represented by large areas of short thornscrub species that vary by location. Generally, the western portions of AMIS contain less dense mixes of short shrubs. Low western slopes contain short blackbrush (*Vachellia rigidula*), cenizo (*Leucophyllum frutescens*), and guajillo (*Senegalia berlandieri*) mixes. Disturbed areas contain more honey mesquite shrubs. Upper slopes are drier and are less dense with viscid acacia (*Vachellia vernicosa*), fragrant mimosa (*Mimosa borealis*), Texas pricklypear cactus (*Opuntia engelmannii*), coyotillo (*Karwinskia humboldtiana*), and leatherstem (*Jatropha dioica*) plants.

The dry uplands on the east side of AMIS contain more, almost pure stands of cenizo and taller blackbrush shrublands. The northern portions of AMIS along the Pecos and Devils Rivers contain mixed thornscrub species with Torrey yucca (*Yucca torreyi*) and Texas sotol (*Dasylirion texana*). The southwest portion of AMIS is dominated by large upland areas of sparse guajillo and cenizo shrubs. True grasslands are rare and only occur as pockets within the larger shrublands. Grass species can vary by location and may have both native and non-native species present. Sparse and barren geological formations such as cliffs, bluffs, and rock outcrops occur between the upland shrublands/grasslands and the start of the inundation and riparian zones (Figure 5).

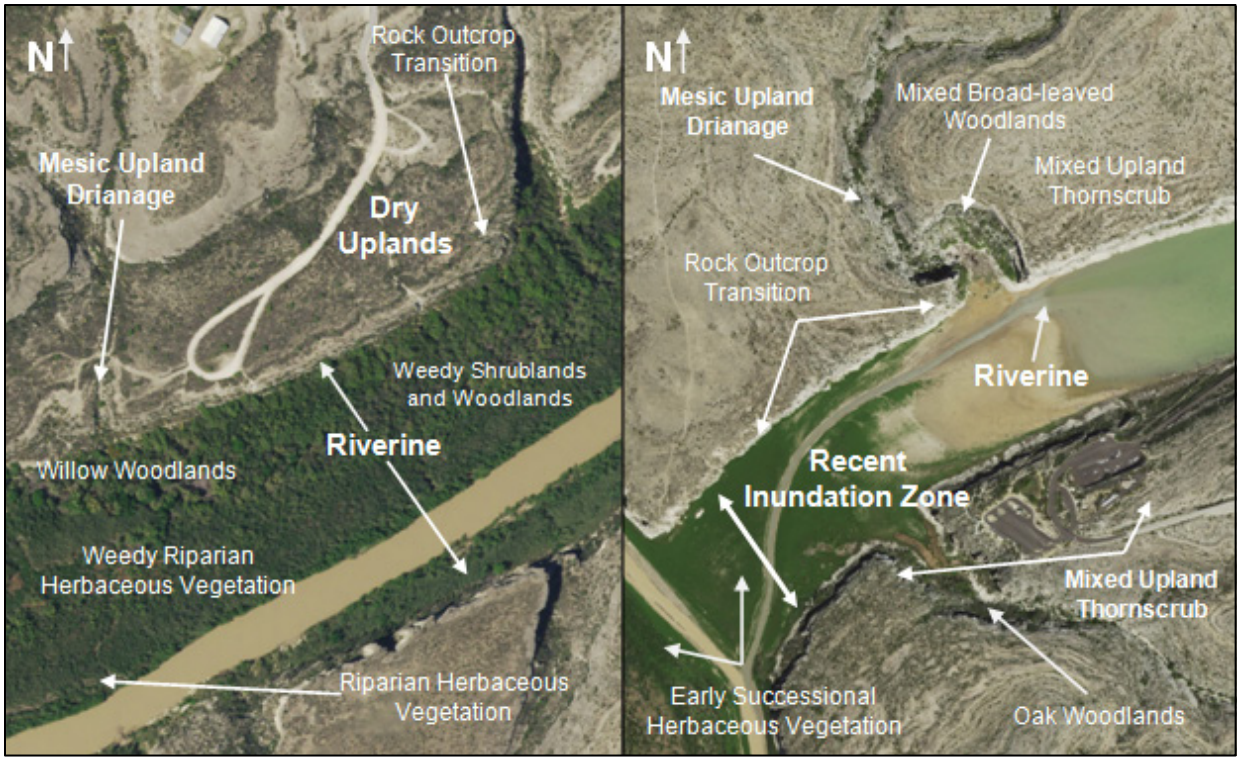


Figure 3. AMIS Riverine Life Zone Examples as seen from Langtry (left) and the Pecos River (right) (NAIP 2016).

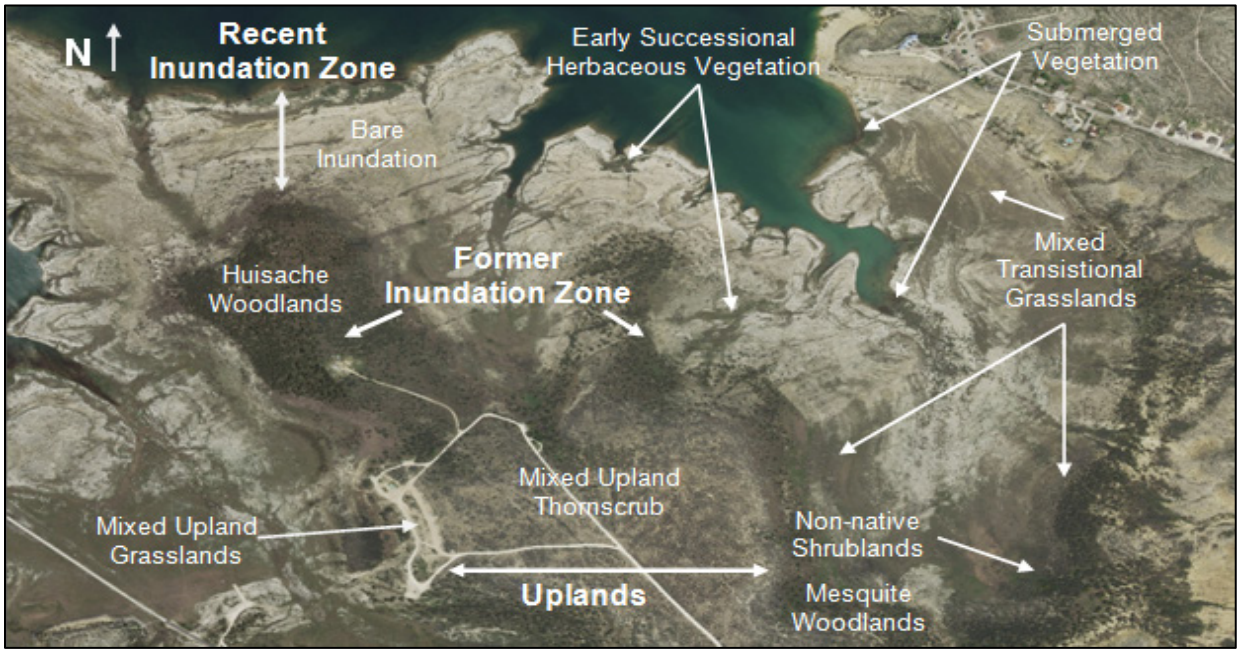


Figure 4. AMIS Upland and Inundation Zone Examples as seen from San Pedro Picnic Area (NAIP 2016).

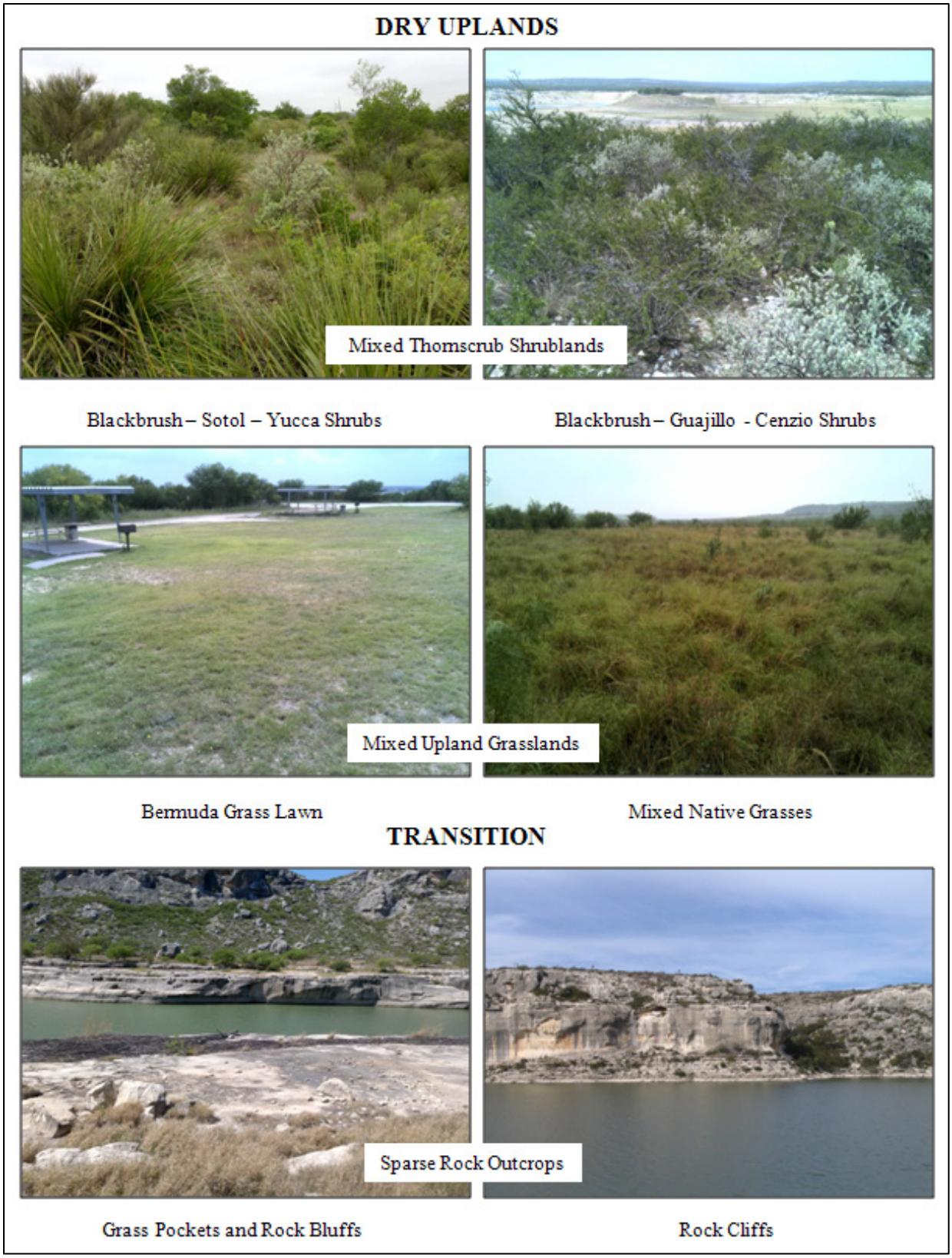


Figure 5. Examples of Common Dry Upland and Transition Vegetation Types (CTI, LBJWC and NPS).

Mesic upland locations include small washes and drainages. Wetter conditions promote taller shrubs and higher concentrations of deciduous and broadleaved trees/tall shrubs including Texas persimmon (*Diospyros texana*), sugarberry (*Celtis laevigata* var. *laevigata*), and spiny hackberry (*Celtis ehrenbergiana*). A mix of tall honey mesquite, blackbrush, and Texas persimmon shrubs are common. Unique oak stands can be found in larger and more mesic drainages off the Rio Grande, Pecos, and Devils Rivers. Lilac chaste trees (*Vitex agnus-castus*) are also found in some of the more mesic areas along the high upper shoreline that might have been introduced from off-site ornamental plantings (Figure 6).

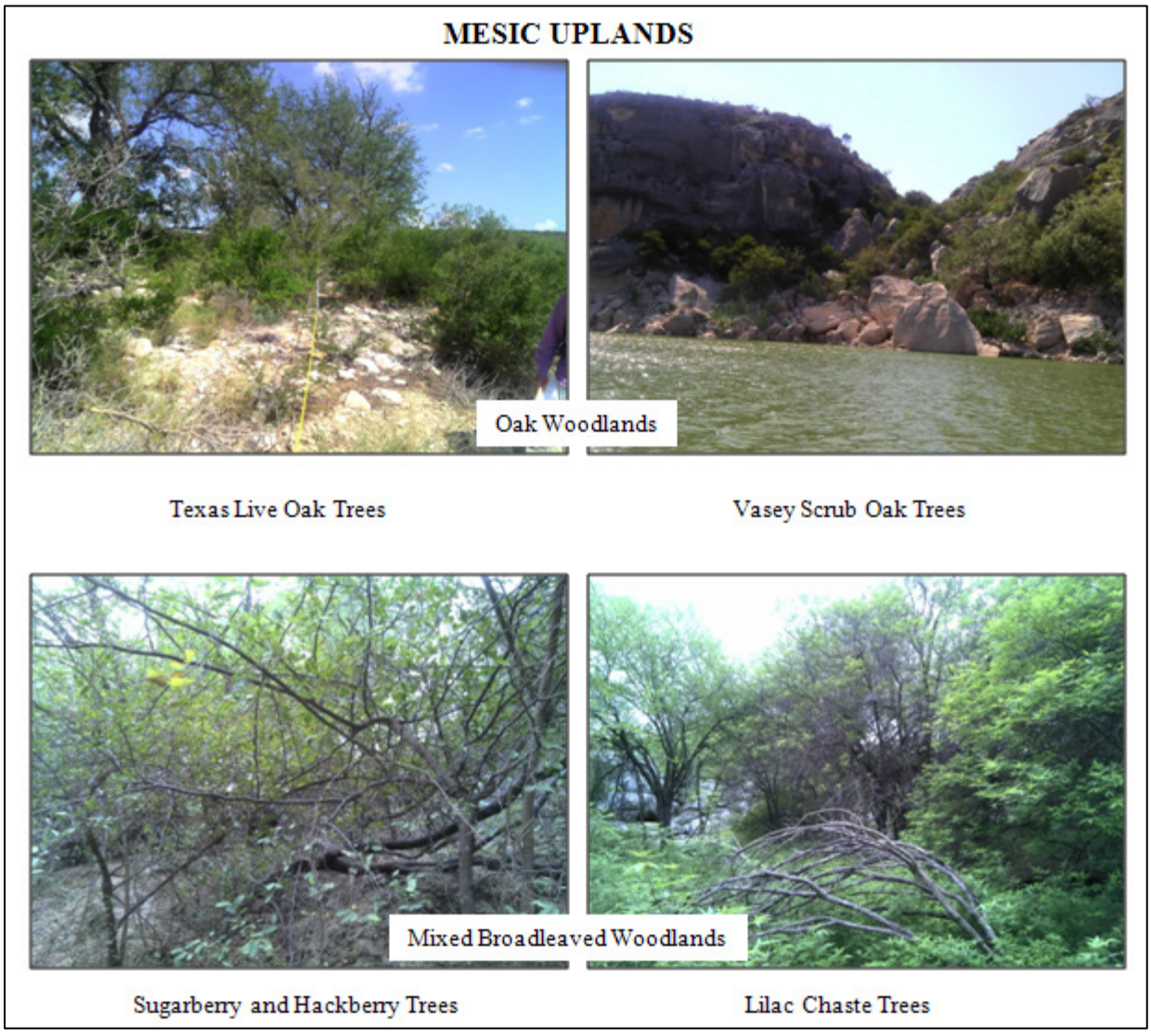


Figure 6. Examples of Common Mesic Upland Vegetation Types (CTI, LBJWC and NPS).

The former inundation zone is a band of vegetation that occurs along the uppermost contour of the reservoir. In this setting, the vegetation escapes most of the more dramatic flooding and receding water cycles allowing more established vegetation to take hold. Common species include thick and

tall huisache (*Acacia farnesiana*) and honey mesquite (*Prosopis grandulosa*) woodlands. Grasslands are also common and are usually composed of introduced or non-native species such as buffelgrass (*Pennisetum ciliare*), red grama (*Bouteloua trifida*), hairy woollygrass (*Erioneuron pilosum*), and silver beardgrass (*Bothriochloa laguroides*) (Figure 7).

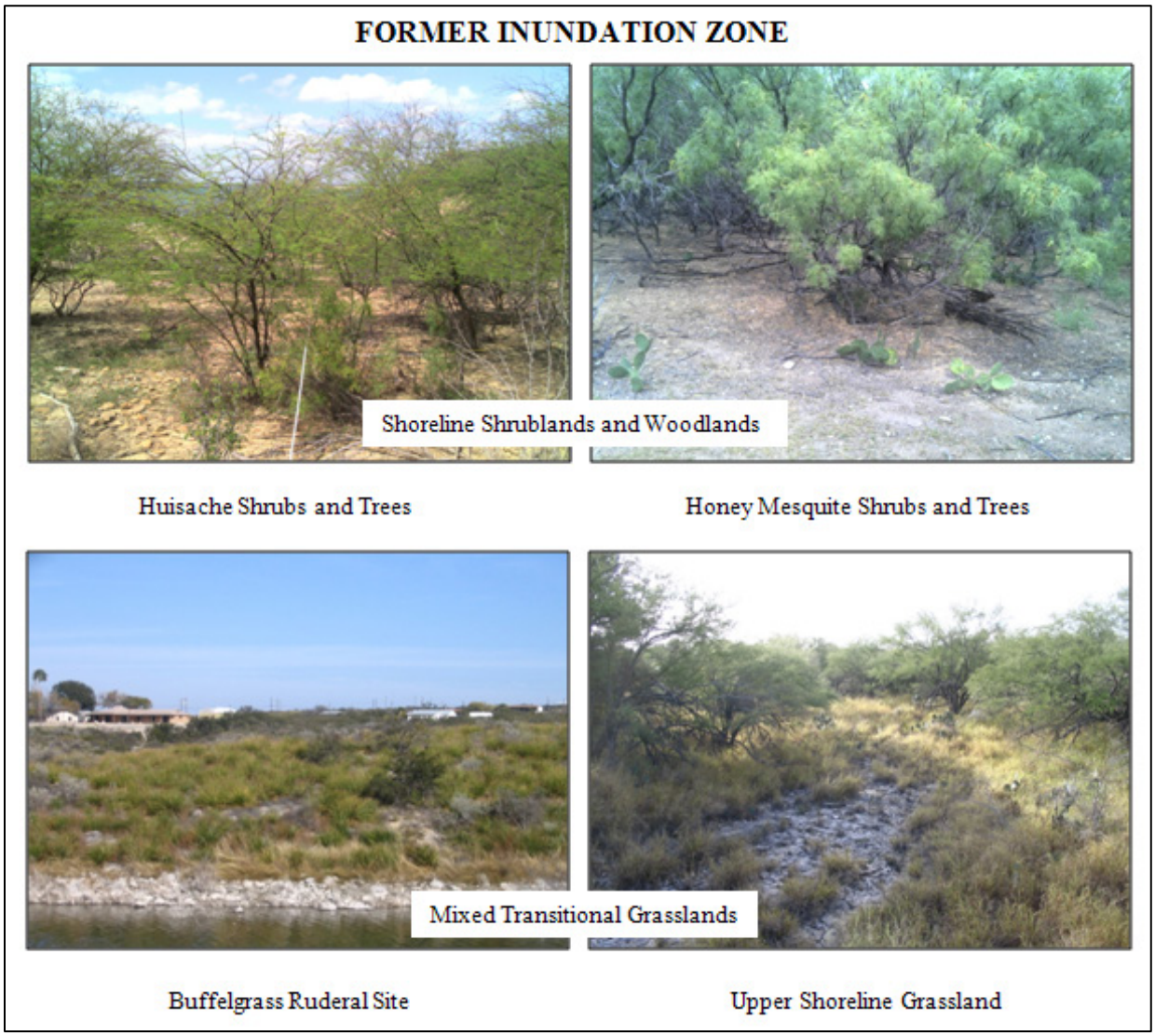


Figure 7. Examples of Common Former Inundation Zone Vegetation Types (CTI, LBJWC and NPS).

The recent inundation zone is the broad draw-down area that is impacted by the periodic filling and emptying of the Amistad Reservoir. This highly dynamic region contains mostly non-native and weedy species. Common shrubs include tree tobacco (*Nicotiana glauca*) and seep-willow (baccharis) (*Baccharis* spp.). Recently exposed areas contain more herbaceous vegetation consisting of Bermuda grass (*Cynodon dactylon*) and fogfruit (*Phyla nodiflora*). Huisache and tamarisk seedlings may also be prevalent There are few true aquatic and submerged plant species at AMIS, but the invasive, non-native species hydrilla or waterthyme (*Hydrilla verticillata*) forms one within the reservoir. Areas

with hydrilla are exposed when water levels recede leaving behind mats of rhizomes, turions, and dead stem/leaf material (Figure 8).

The riverine upper reaches of the Rio Grande, Pecos, and Devils Rivers that are not directly influenced by the reservoir contain various riparian plants common to the Southwest region of the U.S. These include various sizes and densities of willow (*Salix* spp.) trees/saplings, tall honey mesquite stands, non-native tamarisk (*Tamarix ramosissima*) trees/seedlings, tall, thick stands of giant cane (*Arundo donax*) and shorter stands of common reed (*Phragmites australis*). Unique graminoid communities including switchgrass (*Panicum virgatum*), yellow bluestem (*Bothriochloa ischaemum*), and California bulrush (*Schoenoplectus californicus*) can be found both in the upper rivers and below the Amistad Dam (Figure 9).



Figure 8. Examples of Common Recent Inundation Zone Vegetation Types (CTI, LBJWC and NPS).



Figure 9. Examples of Common Riverine Vegetation Types (CTI, LBJWC and NPS).

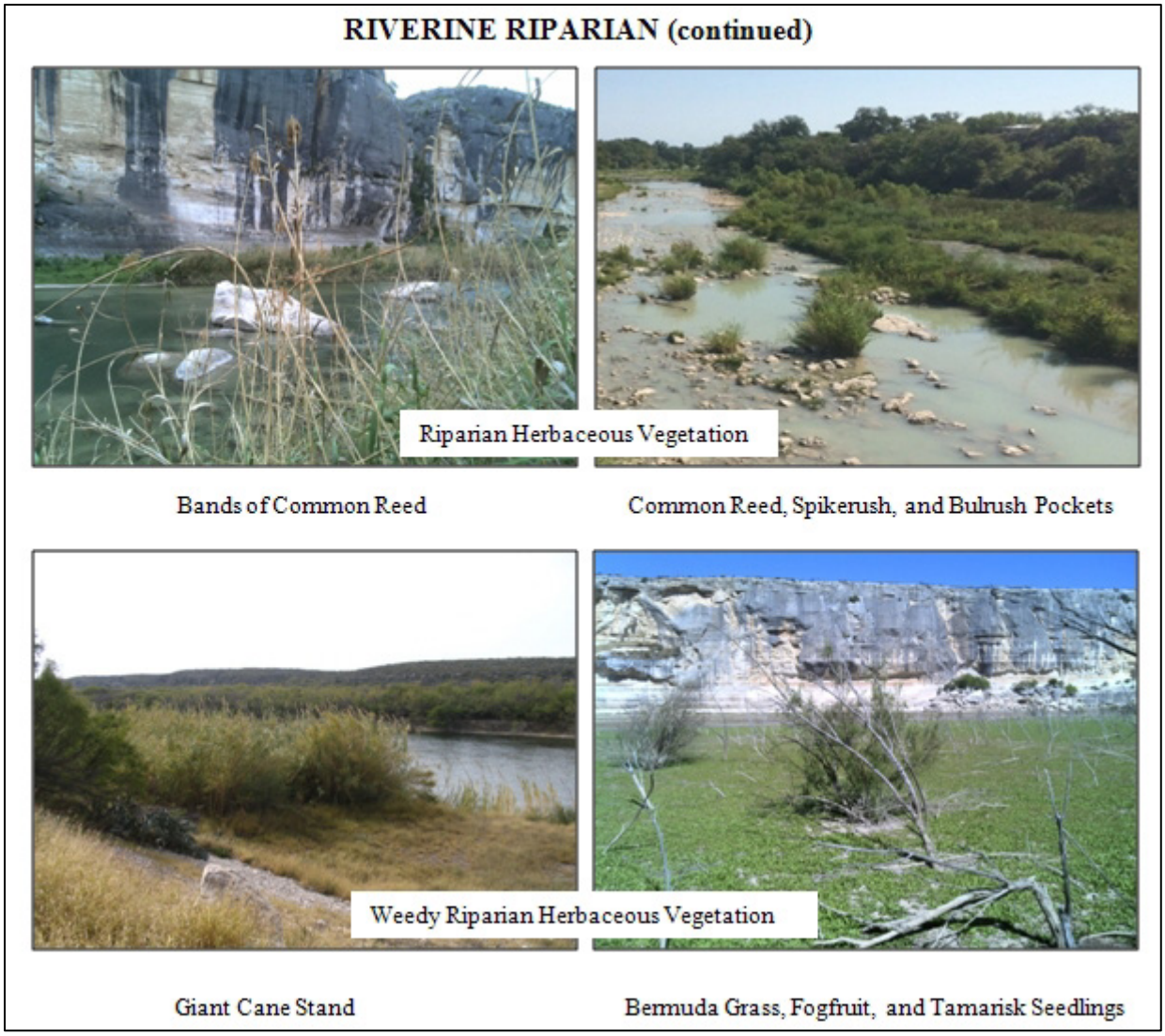


Figure 9 (continued). Examples of Common Riverine Vegetation Types (CTI, LBJWC and NPS).

Vegetation Inventory Project

The decision to inventory, classify, and map the vegetation at AMIS was made in response to guidelines set forth by the NVIP (NPS 2009) and the CHDN (NPS 2001). Work was started at AMIS in 2011, when CTI was contracted to complete three preliminary studies that included a review of the existing (legacy) vegetation data (Von Loh & Cogan 2011a), an update to the vegetation classification (Von Loh & Cogan 2011), and a sampling approach for a plant community inventory (Cogan & Von Loh 2011) at AMIS. Using the preliminary list of plant communities and the recommend sampling strategies found in these reports, the NVIP contracted with the Lady Bird Johnson Wildflower Center (LBJWC) to collect sample plot data in representative vegetation associations at AMIS starting in 2012.

After the plot data was collected at AMIS, CTI was again contracted to begin work on both the final vegetation classification (using the LBJWC data) and the vegetation map. CTI delivered the draft

AMIS classification, field key, and vegetation map layer to the NVIP in 2016. LBJWC field crews completed the accuracy assessment (AA) data collection in 2017. Data from the AA effort was then used to evaluate the draft products by CTI and the results were sent to the NVIP for review and approval in 2018-2019.

Overall the NVIP, CHDN, CTI, and LBJWC professionals (with critical support from AMIS staff), worked together to meet all of the project objectives and ultimately produce all of the final products that met the NVIP's mandates as outlined in their 12 Step Guidance for NPS Vegetation Inventories (NPS 2009). Important directives from the NVIP that were addressed by the team include the following:

- Vegetation Information
    - The vegetation classification will be based on the rUSNVC;
    - A dichotomous field key of vegetation associations will be created;
    - Formal descriptions for each of the vegetation association will be included;
    - Representative ground photos will be attached for all vegetation associations;
    - All field data will be presented in the PLOTS database format.
- Spatial Data
    - The map classification will be based on the rUSNVC and will include AMIS-specific requirements;
    - Descriptions and a key will be created for each of the map units;
    - A spatial geodatabase will be created for all the vegetation data;
    - Digital and hardcopy maps of the vegetation will be created;
    - Metadata will be included for all spatial database layers;
    - An accuracy assessment of the vegetation spatial data will be performed and presented in a detailed final report.

Scope of Work

Vegetation inventory work for AMIS occurred within the administrative boundary as provided in digital form by the NVIP and the NPS Land Resource Division. The AMIS boundary contains both the upland and reservoir (underwater) portions of the recreation area. During the course of the project, the project boundary was updated and a final version was delivered to CTI in July 2018. The latest AMIS boundary (Figure 10) contains 56,726 acres (22,974 ha). Field data was collected mainly above the 1,118-foot contour level of the reservoir. Mapping was done only within the AMIS boundary to the extent of the exposed shoreline as determined by the 2012, 2015, and 2016 base orthoimagery. All work for this project was conducted on the U.S. side of the border.

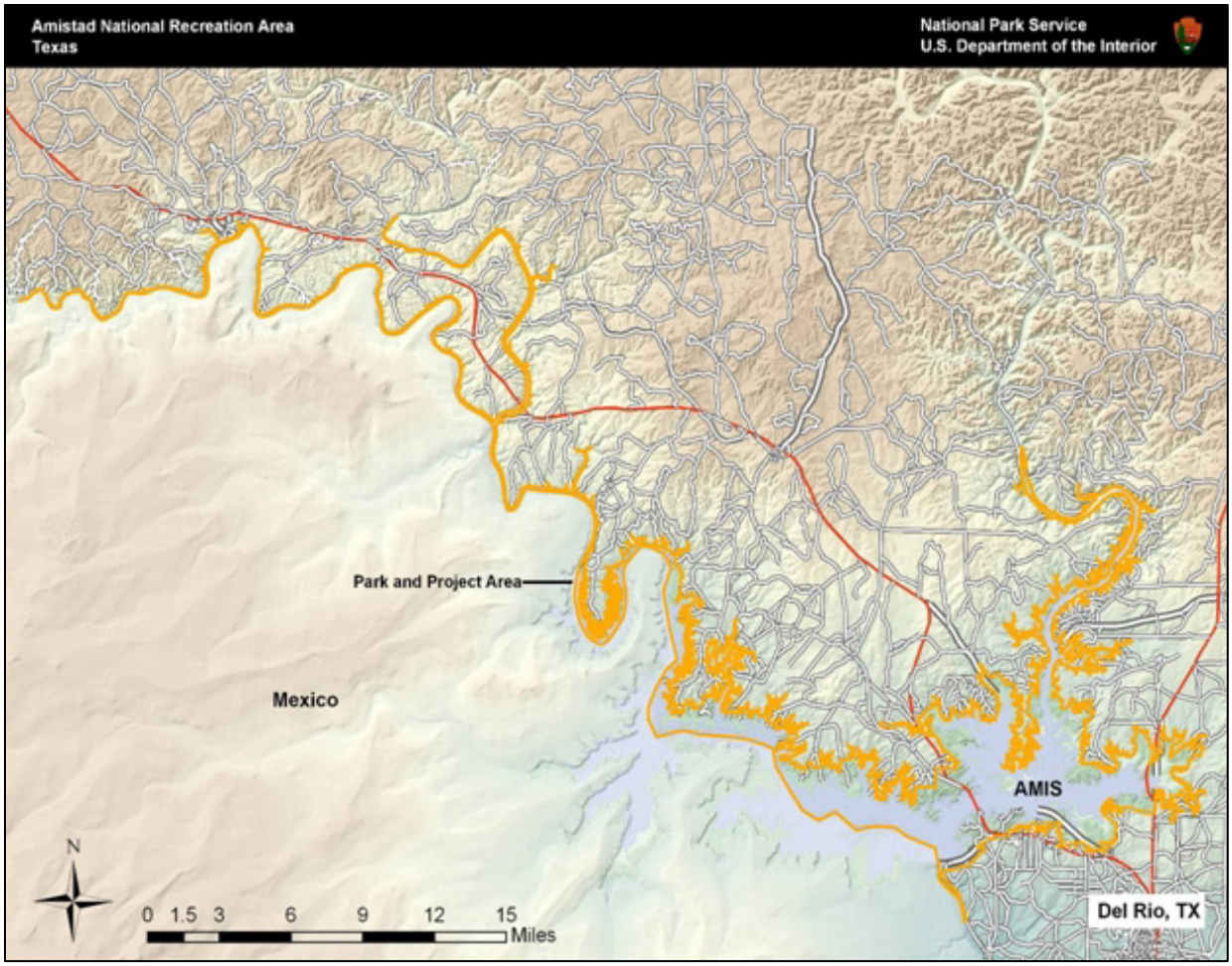


Figure 10. Map of the AMIS Vegetation Inventory Project Boundary (CTI, LBJWC, and NPS).

Methods

All protocols and methods for this project as outlined in the following sections of this report can be found in the original program documents produced by The Nature Conservancy and Environmental Research Systems Institute (1994a, 1994b, and 1994c) and in later revisions (Lea 2011 and Lea and Curtis 2010). The standard vegetation inventory tasks were implemented for AMIS as outlined in the 12 Step Guidance for NPS Vegetation Inventories (NPS 2009). The five major project categories are summarized below, and the following report sections give detailed descriptions for each:

1) Plan, gather legacy and historical data, and coordinate tasks;
2) Survey AMIS to understand and inventory the vegetation using sample plots and observation points;
3) Classify the vegetation using the resulting field data to rUSNVC standard associations and alliances and crosswalk these to recognizable map units;
4) Acquire current digital imagery and interpret the vegetation from the imagery using the rUSNVC and a map unit crosswalk table;
5) Assess the accuracy of the final map product.
6) Summarize the project findings in a final report, create the final vegetation spatial database, and produce all the other standard deliverables.

All protocols for this project as outlined in the following sections can be found on the NVIP website.

Planning, Data Gathering, and Coordination

Planning for this project got underway in 2010 when project leads and representatives from CTI, NVIP, AMIS, and LBJWC attended on-site meetings and numerous conference calls. The goals of these efforts were to:

- Discuss the overall project and review the necessary requirements,
- Discuss availability of existing data,
- Learn about the management issues and concerns,
- Discuss procedural issues and data management,
- Develop a project scope of work and project timeline,
- Discuss future project needs and funding.

After the initial meeting and calls, individual work responsibilities were assigned, tasked, or contracted with various entities to create an experienced vegetation inventory team. The participants in the vegetation inventory project and their responsibilities include the following:

NVIP Staff

- Provide project guidance, contract facilitation, oversight, and funding;
- Provide project management;

- Review draft and final products and finalize the project.

AMIS and CHDN Staffs

- Provide copies of the existing data, provide local expertise, and other resources;
- Supply digital boundary files and ancillary spatial data files;
- Assist with all fieldwork and provide logistical support;
- Review and help develop the vegetation classification;
- Review draft and final products.

Lady Bird Johnson Wildflower Center (LBJWC) (Contractor)

- Collect and manage plot and observation point data;
- Write the plot data collection report;
- Help develop the vegetation classification;
- Collect and manage the accuracy assessment (AA) data;
- Write the AA data collection report;
- Enter plots, observation point, and AA data into the PLOTS database and review for quality assurance purposes;
- Review draft and final products.

Cogan Technology, Inc. (CTI) (Contractor) and Various Sub-contractors

- Help with overall project planning, facilitation and coordination;
- Summarize the legacy data and conduct gradsect planning;
- Develop the vegetation classification (sub-contractor);
- Write the field key and local descriptions for the vegetation types (sub-contractor);
- Map and delineate the vegetation and land use types;
- Ground-truth vegetation and land use/land cover signatures on the imagery;
- Develop map units linked to the rUSNVC;
- Create the draft vegetation map for the AA;
- Assist with the AA data collection;
- Review AA point field determinations, generate contingency tables, and suggest post-AA modifications to the vegetation layer;
- Finalize the vegetation layer;
- Create the final deliverables including a summary report, vegetation classification appendices, a spatial geo-database with all the new spatial layers, FGDC-compliant metadata, field and map guides, a vegetation map layout, graphics, and hyperlink all ground photos to the database.

Field Surveys

Initial project planning and scoping for the field surveys was based on the information gathered in the classification update (Von Loh and Cogan 2011b) and gradsect planning (Cogan and Von Loh 2011) documents. The classification update identified legacy data, existing vegetation classifications and reviewed previous vegetation studies at AMIS. The results were a preliminary list of 23 ecological systems, 41 vegetation alliances, and over 80 potential plant associations. The gradsect and sampling plan provided the field-based sampling approach using a gradient oriented transect (gradsect) consisting of biophysical units (BPUs). BPU polygons (1739 total) were based on four parameters: reservoir contours (i.e. water levels), soils database and spatial data (SSURGO), vegetation cover types, and image-based general topology and vegetation.

The LBJWC field teams used the BPUs to create spatial databases and supporting materials to determine potential sampling sites. Potential targets created from the BPUs were than sorted, filtered by soil type, and proportionally divided across the entire project area. AMIS staff reviewed the results of this selection, determined accessibility (by boat or road), and added some additional areas of interest. Constraints for selection included low water in the main channels of the Rio Grande and Devils Rivers, closed boat ramps and impassable mud flats. Other constraints included the lack of roads, lack of landowner permission to use private roads, and high river cliffs and bluffs. Inaccessible areas were then identified in advance and masked out of the sample selection area. As a result, the plot data collection efforts were then focused only on accessible sites and the field days planned accordingly using this sampling strategy.



Plot Data Collection at Amistad National Recreation Area (LBJWC).

Field surveys began on September 19, 2012 and ended on September 27, 2012. Work began in the west along the Pecos and Rio Grande Rivers and progressed to the eastern portions of AMIS near Del Rio and to the north along Devils River. Geo-referenced coordinates of the target BPUs were used for navigation via Global Positioning System (GPS) receivers. At each site, one of two survey teams

(comprised of two surveyors each) rapidly assessed the vegetation for uniqueness and homogeneity by comparing it to the known list of potential plant communities. Releve-style plot (Mueller-Dombois and Ellenberg 1974) data was then collected if the vegetation was found to either match the list of known types or was unique enough (i.e. clear dominant species, large patch, repeatable, etc.) to document. After the data was collected at each site, the plots were assigned unique numbers according to the nearest BPU target point (e.g. AMIS_007). Ground reference photographs were then taken using digital cameras in the various cardinal directions (North, South, East, and West) or as the vegetation and landscape allowed. Ground photos were later labeled using the same unique plot/observation point numbering system.

Plot size and shape requirements were consistent with NVIP guidelines and were determined by the physiognomy of the plant community being sampled (Table 3). Standard plot size was 400 square meters, although a few plots were smaller for rare or linear types. Measuring tapes were used to establish the circular, square, or rectangle sampling area and the plot size and shape was adjusted as needed to sample linear bands of vegetation in drainage bottoms or other confined sites. Most of the plots were circular in shape followed by rectangular or square shapes. For each circular plot, GPS coordinates were recorded at the intersection of the two transect tapes. For rectangular or square plots, GPS coordinates were recorded in the center of the plot.

Table 3. Plot Sizes Used for Classification Sampling at AMIS.

Dominant Physiognomy	Plot Size	Plot Area
Forest: Trees have their crowns overlapping, usually forming 60-100% cover, and **Woodland**: open stands of trees with crowns usually not touching. Canopy tree cover 25-60%, OR exceeds shrub, dwarf-shrub, herb, and nonvascular cover.	• Circular: 11.28 m radius • Square: 20m x 20 m	400 m^2
Shrubland: Shrubs greater than 0.5 m tall are dominant, usually forming more than 25% cover OR exceeding tree, dwarf-shrub, herb, and nonvascular cover, and **Dwarf-shrubland** (e.g., heath): Shrubs less than 0.5 m tall are dominant, usually forming more than 25% cover OR exceeds tree, shrub, herb, and nonvascular cover.	• Circular: 11.28 m radius • Square: 20m x 20 m	400 m^2
Herbaceous (e.g., grassland, meadow, marsh): Grasses or forbs dominant, usually forming more than 25% cover OR exceeds tree, shrub, dwarf-shrub, and nonvascular cover.	• Circular: 11.28 m radius • Square: 20m x 20 m	400 m^2 or 100 m^2
Nonvascular (e.g., fen, bog, cliff, scree slopes): Nonvascular cover dominant, usually forming more than 25% cover.	• Circular: 11.28 m radius • Square: 20m x 20 m	400 m^2 or 100 m^2
Sparse vegetation (e.g., rock outcrops, talus slopes, and fell-fields): Less than 10% total vegetation cover.	• Circular: 11.28 m radius • Square: 20m x 20 m	400 m^2 or 100 m^2

Following the establishment of each plot, environmental data were recorded on the field forms (Appendix A). Environmental data included elevation, slope, aspect, landform, topographic position, soil texture and drainage, hydrologic (flooding) regime, and various comments. The unvegetated surface was estimated and recorded as percent cover of bedrock, litter/duff, wood, bare soil including sand, large rocks (>10 cm), and small rocks (0.2 to10 cm). Next, the vegetation was visually divided by physiognomy into strata, with the height and canopy cover of the dominant vegetation estimated for each stratum. Within each stratum, species were identified, and the foliar cover of each taxon was estimated using cover classes (Table 4).

Some additional common species that occurred outside of the sampled plots were listed to assist with the creation of the local association descriptions. Species that were not identifiable in the field were collected for identification and later destroyed. Plant species were recorded by their scientific name familiar at the time and were later updated to reflect any changes in nomenclature as dictated by the PLANTS Database (USDA-NRCS 2018). Appendix B contains all species found in and around the sample plots at AMIS during this project.

Table 4. Cover Classes and Vegetation Strata used at AMIS.

Physiognomic Classes	Vegetation Strata Code	Vegetation Strata	Cover Class Code	Cover Class
Forest (>60% Tree Cover)	T1	Emergent Canopy	1	trace
Woodland (25-60% Tree Cover)	T2	Main Canopy	2	few (<1%)
Shrubland (> 25% Shrub Cover)	T3	Subcanopy	3	1-2%,
Shrubland with sparse (< 25%) tree layer	S1	Tall Shrubs	4	2-5%,
Dwarf shrubland (<25%) tree layer	S2	Short Shrubs	5	5-10%,
Herbaceous with sparse (< 25%) tree layer	S3	Dwarf-shrubs	6	10-25%,
Herbaceous with sparse (< 25%) shrub layer	H	Herbaceous Vegetation	7	25-50%,
Herbaceous	V	Vines	8	50-75%,
Nonvascular Bryophyte	E	Emergent	9	75-95%,
Nonvascular Lichen	N	Non-vascular	10	95-100%
Sparsely Vegetated (<10% cover) Vascular	–	–	–	–

A total of 102 target points were sampled by the LBJWC field crews in 2012. These included 100 full Releve-style plots and 2 observation points (rapid assessment type plots with limited species and cover data). Each sampled plot was assigned a provisional community name from the preliminary plant associations and alliances list (Von Loh and Cogan 2011b). All data was then transferred from the field datasheets to the PLOTS database (version 3.2) and reviewed for content and quality assurance by CHDN staff. CHDN was also responsible for certifying the plant species data that was

collected. Upon receipt of the final PLOTS database for AMIS, CTI extracted the geo-referenced coordinates for each unique plot and created a GIS spatial layer (Figure 11). Based on the spatial data attribution, these plots were used to classify 18 of the 31 classes that were later accuracy assessed during this project. The remaining 13 map classes either represent variations of these original types, were previously described during similar legacy studies, or represent park-special or new types found later in the course of the project.



Figure 11. Map of the Vegetation Plots Collected at AMIS (CTI).

Vegetation Classification

CTI used the AMIS plot data to create the vegetation classification by running it through a series of analytical steps. Initial efforts included converting the plot data by individual species and stratum abundance into a species by plot abundance matrix using the data conversion formula given by Jennings et al. (2009). Individual species by plot abundance (i.e., individual cell) values were then scaled using the cover classes applied during the field data collection.

The second step involved taking the species by plots matrix and conducting a primary cluster analysis (McCune and Grace 2002) using a flexible beta value of - 0.5 (Bray-Curtis 1957). Dissimilarly distances were derived using PC-ORD version 6.0 software (McCune and Mefford 2011). The results were placed into a dendrogram that was inspected to determine an "average" level at which the individual clusters were ecologically interpretable. A level of clustering that left about 60% information remaining was selected. Additional clusters were also recognized if they were close to this threshold. This analysis provided 12 initial vegetation clusters to be considered as possible vegetation types.

The third classification step was to evaluate the initial clusters for common environmental conditions. Clusters that had common environmental conditions and few interpretable floristic differences were merged and clusters that seemed overly heterogeneous were split. At this time, the Bray-Curtis distance matrix was also converted to a plot-by-plot similarity matrix. The cells in this matrix were color-coded to better visualize tabular sorting. Finally, individual plots were moved around and sorted from cluster to cluster to optimize the balance between (1) interpretability and ecological consistency of the clusters (particularly at mapping scales) with (2) maximizing within-cluster similarities and between-cluster dissimilarities for the most similar clusters.

The effect of splitting, lumping, and sorting of individual plots between clusters provided 18 interpretable fine-scale types. These were interpreted either as existing rUSNVC associations or as locally named equivalents. Equivalent names for plant association is allowed by NPS guidelines (Lea 2011) and as provided for by the FGDC (2008) for cases were plot data is insufficient or when the rUSNVC name would be problematic for local application.

Plant Associations and Fine Scale Units

Building off the 18 potential types found during the plot data collection efforts, similar existing data from the Larson (2002) and Poole (2004) studies were incorporated into the dataset. These were helpful in assessing variability within types recognized by this analysis and for assessing completeness of the plot data in representing the range of vegetation variability at AMIS. In most cases, it was not difficult to assess whether a Poole (2004) type was included in a broader plot-validated concept or represented a new type not encountered during the plot data collection. In all, 13 additional types that represent concepts or groupings of multiple concepts listed by Poole (2004) were added as likely additional AMIS types, bringing the number of associations to 31. Thirteen out of the 31 potential types had a reasonable match to an existing rUSNVC (2018) alliance or association.

Of the remaining 18 potential AMIS vegetation types, all were found to have one or more of the following limitations that did not allow it to be assigned a rUSNVC type:

- No similar rUSNVC association concept was found;
- A possible match was found, but lacked enough information for comparison;
- A partial match was found, but the published rUSNVC concept had significant conceptual conflicts with the AMIS type;
- A partial match was found, but the published rUSNVC association concept was placed in a higher level that left the potential AMIS type inappropriately distant in the hierarchy.

In these 18 cases, the provisional AMIS associations were given a suitable Latin (floristic) name and NPS unique identifier (in lieu of a rUSNVC identifier), in accordance with the NPS classification guidelines (Lea 2011). Additionally, both the matched rUSNVC and new AMIS-specific associations were given a park or vernacular name. Alternative names are useful in that they include the environmental context, helps with confusing Latin and scientific plant names, and makes them easier to understand.

Plant Alliances and Coarse Scale Units

The 31 fine scale types (associations) were interpreted to belong to 17 broader rUSNVC alliances nested within 14 rUSNVC Groups and 11 rUSNVC Macrogroups (USNVC 2018). These thematically and taxonomically coarser groupings of the associations represent broader levels in the hierarchy that might be more suitable for some management objectives. Despite their relatively new status, the rUSNVC Groups have complete concept descriptions and, unlike published rUSNVC associations, seem to be more comprehensive for vegetation patterns that can be extracted from the AMIS PLOTS data.

Overall, plot replication and representativeness for more extensively distributed upland vegetation at AMIS seems adequate and robust. Riparian and outcrop vegetation are less well sampled, and some small patch or rarer types could use more plot replication to better describe the range of variability. The difficulty in matching the distinct AMIS types with existing rUSNVC associations was further compounded by the location of the recreation area within three ecoregions that have not been fully described within the rUSNVC. The Tamaulipan/South Texas Plains region probably contributes the most floristic elements to the AMIS vegetation, but the other two regions (Chihuahuan Desert/Trans-Pecos and Edwards Plateau/ Balconian) also have significant influence. As a result, several USNVC association concepts from NatureServe Explorer were only partial “fits” for AMIS vegetation units as they occur on transitional and ecotonal locations between the three ecoregions.

The final products of the classification task included creating the field keys and local plant association descriptions. The dichotomous field key to the AMIS plant associations was developed to assist users in identifying plant associations and their corresponding map units in the field (Appendix C). The list of plant associations within the rUSNVC and their local descriptions provide a summary of the classification efforts at AMIS and include unique characteristics found for each plant associations at AMIS (Appendix D).

Digital Imagery and Vegetation Mapping

During the planning and coordination phase, CTI staff reviewed all available existing digital imagery for its potential use as the base-map for the vegetation mapping at AMIS. The most promising and easy to access was the data catalog found on the Texas Natural Resource Information System (TNRIS) website. Navigating to the orthoimagery-statewide web page, the list of existing imagery covering AMIS included multiple products produced annually by the U.S. Department of Agriculture's National Aerial Imagery Program (NAIP). The corresponding NAIP 2010 1-meter (pixel resolution) quarter-quad datasets for AMIS were downloaded and used during the preliminary planning and mapping stages.

Since 2012, other orthoimagery covering AMIS was made available on TNRIS and was downloaded by CTI. These included the 2012 and 2016 versions of the NAIP 1-meter quarter quads and the 2015 Texas Orthoimagery Program (TOP) 50-cm quarter quads (Figure 12). All contained an infrared band and the NAIP 2016 product was determined useful for supplying the most up-to-date vegetation patterns (especially in the dynamic inundation zone and other recently disturbed sites) and as an ancillary dataset if needed for hard to view canyons and within shadows along the river bluffs. Overall the 2015 TOP product was found to be superior to the 2016 NAIP imagery due to its finer resolution and higher contrast. The 2015 TOP imagery was then selected and used as the primary basemap for the remainder of the mapping efforts.

Once digital copies of the imagery were acquired, interpretation and mapping of the vegetation began using a four step process involving: (1) preliminary image classification and segmentation, (2) photo-interpretation and digitizing, (3) ground-truthing of the mapped data, and (4) map refinement and finalization. First, the TOP 2015 imagery was mosaiced and manipulated using image processing and segmentation techniques (e.g. unsupervised image classification, normalized difference vegetation index, etc.) to highlight any subtle vegetation signature differences. All of the preliminary results were evaluated for usefulness and the best examples were first converted to digital lines and polygons, were next combined with other relevant AMIS GIS layers (such as the roads network), and the results were used as the base layer for the new AMIS vegetation mapping effort.

Building off the base layer, all relevant lines and polygons were exported as shapefiles and converted to ArcGIS coverages. The resulting coverages were run through a series of smoothing routines provided in the ArcGIS software. Following the smoothing, all digital line-work was manipulated to remove extraneous lines, eliminate small polygons, and merged polygons that split obvious stands of homogeneous vegetation. The cleaning stage was considered complete when all resulting polygons matched homogenous stands of vegetation apparent on the TOP 2015 imagery.

At this point, the mapping shifted to manual techniques and all vegetation lines and polygons were visually inspected and manually moved, edited and/or updated as needed. Any obvious problems in the mapping (such as shifting and sliver polygons) were edited and resolved. Review of the preliminary layer compared to the NAIP 2012 and 2016 showed that the reservoir level in the TOP 2015 imagery was higher (i.e. more water) than found in the other years.

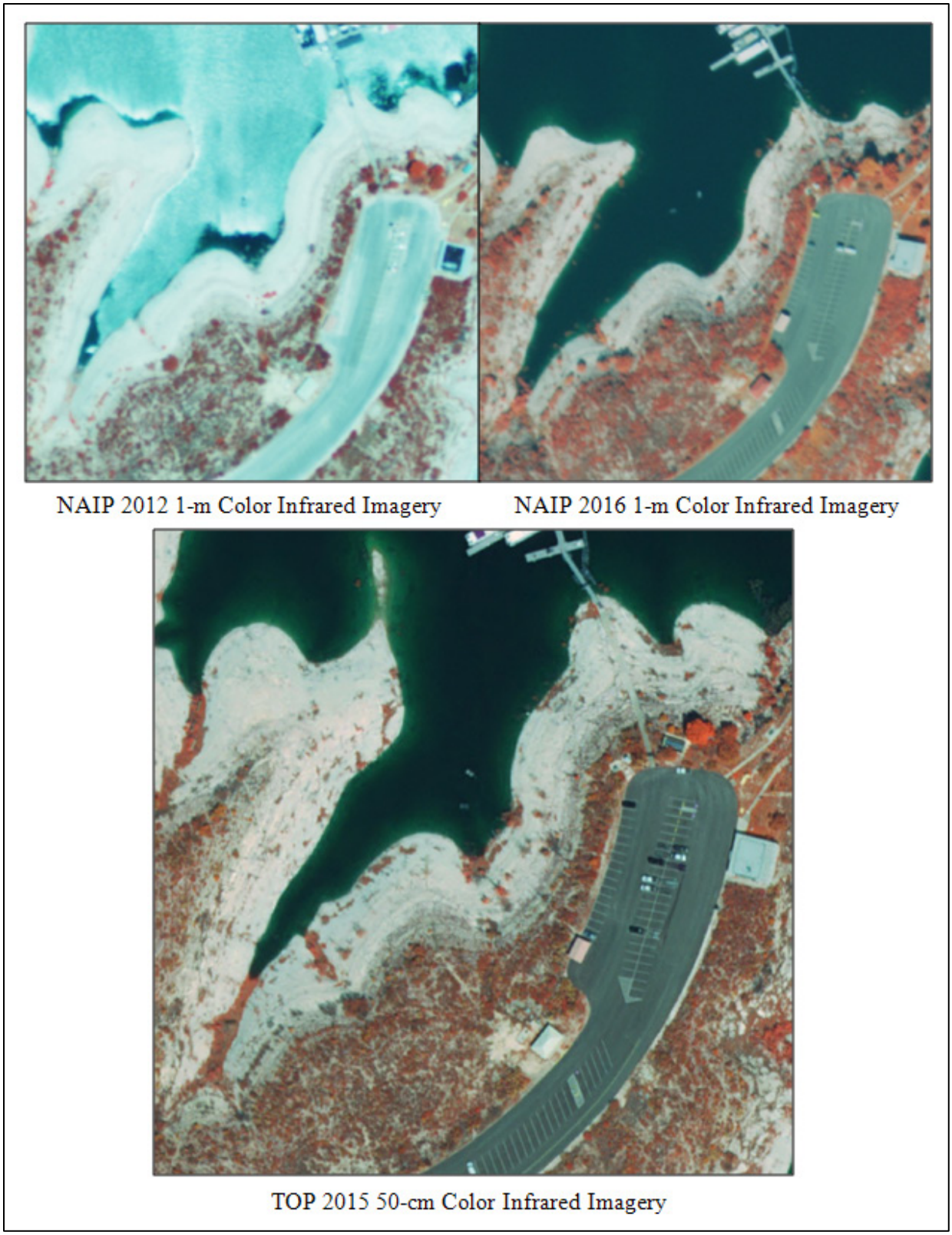


Figure 12. Examples of the Basemap Imagery for AMIS (NAIP and TOP).

To adjust for the fluctuations, CTI re-digitized the reservoir shoreline and included both reservoir water levels in the draft vegetation map. Once the preliminary lines were completed, temporary map unit names and placeholder codes were used to attribute each vegetation polygon. The vegetation layer was then loaded into a mobile GIS laptop computer for on the ground verification purposes at AMIS.

"Ground-truthing" or verifying the vegetation by the mapping team at AMIS occurred during two field trips. The first was started after the conclusion of the initial planning meeting in 2009 and another was conducted in October 2014. During these trips, the preliminary AMIS vegetation layer, orthoimagery, plots and other data points, roads, and other ancillary digital data was loaded onto a portable computer linked to a GPS receiver. Once at AMIS, CTI staff visited representative polygons and verified the map lines and labels against the actual vegetation on the ground from on the computer using ArcGIS software. Additional or missing vegetation polygons were noted, and more general observations were taken to help write the map unit descriptions and to ultimately create the final list of map units. Additional ground-truthing was also conducted at some specific designated sites in 2015 by AMIS biologists at the request of the mapping team.

After the ground-truthing efforts, CTI staff refined the AMIS map layer by adding new polygons, moving/editing lines, and changing or adding polygon map unit labels as necessary. The AMIS vegetation map was considered ready for the AA in 2017 when the final vegetation classification and final list of plant associations/alliances were used to replace the placeholder names. In most cases, the preliminary map unit names and labels were simply changed to reflect the current rUSNVC association or alliance name. Due to the limitations of the imagery and the complex mixing of the vegetation at AMIS some of the map units contained multiple associations from different alliances. This issue was addressed by grouping similar associations/alliances into one map unit. All resulting map units were then correlated or "cross-walked" by noting when plant associations were used as a map unit or when they were grouped. Some park special map units were also created to define planted/ornamental vegetation, submerged vegetation, and bare shoreline areas. To round-out the mapping scheme, additional map units were added for land use types based on a mapping system developed by Anderson et al. (1976). This included land-use and land-cover types not covered by the rUSNVC, such as roads and facilities.

In addition to the final map unit names and codes other polygon specific information or modifiers were added to the vegetation layer (Table 5). Polygon modifiers included physical quantifiers such as average height of the vegetation, average density of the dominant vegetation strata, and the general pattern/shape of the vegetation in each polygon. Topographic and landscape modifiers (i.e. landform, biophysical location, soils, etc.) were also added for each vegetation polygon by extracting data from existing spatial datasets through GIS analysis routines (i.e. zonal statisitics and spatial joining). Finally the vegetation layer was converted to a Geodatabase and all of the common rUSNVC data contained in the final NatureServe classification was joined using relationship-classes.

Table 5. Polygon Attribute Items and Descriptions used in the AMIS GIS Vegetation Layer.

Attribute	Description
AREA*	Surface area of the polygon in meters squared
PERIMETER*	Perimeter of the polygon in meters
AMISVEG*	Unique code for each polygon
AMISVEG_ID*	Unique identification code for each polygon
MAP_CODE	Final Map Unit Codes – Project specific
MAP_DESC	Map Unit Scientific Description Name – Project Specific
MAP_CDESC	Map Unit Common Description Name – Project Specific
DENS_MOD	• Modifier - Percent Cover of the Upper Stratum Layer in the Polygon • Sparse = < 10%, • Open = 10 - 25%, • Intermediate = 25 - 50%, • Discontinuous = 50 - 75%, • Closed = 75 - 100%
PTRN_MOD	• Modifier - Vegetation Pattern within the Polygon • Evenly Dispersed = Homogeneous, • Grouped Stands of Vegetation = Bunched / Clumped, • String of Vegetation = Linear, • Varying densities and gradients of vegetation = Gradational
HT_MOD	• Modifier - Height Range of the Dominant Vegetation Layer • Height classes: < 1, 1 - 3, 3 - 5, 5 - 15, and > 15 Meters
ASPECT	General Aspect (Direction) of the Polygon in Degrees
ASPECT_DIR	General Aspect Direction of the Polygon
SLOPE	General Slope of the Polygon in Degrees
ELEV_FT	Average Elevation in the Polygon (Feet)
ELEV_MTRS	Average Elevation in the Polygon (Meters)
LANDFORM	General Landforms
TOPOLOGY	General Landscape Features
PHYS_VEG	General Physical Vegetation
BPS_VEG	General Biophysical Vegetation
SOIL	General Soil Type in the Polygon (Golden, M. L., et al., 1982)
COMMENTS	Additional Comments about the Vegetation for Individual Polygons
ACRES	Surface area of the polygon in acres
HECTARES	Surface area of the polygon in hectares

*Represent ArcGIS default attributes and values.

Accuracy Assessment

Once the vegetation layer was completed, the accuracy assessment (AA) was conducted. Typically, in mapping exercises both thematic or attribute map accuracy as well as the positional or polygon line accuracy are considered. In the case of the NVIP however, checking the positional accuracy is usually omitted since rarely does vegetation split on discrete edges that can be positively located in the field. The subjectivity involved in this effort plus the high resolution and accuracy of TOP imagery allows for the assumption that all products derived from them are well within National Map Accuracy Standards for 1:12,000-scale maps (±30 feet).

The thematic accuracy of the vegetation map was assessed using the methodology provided by the NVIP (TNC and ESRI 1994c and Lea and Curtis 2010). The revised protocols included a four step AA process consisting of a (1) sample design, (2) sample site selection, (3) data collection, and (4) data analysis. The design of the AA process followed the three possible scenarios provided in the field manual with stratified random targets placed in each map class based on their respective frequency and abundance (Table 6).

Table 6. Standard Sample Size Allocations for AA Points Based on Map Unit Area.

Map Class Total Area[1]	Number of Observations Per Map Class[2]
> 50 hectares	30
8.33 to 50 hectares	0.6 per hectare
< 8.33 hectares	5

[1] As measured before buffering for cost surface (access buffer) or for map class boundary buffer.

[2] Or as many spatially independent (non-overlapping) observation sites as map class area, MMU size and other considerations will allow

The sample size parameters were loaded into a custom GIS program along with the vegetation layer to perform the sample site selection. The entire project area was included in the point selection process and the GIS program stratified the random AA target locations for each of the vegetation map classes based on its corresponding area (Table 6). The program also buffered possible AA target sites 10 meters (33 ft) away from any polygon boundary and 50 meters (165 ft) away from any other data point. Being able to choose minimum distance to polygon boundaries helped to minimize confusion and account for the horizontal error typically encountered in GPS receivers. Additional target points were added to long linear riparian polygons and rare types that were below the 10-meter (33 ft) radius threshold. Some difficult to access areas (e.g. remote islands and submerged lands) were removed and replaced with other random target locations. Finally, an additional set of independent back-up targets were created in case the originals could not be easily reached in the field. By default, difficult targets were replaced with easier backup ones by the field crews for safety and economic reasons.

The AA data collection process was started once the LBJWC was provided the AA target point locations, the key to the associations and map units, and all associated digital GIS files. LBJWC staff than created custom field maps, coordinated with AMIS staff for logistics and site access, and trained

the field crews on the AA methodology. AA fieldwork began in March 2017 during five, six-day trips that included eight field crew members working in teams of two. Fieldwork was conducted both from land and via boat access.

On average, each field crew sampled four or five target points per day and attempted to access more if possible. After reaching a target site, the observers completed a paper copy of the AA Form (Appendix A). The waypoint as indicated on a GPS receiver was recorded and the site was photographed in each of the cardinal directions. At most AA points, the observation area was an estimated circle with a radius of 40 meters (131 feet), or roughly equivalent to the minimal mapping unit of 0.5 hectare. Smaller observation areas of 0.25 or 0.1 hectare were used for rare (smaller) or linear stands. The botanist recorded the dominant vegetation by cover class and used the vegetation key to determine the association(s). If the AA sampling area covered more than one type, all possible vegetation associations were noted. After determining the association(s), the botanist noted the usefulness of the vegetation key and recorded environmental and supplemental data. At the end of each day, all of the teams met to identify unknown plant species and checked the AA forms for completeness. Of the 702 potential AA targets prescribed by the NVIP methodology, the LBJWC crews sampled 562 targets. The final AA point tally was lower than expected for a variety of reasons including limited time and finances, lack of access from private lands, and recent inundation/flooding of shoreline vegetation. Appendix B contains all the species identified during the AA point data collection.

After the fieldwork was competed, all AMIS AA data was entered into the PLOTS database. The AA data was then exported into a GIS point layer (Figure 13). The AA point layer was then overlain on the AMIS vegetation map and the vegetation field call(s) was compared to the corresponding vegetation polygon. At this stage, points that differed from the predicted polygon labels were examined and obvious errors in the data were corrected. Common errors included: (1) incorrect UTM coordinates (handwriting/transcription errors on the datasheet vs. the actual GPS waypoint location), (2) incomplete and/or incorrect field calls (corrected based on actual species and cover data), (3) discrepancies in the field key (i.e. wrong couplet was used), or (4) data was collected in a polygon that was obviously labeled incorrectly (e.g. a vegetated polygon labeled as a road). Changes were made and recorded in the comments field of the AA point layer.

The second review step involved deciding between the primary or secondary field call for the plant association. This was done by first adding a “Final_Code” attribute to the AA point layer and then comparing the assigned field names of the point with its corresponding location on the digital imagery. In most cases, the primary association name assigned by the field crew was used. However, some points were assigned their secondary field call based on one of the following reasons: (1) it appeared that the second call was the better choice due to the overhead perspective (e.g. a stand judged to be a sparse shrubland on the imagery vs. herbaceous vegetation in the field), (2) the data were actually recorded in an inclusion or a small stand below the MMU size, or (3) the second call more appropriately matched the ecological context (e.g. riparian vegetation along a stream vs. an upland vegetation type).



Figure 13. Map of the Accuracy Assessment Points Collected at AMIS (CTI).

Once the data were reviewed, the final AA analysis was conducted using custom GIS programs and AA templates supplied by the NVIP. Through this automated process, the final map units in the AA layer were compared to the map unit designations for their corresponding polygons. All of the statistics and calculations used to analyze these data are described at length in the program manuals (TNC and ESRI 1994c and Lea and Curtis 2010). Final percent accuracy for each of the map classes was recorded using contingency tables (error matrices).

Results

Vegetation Classification

The final AMIS classification contains 31 associations, 17 alliances, 14 groups, and 11 macrogroups within the rUSNVC (Appendix D). The final AMIS classification was primarily based on the 102 plots collected by LBJWC and ancillary data (Poole 2013). Additions were also made after the plot sampling based on ground-truthing efforts. This included adding two previously undescribed graminoid types: (*Bouteloua* spp., *Pappophorum bicolor*, *Tiquilia canescens*) Tamaulipan Herbaceous Vegetation and *Schoenoplectus californicus* Tamaulipan Riparian Herbaceous Vegetation.

Of the 31 associations, 18 were not directly matched to existing rUSNVC associations but can be considered park special types. Park specials at AMIS represent local plant communities that differ slightly from existing rUSNVC association concepts or lack enough data to describe a new association. Park special types are not officially included in the rUSNVC hierarchy, but many times can be linked to an Alliance or Group level for classification and mapping purposes. With additional data and analysis, some of the park special plant communities may become new associations or may be subsumed into existing rUSNVC associations. Others might be unique vegetation stands that remain as a locally independent type. The special plant communities found at AMIS can be distinguished by their element codes. rUSNVC associations begin with the CEGL prefix versus the NPSAMIS prefix for park special types. All plant communities are listed in Table 7 with their corresponding element codes.

Table 7. Summary of rUSNVC Plant Associations/Alliances for AMIS.

AMIS Plant Association Name [AMIS Plant Association Local Name]	**rUSNVC Element Code**
***Quercus fusiformis* / *Vachellia rigidula* Woodland** [Texas Live Oak Woodland]	NPSAMIS004
***Quercus vaseyana - Fraxinus greggii - Celtis* spp. Woodland** [Vasey Scrub Oak - Littleleaf Ash - Hackberry Woodland]	NPSAMIS005
***Quercus gravesii* / *Pistacia mexicana* Woodland** [Graves' Oak / Texas Pistachio Woodland] *	NPSAMIS012
***Vachellia farnesiana* - (*Prosopis glandulosa*) Riparian Woodland** [Huisache Riparian Woodland]	CEGL002131
***Prosopis glandulosa* Riparian Woodland** [Mesquite Riparian Woodland]	NPSAMIS033
***Salix gooddingii - Salix thurberi - Fraxinus berlandieri* Woodland** [Willow Riparian Woodland] *	NPSAMIS035

* Represent Poole (2013) classification associations that were not represented by current classification plots.

Table 7 (continued). Summary of rUSNVC Plant Associations/Alliances for AMIS.

AMIS Plant Association Name [AMIS Plant Association Local Name]	**rUSNVC Element Code**
***Celtis laevigata* - *Ulmus crassifolia* / *Urvillea ulmacea* Tamaulipan Riparian Scrub Alliance** [Sugarberry - Cedar Elm / Apaac Tamaulipan Riparian Scrub Alliance]	A3842
***Tamarix* spp. Riparian Shrubland** [Tamarisk Riparian Shrubland]	CEGL003114
***Panicum virgatum* - *Andropogon glomeratus* - *Cladium mariscus* ssp. *Jamaicense* Riverbank Herbaceous Vegetation** [Edwards Plateau Stream Scoured Grassland] *	CEGL004928
***Eleocharis* spp. Comanchian - Tamaulipan Herbaceous Vegetation** [Spikerush Herbaceous Vegetation] *	NPSAMIS029
***Justicia americana* - *Bacopa monnieri* Edwards Plateau Herbaceous Vegetation** [Water-willow Riparian Herbaceous Vegetation] *	CEGL004926
***Arundo donax* Riverbank Herbaceous Vegetation** [Giant Cane Riparian Herbaceous Vegetation] *	CEGL004101
***Phragmites australis* ssp. *berlandieri* Riverbank Wet Meadow** [Common Reed Riparian Herbaceous Vegetation] *	CEGL004115
***Cynodon dactylon* - *Phyla nodiflora* Riparian Herbaceous Vegetation** [Bermuda Grass - Fogfruit Riparian Herbaceous Vegetation]	NPSAMIS002
***Baccharis neglecta* - *Nicotiana glauca* Shrubland** [Rooseveltweed - Tree-tobacco Shrubland]	NPSAMIS007
***Bacopa monnieri* - (*Cynodon dactylon*, *Phyla nodiflora*) Herbaceous Vegetation** [Water Hyssop - Bermuda Grass - Fogfruit Sparse Riparian Herbaceous Vegetation]	NPSAMIS031
***Leucophyllum frutescens* Shrubland** [Cenizo Shrubland]	CEGL002168
***Vachellia rigidula* Shrubland** [Blackbrush - Cenizo Shrubland]	CEGL003874
***Senegalia berlandieri* - *Leucophyllum frutescens* Shrubland** [Guajillo - Cenizo Shrubland]	CEGL007758
***Vachellia rigidula* - *Leucophyllum frutescens* - *Senegalia berlandieri* Shrubland** [Guajillo - Blackbrush - Torrey Yucca Shrubland]	CEGL007759
***Vachellia rigidula* - *Diospyros texana* - *Dasylirion texanum* Shrubland** [Blackbrush - Texas Persimmon - Texas Sotol Shrubland]	NPSAMIS003
***Vachellia rigidula* - *Prosopis glandulosa* - *Diospyros texana* Shrubland** [Blackbrush - Honey Mesquite - Texas Persimmon Shrubland]	NPSAMIS032

* Represent Poole (2013) classification associations that were not represented by current classification plots.

Table 7 (continued). Summary of rUSNVC Plant Associations/Alliances for AMIS.

AMIS Plant Association Name [AMIS Plant Association Local Name]	**rUSNVC Element Code**
***Vachellia rigidula - Opuntia engelmannii* var*. lindheimeri - Jatropha dioica - Lippia graveolens* Shrubland** [Dry Mixed Thornscrub Shrubland]	NPSAMIS026
***Mimosa borealis* Dwarf-shrubland** [Mimosa Dwarf-shrubland]	NPSAMIS013
***Prosopis glandulosa var. glandulosa - Parkinsonia texana* var*. macra* - (*Cordia boissieri, Koeberlinia spinosa*) Shrubland** [Mesquite Upland Shrubland]	CEGL007762
***Vitex agnus-castus* Shrubland** [Lilac Chaste Tree Riparian Shrubland]	NPSAMIS009
(*Pennisetum ciliare*, *Bothriochloa* spp., *Aristida purpurea*) Tamaulipan Herbaceous Vegetation [Ruderal Mixed Grassland]	NPSAMIS006
(*Bouteloua* spp., *Pappophorum bicolor*, *Tiquilia canescens*) Tamaulipan Herbaceous Vegetation [Dry Native Mixed Grassland]	NPSAMIS034
***Vachellia vernicosa - Calliandra conferta* Shrubland** [Viscid Acacia Shrubland]	NPSAMIS014
***Porophyllum scoparium* - (*Heterotheca fulcrata*, *Penstemon baccharifolius*) Sparse Vegetation** [Xeric Outcrop Sparse Vegetation] *	NPSAMIS016
***Hydrilla verticillata* Ruderal Aquatic Vegetation** [Hydrilla Submerged Aquatic Vegetation] *	CEGL004702

* Represent Poole (2013) classification associations that were not represented by current classification plots.

The physiognomic class summary for the AMIS rUSNVC plant associations includes a total of six woodland, 12 shrubland, one dwarf shrubland, 10 herbaceous vegetation, one sparsely vegetated, and one submerged herbaceous association. In addition, one plant alliance = *Celtis laevigata - Ulmus crassifolia / Urvillea ulmacea* A3842 Tamaulipan Riparian Scrub Alliance was also included as a stand-alone type (as requested by AMIS management) to characterize mesic uplands that had high cover of hackberry trees.

In general, the rUSNVC nomenclature uses the current scientific species names as described by the USDA-NRCS (2018) for each association. However, the national classification occasionally lags in updating new plant names. For AMIS, the rUSNVC (2017) retains the older genus name *Acacia* for species that now are treated as *Vachellia* and *Senegalia* by the PLANTS database (USDA-NRCS 2018). For this project, the older *Acacia* genus is retained in some portions of the PLOTS database, but the new names are used in the mapping and in the classification documents (Appendices B and C). The rUSNVC naming methodology includes: using parentheses "( )" in the name to indicate that

the species may or may not be present, a dash "-" between species to indicate species occurring in the same vegetation layer (i.e. stratum), a slash "/" to indicate species that occur in different vegetation layers, and lower confidence associations are sometimes given a [Provisional] status.

Digital Imagery and Mapping

For AMIS, 50 map units (37 vegetated and 13 land-use/land-cover types) were developed. AMIS map classes or units represent a compromise between the detail of the rUSNVC, the needs of the resource management staff (e.g. detailed mapping of riparian and wetland types), and the limitations of the imagery. An effort was made to crosswalk the final list of map classes/units to corresponding plant associations/alliances and land use classes. When a direct rUSNVC link to an association was not feasible, broader alliances or descriptive local map units (park specials) were created. In addition, some of the more widespread and disturbance-oriented associations occurred across multiple map units. Table 8 contains the final list of map units and their crosswalk to associations/alliances or map unit descriptions and Appendix E contains descriptions and representative photographs for all the vegetation map units used at AMIS.

Table 8. AMIS Map Units and Relationships to the rUSNVC or Local Map Unit Description.

Map Code	**AMIS Map Unit Name** [AMIS Map Unit Local Name]	**rUSNVC Element Name and Code** **or [Local Description]**
W_FOR	**Mixed Ornamental and Planted Shrubland / Woodland**	[Park Special Map Unit]
W_GOAK	***Quercus gravesii* / *Pistacia mexicana* Woodland** [Graves' Oak - Texas Pistachio Woodland]	*Quercus gravesii* / *Pistacia mexicana* Woodland NPSAMIS012
W_HMX	**Periodically Submerged Inundation Zone and Shoreline *Vachellia farnesiana* - (*Prosopis glandulosa*) Woodland** [Periodically Submerged Inundation Zone and Shoreline Huisache and Honey Mesquite Woodland]	*Vachellia farnesiana - (Prosopis glandulosa*) Riparian Woodland CEGL002131 *Prosopis glandulosa* Riparian Woodland NPSAMIS033
W_HR	***Vachellia farnesiana* - (*Prosopis glandulosa*) Riparian Woodland** [Huisache - (Honey Mesquite) Riparian Woodland]	*Vachellia farnesiana - (Prosopis glandulosa*) Riparian Woodland CEGL002131
W_MNW	**Mixed Native Tree Woodland**	[Park Special Map Unit]
W_MRIP	***Prosopis glandulosa* Riparian Woodland** [Honey Mesquite Riparian Woodland]	*Prosopis glandulosa* Riparian Woodland NPSAMIS033
W_ST	***Celtis* spp. / Thornscrub Mesic and Riparian Shrubland and Woodland** [Hackberry / Thornscrub Mesic and Riparian Shrubland and Woodland]	*Celtis laevigata - Ulmus crassifolia* / *Urvillea ulmacea* Tamaulipan Riparian Scrub Alliance A3842

Table 8 (continued). AMIS Map Units and Relationships to the rUSNVC or Local Map Unit Description.

Map Code	AMIS Map Unit Name [AMIS Map Unit Local Name]	rUSNVC Element Name and Code or [Local Description]
W_TOAK	***Quercus fusiformis* Woodland** [Texas Live Oak Woodland]	*Quercus fusiformis* / *Vachellia rigidula* Woodland NPSAMIS004
W_VOAK	***Quercus vaseyana - Fraxinus greggii - Celtis laevigata* var. *reticulata* Woodland** [Vasey Scrub Oak - Littleleaf Ash - Hackberry Woodland]	*Quercus vaseyana - Fraxinus greggii - Celtis* spp. Woodland NPSAMIS005
W_WIL	***Salix* spp. Riparian Woodland** [Willow Riparian Woodland]	*Salix gooddingii - Salix thurberi - Fraxinus berlandieri* Woodland NPSAMIS035
S_BB	***Vachellia rigidula - Leucophyllum frutescens* Shrubland** [Blackbrush - Cenizo Shrubland]	*Vachellia rigidula* Shrubland CEGL003874
S_BMP	***Vachellia rigidula - Prosopis glandulosa - Diospyros texana* Shrubland** [Blackbrush - Honey Mesquite - Texas Persimmon Shrubland]	*Vachellia rigidula - Prosopis glandulosa - Diospyros texana* Shrubland NPSAMIS032
S_BPTS	***Vachellia rigidula - Diospyros texana - Dasylirion texana* Shrubland** [Blackbrush - Texas Persimmon - Texas Sotol Shrubland]	*Vachellia rigidula - Diospyros texana - Dasylirion texanum* Shrubland NPSAMIS003
S_CEN	***Leucophyllum frutescens* Shrubland** [Cenizo Shrubland]	*Leucophyllum frutescens* Shrubland CEGL002168
S_GBTY	***Senegalia berlandieri - Vachellia rigidula - Yucca torreyi* Shrubland** [Guajillo - Blackbrush - Torrey's Yucca Shrubland]	*Vachellia rigidula - Leucophyllum frutescens - Senegalia berlandieri* Shrubland CEGL007759
S_GC	***Senegalia berlandieri - Leucophyllum frutescens* Shrubland** [Guajillo - Cenizo Shrubland]	*Senegalia berlandieri - Leucophyllum frutescens* Shrubland CEGL007758
S_LCT	***Vitex agnus-castus* Shrubland** [Lilac Chaste Tree Shrubland]	*Vitex agnus-castus* Shrubland NPSAMIS009
S_MUP	***Prosopis glandulosa* Upland Shrubland** [Honey Mesquite Upland Shrubland]	*Prosopis glandulosa* var. *glandulosa - Parkinsonia texana* var. *macra - (Cordia boissieri, Koeberlinia spinosa*) Shrubland CEGL007762
S_SHR	**Mixed Inundation Zone and Shoreline Shrubland**	*Baccharis neglecta - Nicotiana glauca* Shrubland NPSAMIS007
S_SHRX	**Periodically Submerged Inundation Zone and Shoreline Shrubland**	*Baccharis neglecta - Nicotiana glauca* Shrubland NPSAMIS007 *Tamarix* spp. Riparian Shrubland CEGL003114

Table 8 (continued). AMIS Map Units and Relationships to the rUSNVC or Local Map Unit Description.

Map Code	AMIS Map Unit Name [AMIS Map Unit Local Name]	rUSNVC Element Name and Code or [Local Description]
S_TAM	***Tamarix ramosissima* Riparian Shrubland** [Tamarisk Riparian Shrubland]	*Tamarix* spp. Riparian Shrubland CEGL003114
S_THRN	**Dry Mixed Thornscrub Shrubland**	*Vachellia rigidula - Opuntia engelmannii* var. *lindheimeri - Jatropha dioica - Lippia graveolens* Shrubland NPSAMIS026
S_VARG	***Vachellia vernicosa - Calliandra conferta* Shrubland** [Viscid Acacia - Rio Grande Stickpea Shrubland]	*Vachellia vernicosa - Calliandra conferta* Shrubland NPSAMIS014
DS_FM	***Mimosa borealis* Dwarf-Shrubland** [Fragrant Mimosa Dwarf-Shrubland]	*Mimosa borealis* Dwarf-shrubland NPSAMIS013
H_BGFF	***Cynodon dactylon - Phyla nodiflora* Inundation Zone and Shoreline Herbaceous Vegetation** [Bermuda Grass - Fogfruit Inundation Zone and Shoreline Herbaceous Vegetation]	*Cynodon dactylon - Phyla nodiflora* Riparian Herbaceous Vegetation NPSAMIS002
H_CANE	***Arundo donax* Riparian Herbaceous Vegetation** [Giant Cane Riparian Herbaceous Vegetation]	*Arundo donax* Riverbank Herbaceous Vegetation CEGL004101
H_CBUL	***Schoenoplectus californicus* Riparian Herbaceous Vegetation** [California Bulrush Riparian Herbaceous Vegetation]	*Schoenoplectus californicus* Tamaulipan Riparian Herbaceous Vegetation NPSAMIS030
H_NAT	**Upland Mixed Native Grassland**	(*Bouteloua spp., Pappophorum bicolor, Tiquilia canescens*) Tamaulipan Herbaceous Vegetation NPSAMIS006
H_REED	***Phragmites australis* Riparian Herbaceous Vegetation** [Common Reed Riparian Herbaceous Vegetation]	*Phragmites australis* ssp. *berlandieri* Riverbank Wet Meadow CEGL004115
H_RVR	**Mixed Riverbank Herbaceous Vegetation Complex**	*Porophyllum scoparium* - (*Heterotheca fulcrata, Penstemon baccharifolius*) Sparse Vegetation NPSAMIS016
H_SUB	**Mixed *Hydrilla verticillata* and Other Submerged Aquatic Vegetation** [Mixed Hydrilla and Other Submerged Aquatic Vegetation]	*Hydrilla verticillata* Ruderal Aquatic Vegetation CEGL004702
H_UPG	**Upland Ruderal Mixed Grassland**	[Park Special Map Unit]

Table 8 (continued). AMIS Map Units and Relationships to the rUSNVC or Local Map Unit Description.

Map Code	AMIS Map Unit Name [AMIS Map Unit Local Name]	rUSNVC Element Name and Code or [Local Description]
SP_RCK	**Xeric Rock Outcrop Sparse Vegetation**	*Porophyllum scoparium* = *(Heterotheca fulcrata, Penstemon baccharifolius*) Sparse Vegetation NPSAMIS016
SP_SHR	**Mixed Inundation Zone and Shoreline Sparse Herbaceous Vegetation**	*Bacopa monnieri* - (*Cynodon dactylon, Phyla nodiflora*) Herbaceous Vegetation NPSAMIS031
SP_SHRX	**Periodically Submerged Sparsely Vegetated Inundation Zone and Shoreline**	[Park Special Map Unit]
SP_TRAN	**Sparsely Vegetated Transitional and Disturbed Areas**	[Park Special Map Unit]
SP_WASH	**Sparsely Vegetated Washes and Drainages**	[Park Special Map Unit]
L_AGRI	**Agricultural Business / Ranches**	[Ranch and Farm Areas]
L_COMM	**Communications and Utilities**	[Substations, Water Towers, and Communication Facilities]
L_CUL	**Cultural and Historic Agricultural Remnants**	[Water Tanks, Corrals, Foundations, and other Historical Remnants]
L_FACL	**NPS and Other Facilities**	[Visitor Center, Maintenance Yard, Picnic Areas, Boat Ramps, and Campgrounds]
L_FIELD	**Planted / Cultivated Fields**	[Fallow and Tilled Agricultural Fields]
L_FLAT	**Barren Dirt and Rock Flats**	[Bare Mud Flats and River Bottoms]
L_PITS	**Quarries / Strip Mines / Gravel Pits**	[Disturbed Sites for Sand, Gravel, or Rock]
L_POND	**Small Lake / Pond**	[Natural Catchments and Small Human-made Water Impoundments]
L_RESD	**Residential Areas**	[Housing and Residential Areas]
L_RESV	**Reservoir / Lake**	[Man-made Lakes and Large Impoundments]
L_ROAD	**Main Roads and Transportation Structures**	[Paved and Gravel Roads]
L_STRM	**Stream / River**	[Perennial Streams and Rivers]
L_TRL	**Trails and 2-Track Roads**	[Dirt Roads, Hiking, and Social Trails]

The following rUSNVC type(s) to map unit(s) relationships represent the possible mapping scenarios encountered in the AMIS project:

1) **One-to-One Relationship** = When a plant association or a vegetation alliance had a unique photo signature and could be readily delineated on the imagery, the map unit adopted the unique plant association/alliance name or similar synonym. This was the most common scenario at AMIS occurring for 23 out of the 31 vegetated map classes.

2) **Many-to-One Relationship** = When related plant associations shared the same signature and could not be distinguished on the imagery, several plant associations were combined into a single complex. This scenario was especially true for several common map classes that were flooded and inundated on the imagery and therefore could not be distinguished from the drier upland variation of the same map unit.

    a) Map Unit = Periodically Submerged Inundation Zone and Shoreline (W_HMX)
    Associations = *Vachellia farnesiana* - (*Prosopis glandulosa*) Riparian Woodland (CEGL002131) and *Prosopis glandulosa* Riparian Woodland (NPSAMIS03)
    Reason = W_HMX was used to indicate woodland areas that were recently flooded and could contain stands of either honey mesquite or huisache.

    b) Map Unit = Periodically Submerged Inundation Zone and Shoreline Shrubland (S_SHRX)
    Associations = *Baccharis neglecta* - *Nicotiana glauca* Shrubland (NPSAMIS007) and *Tamarix* spp. Riparian Shrubland (CEGL003114)
    Reason = The S_SHRX map unit was a submerged type and the shrub species could not be reliably identified on the imagery.

3) **One-to-Many Relationship** = Some of the rUSNVC associations occurred in more than one map unit due to the separating of flooded and inundated areas from dry locations around the reservoir. These include the following:

    a) *Vachellia farnesiana* - (*Prosopis glandulosa*) Riparian Woodland (CEGL002131) and *Prosopis glandulosa* Riparian Woodland (NPSAMIS03).
    Map Units = W_MRIP, W_HR and W_HMX.
    Reason = W_HMX was used to indicate woodland areas that were recently flooded and could contain stands of either honey mesquite or huisache.

    b) *Baccharis neglecta* - *Nicotiana glauca* Shrubland (NPSAMIS007)
    Map Units = S_SHR and S_SHRX
    Reason = S_SHRX was used to indicate shoreline shrubland areas that were flooded during the mapping.

    c) *Tamarix* spp. Riparian Shrubland (CEGL003114)
    Map Units = S_TAM and S_SHRX
    Reason = Tamarisk occurred as both seedling in inundated sites (S_SHRX) and as taller shrubs in exposed and dry areas (S_TAM).

    d) *Porophyllum scoparium* - (*Heterotheca fulcrata*, *Penstemon baccharifolius*) Sparse Vegetation (NPSAMIS016)
    Map Units = H_RVR and SP_RCK
    Reason = Sparse shoreline and transition zone vegetation was found both along rivers in the transition zone to the uplands (H_RVR) and on rock bluffs/outcrops (SP_RCK).

4) **Additional Park Special Map Classes** = Map Units that were not linked or cross walked to the rUSNVC at this time. Park special map units were created for unique situations not fully

addressed in the rUSNVC, specifically planted and cultivated shrubs/trees, rare mixed woodlands, non-native grasses and sparsely vegetation landforms/geologic features.

a) Mixed Ornamental and Planted Shrubland / Woodland
Map Unit = W_FOR
Reason = Mixed ornamental and planted trees only occurred along the boundary and some other developed sites that were too small to be sampled and classified.

b) Mixed Native Tree Woodland
Map Unit = W_MNW
Reason = Mixed native tree stands only occurred in a few small areas that were not sampled during the plot data collection stage and could not be classified to an association/alliance.

c) Upland Ruderal Mixed Grassland
Map Unit = H_UPG
Reason = Non-native and planted grasses were only found at few isolated upland areas in AMIS. This map unit was created to help separate more disturbed grasslands from similar native types (H_NAT).

d) Periodically Submerged Sparsely Vegetated Inundation Zone and Shoreline
Map Unit = SP_SHRX
Reason = Barren areas in recently submerged and inundated sites contained little to no vegetation that could be classified to an association/alliance.

e) Sparsely Vegetated Transitional and Disturbed Areas
Map Unit = SP_TRAN
Reason = Barren and recently disturbed sites in the upland portions of AMIS contained little to no vegetation and were not classified to an association/alliance

f) Sparsely Vegetated Washes and Drainages
Map Unit = SP_WASH
Reason = Linear washes with little to no vegetation were not classified to an association/alliance.

5) **Land Use - Land Cover** = All 13 of the Land Use and Land Cover types (L_XX) that were not recognized by the rUSNVC and received an Anderson et al. (1976, updated 2002) map unit designation.

Vegetation Map

The AMIS vegetation map consists of 22,758 polygons totaling 22,974 hectares (56,726 acres) (Appendix F) with an average polygon size of about 1.0 hectares (2.5 acres) (Table 9). The small average polygon size for AMIS was due to the detailed mapping of the inundation zone, the small and rare native vegetation sites, and the arbitrary upper boundary of AMIS that follows the 1,114-ft contour level. The AMIS boundary cuts across many map units and artificially clips them into smaller polygons. An example of this would be where the boundary falls midway along a steep river bluff resulting in multiple sliver-like polygons of SP_RCK when in fact they are all part of the same larger rock formation. The mapping was also finely detailed since the 2015 TOP imagery was of high

resolution allowing for very small stands of vegetation important to AMIS management (e.g. native grassland, wetland, and riparian vegetation) to be accurately delineated below the MMU. All of the factors taken together warranted the production of a very thorough and detailed vegetation map. Figure 14 shows an example of the detailed nature of the AMIS vegetation mapping.

Table 9. Summary Statistics for the AMIS Map Class Polygons.

Map Code	Map Unit Common Name	Number of Polygons	Acres	Hectares
W_FOR	Mixed Ornamental and Planted Shrubland / Woodland	35	5.0	2.0
W_GOAK	Graves' Oak / Texas Pistachio Woodland	6	4.2	1.7
W_HMX	Periodically Submerged Inundation Zone and Shoreline Huisache and Honey Mesquite Woodland	476	929.4	376.5
W_HR	Huisache Riparian Woodland	1,272	1,688.3	683.6
W_MNW	Mixed Native Tree Woodland	38	47.9	19.4
W_MRIP	Honey Mesquite Riparian Woodland	336	484.0	196.0
W_ST	Sugarberry / Thornscrub Mesic and Riparian Shrubland and Woodland	95	80.8	32.7
W_TOAK	Texas Live Oak Woodland	25	23.7	9.6
W_VOAK	Vasey Scrub Oak - Littleleaf Ash - Hackberry Woodland	33	23.8	9.6
W_WIL	Willow Riparian Woodland	100	417.2	169.0
S_BB	Blackbrush - Cenizo Shrubland	997	1,015.6	411.3
S_BMP	Blackbrush - Mesquite - Texas Persimmon Shrubland	1,402	1,898.9	769.1
S_BPTS	Blackbrush - Texas Persimmon - Texas Sotol Shrubland	324	461.9	187.1
S_CEN	Cenizo Shrubland	345	874.5	354.2
S_GBTY	Guajillo - Blackbrush - Torrey Yucca Shrubland	988	1,921.1	778.0
S_GC	Guajillo - Cenizo Shrubland	952	2,501.5	1,013.1
S_LCT	Lilac Chaste Tree Shrubland	92	41.9	17.0
S_MUP	Honey Mesquite Upland Shrubland	507	1,001.6	405.5
S_SHR	Mixed Inundation Zone and Shoreline Shrubland	2,024	3,397.4	1,376.0
S_SHRX	Periodically Submerged Inundation Zone and Shoreline Shrubland	182	870.1	352.4
S_TAM	Tamarisk Riparian Shrubland	1,009	1,321.3	535.1
S_THRN	Dry Mixed Thornscrub Shrubland	1,483	2,728.1	1,104.8
S_VARG	Viscid Acacia - Rio Grande Stickpea Shrubland	32	32.8	13.3

Table 9 (continued). Summary Statistics for the AMIS Map Class Polygons.

Map Code	Map Unit Common Name	Number of Polygons	Acres	Hectares
DS_FM	Fragrant Mimosa Dwarf-Shrubland	25	22.8	9.2
H_BGFF	Bermuda Grass - Fogfruit Inundation Zone and Shoreline Herbaceous Vegetation	1,623	3,299.1	1,336.0
H_CANE	Giant Cane Riparian Herbaceous Vegetation	170	185.8	75.3
H_CBUL	California Bulrush Riparian Herbaceous Vegetation	4	10.7	4.3
H_NAT	Upland Mixed Native Grassland	4	5.2	2.1
H_REED	Common Reed Riparian Herbaceous Vegetation	83	56.0	22.7
H_RVR	Mixed Riverbank Herbaceous Vegetation Complex	63	51.2	20.8
H_SUB	Mixed Hydrilla and Other Submerged Aquatic Vegetation	158	223.5	90.5
H_UPG	Upland Ruderal Mixed Grassland	502	374.6	151.8
SP_RCK	Xeric Rock Outcrop Sparse Vegetation	1,939	1,339.3	542.4
SP_SHR	Mixed Inundation Zone and Shoreline Sparse Herbaceous Vegetation	3,685	5,046.4	2,044.1
SP_SHRX	Periodically Submerged Sparsely Vegetated Inundation Zone and Shoreline	464	3,867.7	1,566.4
SP_TRAN	Sparsely Vegetated Transitional and Disturbed Areas	164	85.2	34.4
SP_WASH	Sparsely Vegetated Upland Washes and Drainages	344	142.2	57.5
L_AGRI	Agricultural Business / Ranches	1	< 0.1	< 0.1
L_COMM	Communications and Utilities	3	1.5	0.6
L_CUL	Cultural and Historic Agricultural Remnants	40	3.0	1.2
L_FACL	NPS and Other Facilities	172	27.2	11.0
L_FIELD	Planted / Cultivated Fields	1	0.5	0.2
L_FLAT	Barren Dirt and Rock Flats	14	33.2	13.4
L_PITS	Quarries / Strip Mines / Gravel Pits	7	14.9	6.0
L_POND	Small Lake / Pond	17	9.2	3.7
L_RESD	Residential Areas	21	2.4	0.9
L_RESV	Reservoir / Lake	5	18,274.8	7,401.3
L_ROAD	Main Roads and Transportation Structures	48	263.9	107.0
L_STRM	Stream / River	60	1,469.4	595.1

Table 9 (continued). Summary Statistics for the AMIS Map Class Polygons.

Map Code	Map Unit Common Name	Number of Polygons	Acres	Hectares
L_TRL	Trails and 2-Track Roads	388	144.6	58.5
–	Subtotal Woodlands	2,416	3,704	1,500
–	Subtotal Shrublands	10,337	18,067	7,317
–	Subtotal Dwarf Shrublands	25	23	9
–	Subtotal Herbaceous Vegetation	2,607	4,206	1,704
–	Subtotal Sparse Vegetation	6,596	10,481	4,245
–	Subtotal Land-Use and Land-Cover	777	20,245	8,199
–	Subtotal All Vegetation and Sparse Areas	21,981	36,481	14,775
–	**TOTALS**	**22,758**	**56,726**	**22,974**



Figure 14. Example of the AMIS Vegetation Map Layer (CTI and 2005 Top Imagery).

Based on the final vegetation layer, open water, which included the Amistad Reservoir and perennial streams, totaled 35% (19,744 acres) of the project area. Of the remaining 36,981 acres (65%), 22% (12,437 acres) were mapped in the recent inundation zone of the reservoir, and 2% (1,304 acres) were in the former inundation zone (i.e. transitional woodlands and grasslands). Other upland land-use and land-cover areas accounted for about 3% (1,970 acres). The remaining 38% (21,270 acres) in the dry/mesic uplands and riparian areas that best represents the extent of the mostly native and stable vegetation occurring at AMIS. Within this subtotal, Huisache Riparian Woodland (W_HR) covered the most area for a woodland type with 1,688 acres. The largest upland shrubland types were the Dry Mixed Thornscrub Shrubland (S_THRN) and the Guajillo - Cenizo Shrubland (S_GC) with 2,728 acres and 2,502 acres, respectively. Also of note were the 1,507-acre extent of the invasive giant cane and tamarisk types that occurred primarily in the riparian areas and to lesser extent in the inundation zone.

For more detailed analysis of the vegetation trends at AMIS, the vegetation spatial database can be further explored and manipulated using the linked rUSNVC databases and the additional polygon attributes in a GIS program. In general, the extensive database created for AMIS during this project is difficult to convey in a table or on a two-dimensional map, but it should be understood that the different attributes can be combined in many ways and at different scales and resolutions to produce additional products better representing the full spectrum of the vegetative diversity. For example by querying the vegetation spatial database using the modifying attributes of density, height, and pattern (i.e. map_code = “W_HR” + ptrn_mod = “Homogeneous” + ht_mod = “5-15 m” + dens_mod = “75-100%”) would create a map with all of the tall, homogeneous and dense huisache woodlands that may represent important wildlife habitat.

Accuracy Assessment

A total of 562 AA target points were sampled by the LBJWC field crews and distributed throughout AMIS project area, including target sites in remote reaches of the Pecos and Devils Rivers. After the fieldwork, the resulting AA data was entered into the PLOTS database and reviewed. Based on the previously undescribed vegetation encountered at a few of the remote AA targets, the AMIS classification was updated to include the rare *(Bouteloua* spp., *Pappophorum bicolor*, *Tiquilia canescens*) Tamaulipan Herbaceous Vegetation and *Schoenoplectus californicus* Tamaulipan Riparian Herbaceous Vegetation types.

Review of the AA database further revealed that 3 points were recorded in the wrong location or were too close together (i.e. duplicate of the same target) and another 3 points were recorded in areas outside the scope of the assessment (e.g. recently exposed shoreline). These 6 points were removed from analysis yielding a final sample size of 559 points. Six vegetation types were not assessed in the field by LBJWC. The W_FOR map unit was not found within the park in large enough polygons to access, as most were located directly on the boundary with private lands. The H_CBUL was not included due to the difficult logistics of getting to the small stands within the active Rio Grande River channel below the Amistad Dam and most of the H_CBUL sites were already previously documented during the map verification stage. The sparse vegetation map units (except for SP_SHR) were also not targeted for the following reasons. The SP_RCK map unit was only found on steep and

hard to get to locations. The SP_SHRX map unit was derived from the SP_SHR map unit and was not included during the sample site selection. The SP_WASH was added after the AA fieldwork to account for small linear (mostly unvegetated) sites in the uplands along the project boundary. Finally, the SP_TRAN map unit was only used for disturbed sites that were mostly unvegetated and small.

Analysis of the AA points involved a point-by-point review in two stages. In stage one, the preliminary error matrix was reviewed by CTI staff. All errors in the AA database were corrected at this time including fixing wrong locations (outside of the target area), changing ambiguous field determinations (incorrect rUSNVC names), and changing the primary call to the secondary call based on actual species abundance and cover. Some AA points were also modified to better address the vegetation as seen from an overhead perspective versus on the ground viewing. This included adding new second vegetation determinations for small inclusions that better reflected the larger mapping concept, addressing ecotones and transitional areas, and for areas were the field determination clearly did not match the field data.

Following the first AA point review the results were presented to NVIP and AMIS staffs and recommendations were made to improve the accuracy of the map. This included combining a preliminary shoreline herbaceous vegetation type with the SP_SHR map unit. Since these are dynamic inundation zone types that change frequently, it was not of importance to the current management of the park. In addition, the AMIS staff also requested that all of the map units remain in the map and that they would accept any lower than expected accuracy values. The stated reasons for their request included high conservation value for the native types and the importance of knowing the locations of the invasive H_SUB type.

Stage two of the analysis involved re-running the accuracy assessment using the corrected AA points. The resulting contingency tables (i.e. error matrices) include the observation counts with the predicted values (polygon map labels) as rows and the reference data values (AA field calls) as columns. The individual cell values represent the number of map units mapped in each class (row) that were found to be of a specific class (column) in the field. The values in the shaded cells along the diagonal represent correct map units, whereas those off the diagonal represent mismatched or incorrect types. The results of the sample contingency analysis are presented in Table 10 and are summarized in Table 11. The population contingency analysis is like the sample contingency assessment, but the population values consider the proportion of the target area rather than just the raw count of observations. The results of the population table are summarized in Table 12. Due to space and page size limitations, the actual population contingency table can only be viewed directly from the project deliverable files (see AMIS_AA_Matrices.xls).

Table 10. Sample Contingency Table for AMIS.

Map Unit	DS_FM	H_BGFF	H_CANE	H_NAT	H_REED	H_RVR	H_SUB	H_UPG	SP_SHR
DS_FM	3	0	0	0	0	0	0	0	0
H_BGFF	0	29	0	0	0	1	0	0	0
H_CANE	0	0	14	0	2	0	0	0	0
H_NAT	0	0	0	2	0	0	0	0	0
H_REED	0	0	0	0	8	0	0	0	0
H_RVR	0	1	0	0	0	3	0	0	0
H_SUB	0	0	0	0	0	0	1	0	0
H_UPG	0	0	0	0	0	0	0	10	0
SP_SHR	0	0	0	0	0	0	0	0	3
S_BB	0	0	0	0	0	0	0	0	0
S_BMP	0	0	0	0	0	0	0	0	0
S_BPTS	0	0	0	0	0	0	0	0	0
S_CEN	0	0	0	0	0	0	0	0	0
S_GBTY	0	0	0	0	0	0	0	0	0
S_GC	0	0	0	0	0	0	0	0	0
S_LCT	0	0	0	0	0	0	0	0	0
S_MUP	0	0	0	0	0	0	0	0	0
S_SHR	0	1	0	0	0	0	1	0	0
S_SHRX	0	0	0	0	0	0	0	0	0
S_TAM	0	0	0	0	0	0	0	0	0
S_THRN	0	0	0	0	0	1	0	0	0
S_VARG	0	0	0	0	0	0	0	0	0
W_GOAK	0	0	0	0	0	0	0	0	0
W_HMX	0	0	0	0	0	0	0	0	0
W_HR	0	0	0	0	0	0	0	0	0
W_MNW	0	0	0	0	0	0	0	0	0
W_MRIP	0	0	0	0	0	0	0	0	0
W_ST	0	0	0	0	0	0	0	0	0
W_TOAK	0	0	0	0	0	0	0	0	0
W_VOAK	0	0	0	0	0	0	0	0	0
W_WIL	0	0	0	0	0	0	0	0	0
Column Total	**3**	**31**	**14**	**2**	**10**	**5**	**2**	**11**	**3**
Total Correct	**3**	**29**	**14**	**2**	**8**	**3**	**1**	**10**	**3**
Producer's Accuracy	**100%**	**94%**	**100%**	**100%**	**80%**	**60%**	**50%**	**91%**	**100%**

Table 10 (continued). Sample Contingency Table for AMIS.

Map Unit	S_BB	S_BMP	S_BPTS	S_CEN	S_GBTY	S_GC	S_LCT	S_MUP	S_SHR
DS_FM	0	0	0	0	0	0	0	0	0
H_BGFF	0	0	0	0	0	0	0	1	1
H_CANE	0	0	0	0	0	0	0	0	1
H_NAT	0	0	0	0	0	0	0	0	0
H_REED	0	0	0	0	0	0	0	0	0
H_RVR	0	0	0	0	0	0	0	0	0
H_SUB	0	0	0	0	0	0	0	0	0
H_UPG	0	0	0	0	0	0	0	0	0
SP_SHR	0	0	0	0	0	0	0	0	2
S_BB	25	0	0	0	0	0	0	0	0
S_BMP	0	38	1	0	0	1	0	3	1
S_BPTS	0	2	7	0	0	1	0	0	0
S_CEN	0	1	0	29	0	0	0	0	0
S_GBTY	3	0	0	1	27	2	0	0	0
S_GC	0	0	0	4	1	28	0	0	0
S_LCT	0	0	0	0	0	0	7	0	0
S_MUP	1	1	0	0	0	0	0	40	0
S_SHR	0	0	0	0	0	0	0	0	21
S_SHRX	0	0	0	0	0	0	0	0	0
S_TAM	0	0	0	0	0	0	0	0	0
S_THRN	0	1	0	0	0	2	0	0	0
S_VARG	0	0	0	0	0	0	0	0	0
W_GOAK	0	0	0	0	0	0	0	0	0
W_HMX	0	0	0	0	0	0	0	0	0
W_HR	0	1	0	0	0	0	0	0	0
W_MNW	0	0	0	0	0	0	0	0	0
W_MRIP	0	1	0	0	0	0	0	2	0
W_ST	0	1	0	0	0	0	0	0	0
W_TOAK	0	0	0	0	0	0	0	0	0
W_VOAK	0	1	0	0	0	0	0	0	0
W_WIL	0	0	0	0	0	0	0	0	0
Column Total	**29**	**47**	**8**	**34**	**28**	**34**	**7**	**46**	**28**
Total Correct	**25**	**38**	**7**	**29**	**27**	**28**	**7**	**40**	**21**
Producer's Accuracy	**86%**	**81%**	**88%**	**85%**	**96%**	**82%**	**100%**	**87%**	**75%**

Table 10 (continued). Sample Contingency Table for AMIS.

Map Unit	S_SHRX	S_TAM	S_THRN	S_VARG	W_GOAK	W_HMX	W_HR	W_MNW	W_MRIP
DS_FM	0	0	1	1	0	0	0	0	0
H_BGFF	0	0	0	0	0	1	0	0	0
H_CANE	0	0	0	0	0	0	0	0	0
H_NAT	0	0	0	0	0	0	0	0	0
H_REED	0	0	0	0	0	0	0	0	0
H_RVR	0	0	0	0	0	0	0	0	0
H_SUB	0	0	0	0	0	0	0	0	0
H_UPG	0	0	0	0	0	0	0	0	0
SP_SHR	0	0	0	0	0	0	0	0	0
S_BB	0	0	2	0	0	0	0	0	0
S_BMP	0	0	0	0	0	0	0	0	1
S_BPTS	0	0	0	0	0	0	0	0	0
S_CEN	0	0	0	0	0	0	0	0	0
S_GBTY	0	0	3	0	0	0	0	0	0
S_GC	0	0	0	0	0	0	0	0	0
S_LCT	0	0	1	0	0	0	0	0	0
S_MUP	0	0	1	0	0	0	0	0	0
S_SHR	0	0	0	0	0	1	0	0	0
S_SHRX	1	0	0	0	0	0	0	0	0
S_TAM	0	21	0	0	0	0	0	0	0
S_THRN	0	0	32	0	0	0	0	0	0
S_VARG	0	0	0	3	0	0	0	0	0
W_GOAK	0	0	0	0	2	0	0	0	0
W_HMX	0	0	0	0	0	17	0	0	0
W_HR	0	0	0	0	0	0	28	0	1
W_MNW	0	0	0	0	0	0	0	7	0
W_MRIP	0	0	0	0	0	0	1	0	24
W_ST	0	0	0	0	0	0	0	0	0
W_TOAK	0	0	0	0	1	0	0	0	0
W_VOAK	0	0	0	0	0	0	0	0	0
W_WIL	0	1	0	0	0	0	0	0	0
Column Total	**1**	**22**	**40**	**4**	**3**	**19**	**29**	**7**	**26**
Total Correct	**1**	**21**	**32**	**3**	**2**	**17**	**28**	**7**	**24**
Producer's Accuracy	**100%**	**95%**	**80%**	**75%**	**67%**	**89%**	**97%**	**100%**	**92%**

Table 10 (continued). Sample Contingency Table for AMIS.

Map Unit	W_ST	W_TOAK	W_VOAK	W_WIL	Row Total	Total Correct	User's Accuracy
DS_FM	0	0	0	0	**5**	**3**	**60%**
H_BGFF	0	0	0	0	**33**	**29**	**88%**
H_CANE	0	0	0	1	**19**	**14**	**74%**
H_NAT	0	0	0	0	**2**	**2**	**100%**
H_REED	0	0	0	0	**8**	**8**	**100%**
H_RVR	0	0	0	0	**4**	**3**	**75%**
H_SUB	0	0	0	0	**1**	**1**	**100%**
H_UPG	0	0	0	0	**10**	**10**	**100%**
SP_SHR	0	0	0	0	**5**	**3**	**60%**
S_BB	0	0	0	0	**27**	**25**	**93%**
S_BMP	2	0	0	0	**48**	**38**	**79%**
S_BPTS	0	0	0	0	**10**	**7**	**70%**
S_CEN	0	0	0	0	**30**	**29**	**97%**
S_GBTY	0	0	0	0	**36**	**27**	**75%**
S_GC	0	0	0	0	**33**	**28**	**85%**
S_LCT	0	0	0	0	**8**	**7**	**88%**
S_MUP	0	0	0	0	**43**	**40**	**93%**
S_SHR	0	0	0	0	**24**	**21**	**88%**
S_SHRX	0	0	0	0	**1**	**1**	**100%**
S_TAM	0	0	0	2	**24**	**21**	**88%**
S_THRN	0	0	0	0	**36**	**32**	**89%**
S_VARG	0	0	0	0	**3**	**3**	**100%**
W_GOAK	0	0	0	0	**2**	**2**	**100%**
W_HMX	0	0	0	0	**17**	**17**	**100%**
W_HR	1	0	0	0	**31**	**28**	**90%**
W_MNW	0	0	0	0	**7**	**7**	**100%**
W_MRIP	0	0	0	1	**29**	**24**	**83%**
W_ST	9	0	0	0	**10**	**9**	**90%**
W_TOAK	0	6	0	0	**7**	**6**	**86%**
W_VOAK	0	0	9	0	**10**	**8**	**90%**
W_WIL	0	0	0	35	**36**	**35**	**97%**
Column Total	**12**	**6**	**9**	**39**	–	–	–
Total Correct	**9**	**6**	**9**	**34**	–	–	–
Producer's Accuracy	**75%**	**100%**	**100%**	**90%**	–	–	–

Table 11. Sample Contingency Table Analysis Results for AMIS.

Map Code	Users Accuracy	90% Confidence Interval -	90% Confidence Interval +	Producers Accuracy	90% Confidence Interval -	90% Confidence Interval +
W_GOAK	100%	75%	100%	67%	55%	79%
W_HMX	100%	97%	100%	89%	79%	99%
W_HR	90%	80%	100%	97%	96%	99%
W_MNW	100%	93%	100%	100%	100%	100%
W_MRIP	83%	69%	96%	92%	80%	100%
W_ST	90%	69%	100%	79%	35%	100%
W_TOAK	86%	57%	100%	100%	100%	100%
W_VOAK	90%	69%	100%	100%	100%	100%
W_WIL	97%	91%	100%	90%	80%	100%
S_BB	93%	82%	100%	86%	83%	89%
S_BMP	79%	70%	91%	81%	78%	84%
S_BPTS	70%	41%	99%	88%	87%	89%
S_CEN	97%	90%	100%	89%	70%	100%
S_GBTY	75%	62%	88%	96%	94%	98%
S_GC	85%	73%	97%	82%	77%	87%
S_LCT	88%	62%	100%	100%	100%	100%
S_MUP	93%	86%	100%	87%	78%	92%
S_SHR	88%	74%	100%	75%	48%	100%
S_SHRX	100%	50%	100%	100%	100%	100%
S_TAM	88%	80%	100%	95%	91%	99%
S_THRN	89%	79%	99%	80%	69%	91%
S_VARG	100%	83%	100%	75%	62%	88%
DS_FM	60%	14%	100%	100%	100%	100%
H_BGFF	88%	77%	99%	94%	92%	96%
H_CANE	74%	59%	97%	100%	99%	100%
H_NAT	100%	75%	100%	100%	99%	100%
H_REED	100%	94%	100%	80%	71%	89%
H_RVR	75%	27%	100%	80%	10%	100%

Table 11 (continued). Sample Contingency Table Analysis Results for AMIS.

Map Code	Users Accuracy	90% Confidence Interval -	90% Confidence Interval +	Producers Accuracy	90% Confidence Interval -	90% Confidence Interval +
H_SUB	100%	5%	100%	50%	39%	61%
H_UPG	100%	95%	100%	91%	29%	100%
SP_SHR	60%	14%	100%	100%	95%	100%

Table 12. Population Contingency Table Analysis Results for AMIS.

Map Code	Users Accuracy	90% Confidence Interval -	90% Confidence Interval +	Producers Accuracy	90% Confidence Interval -	90% Confidence Interval +
W_GOAK	100%	75%	100%	55%	55%	55%
W_HMX	100%	97%	100%	79%	79%	79%
W_HR	90%	80%	100%	99%	98%	99%
W_MNW	100%	93%	100%	100%	100%	100%
W_MRIP	82%	69%	96%	81%	80%	81%
W_ST	90%	69%	100%	35%	35%	35%
W_TOAK	86%	57%	100%	100%	100%	100%
W_VOAK	91%	69%	100%	100%	100%	100%
W_WIL	97%	91%	100%	74%	74%	74%
S_BB	93%	82%	100%	84%	83%	84%
S_BMP	81%	70%	91%	83%	83%	84%
S_BPTS	70%	41%	99%	89%	89%	89%
S_CEN	97%	90%	100%	70%	70%	71%
S_GBTY	75%	62%	88%	95%	94%	96%
S_GC	85%	73%	97%	86%	85%	87%
S_LCT	88%	62%	100%	100%	100%	100%
S_MUP	93%	86%	100%	79%	78%	79%
S_SHR	88%	74%	100%	51%	48%	53%
S_SHRX	100%	50%	100%	100%	100%	100%
S_TAM	91%	80%	100%	99%	99%	99%

Table 12 (continued). Population Contingency Table Analysis Results for AMIS.

Map Code	Users Accuracy	90% Confidence Interval -	90% Confidence Interval +	Producers Accuracy	90% Confidence Interval -	90% Confidence Interval +
S_THRN	89%	79%	99%	90%	89%	91%
S_VARG	100%	83%	100%	88%	88%	88%
DS_FM	60%	14%	100%	100%	100%	100%
H_BGFF	88%	77%	99%	95%	94%	96%
H_CANE	78%	59%	97%	100%	99%	100%
H_NAT	100%	75%	100%	100%	100%	100%
H_REED	100%	94%	100%	71%	71%	71%
H_RVR	75%	27%	100%	2%	2%	2%
H_SUB	100%	50%	100%	61%	61%	61%
H_UPG	100%	95%	100%	30%	29%	30%
SP_SHR	60%	14%	100%	100%	95%	100%

By reading across these tables (i.e., rows) one can calculate the percent error of commission, or how many polygons for each map unit were incorrectly labeled when compared to the field data. By reading down the tables (i.e., columns) one can calculate the percent error of omission, or how many polygons for that type were left off the map. Numbers “on the diagonal” tell the user how well the map unit was interpreted and how confident they can be in using it. Numbers “off the diagonal” yield important information about the deficiencies of the map including which types were either: (1) over-mapped - commission errors on the right –more of this type was mapped than occurs at the site, or (2) under-mapped - omission errors on the bottom – some of this type was mapped as other map units

Based on the population accuracy analysis for AMIS the overall accuracy and Kappa values of the vegetation layer are as follows:

- Total Aa Sites (Samples) = 559
- Sample Overall Accuracy = 87.0%
- Population Overall Accuracy (P_c) = 83.4%
- Lower Limit, 90% Confidence Interval = 84.9%
- Upper Limit, 90% Confidence Interval = 89.7%
- Kappa (**K**): = 87.3%
- Lower Limit, 90% Confidence Interval, **K** = 84.9%
- Upper Limit, 90% Confidence Interval, **K** = 89.7%

Reviewing the existing AA data shows that most of the map units had both high users and producers error accuracy of at least 80%. The map units below 80% accuracy had either marginal accuracy of 60% – 79% or low accuracy of < 60%. Table 13 contains a short summary of the moderate and low accuracy map classes and possible reasons for the lower than expected rates. One source of error for all the rare and infrequent map units at AMIS was the small sample size allocations that fell below the NVIP standards (Lea and Curtis 2010).

Table 13. Marginal and Low Accuracy Level Map Classes and Sources of Error.

Map Code	Producers Accuracy	Users Accuracy	Results and Likely Error Explanations
DS_FM	100%	60%	Over-mapped. Low sample size and rare type. Less of this type exists than mapped. Some areas believed to be DS_FM were S_THRN and S_VARG.
H_CANE	100%	74%	Slightly over-mapped. Included within other riverine types and hard to distinguish on the imagery. Some areas believed to be H_CANE were H_REED, S_SHR and W_WIL.
H_RVR	60%	75%	Low sample size and hard to distinguish. H_RVR has similar components (Bermuda grass) to the H_BGFF type.
H_SUB	50%	100%	Under-mapped. Low sample size and most areas were underwater. Recently exposed sites contained similar elements as the SP_SHR and S_SHR types
SP_SHR	100%	60%	Over-mapped. Likely represents a dynamic gradient with the S_SHR or H_BGFF types.
S_BMP	81%	79%	Slightly over-mapped. High species overlap with the other thornscrub types, especially S_BPTS, S_MUP, and W_ST. May represent a thornscrub gradient or ecotonal type.
S_BPTS	88%	70%	Slightly over-mapped. High species overlap with the other thornscrub types, especially S_BMP, S_MUP, and W_ST. May represent a thornscrub gradient or ecotonal type.
S_GBTY	96%	75%	Slightly over-mapped. High species overlap with the other thornscrub types, especially S_BB, S_GC, and W_ST. May represent a thornscrub gradient or ecotonal type.
S_SHR	75%	93%	Slightly under-mapped. Likely more of this type occurred than mapped. Confused with the other inundation zone types.
S_VARG	75%	100%	Slightly under-mapped. A rare type, more of this type occurred than mapped. Confused with the DS_FM type.
W_ST	75%	90%	Slightly under-mapped. More of this type occurred than mapped. Confused with the similar thornscrub types, especially S_BMP and W_HR types.
DS_FM	100%	60%	Over-mapped. Low sample size and rare type. Less of this type exists than mapped. Some areas believed to be DS_FM were S_THRN and S_VARG.

The low number of AA points for some of these types was likely due to the difficult logistics at AMIS and the financial constraints limiting the amount of time that the field crews could spend in the field, reducing the number of targets that they could visit. Noticeably the AA results for these map units with limited sample sizes (1-3) present either a highly inflated or a highly deflated value when compared to map units with more robust data. More sampling in the under-sampled types would better reflect the true individual map class accuracy and reduce the corresponding confidence intervals.

Other general sources of error can likely be explained by the difficulty in resolving the difference in scale and perspective between viewing the vegetation on the imagery and assessing it on the ground. For example, sampling could have occurred in inclusions of shrublands or herbaceous vegetation in canopy openings that were actually part of a larger woodland type. In addition, the similar appearance of closely related mapping units and units with the same species likely caused some confusion in the mapping signatures leading to incorrect polygon labels.

Discussion

The vegetation at AMIS is coarsely divided between more natural riparian and upland areas and disturbed lower basins periodically inundated by the Amistad Reservoir. The AMIS uplands consist of dry rolling hills and low slopes with large swaths of short thorny shrubs and sparse grasses. In more mesic upland areas, taller and denser shrubs and some trees occur in drainages and along dry streams banks. Riparian areas not influenced by the reservoir occur along the Rio Grande, Pecos, and Devils Rivers and contain distinctive and often thick bands of both native and non-native trees, shrubs, and grasses. In the reservoir draw-down zone, bare soils are quickly invaded by early successional forbs and grasses. If left exposed, these sites can become covered with weedy shrubs. Together these wide-ranging and remote habitats made for many challenges during the vegetation inventory project. Logistical issues included working from boats, obtaining neighboring landowner access permission, negotiating mud flats and rock cliffs, and working from limited roads and trails. Classification and mapping challenges included precisely separating similar upland associations with overlapping plant species and properly documenting the vegetation that resulted from fluctuating water levels. Although largely successful, the AMIS inventory and mapping process described in this report revealed opportunities for improvement and new approaches for future work.

Approaches that Worked Well

Having access to existing vegetation data at AMIS accelerated the classification process and allowed for targeted sampling in known types. Field sampling was greatly aided by the use of AMIS-provided boats and guides. AMIS staff also provided invaluable guidance on logistics and imparted local knowledge about unique stands of vegetation. Completing some of the field work in the spring allowed access to upstream sites by boat that might have not been accessible later in the year. Both spring and fall field efforts helped minimize the dangers from heat exposure while still allowing for accurate plant identification. Timely and high-resolution base imagery was essential to produce the detailed and accurate maps and the 2015 TOP imagery was of superior quality and resolution when compared to similar NAIP or other existing imagery sources. Further, having imagery with 4-bands and the ability to view the vegetation in a color infrared format was essential to the detailed and accurate mapping of the vegetation at AMIS.

Areas for Improvement

NPS vegetation inventory projects are by design lengthy projects that incorporate numerous cooperators and partners. Having more than one group working on the project can lead to a loss of intuitional knowledge and an overlap in responsibilities. Stream-lining the number of people working on the project, creating clear roles for each partner, mandating standardized project reports and interim products, and having designated project leads would help economize and make the project more efficient. Inherent to all vegetation mapping projects is also the need to produce both a complete and up-to-date vegetation classification and a rUSNVC-relatable set of map units. In the future, it may be possible to supplement the AMIS classification by collecting additional field data that may help remove the provisional or local status of the non-rUSNVC plant associations. Similarly, more fieldwork may also allow for more detailed ground-truthing and/or create new or refined map classes. More targeted sampling in unvisited areas may also help find potentially new

types and/or complete the range of variation for existing types. Finally, clear and precise guidance would be helpful on how to classify and map highly disturbed areas such as inundated floodplains, basins, and river channels.

Field Surveys and Classification

At AMIS, the existing legacy data (Poole 2004) was a great starting point for the vegetation survey efforts. The previous study not only provided a framework for identifying plant associations in the field, but also provided a comprehensive list of known plant species occurring at AMIS. Supplementing the existing data was the gradsect layer of BPUs that helped direct sampling into different habitats. The resulting field survey yielded 47 preliminary associations. Through cluster techniques and other analyses, the preliminary number of associations was thinned to 28. Examining the distribution of the plot locations revealed several large areas devoid of any sampling data (largely due to logistics). These data gaps were addressed during the mapping stage by flagging unique vegetation stands that were not sampled. The flagged polygons were then signaled out for more fieldwork and investigation during both the ground verification and the AA stages of the project. Based on these targeted efforts a few more associations were identified and later classified for AMIS.

Future classification work would likely benefit from more of this targeted approach using aerial imagery to identify unique vegetation stands before surveying. Two potential targets would be the mixed native woodland (W_MNW) polygons located in the west (Upper Rio Grande and Pecos Rivers) compared to those in the east (Devils River). Another general area to examine would be the small stretch of the Rio Grande River below the dam. One shrub type to monitor for sampling and inclusion across all of AMIS would be sites dominated by whitebrush (*Aloysia gratissima*). Finally, over time it is important to remember that some plant associations may drop out, be replaced, or become more prevalent. These trends and others could be monitored by revisiting the same field survey sites or by establishing new and/or permanent plot locations.

The vegetation at AMIS was classified using the revised U.S. National Vegetation Standard, Version 2 (rUSNVC) (FGDC 2008). There exists some confusion over how physiognomy is used in classifying existing vegetation in Version 2 compared to Version 1 (FGDC 1997). To clarify, the physiognomy of a plant community (i.e. forest, woodland, shrubland, shrub steppe, herbaceous or sparse vegetation) does not trump floristic composition or ecology. Further, the strict and detailed physiognomic hierarchy of the USNVC version 1 is not maintained in the rUSNVC. Rather, very broad physiognomic criteria are applied at higher levels, with floristics playing an increasingly stronger role at the mid and lower levels. As a result, the association and alliance levels only have fine-scale physiognomic criteria when they are supported by floristics and ecology. Thus “forest to open woodland” is separated from “shrubland and grassland” at the highest levels, based on the 10% or more cover of trees and finer scale splits are only made at lower levels as needed. For example, wooded shrubland physiognomic class is no longer applicable in the rUSNVC unless ecologically justified by floristic composition.

The use of the new rUSNVC at AMIS likely helped reduce the number of potentially confusing plant associations resulting from mixed stands of vegetation. For example, shrub dominated vegetation with scattered trees (up to 9% cover of trees) is now classified as a shrubland and if there is 10% or

more cover of trees, then the stand is classified as woodland. This discourages the classification of transitional vegetation (either spatial transitions such as in ecotones, or temporal transitions when trees colonize/invade shrublands) to rUSNVC associations, reducing the proliferation of associations based solely on physiognomy and reducing the complexity of the classification in general.

Digital Imagery and Mapping

The vegetation map for AMIS was based primarily on the 2015 TOP orthoimagery. However, both the 2012 and 2016 NAIP products were used to help delineate confusing upland areas, areas with dark shadows, and rapidly changing areas within the inundation zone. In general, the AMIS vegetation map should be considered a snapshot in time directly relating to the 2015 TOP imagery. For specific map units, especially the inundation zone and riverine map units, the timing of the mapping is more related to a range of dates extending from 2012 – 2016. For example, the shoreline of the reservoir was lower in 2012 and this extent was used to provide the lower limits of the periodically submerged vegetation (S_SHRX and SP_SHRX). As the data are used, it should be remembered that fires, floods, and other changes to the landscape since 2015 are not included in this product. In the future, it might be beneficial to update the map with newer imagery and use GPS receivers to collect coordinates in the field after major events (e.g. wildfire perimeters, points for insect infestations, etc.).

It is also important to understand that the mapping portion of this project is primarily a remotely sensed exercise and the field work was conducted on site, therefore all resulting products are scale dependent. As a rule, the mapping portions should be considered as a broad overview and the field data as site-specific. An analyst can enlarge the imagery beyond the 1:12,000-scale using GIS software to see more detail. However, it should be remembered that the actual interpretation/mapping was conducted at 1:12,000-scale. As such, any work performed with this product at a finer scale (enlarged image) could lead to some uncertainty. In contrast, the fieldwork was conducted at individual locations at one specific time and any extrapolation using these locations to represent outlying areas or using them to determine species presence at different times/seasons is less reliable. Database users should recognize scale limitations and balance research and modeling projects accordingly.

Accuracy Assessment

A formal accuracy assessment is critical to determining the overall usefulness of the vegetation map and its ability to predict the size, shape, and location of individual map units on the landscape. As such, users of this product should remember that the AA results were directly dependent on many key factors including:

- Field Surveys - thoroughness of the sampling to reach all areas of the recreation area;
- Field Crews - level of expertise to consistently identify and record species and cover values;
- Classification - ability to describe ecotones and the full variation of each association;
- Field Key - its ability to reliably and consistently identify and separate unique associations;
- Date Entry - consistent maintenance of data with minimal errors;

- Orthoimagery - ability to provide consistent vegetation signatures that repeat across the landscape;
- Vegetation Stability - little if any changes occurred between the timing of the orthoimagery to when the AA fieldwork occurred.

Although the accuracy for AMIS was high, improvements can be made, and users should fully explore and understand the sources of error in the contingency tables and the factors stated above. Specific areas at AMIS that likely warrant more investigation or future efforts to improve the accuracy include the following four life zone categories:

1) **Oak Types:** The unique nature of the AMIS boundary with an arbitrary boundary line following the 1,114-ft contour level created some very rare and hard to identify types. This was especially true in the riverine portions of the project area where the boundary closely followed the narrow river channels. In these areas, the oak types (W_GOAK, W_TOAK, and W_VOAK) grew in small drainages, alcoves, and along intermittent streams. The presence of these large trees made them readily observable to field crews. However, the crowns of all three oak types were usually obscured by shadows on the imagery, occurred in mixed stands, and/or were very similar in appearance to each other and to other broad-leaved trees. More site-specific ground-truthing would help better identify the various oak trees and father document their precise location and distribution within the AMIS project area.

2) **Thornscrub Types:** The uplands at AMIS supported large areas dominated by closely related thornscrub species mainly, blackbrush, cenizo, guajillo, and honey mesquite in varying assemblages. Based on the rUSNVC and previous studies an effort was made to finely split the various thornscrub associations during the mapping based on grouping of the dominate shrub species and the presence of yucca or sotol in the understory. Likely, these types represent more of a gradient that follows soils, moisture levels, past disturbances, and topographic position. By merging various thornscrub map units based on location higher accuracy may be achieved. An example would be a very dry (high elevation) type (S_GC, S_CEN, S_THRN), an intermediate type (S_BPTS, S_GBTY), a mesic (low elevation) type (S_BB, S_BMP, W_ST), and a disturbed (cross elevation) type (S_MUP and W_MRIP).

3) **Inundation Zone Types:** The inundation zone at AMIS was extremely difficult to delineate and to access accurately. The fluctuating nature of the water level in the reservoir during a single year and across multiple years had a profound effect on the vegetation. This resulted in some vegetated sites being underwater and some bare shoreline areas having new vegetation (all occurring between when the imagery was acquired and when the AA fieldwork was started). A more formal mapping strategy is likely needed to address these dynamic areas. One option, as was taken in this project, was to map the vegetation as it occurred on the base imagery (2015) using the established vegetation associations but also include an upper and lower extent (2012 and 2016) and create new modified map units to address the recently inundated (flooded) areas (W_HMX, S_SHRX, and SP_SHRX). Another, simpler approach would be to create a large, singular inundation unit that can contain any of the possible weedy associations (H_BGFF,

S_SHR, and SP_SHR) based on the average low (conservation pool) and high (full pool) water levels.

4) **Riverine Types:** Like the inundation zone, vegetation types occurring in the Rio Grande, Pecos, and Devils Rivers may also be affected by dramatic flooding and drought conditions. More ground-truthing of these types may warrant broader map units that combine established and resilient woodland stands (W_MNW, W_WIL, and W_MRIP) from more variable and flood susceptible shrub and herbaceous types (S_SHR, S_TAM, H_REED, H_CANE and H_RVR).

Future Recommendations

The vegetation inventory project for AMIS represents the best efforts put forth by many dedicated experts over a relatively short period of time. In order to create the best possible "long-term" product, this project should not be viewed as final, but rather as the starting point for an on-going effort. AMIS staff and researchers should continue to explore the recreation area and observe the vegetation. Improvements and up-dates to the products presented in this report should be made as needed and on a periodic basis. Present and future researchers should be encouraged to scrutinize the vegetation at AMIS, sample more of the rare and under-represented types, modify the classification and field key to better document the full range of variation, update and improve the GIS layers, and be ever vigilant to record any recent changes or new types that may have been overlooked.

In summary, the products produced as part of this project can assist and direct future vegetation and land-use monitoring and management, as follows:

1) The diversity of plant species and dynamic nature of AMIS with respect to the inundation zone, non-native species encroachment, fire, water diversions, climate change, and other vegetation altering influences warrants periodic **field surveys** by experienced ecologists. Sampling more of the plant communities would also be beneficial allowing for the possibility of discovering new associations, updating the descriptions of the current plant associations, and devising better landscape management strategies. All new information could be used to update both the GIS map layer and the classification.
2) Remote sensing does not replace on-the-ground knowledge provided by GPS-linked plots, observations, site photographs, and verification/ground-truthing work. Time, topographic features, and funding limitations curtailed the amount of **ground-truthing** performed at AMIS. As research opportunities arise, maps should be examined in the field by experienced crews. In addition, GPS receiver data and other GIS layers (such as soils and geology) should be used to improve and update the spatial data. Data could be collected on a standard field form, stored, and then used to update the GIS layer on an annual basis. The vegetation map layer should not be viewed as static but should be updated with more current and accurate information as it becomes available.
3) To understand better the limitations of the map layer, the **accuracy assessment** data as presented in the error matrices should be thoroughly reviewed by all users. Map classes with low accuracy should be examined to determine if they could be improved with future studies using ground-truthing or other remote-sensing formats (e.g. LIDAR, hyperspectral imagery,

etc.). Landscape modeling may help to tease out the locations of rare types based on specific habitat information such as deep soil types, unique geologic formations, and distance from water sources. For some applications, it may make sense to combine map classes into higher units, such as rUSNVC Groups or biophysical types to improve accuracy and present a broader perspective.

4) For monitoring purposes, **change over time** could be addressed by similar remote sensing projects. New imagery as it becomes available could be analyzed to create up-to-date vegetation layers that could be used for comparison purposes. Also, periodically and immediately following vegetation altering events, new data should be collected, and any changes noted in a new or modified vegetation layer. Through this process, new AMIS vegetation map layers can be prepared on a regular basis to prevent the vegetation map from becoming outdated.
5) In the future, resource management personnel could link the habitat for **species of concern** to specific associations and map units. These map units could be used to help locate potential sites of rare, endangered, or threatened species or identify areas for non-native plant removal or treatment. Known populations of threatened, endangered, or non-native species could be overlain on the vegetation map using point or small polygon layers to extract helpful plant community indicator data such as soil type, slope, aspect, hydrology, etc.

Research Opportunities

The wide array of final products produced for this project lends themselves for future research opportunities. On the inventory and classification side, research could include setting up a photo-monitoring project that periodically retakes plot photographs. This would help to document vegetation change over time. Another option would be mine the PLOTS database for locations of species of concern for both rare plants and problematic invasive species. For example, several plant species of conservation concern and that are endemic to Texas were documented in the plot data collection. These locations could be used as the basis for more rare plant surveys, the start of mapping their distributions, and/or analyzing their habitats for vulnerabilities (flooding, erosion, non-native species invasion, etc.).

On the mapping side, having an accurate and current vegetation map in a geodatabase presents many new and exciting opportunities including expanding or linking the GIS layer to derive other information such as fire models, wildlife habitat monitoring locations, habitat structural analyses, and inventorying areas that are likely vectors for invasive species. The map could also be enhanced by overlaying other existing GIS layers including geology, hydrology, elevation, and soils. In this manner complex interactions between these layers could be examined and yield important information about growth rates, regeneration after disturbance, biomass distribution, and stream morphology. Through innovative analyses the vegetation layer could be used as a baseline for other ecological and climate-related studies including examining how the vegetation is impacted by global warming events and how it interacts with soil chemistry, pollution, paleontological/archeological sites, insect infestations, weather patterns, etc.

Having consistent ecological and digital map data for plant associations across a large geographical span (BIBE to RIGR to AMIS) could create some exciting prospects for ecoregion analysis and study. Investigations could include examining the distribution, health, and vigor of common species (such as creosotebush) overtime as it relates to drought, flooding, or human activities. The active control of non-native species upriver could also be examined in relation to the amount, or rate of recovery of these same types further down the Rio Grande River and around the Amistad Reservoir. These and many other opportunities could result from linking all the regional vegetation data for the three neighboring NPS units into a seamless classification and related geo-database.

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Appendix A. AMIS Data Forms

CHIHUAHUAN DESERT NETWORK - VEGETATION INVENTORY FORM *rev. 2010-09-16 CL*

GENERAL INFORMATION
PLOT: _____
Project: CHDN Vegetation mapping
Date: _____
Surveyors: _____

PLOT LOCATION
Managed Area (Park): Amistad National Recreation Area
Survey Site: _____
County: Val Verde State: Texas

Plot dimensions: _____ by _____ m
Sample area _____ sq. m

PLOT DOCUMENTATION
Photo File: _____

Type of GPS unit: _____
UTM zone 14N Datum: NAD-83
GPS pointname or file:
est accuracy: _____ m/ft
Receiver status (circle): 2D / 3D / 3D WAAS

Field UTM X__ __ __,__ __ __ E Y__,__ __ __,__ __ __ N
Corrected UTM X__ __ __,__ __ __ E Y__,__ __ __,__ __ __ N
LAT _____
LAT corrected _____
LONG _____
LONG corrected _____
Marked est. location on toposheet ____ yes

Relative Stand Size
A - extensive (> 100x plot size)
B - large (10-100x plot size)
C - small (3-10x plot size)
D - very small (1-3x plot size)
U - Unknown

SITE CHARACTERISTICS compass: magnetic corrected

Elevation _____ units (circle one): feet / meters
How obtained (circle one) via GPS / map / altimeter

Slope (o) ____
single measure. __ avg of __
0° (flat)
1-5° (gentle)
6-14° (moderate)
15-25% (somewhat steep)
26-45° (steep)
46-69° (very steep)
70-90° (extremely steep)
> 90° (overhanging)

Slope Shape (V w/ slope)
VERTICALLY
C - concave
X - convex
S - straight

HORIZONTALLY
C - concave
X - convex
S - straight

H - hummock (___% of plot) and hollow (___%) microtopography
I - irregular craggy/ bouldery microtopography

Aspect
BEARING in degrees) _____
single measure. _____ circle one: magnetic / true
or, average of _____ readings

or, ASPECT CLASS (true North only) (circle one)
F (flat) N 338-22° NE 23-67°
V (variable) E 68-112° SE 113-157°
S 158-202° SW 203-247°
W 248-292° NW 293-337°

Topographic Position
interfluve/summit
high slope
high level
mid slope
low slope
toe slope
low level

Landform

alluvial fan	canyon	dune field	hoodoo	plateau	swale
alluvial flat	channel	earthflow	interdune	playa	talus
alluvial terrace	cliff	escarpment	interfluve	ravine	valley
badlands	collapse sinkhole	fault scarp	island	ridge	valley floor
bar	cuesta	floodplain	knob	rim	
basin	debris slide	foothills	knoll	saddle	
basin floor	depression	gorge	lakebed	scarp	
bench	desert pavement	graben	ledge	scarp slope	
blowout	dike	gulch	mesa	seep	
bottomland	dome	hanging valley	mountain	slide	
butte	draw	hill	oxbow	slope	
caldera	dune	hogback	piedmont	stream terrace	

Surface Substrate	% Cover
bedrock	
large rocks* (boulders)	
small rocks** (gravel and cobbles)	
bare soil*** (including sand)	
litter/duff	
wood	
* > 10 cm mean diameter	
** 0.2 to 10 cm mean diameter	
*** < 2 mm mean diameter	
TOTAL	100%

Figure A-1. AMIS 2012 Plot Form Example.

Rock types present (if known)

Soil Drainage Class	Soil Texture	Cowardin System	Hydrologic Regime
A - very poorly drained	A - clay	A - Upland	A -Terrestrial(i.e. not a wetland)
B - poorly drained	B - clay loam	B - Lacustrine	
C - somewhat poorly drained	C - loam	C - Riverine	B - Permanently flooded
D - moderately well drained	D - muck	D - Palustrine	C - Semipermanently flooded
E - well drained	E - peat		D - Seasonally flooded
F - rapidly drained	F - sand		E - Intermittently flooded
	G - sandy clay loam		F - Temporarily flooded
	H - sandy loam		G - Saturated
	I - silt loam		

Environmental Comments (e.g., evidence of anthropogenic disturbance, etc.) (optional):

Landscape Comments (optional):

Hydrology evidence (optional)

Sketch plot configuration, indicate the plot architecture, points where GPS positions were collected, locations of permanent stakes (if any), locations and bearings of photopoints, and directions and distances to landmarks. Use the symbols in the key below for GPS points, photos, and permanent markers. Also provide driving and walking directions to plot, accompanied, if possible, by a sketch showing plot orientation and depicting roads, trails, etc..

⊗	GPS position
○→	Photo # and direction
●	Permanent Marker

Figure A-1 (continued). AMIS 2012 Plot Form Example.

II. VEGETATION STRUCTURE AND PHYSIOGNOMY

NOTE: Record height (m), cover class (10 pt scale), and phenology / lifeform for each stratum.

Stratum	T1	T2	T3	S1	S2	S3	H	V	E	N
COVER CLASS										
Max Height m										

T1 = Emergent trees S2 = Short shrub V = Vine
T2 = Tree canopy S3 = Dwarf shrub E = Epiphyte
T3 = Tree subcanopy H = Herbaceous N = Nonvascular (lichens, bryophytes and/or algae)
S1 = Tall shrub

PHYSIOGNOMIC CLASS	LEAF PHENOLOGY (dominant stratum)	LEAF TYPE (dominant stratum)
Forest (>60% Tree Cover)	Deciduous (< 25% evergreen)	(may select more than one)
Woodland (25-60% Tree Cover)	Mixed deciduous (25-49% evergreen)	Broadleaf
Shrubland (> 25% Shrub Cover)	Mixed evergreen (25-49% deciduous)	Needleleaf
Shrubland with sparse (< 25%) tree layer)	Evergreen (< 25% deciduous)	Mixed
Herbaceous with sparse (< 25%) tree layer	Perennial graminoid*	Broadleaf Herbaceous
Herbaceous with sparse (< 25%) shrub layer	Perennial forb*	Graminoid
Herbaceous	Annual graminoid*	Pteridophyte
Nonvascular Bryophyte	Annual herbaceous*	Bryophyte
Nonvascular Lichen	Not applicable	Lichen
Sparsely Vegetated (<10% cover) Vascular	* = may select more than one, if mixed	Algae

III. SPECIES COMPOSITION AND COVER CLASS BY STRATUM. Record species cover in the following cover classes:
1=trace, 2=a few to frequent, but scattered (<1%), 3=1-2%, 4=2-5%, 5=5-10%, 6=10-25%, 7=25-50%, 8=50-75%, 9=75-95%, 10=95-100%
record cover values for each stratum AND for total cover in entire sample. Check "C" for collection, "D" for discard, ID flag 1-5

T1	T2	T3	S1	S2	S3	H	V	E	N		TC	TAXON NAME	C	#	D

Figure A-1 (continued). AMIS 2012 Plot Form Example.

AA Point Code: AMIS_AA #_____

SITE NAME: _____(for GPS verification) WPT:_____

DATE: MO _____DAY_____ YEAR 2017 Start time:_____

SURVEYORS: _____(circle names making plant association)

WAYPOINT: _____GPS Unit ID: _____

UTM Zone: 14 Datum: NAD83 GPS Unit Make and Model: Garmin Montana 650t or 680t (circle one)

UTM: X (Easting) _____ Y (Northing) _____elev. _____m

GPS ERROR _____m #Satellites _____

ENVIRONMENTAL INFORMATION:

Landform:_____ Topographic Description:_____
Ex. Ridge, canyon floor, terrace, river bank, arroyo Ex. Top of ridge, mid-slope, base of slope

Slope: ° (0-90°) (Use a clinometer) Aspect of slope: degrees (0-360°)

PLOT INFORMATION:

Plot Shape (circle one): circle rectangle square

Plot Size:_____(ha) Dimensions: Length =_____m x Width =_____m / or radius =_____ m

Plot Comments:

PHOTO DOCUMENTATION Photographer: _____

Image	Image ID#	Bearing (degrees)	Comments; mark most representative view
Datasheet Image		N/A	
N			
E			
S			
W			

ENVIRONMENTAL & DISTURBANCE COMMENTS (circle all that apply)

1. Natural disturbance. 2. Flooding evidence. 3. Fire history. 4. Anthropogenic disturbance. 5. Overgrazed. 6. In use by livestock. 7. Old ranch site. 8. Dead trees. 9. Invasive species present. 10. Other (Describe).

Vouchers Collected: LIST Taxon name and I.D. with Unique Number:

Taxon	I.D. # & Photo #	Verified I.D. Taxon Name

Figure A-2. AMIS 2017 Accuracy Assessment Form Example (blank).

2017ACCURACY ASSESSMENT FORM – AMIS

PLANT ASSOCIATION AT AA POINT **AMIS AA#_____**

Based on Classification Key and within plot dimensions of AA target point:

Primary Association by Name: _____

Secondary Association by Name: _____

Tertiary Association by Name: _____

Veg Key Fit: **H** **M** **L** **Fit of plants to veg Key:** **H** **M** **L**

Veg Key Comments (Circle all that apply and briefly describe): 1. Field key did not work. 2. Unusual vegetation conditions that may affect the identification of veg type. 3. Secondary field call (if significant ambiguity about primary field call). 4. Tertiary field call (if significant ambiguity about primary and secondary call). 5. Obviously undescribed vegetation type. 6. Other:

DOMINANT VEGETATION BY STRATUM (COVER CLASS) *Note: c.s. = Cover Scale, see Legend, below.*

T1 20-35m	Total % Cover in plot_____%	c.s.	S3 <0.5m	Total % Cover in plot _____%	c.s.
1			1		
2			2		
3			3		
T2 10-20m	**Total % Cover in plot_____%**	**c.s.**	**Herb/Grass**	**Total % Cover in plot _____%**	**c.s.**
1			1		
2			2		
3			3		
T3 5-10m	**Total % Cover in plot_____%**	**c.s.**	**Vine**	**Total % Cover in plot _____%**	**c.s.**
1			1		
2			2		
3			3		
S1 2-5m	**Total % Cover in plot_____%**	**c.s.**	**Aquatic E S F**	**Total % Cover in plot _____%**	**c.s.**
1			1		
2			2		
3			3		
S2 0.5-2m	**Total % Cover in plot_____%**	**c.s.**	**Other tree or shrub species > 10% cover in plot***		**c.s.**
1			1		
2			2		
3			3		

*** List stratum (i.e. S1) with species name (i.e. Cepa occi)**

***Cover Scale Legend:**

1=	trace (1- 3 plants)		
2=	few to frequent but scattered (>3 plants but <1% cover)	**6=**	10-25%
		7=	25-50%
3=	1-2%	**8=**	50-75%
4=	2-5%	**9=**	75-95%
5=	5-10%	**10=**	95-100%

Figure A-2 (continued). AMIS 2017 Accuracy Assessment Form Example (blank).

Appendix B. AMIS List of Plant Species

Plant Species Found During the AMIS Field Sampling

This appendix contains a list of the vascular plant taxa observed at AMIS during the vegetation classification plot and accuracy assessment sampling (Table B-1.). Genera, species, and infraspecific taxa are sorted alphabetically within families. The families are sorted alphabetically within the following order of Class/Division: Pteridophytes, Gymnosperms, Dicots, and Monocots. See end of table for reference code legend and nomenclature footnotes.

Table B-1. AMIS Plant Species

Family	Scientific (Latin) Name and Author	Common name	Ref.
Pteridaceae	*Astrolepis integerrima (Hook.) Benham & Windham*	hybrid cloakfern	Tndd
	Cheilanthes Sw.	lipfern	Tndd
	Notholaena R. Br.	cloak fern	Tndd
	Pellaea ovata (Desv.) Weath.	ovateleaf cliffbrake	Tndd
Selaginellaceae	*Selaginella P. Beauv.*	spikemoss	Tndd
	Selaginella lepidophylla (Hook. & Grev.) Spring	flower of stone	Tndd
	Selaginella wrightii Hieron.	Wright's spikemoss	Tndd
Cupressaceae	*Juniperus L.*	juniper	Po2
	Juniperus pinchotii Sudw.	Pinchot's juniper	Po2
Ephedraceae	*Ephedra antisyphilitica Berl. ex C.A. Mey.*	clapweed	Po2
	Ephedra aspera Engelm. ex S. Watson	rough jointfir	Tndd
Acanthaceae	*Dyschoriste linearis (Torr. & A. Gray) Kuntze*	polkadots	PW
	Ruellia L.	wild petunia	PW
	Ruellia ciliatiflora Hook.	hairyflower wild petunia	PW
Amaranthaceae	*Alternanthera caracasana Kunth*	washerwoman	PW
	Froelichia Moench	snakecotton	PW
	Froelichia gracilis (Hook.) Moq.	slender snakecotton	PW
Anacardiaceae	*Pistacia mexicana Kunth*	American pistachio	PW
	Rhus microphylla Engelm. ex A. Gray	littleleaf sumac	PW
	Rhus virens Lindh. ex A. Gray	evergreen sumac	PW
	Toxicodendron radicans (L.) Kuntze	eastern poison ivy	PW

Table B-1 (continued). AMIS Plant Species

Family	Scientific (Latin) Name and Author	Common name	Ref.
Apiaceae	*Ammoselinum popei Torr. & A. Gray*	plains sandparsley	PW
	Bowlesia incana Ruiz & Pav.	hoary bowlesia	PW
	Daucus pusillus Michx.	American wild carrot	PW
	Torilis arvensis (Huds.) Link	spreading hedgeparsley	PW
Apocynaceae	*Amsonia Walter*	blustar	PW
	Amsonia longiflora Torr. var. salpignantha (Woodson) S.P. McLaughlin	tubular bluestar	PW
	Asclepias oenotheroides Cham. & Schltdl.	zizotes milkweed	PW
	Cynanchum barbigerum (Scheele) Shinners	bearded swallow-wort	PW
	Cynanchum L.	swallow-wort	PW
	Cynanchum racemosum (Jacq.) Jacq. var. unifarium (Scheele) E. Sundell	talayote	PW
	Funastrum Fourn.	twinevine	PW
	Funastrum cynanchoides (Decne.) Schltr.	fringed twinevine	PW
	Mandevilla macrosiphon (Torr.) Pichon	plateau rocktrumpet	PW
	Matelea Aubl.	milkvine	PW
	Matelea sagittifolia (A. Gray) Woodson	arrowleaf milkvine	PW
Aristolochiaceae	*Aristolochia coryi I.M. Johnst.*	Cory's dutchman's pipe	PW
Asteraceae	*Acourtia runcinata (Lag. ex D. Don) B.L. Turner*	featherleaf desertpeony	PW
	Ambrosia L.	ragweed	PW
	Aphanostephus DC.	dozedaisy	PW
	Baccharis L.	baccharis	PW
	Baccharis neglecta Britton	Rooseveltweed	PW
	Brickellia laciniata A. Gray	splitleaf brickellbush	PW
	Calyptocarpus vialis Less.	straggler daisy	PW
	Centaurea L.	knapweed	PW
	Centaurea melitensis L.	Maltese star-thistle	PW
	Chaetopappa DC.	eastdaisy	PW
	Chaetopappa bellioides (A. Gray) Shinners	manyflower lleastdaisy	PW
	Chloracantha spinosa (Benth.) G.L. Nesom	spiny chloracantha	PW

Table B-1 (continued). AMIS Plant Species

Family	Scientific (Latin) Name and Author	Common name	Ref.
Asteraceae (continued)	*Chrysactinia mexicana A. Gray*	damianita	PW
	Cirsium Mill.	thistle	PW
	Cirsium texanum Buckley	Texas thistle	PW
	Conoclinium greggii (A. Gray) Small	palmleaf thoroughwort	1
	Conyza canadensis (L.) Cronquist	Canadian horseweed	PW
	Erigeron L.	fleabane	PW
	Erigeron modestus A. Gray	plains fleabane	PW
	Eupatorium serotinum Michx.	lateflowering thoroughwort	PW
	Evax Gaertn.	pygmy cudweed	Dlo
	Evax verna Raf.	spring pygmycudweed	Dlo
	Flourensia cernua DC.	American tarwort	PW
	Flyriella parryi (A. Gray) R.M. King & H. Rob.	Chisos Mountain brickellbush	PW
	Gaillardia Foug.	blanketflower	PW
	Gaillardia pulchella Foug.	Indian blanket	PW
	Gaillardia pulchella Foug. var. pulchella	Indian blanket	PW
	Gaillardia suavis (A. Gray & Engelm.) Britton & Rusby	perfumeballs	PW
	Gamochaeta Weddell	everlasting	PW
	Gutierrezia Lag.	snakeweed	PW
	Gutierrezia microcephala (DC.) A. Gray	threadleaf snakeweed	PW
	Gutierrezia sarothrae (Pursh) Britton & Rusby	broom snakeweed	PW
	Gymnosperma glutinosum (Spreng.) Less.	gumhead	PW
	Haploesthes greggii A. Gray	false broomweed	PW
	Helenium L.	sneezeweed	PW
	Helenium microcephalum DC.	smallhead sneezeweed	PW
	Liatris Gaertn. ex Schreb.	blazing star	PW
	Palafoxia Lag.	palafox	PW
	Parthenium confertum A. Gray	Gray's feverfew	PW
	Parthenium L.	feverfew	PW

Table B-1 (continued). AMIS Plant Species

Family	Scientific (Latin) Name and Author	Common name	Ref.
Asteraceae (continued)	*Parthenium incanum Kunth*	mariola	PW
	Pinaropappus Roseus (Less.) Less.	white rocklettuce	PW
	Pluchea Cass.	camphorweed	PW
	Pluchea odorata (L.) Cass.	sweetscent	PW
	Porophyllum scoparium A. Gray	Trans-Pecos poreleaf	PW
	Pseudognaphalium Kirp.	cudweed	PW
	Pseudognaphalium luteoalbum (L.) Hilliard & B.L. Burtt	Jersey cudweed	PW
	Pseudognaphalium stramineum (Kunth) Anderb.	cottonbatting plant	PW
	Psilostrophe tagetina (Nutt.) Greene	woolly paperflower	PW
	Ratibida columnifera (Nutt.) Wooton & Standl.	upright prairie coneflower	PW
	Senecio flaccidus Less. var. flaccidus	threadleaf ragwort	PW
	Silybum marianum (L.) Gaertn.	blessed milkthistle	Tndd
	Sonchus oleraceus L.	common sowthistle	PW
	Symphyotrichum Nees	aster	PW
	Thelesperma filifolium (Hook.) A. Gray	stiff greenthread	PW
	Thelesperma simplicifolium A. Gray	slender greenthread	PW
	Thymophylla Lag.	pricklyleaf	PW
	Thymophylla acerosa (DC.) Strother	pricklyleaf dogweed	PW
	Thymophylla micropoides (DC.) Strother	woolly pricklyleaf	PW
	Thymophylla pentachaeta (DC.) Small	fiveneedle pricklyleaf	S1
	Thymophylla pentachaeta (DC.) Small var. pentachaeta	fiveneedle pricklyleaf	S1
	Verbesina encelioides (Cav.) Benth. & Hook. f. ex A. Gray	golden crownbeard	PW
	Verbesina encelioides (Cav.) Benth. & Hook. f. ex A. Gray ssp. exauriculata (B.L. Rob. & Greenm.) J.R. Coleman	golden crownbeard	GP
	Viguiera stenoloba S.F. Blake	resinbush	Tndd
	Wedelia acapulcensis Kunth var. hispida (Kunth) Strother	hairy wedelia	S2

Table B-1 (continued). AMIS Plant Species

Family	Scientific (Latin) Name and Author	Common name	Ref.
Asteraceae (continued)	*Xanthium strumarium L.*	rough cocklebur	PW
	Xanthium strumarium L. var. canadense (Mill.) Torr. & A. Gray	Canada cocklebur	Dlo
Berberidaceae	*Mahonia trifoliolata (Moric.) Fedde*	algerita	2
Bignoniaceae	*Chilopsis linearis (Cav.) Sweet ssp. arcuata (Fosberg) Henrickson*	desert willow	PW
Boraginaceae	*Cryptantha Lehm. ex G. Don*	cryptantha	PW
	Heliotropium curassavicum L.	salt heliotrope	PW
	Heliotropium curassavicum L. var. curassavicum	salt heliotrope	PW
	Heliotropium procumbens Mill.	fourspike heliotrope	Tndd
	Heliotropium torreyi I.M. Johnst.	slimleaf heliotrope	Tndd
	Lappula squarrosa (Retz.) Dumort.	European stickseed	A
	Nama L.	fiddleleaf	PW
	Nama hispidum A. Gray	bristly nama	Dlo
	Nama jamaicense L.	Jamaicanweed	PW
	Nama parvifolium (Torr.) Greenm.	small-leaf fiddleleaf	Tndd
	Phacelia congesta Hook.	caterpillars	PW
	Tiquilia Pers.	crinklemat	PW
	Tiquilia canescens (DC.) A.T. Richardson	woody crinklemat	PW
	Tiquilia canescens (DC.) A.T. Richardson var. canescens	woody crinklemat	PW
Brassicaceae	*Lepidium L.*	pepperweed	PW
	Lesquerella argyraea (A. Gray) S. Watson	silver bladderpod	Tndd
	Physaria (Nutt. ex Torr. & A. Gray) A. Gray	twinpod	PW
Cactaceae	*Ancistrocactus brevihamatus (Engelm.) Britton & Rose*	shorthook fishhook cactus	PW
	Coryphantha (Engelm.) Lem.	beehive cactus	PW
	Coryphantha sulcata (Engelm.) Britton & Rose	pineapple cactus	PW
	Cylindropuntia leptocaulis (DC.) F.M. Knuth	Christmas cactus	PW

Table B-1 (continued). AMIS Plant Species

Family	Scientific (Latin) Name and Author	Common name	Ref.
Cactaceae (continued)	*Echinocactus texensis Hopffer*	horse crippler	PW
	Echinocereus coccineus Engelm. var. paucispinus (Engelm.) D.J. Ferguson	scarlet hedgehog cactus	PW
	Echinocereus enneacanthus Engelm.	pitaya	PW
	Echinocereus enneacanthus Engelm. var. enneacanthus	pitaya	PW
	Echinocereus reichenbachii (Terscheck ex Walp.) hort ex Haage	lace hedgehog cactus	PW
	Echinocereus stramineus (Engelm.) F. Seitz	strawberry hedgehog cactus	PW
	Epithelantha micromeris (Engelm.) F.A.C. Weber ex Britton & Rose	pingpong-ball cactus	PW
	Ferocactus hamatacanthus (Muehlenpf.) Britton & Rose	turk's head	PW
	Ferocactus hamatacanthus (Muehlenpf.) Britton & Rose var. hamatacanthus	turk's head	PW
	Grusonia schottii (Engelm.) H. Rob.	Big Bend pricklypear	Pi
	Mammillaria Haw.	globe cactus	PW
	Mammillaria heyderi Muehlenpf. var. heyderi	little nipple cactus	PW
	Neolloydia conoidea (DC.) Britton & Rose	Chihuahuan beehive	PW
	Opuntia atrispina Griffiths	border pricklypear	PW
	Opuntia camanchica Engelm. & J.M. Bigelow	tulip pricklypear	PW
	Opuntia engelmannii Salm-Dyck ex Engelm.	cactus apple	PW
	Opuntia engelmannii Salm-Dyck ex Engelm. var. lindheimeri (Engelm.) Parfitt & Pinkava	Texas pricklypear	PW
	Opuntia macrorhiza Engelm.	twistspine pricklypear	PW
	Opuntia Mill.	pricklypear	PW
	Thelocactus setispinus (Engelm.) E.F. Anderson	miniature barrel cactus	Edl
Campanulaceae	*Triodanis Raf. ex Greene*	Venus' looking-glass	PW
	Triodanis coloradoensis (Buckley) McVaugh	Colorado Venus' looking-glass	PW
Cannabaceae	*Celtis L.*	hackberry	PW
	Celtis ehrenbergiana (Klotzsch) Liebm.	spiny hackberry	3

Table B-1 (continued). AMIS Plant Species

Family	Scientific (Latin) Name and Author	Common name	Ref.
Cannabaceae (continued)	*Celtis laevigata Willd.*	sugarberry	Po2
	Celtis laevigata Willd. var. laevigata	sugarberry	Po2
	Celtis laevigata Willd. var. reticulata (Torr.) L.D. Benson	netleaf hackberry	Po2
Celastraceae	*Schaefferia cuneifolia A. Gray*	desert yaupon	PW
Chenopodiaceae	*Chenopodium berlandieri Moq. var. berlandieri*	pitseed goosefoot	CM
Convolvulaceae	*Convolvulus L.*	bindweed	PW
	Convolvulus equitans Benth.	Texas bindweed	PW
	Cuscuta L.	dodder	PW
	Dichondra J.R. Forst. & G. Forst.	ponysfoot	PW
	Evolvulus L.	dwarf morning-glory	PW
	Evolvulus alsinoides (L.) L. var. angustifolius Torr.	slender dwarf morning-glory	PW
	Evolvulus sericeus Sw.	silver dwarf morning-glory	PW
	Ipomoea L.	morning-glory	PW
	Ipomoea cordatotriloba Dennst.	tievine	PW
	Ipomoea cordatotriloba Dennst. var. cordatotriloba	tievine	Tndd
	Merremia dissecta (Jacq.) Hallier f.	noyau vine	PW
Cucurbitaceae	*Cucurbita foetidissima Kunth*	Missouri gourd	PW
	Ibervillea Greene	globeberry	PW
	Ibervillea tenuisecta (A. Gray) Small	slimlobe globeberry	PW
	Melothria pendula L.	Guadeloupe cucumber	PW
Ebenaceae	*Diospyros texana Scheele*	Texas persimmon	PW
Euphorbiaceae	*Acalypha L.*	copperleaf	PW
	Acalypha monostachya Cav.	round copperleaf	PW
	Acalypha phleoides Cav.	shrubby copperleaf	PW
	Argythamnia P. Brown	silverbush	PW
	Argythamnia humilis (Engelm. & A. Gray) Müll. Arg.	low silverbush	PW
	Argythamnia serrata (Torr.) Müll. Arg.	Yuma silverbush	PW

Table B-1 (continued). AMIS Plant Species

Family	Scientific (Latin) Name and Author	Common name	Ref.
Euphorbiaceae (continued)	*Bernardia myricifolia (Scheele) S. Watson*	mouse's eye	PW
	Chamaesyce A. Gray	sandmat	Tndd
	Croton L.	croton	PW
	Croton dioicus Cav.	grassland croton	PW
	Croton fruticulosus Engelm. ex Torr.	bush croton	PW
	Croton incanus Kunth	Torrey's croton	PW
	Croton monanthogynus Michx.	prairie tea	PW
	Jatropha dioica Cerv.	leatherstem	PW
	Jatropha dioica Cerv. var. dioica	leatherstem	PW
	Phyllanthus polygonoides Nutt. ex Spreng.	smartweed leaf-flower	PW
	Ricinus communis L.	castorbean	PW
	Stillingia texana I.M. Johnst.	Texas toothleaf	PW
	Stillingia treculiana (Müll. Arg.) I.M. Johnst.	Trecul's toothleaf	PW
	Tragia L.	noseburn	PW
Fabaceae	*Calliandra conferta Benth.*	Rio Grande stickpea	Is
	Dalea formosa Torr.	featherplume	PW
	Dalea L.	prairie clover	PW
	Eysenhardtia texana Scheele	Texas kidneywood	PW
	Galactia texana (Scheele) A. Gray	Texas milkpea	PW
	Indigofera lindheimeriana Scheele	Lindheimer's indigo	PW
	Leucaena retusa Benth.	littleleaf leadtree	PW
	Lupinus L.	lupine	PW
	Melilotus officinalis (L.) Lam.	yellow sweetclover	PW
	Mimosa L.	sensitive plant	PW
	Mimosa aculeaticarpa Ortega var. biuncifera (Benth.) Barneby	catclaw mimosa	PW
	Mimosa borealis A. Gray	fragrant mimosa	PW
	Mimosa texana (A. Gray) Small	Texas mimosa	PW
	Parkinsonia aculeata L.	Jerusalem thorn	PW
	Parkinsonia texana (A. Gray) S. Watson	Texas paloverde	Is

Table B-1 (continued). AMIS Plant Species

Family	Scientific (Latin) Name and Author	Common name	Ref.
Fabaceae (continued)	*Parkinsonia texana (A. Gray) S. Watson var. texana*	Texas paloverde	Is
	Prosopis glandulosa Torr.	honey mesquite	PW
	Prosopis glandulosa Torr. var. glandulosa	honey mesquite	PW
	Senegalia berlandieri Britton & Rose	guajillo	PW
	Senegalia greggii (A. Gray) Britton & Rose	catclaw acacia	PW
	Senegalia roemeriana (Scheele) Britton & Rose	roundflower catclaw	PW
	Senegalia wrightii (Benth.) Britton & Rose	catclaw acacia	PW
	Senna Mill.	senna	PW
	Senna bauhinioides (A. Gray) Irwin & Barneby	twinleaf senna	PW
	Senna lindheimeriana (Scheele) Irwin & Barneby	velvet leaf senna	PW
	Senna roemeriana (Scheele) Irwin & Barneby	twoleaf senna	PW
	Sophora secundiflora (Ortega) Lag. ex DC.	mescal bean	Is
	Vachellia constricta (Benth.) Seigler & Ebinger	whitethorn acacia	PW
	Vachellia farnesiana (L.) Wight & Arn.	huisache = sweet acacia	PW
	Vachellia rigidula (Benth.) Seigler & Ebinger	blackbrush acacia	PW
	Vachellia vernicosa (Britton & Rose) Seigler & Ebinger	vicid acacia	PW
	Vicia L.	vetch	PW
	Vicia ludoviciana Nutt.	Louisiana vetch	PW
Fagaceae	*Quercus L.*	oak	PW
	Quercus fusiformis Small	Texas live oak	PW
	Quercus gravesii Sudw.	Graves' = Chisos red oak	PW
	Quercus vaseyana Buckley	sandpaper oak	PW
Fouquieraceae	*Fouquieria splendens Engelm. ssp. splendens*	ocotillo	PW
Gentianaceae	*Centaurium beyrichii (Torr. & A. Gray ex Torr.) B.L. Rob.*	quinineweed	Tndd

Table B-1 (continued). AMIS Plant Species

Family	Scientific (Latin) Name and Author	Common name	Ref.
Juglandaceae	*Carya illinoinensis (Wangenh.) K. Koch*	pecan	PW
	Juglans microcarpa Berl.	little walnut	PW
Koeberliniaceae	*Koeberlinia spinosa Zucc.*	crown of thorns	PW
Krameriaceae	*Krameria L.*	ratany	PW
	Krameria erecta Willd. ex Schult.	littleleaf ratany	PW
	Krameria grayi Rose & Painter	white ratany	Tndd
	Krameria ramosissima (A. Gray) S. Watson	manystem ratany	PW
Lamiaceae	*Hedeoma Pers.*	false pennyroyal	PW
	Hedeoma acinoides Scheele	slender false pennyroyal	PW
	Hedeoma drummondii Benth.	Drummond's false pennyroyal	PW
	Hedeoma hispida Pursh	rough false pennyroyal	Tndd
	Hedeoma nana (Torr.) Briq.	dwarf false pennyroyal	PW
	Marrubium vulgare L.	horehound	PW
	Salvia ballotiflora Benth.	shrubby blue sage	PW
	Salvia farinacea Benth.	mealycup sage	PW
	Salvia roemeriana Scheele	cedar sage	PW
	Salvia texana (Scheele) Torr.	Texas sage	PW
	Scutellaria L.	skullcap	PW
	Scutellaria drummondii Benth.	Drummond's skullcap	PW
	Teucrium canadense L.	Canada germander	PW
Loasaceae	*Cevallia sinuata Lag.*	stinging serpent	PW
	Mentzelia L.	blazingstar	PW
Malpighiaceae	*Galphimia angustifolia Benth.*	narrowleaf goldshower	PW
Malvaceae	*Abutilon Mill.*	Indian mallow	PW
	Abutilon fruticosum Guill. & Perr.	Texas Indian mallow	PW
	Abutilon incanum (Link) Sweet	pelotazo	PW
	Abutilon parvulum A. Gray	dwarf Indian mallow	PW
	Abutilon wrightii A. Gray	Wright's Indian mallow	PW
	Allowissadula holosericea (Scheele) D.M. Bates	Chisos Mountain false Indianmallow	PW

Table B-1 (continued). AMIS Plant Species

Family	Scientific (Latin) Name and Author	Common name	Ref.
Malvaceae (continued)	*Hibiscus martianus Zucc.*	heartleaf rosemallow	PW
	Malvastrum coromandelianum (L.) Garcke	threelobe false mallow	PW
	Meximalva filipes (A. Gray) Fryxell	texasfan	PW
	Sida L.	fanpetals	PW
	Sida abutifolia Mill.	spreading fanpetals	PW
	Sida tragiifolia A. Gray	earleaf fanpetals	PW
	Sphaeralcea A. St.-Hil.	globemallow	PW
	Sphaeralcea angustifolia (Cav.) G. Don	copper globemallow	PW
Meliaceae	*Melia azedarach L.*	Chinaberrytree	PW
Menispermaceae	*Cocculus carolinus (L.) DC.*	Carolina coralbead	PW
Moraceae	*Morus alba L.*	white mulberry	PW
Nyctaginaceae	*Acleisanthes A. Gray*	trumpets	PW
	Acleisanthes longiflora A. Gray	angel's trumpets	PW
	Allionia incarnata L.	trailing windmills	PW
	Boerhavia L.	spiderling	PW
	Boerhavia coccinea Mill.	scarlet spiderling	PW
	Boerhavia linearifolia A. Gray	narrowleaf spiderling	PW
	Mirabilis L.	four o' clock	PW
Oleaceae	*Forestiera acuminata (Michx.) Poir.*	eastern swampprivet	Tndd
	Forestiera angustifolia Torr.	Texas swampprivet	PW
	Fraxinus L.	ash	PW
	Fraxinus albicans Buckley	Texas ash	N
	Fraxinus berlandieriana DC.	Mexican ash	PW
	Fraxinus greggii A. Gray	Gregg's ash	PW
	Menodora heterophylla Moric. ex DC.	low menodora	PW
	Menodora scabra A. Gray	rough menodora	PW
Oxalidaceae	*Oxalis L.*	woodsorrel	PW
	Oxalis dichondrifolia A. Gray	peonyleaf woodsorrel	PW
	Oxalis dillenii Jacq.	slender yellow woodsorrel	PW
	Oxalis drummondii A. Gray	Drummond's woodsorrel	Tndd

Table B-1 (continued). AMIS Plant Species

Family	Scientific (Latin) Name and Author	Common name	Ref.
Papaveraceae	*Argemone L.*	pricklypoppy	PW
	Argemone mexicana L.	Mexican pricklypoppy	PW
Passifloraceae	*Passiflora tenuiloba Engelm.*	birdwing passionflower	PW
Phytolaccaceae	*Rivina humilis L.*	rougeplant	PW
Plantaginaceae	*Bacopa monnieri (L.) Pennell*	herb of grace	PW
	Leucospora multifida (Michx.) Nutt.	narrowleaf paleseed	Tndd
	Maurandella antirrhiniflora (Humb. & Bonpl. ex Willd.) Rothm.	climbing snapdragon	PW
	Penstemon baccharifolius Hook.	baccharisleaf beardtongue	PW
	Plantago L.	plantain	PW
	Plantago rhodosperma Decne.	redseed plantain	PW
Platanaceae	*Platanus occidentalis L.*	American sycamore	PW
Polygalaceae	*Polygala L.*	polygala	Tndd
	Polygala lindheimeri A. Gray	shrubby milkwort	Tndd
	Polygala lindheimeri A. Gray var. lindheimeri	shrubby milkwort	Tndd
	Polygala macradenia A. Gray	glandleaf milkwort	Tndd
Polygonaceae	*Polygonum punctatum Elliott*	dotted smartweed	Tndd
	Rumex L.	dock	PW
	Rumex crispus L.	curly dock	PW
Portulacaceae	*Portulaca pilosa L.*	kiss me quick	PW
Ranunculaceae	*Clematis L.*	leather flower	PW
	Clematis drummondii Torr. & A. Gray	Drummond's clematis	PW
	Clematis pitcheri Torr. & A. Gray var. pitcheri	bluebill	PW
Rhamnaceae	*Colubrina texensis (Torr. & A. Gray) A. Gray*	Texan hogplum	PW
	Condalia ericoides (A. Gray) M.C. Johnst.	javelina bush	PW
	Condalia hookeri M.C. Johnst.	Brazilian bluewood	Tndd
	Condalia spathulata A. Gray	knifeleaf condalia	Tndd
	Condalia viridis I.M. Johnst.	green snakewood	PW
	Karwinskia humboldtiana (Schult.) Zucc.	coyotillo	PW
	Ziziphus obtusifolia (Hook. ex Torr. & A. Gray) A. Gray	lotebush	PW

Table B-1 (continued). AMIS Plant Species

Family	Scientific (Latin) Name and Author	Common name	Ref.
Rosaceae	*Rubus L.*	blackberry	PW
Rubiaceae	*Cephalanthus occidentalis L.*	common buttonbush	PW
	Galium L.	bedstraw	PW
	Galium aparine L.	stickywilly	PW
	Galium uncinulatum DC.	bristly bedstraw	PW
	Houstonia acerosa (A. Gray) A. Gray ex Benth. & Hook. f.	needleleaf bluet	PW
Rutaceae	*Ptelea trifoliata L.*	common hoptree	PW
	Thamnosma texana (A. Gray) Torr.	rue of the mountains	PW
Salicaceae	*Salix L.*	willow	PW
	Salix nigra Marshall	black willow	Tndd
Sapindaceae	*Ungnadia speciosa Endl.*	Mexican buckeye	PW
Scrophulariaceae	*Leucophyllum frutescens (Berl.) I.M. Johnst.*	Texas barometer bush	PW
Simaroubaceae	*Castela erecta Turp. ssp. texana (Torr. & A. Gray) Cronquist*	Texan goatbush	PW
Solanaceae	*Calibrachoa parviflora (Juss.) D'Arcy*	seaside petunia	PW
	Chamaesaracha (A. Gray) Benth.	five eyes	PW
	Chamaesaracha coniodes (Moric. ex Dunal) Britton	gray five eyes	PW
	Datura wrightii Regel	sacred thorn-apple	PW
	Lycium berlandieri Dunal	Berlandier's wolfberry	PW
	Nicotiana L.	tobacco	PW
	Nicotiana glauca Graham	tree tobacco	PW
	Nicotiana repanda Willd. ex Lehm.	fiddleleaf tobacco	PW
	Physalis L.	groundcherry	PW
	Solanum elaeagnifolium Cav.	silverleaf nightshade	PW
	Solanum rostratum Dunal	buffalobur nightshade	PW
Sterculiaceae	*Melochia pyramidata L.*	pyramidflower	PW
Tamaricaceae	*Tamarix L.*	tamarisk	PW
	Tamarix ramosissima Ledeb.	saltcedar	Tndd

Table B-1 (continued). AMIS Plant Species

Family	Scientific (Latin) Name and Author	Common name	Ref.
Theophrastaceae	*Samolus ebracteatus Kunth*	limewater brookweed	PW
	Samolus ebracteatus Kunth ssp. cuneatus (Small) R. Knuth	limewater brookweed	Dlo
Urticaceae	*Parietaria pensylvanica Muhl. ex Willd.*	Pennsylvania pellitory	PW
Verbenaceae	*Aloysia Juss.*	beebrush	PW
	Aloysia gratissima (Gillies & Hook.) Troncoso	whitebrush	PW
	Glandularia bipinnatifida (Nutt.) Nutt.	Dakota mock vervain	PW
	Lantana L.	lantana	PW
	Lantana achyranthifolia Desf.	brushland shrubverbena	PW
	Lantana urticoides Hayek	West Indian shrubverbena	PW
	Lippia L.	lippia	PW
	Lippia graveolens Kunth	Mexican oregano	PW
	Phyla nodiflora (L.) Greene	turkey tangle fogfruit	PW
	Verbena L.	vervain	PW
	Verbena canescens Kunth	gray vervain	PW
	Verbena halei Small	Texas vervain	PW
	Verbena neomexicana (A. Gray) Small var. hirtella L.M. Perry	hillside vervain	CJ
	Vitex agnus-castus L.	lilac chastetree	Tndd
Viscaceae	*Phoradendron tomentosum (DC.) Engelm. ex A. Gray*	Christmas mistletoe	Tndd
Vitaceae	*Cissus trifoliata (L.) L.*	sorrelvine	PW
	Vitis L.	grape	PW
	Vitis monticola Buckley	sweet mountain grape	PW
	Vitis rupestris Scheele	sand grape	Tndd
Zygophyllaceae	*Guaiacum angustifolium Engelm.*	Texas lignum-vitae	PW
	Larrea tridentata (DC.) Coville	creosote bush	PW
Amaryllidaceae	*Allium L.*	onion	PW
	Cooperia Herb.	rainlily	Tndd
Asparagaceae	*Agave lechuguilla Torr.*	lechuguilla	PW
	Dasylirion texanum Scheele	Texas sotol	PW

Table B-1 (continued). AMIS Plant Species

Family	Scientific (Latin) Name and Author	Common name	Ref.
Asparagaceae (continued)	*Hesperaloe parviflora (Torr.) J.M. Coult.*	redflower false yucca	PW
	Nolina texana S. Watson	Texas sacahuista	PW
	Yucca L.	yucca	PW
	Yucca thompsoniana Trel.	Thompson's yucca	PW
	Yucca torreyi Shafer	Torrey's yucca	PW
Cyperaceae	*Carex L.*	sedge	PW
	Cladium mariscus (L.) Pohl ssp. jamaicense (Crantz) Kük.	Jamaica swamp sawgrass	PW
	Cyperus L.	flatsedge	PW
	Cyperus erythrorhizos Muhl.	redroot flatsedge	PW
	Cyperus odoratus L.	fragrant flatsedge	PW
	Eleocharis R. Br.	spikerush	PW
	Fimbristylis vahlii (Lam.) Link	Vahl's fimbry	Tndd
	Fuirena simplex Vahl	western umbrella-sedge	PW
Hydrocharitaceae	*Hydrilla verticillata (L. f.) Royle*	waterthyme	Tndd
Poaceae	*Andropogon glomeratus (Walter) Britton, Sterns & Poggenb.*	bushy bluestem	PW
	Aristida L.	threeawn	PW
	Aristida purpurea Nutt.	purple threeawn	PW
	Aristida purpurea Nutt. var. longiseta (Steud.) Vasey	Fendler threeawn	PW
	Aristida purpurea Nutt. var. purpurea	purple threeawn	PW
	Aristida purpurea Nutt. var. wrightii (Nash) Allred	Wright's threeawn	PW
	Arundo donax L.	giant reed	PW
	Bothriochloa ischaemum (L.) Keng	yellow bluestem	PW
	Bothriochloa ischaemum (L.) Keng var. songarica (Rupr. ex Fisch. & C.A. Mey.) Celarier & Harlan	yellow bluestem	Po1
	Bothriochloa Kuntze	beardgrass	PW
	Bothriochloa laguroides (DC.) Herter	silver beardgrass	PW

Table B-1 (continued). AMIS Plant Species

Family	Scientific (Latin) Name and Author	Common name	Ref.
Poaceae (continued)	*Bothriochloa laguroides (DC.) Herter ssp. torreyana (Steud.) Allred & Gould*	silver beardgrass	Po1
	Bouteloua barbata Lag.	sixweeks grama	PW
	Bouteloua curtipendula (Michx.) Torr.	sideoats grama	PW
	Bouteloua dactyloides (Nutt.) J.T. Columbus	buffalograss	Po1
	Bouteloua gracilis (Willd. ex Kunth) Lag. ex Griffiths	blue grama	PW
	Bouteloua hirsuta Lag.	hairy grama	PW
	Bouteloua Lag.	grama	PW
	Bouteloua rigidiseta (Steud.) Hitchc.	Texas grama	Tndd
	Bouteloua trifida Thurb.	red grama	PW
	Cenchrus L.	sandbur	Po1
	Cenchrus myosuroides Kunth	big sandbur	PW
	Chloris Sw.	windmill grass	PW
	Chloris cucullata Bisch.	hooded windmill grass	PW
	Cynodon dactylon (L.) Pers.	Bermudagrass	PW
	Dichanthium annulatum (Forssk.) Stapf	Kleberg's bluestem	Tndd
	Digitaria pubiflora (Vasey) Wipff	Carolina crabgrass	PW
	Elymus canadensis L.	Canada wildrye	PW
	Eragrostis von Wolf	lovegrass	PW
	Eragrostis barrelieri Daveau	Mediterranean lovegrass	PW
	Eragrostis curtipedicellata Buckley	gummy lovegrass	PW
	Eragrostis intermedia Hitchc.	plains lovegrass	PW
	Eragrostis lehmanniana Nees	Lehmann lovegrass	PW
	Eragrostis palmeri S. Watson	Rio Grande lovegrass	PW
	Erioneuron pilosum (Buckley) Nash	hairy woollygrass	PW
	Hesperostipa comata (Trin. & Rupr.) Barkworth	needle and thread	PW
	Heteropogon contortus (L.) P. Beauv. ex Roem. & Schult.	tanglehead	PW
	Hilaria belangeri (Steud.) Nash	curly-mesquite	PW

Table B-1 (continued). AMIS Plant Species

Family	Scientific (Latin) Name and Author	Common name	Ref.
Poaceae (continued)	*Limnodea arkansana (Nutt.) L.H. Dewey*	Ozark grass	PW
	Melica montezumae Piper	Montezuma melicgrass	PW
	Muhlenbergia Schreb.	muhly	PW
	Muhlenbergia porteri Scribn. ex Beal	bush muhly	PW
	Nassella leucotricha (Trin. & Rupr.) Pohl	Texas wintergrass	PW
	Panicum L.	panicgrass	PW
	Panicum hallii Vasey	Hall's panicgrass	PW
	Panicum hallii Vasey var. hallii	Hall's panicgrass	PW
	Panicum virgatum L.	switchgrass	PW
	Pappophorum bicolor Fourn.	pink pappusgrass	PW
	Paspalum L.	crowngrass	PW
	Pennisetum ciliare (L.) Link	buffelgrass	PW
	Phragmites australis (Cav.) Trin. ex Steud.	common reed	PW
	Pleuraphis mutica Buckley	tobosagrass	Tndd
	Polypogon monspeliensis (L.) Desf.	annual rabbitsfoot grass	PW
	Schizachyrium scoparium (Michx.) Nash	little bluestem	PW
	Setaria P. Beauv.	bristlegrass	PW
	Setaria grisebachii Fourn.	Grisebach's bristlegrass	PW
	Setaria leucopila (Scribn. & Merr.) K. Schum.	streambed bristlegrass	PW
	Setaria Scheelei (Steud.) Hitchc.	southwestern bristlegrass	PW
	Sorghum halepense (L.) Pers.	Johnsongrass	PW
	Sporobolus R. Br.	dropseed	PW
	Sporobolus pyramidatus (Lam.) Hitchc.	Madagascar dropseed	PW
	Tridens albescens (Vasey) Wooton & Standl.	white tridens	PW
	Tridens eragrostoides (Vasey & Scribn.) Nash	lovegrass tridens	Po1
	Tridens muticus (Torr.) Nash	slim tridens	Po1
	Tridens muticus (Torr.) Nash var. muticus	slim tridens	Po1
	Tridens texanus (S. Watson) Nash	Texas fluffgrass	PW
	Tripsacum dactyloides (L.) L.	eastern gamagrass	PW

Table B-1 (continued). AMIS Plant Species

Family	Scientific (Latin) Name and Author	Common name	Ref.
Potamogetonaceae	*Potamogeton L.*	pondweed	PW
Smilacaceae	*Smilax L.*	greenbrier	PW
	Smilax bona-nox L.	saw greenbrier	PW

The nomenclature for the list follows USDA-NRCS (2018), where possible (see exceptions below). Family assignments are based on Powell and Worthington (2018) for angiosperms and Turner et al. (2003) for pteridophytes and gymnosperms.

In the "Ref." (reference) column, the following codes denote literature sources are used as the stable source of the taxonomic concept that is associated with the Latin name that is used by USDA-NRCS (2018). While use of USDA-NRCS (2018) generally is required for many federal projects, the content lacks stability as a concept source, since the taxonomic concepts behind unique names are sometimes revised without notification to users.

A = Ackerfield (2015).
CJ = Correll and Johnston (1979).
CM = Clemants and Mosyakin (1999).
Edl = Everitt et al. (2002).
GP = The Great Plains Flora Association (1986).
Is = Isely (1998).
N = Nesom (2010).
Pi = Pinkava (2003).
Po1 = Powell (1994).
Po2 = Powell (1998).
PW = Powell and Worthington (2018).
S1 = Strother (2006a).
S2 = Strother (2006b).
Tndd = Turner et al. (2003).

In the "Ref." column, the following numeric designation is used to denote a synonym or equivalent concept for USDA-NRCS (2018) Latin names that could not be located in a published source.

1 = Conoclinium dissectum A. Gray of Powell and Worthington (2018).
2 = *Berberis trifoliolata* Moric. of Powell and Worthington (2018).
3 = *Celtis ehrenbergiana* Torr. of Powell and Worthington (2018).

Appendix C. AMIS Plant Association Field Keys

Field Key to the Vegetation Associations of AMIS

The Amistad National Recreation Area (AMIS) Vegetation Classification was completed as part of the National Park Service's National Vegetation Inventory Program. A diverse variety of plant associations and other vegetation types were classified using field data collected in 2012 by Lady Bird Johnson Wildflower Center at the University of Texas in Austin, TX. This key is structured to facilitate identification of plant associations with one or more dominant or characteristic species, and in some cases, the key also relates associations to their primary habitats and range within AMIS. Because of natural variation within plant associations, it is possible that a community can be keyed to more than one type. For sites within ecotones (areas where dominant species intermix between plant associations), it may be difficult to determine one definitive association name. Dominant species by general location are included below as an aid to the keys.

This key applies to terrestrial or wetland settings with natural surfaces (*i.e.*, does not include open water, human-made surfaces, or cultivated vegetation).

1A. The combined individual cover of List A1 taxa (riparian indicators) (Table C-1 below) is greater than or equal to the combined individual cover of List A2 taxa (upland indicators). use **Riparian Key** (page **C-2**)

1B. The combined individual cover of List A1 taxa (riparian indicators) (Table C-1 below) is less than the combined individual cover of List A2 taxa (upland indicators)....use **Upland Key** (page **C-5**)

Table C-1. List of Indicator Taxa.

Indicator Type	Scientific Name	Common Name
Riparian	*Alternanthera caracasana*	mat chaff-flower
	Arundo donax	giant cane
	Baccharis neglecta	Rooseveltweed
	Bacopa monnieri	coastal water-hyssop
	Cephalanthus occidentalis	buttonbush
	Cladium mariscus ssp. *jamaicensis*	swamp sawgrass
	Cynodon dactylon	Bermuda grass
	Eleocharis spp.*	spikerushes
	Heliotropium curassavicum	salt heliotrope
	Hydrilla verticillata	hydrilla
	Justicia Americana	American water-willow
	Panicum virgatum	switchgrass

* Treat these genera as single taxon (i.e., equivalent to other individual species)

Table C-1. List of Indicator Taxa.

Indicator Type	Scientific Name	Common Name
Riparian (continued)	*Phragmites australis*	common reed
	Phyla nodiflora	turkey tangle fogfruit
	Platanus occidentalis	eastern sycamore
	Salix spp.*	willows
	Schoenoplectus californicus	California bulrush
	Vachellia farnesiana (=*Acacia farnesiana*)	huisache
Upland	*Bouteloua* spp.	grama grasses, buffalo grass
	Calliandra conferta	Rio Grande stickpea
	Castela erecta ssp. *texana*	Hall's panicgrass
	Heliotropium torreyi	slimleaf heliotrope
	Leucophyllum frutescens	cenizo
	Lippia graveolens	Mexican oregano
	Karwinskia humboldtiana	coyotillo
	Mimosa spp.*	catclaws
	Panicum hallii	Hall's panicgrass
	Pappophorum bicolor	pink pappusgrass
	Senegalia berlandieri (=*Acacia berlandieri*)	guajillo
	Tiquilia canescens	woody crinklemat
	Vachellia rigidula (=A*cacia rigidula*)	blackbrush

* Treat these genera as single taxon (i.e., equivalent to other individual species)

Riparian Vegetation Key

R1A. The total cover of at least one individual woody stratum[1]** (tree or shrub) species is greater than or equal to 10% ..... go to **R2**

R2A. The combined individual cover of *Vachellia farnesiana* (huisache) and/or *Prosopis glandulosa* (honey mesquite) is greater than or equal to 7%..... go to **R3**

[1] Note: For purposes of defining "woody" versus herbaceous, this key follows Powell (1998). In terms of taxa found at AMIS that are most likely to affect use of this key, *Arundo donax*, a somewhat woody (bamboo-like) grass, and *Tiquilia canescens*, a perennial with a sometimes-woody base, are both regarded to be herbaceous (non-woody) species.

R3A. The cover of *Vachellia farnesiana* (huisache) is greater than or equal to the combined individual cover of *Prosopis glandulosa* (honey mesquite), *Diospyros texana* (Texas persimmon), and/or *Opuntia engelmannii* var. *lindheimeri* (Texas pricklypear) .... **Huisache Riparian Woodland**

R3B. The combined individual cover of *Prosopis glandulosa* (honey mesquite), *Diospyros texana* (Texas persimmon), and/or *Opuntia engelmannii* var. *lindheimeri* (Texas pricklypear) is greater than the cover of *Vachellia farnesiana*..... **Mesquite Riparian Woodland**

R2B. The combined individual cover of *Vachellia farnesiana* (huisache) and/or *Prosopis glandulosa* (honey mesquite) is less than 7%..... go to **R4**

R4A. The ***relative*** cover of *Tamarix* spp. (tamarisk) is greater than or equal to 50% of the total woody strata cover..... **Tamarisk Riparian Shrubland**

R4B. The ***relative*** cover of *Tamarix* spp. (tamarisk) is less than 50% of the total woody strata cover ..... go to **R5**

R5A. The combined individual cover of *Baccharis neglecta* (Rooseveltweed), *Baccharis salicifolia* (seep-willow), and/or *Nicotiana glauca* (tree-tobacco), (1) is greater than or equal to the combined individual cover of all *Salix* spp. (willows) AND (2) is greater than or equal to the cover of any other individual woody species, other than *Tamarix* spp. (tamarisk) (*i.e*., ignore cover of *Tamarix* spp. that may be present, for purposes of this couplet)..... **Rooseveltweed - Tree-tobacco Riparian Shrubland**

R5B. The combined individual cover of *Baccharis neglecta* (Rooseveltweed), *Baccharis salicifolia* (seep-willow), and/or *Nicotiana glauca*(tree-tobacco), EITHER (1) is less than the combined individual cover of all *Salix* spp. (willows) OR (2) or is less than the cover of any other individual woody species, other than *Tamarix spp*. (tamarisk) (*i.e*., ignore cover of any *Tamarix* spp. that may be present, for purposes of this couplet)..... go to **R6**

R6A. The combined individual cover of all *Salix* spp. (willows) is greater than or equal to the cover of any other woody species, excluding *Tamarix* spp. (tamarisk) .... **Willow Riparian Woodland**

R6B. The cover of at least one other woody species, excluding *Tamarix* spp. (tamarisk) is greater than the combined individual cover of all *Salix* spp. (willows)..... ..... **Edwards Plateau Stream Scoured Grassland**

R1B. The total cover of no individual woody stratum* (tree or shrub) species is greater than or equal to 10% ..... go to **R7**

R7A. The cover of *Hydrilla verticillata* (hydrilla) is greater than or equal to the cover of any other species..... **Hydrilla Submerged Aquatic Vegetation**

R7B. The combined cover of at least one other species is greater than the cover of *Hydrilla verticillata* (hydrilla)..... go to **R8**

R8A. The combined individual cover of all forb species (including, but not limited to, *Phyla nodiflora* (turkey tangle fogfruit), *Heliotropium curassavicum* (salt heliotrope), *Alternanthera caracasana* (mat chaff-flower), *Polygonum* spp. (smartweeds), *Senna lindheimeriana* (velvetleaf senna), *Bacopa monnieri* (coastal water-hyssop), and *Justicia americana* (American water-willow)) is greater than or equal to the combined individual cover of all grass (*Poaceae*) species (including, but not limited to, *Cynodon dactylon* (Bermuda grass), *Pennisetum ciliare* (buffelgrass), *Bothriochloa ischaemum* (yellow bluestem), *Arundo donax* (giant cane), *Phragmites australis* (common reed), *Panicum virgatum* (switchgrass), *Setaria* spp. (foxtails), and *Nassella leucotricha* (Texas wintergrass), etc.) and all sedge (*Cyperaceae*) species (including, but not limited to, *Eleocharis* spp. (spikerushes), *Cyperus* spp. (flatsedges), *Fimbristylis vahlii* (Vahl's fimbry), *Cladium mariscus* ssp. *jamaicensis* (swamp sawgrass), and/or *Schoenoplectus* spp. (bulrushes))..... go to **R9**

R9A. No other forb species has a higher cover than that of *Justicia americana* (American water-willow) ..... **Water-willow Riparian Herbaceous Vegetation**

R9B. At least one forb species has a higher cover than that of *Justicia americana* (American water-willow) ..... go to **R10**

R10A. BOTH (1) a species other than *Bacopa monnieri* (coastal water-hyssop) has the highest cover (or is equal in cover to the highest) of any vascular plant species AND (2) total plant cover is greater than 5% .... **Bermuda Grass - Fogfruit Riparian Herbaceous Vegetation**

R10B. EITHER *Bacopa monnieri* (coastal water-hyssop) has the highest cover of any vascular plant species OR total plant cover is less than or equal to 5% .... **Water Hyssop - Bermuda Grass - Fogfruit Sparse Riparian Herbaceous Vegetation**

R8B. The combined individual cover of forb species is less than the combined individual cover of all grass (*Poaceae*) species and/or all sedge (*Cyperaceae*) species ..... go to **R11**

R11A. The combined individual cover of all grass (*Poaceae*) species is greater than or equal to the combined individual cover of all sedge (*Cyperaceae*) species ..... go to **R12**

R12A. No other grass (*Poaceae*) species has a higher cover than that of *Panicum virgatum* (switchgrass)..... **Edwards Plateau Stream Scoured Grassland**

R12B. At least one grass (*Poaceae*) species has a higher cover than that of *Panicum virgatum* (switchgrass)..... go to **R13**

R13A. No other grass (*Poaceae*) species has a higher cover than that of *Cynodon dactylon* (Bermuda grass) ..... **Bermuda Grass - Fogfruit Riparian Herbaceous Vegetation**

R13B. At least one grass (*Poaceae*) species has a higher cover than that of *Cynodon dactylon* (Bermuda grass) ..... go to **R14**

R14A. No other grass (*Poaceae*) species has a higher cover than that of *Phragmites australis* (common reed) ..... **Common Reed Riparian Herbaceous Vegetation**

R14B. At least one grass (*Poaceae*) species has a higher cover than that of *Phragmites australis* (common reed)..... go to **R15**

R15A. No other grass (*Poaceae*) species has a higher cover than that of *Arundo donax* (giant cane)..... **Giant Cane Riparian Herbaceous Vegetation**

R15B. At least one grass (*Poaceae*) species has a higher cover than that of *Arundo donax* (giant cane)..... **Ruderal Mixed Grassland**

R11B. The combined individual cover of all grass (*Poaceae*) species is less than the combined individual cover of all sedge (*Cyperaceae*) species ..... go to **R16**

R16A. The cover of *Schoenoplectus californicus* (California bulrush) is greater than or equal to the cover of any other individual species..... ..... **California Bulrush Riparian Herbaceous Vegetation**

R16B. The cover of at least one species is greater than the cover of *Schoenoplectus californicus* (California bulrush)..... go to **R17**

R17A. The combined individual cover of all *Eleocharis* spp. (spike rushes) is greater than or equal to the cover of any other individual species..... **Spikerush Herbaceous Vegetation**

R17B. The cover of at least one species is greater than the combined individual cover of all *Eleocharis* spp. ..... **Edwards Plateau Stream Scoured Grassland**

Upland Vegetation Key

U1A. Total vascular plant cover is greater than or equal to ..... go to **U2**

U2A. The tree stratum cover (all woody plants > 5 meters tall) is greater than or equal to 15% ..... go to **U3**

U3A. No other species in the tree stratum has a higher cover than that of *Quercus gravesii* (Graves' oak)..... **Graves' Oak Woodland**

U3B. At least one species has a higher cover in the tree stratum than that of *Quercus gravesii* (Graves' oak)..... go to **U4**

U4A. No other species in the tree stratum has a higher cover than that of *Quercus fusiformis* (Texas live oak)..... **Texas Live Oak Woodland**

U4B. At least one species has a higher cover in the tree stratum than that of *Quercus fusiformis* (Texas live oak)..... go to **U5**

U5A. Either *Fraxinus greggii* (littleleaf ash) or *Quercus vaseyana* (Vasey scrub oak) has the highest cover in the tree stratum..... ..... **Vasey Scrub Oak - Littleleaf Ash - Hackberry Woodland**

U5B. A species other than *Fraxinus greggii* (littleleaf ash) or *Quercus vaseyana* (Vasey scrub oak) has the highest cover in the tree stratum..... go to **U6**

U2B. The tree stratum cover (all woody plants > 5 meters tall) is less than..... go to **U6**

U6A. BOTH (1) the herbaceous stratum cover is greater than or equal to 50% AND (2) the shrub stratum cover is less than 15% ..... go to **U7**

U7A. The combined individual cover of *Bouteloua* spp, (gramas, buffalo grass, etc.), *Pappophorum bicolor*, (pink pappusgrass), *Panicum hallii* (Hall's panicgrass) and/or *Tiquilia canescens* (woody crinklemat) is greater than or equal to the combined individual cover of *Dichanthium annulatum* (Kleberg's bluestem), *Pennisetum ciliare (buffelgrass)*, (buffelgrass), *Bothriochloa ischaemum* (yellow bluestem), and/or *Cynodon dactylon (Bermuda grass)* (Bermuda grass) .... **Dry Native Mixed Grassland**

U7B. The combined individual cover of *Bouteloua* spp, (gramas, buffalo grass), *Pappophorum bicolor*, (pink pappusgrass), *Panicum hallii* (Hall's panicgrass) and/or *Tiquilia canescens* (woody crinklemat) is less than the combined individual cover of *Dichanthium annulatum* (Kleberg's bluestem), *Pennisetum ciliare (buffelgrass)*, (buffelgrass), *Bothriochloa ischaemum* (yellow bluestem), and/or *Cynodon dactylon (Bermuda grass)* (Bermuda grass)..... **Ruderal Mixed Grassland**

U6B. EITHER (1) the herbaceous stratum cover is less than 50% OR (2) the shrub stratum cover is greater than or equal to 15%..... go to **U8**

U8A. The combined individual cover of *Fraxinus greggii* (littleleaf ash) and/or *Quercus vaseyana* (Vasey scrub oak) is greater than or equal to 10%..... ..... **Vasey Scrub Oak - Littleleaf Ash - Hackberry Woodland**

U8B. The combined individual cover of *Fraxinus greggii* (littleleaf ash) and/or *Quercus vaseyana* (Vasey scrub oak) is less than 10%. ..... .go to **U9**

U9A. The cover of *Prosopis glandulosa* (honey mesquite) is greater than or equal to 5% ..... go to **U10**

U10A. The cover of *Senegalia berlandieri* (guajillo) is greater than the cover of *Vachellia rigidula* (blackbrush) ..... go to **U11**

U11A. The cover of *Senegalia berlandieri* (guajillo) is greater than the cover of *Prosopis glandulosa* (honey mesquite) ..... **Guajillo - Cenizo Shrubland**

U11B. The cover of *Senegalia berlandieri* (guajillo) is less than or equal to the cover of *Prosopis glandulosa* (honey mesquite) ..... **Mesquite Upland Shrubland**

U10B. The cover of *Vachellia rigidula* (blackbrush) is greater than or equal to the cover of *Senegalia berlandieri* (guajillo) ..... go to **U12**

U12A. The combined individual cover of *Vachellia rigidula* (blackbrush) and/or *Diospyros texana* (Texas persimmon) is greater than the cover of *Prosopis glandulosa* (honey mesquite) ..... **Blackbrush - Mesquite - Texas Persimmon Shrubland**

U12B. The combined individual cover of *Vachellia rigidula* (blackbrush) and/or *Diospyros texana* (Texas persimmon) is less than or equal to the cover of *Prosopis glandulosa* (honey mesquite) ..... **Mesquite Upland Shrubland**

U9B. The cover of *Prosopis glandulosa* (honey mesquite) is less than 5% ... go to **U13**

U13A. The ***relative*** cover of *Mimosa* spp. (catclaws) in the shrub stratum is greater than or equal to 30% ..... **Mimosa Dwarf-Shrubland**

U13B. The ***relative*** cover of *Mimosa* spp. (catclaws) in the shrub stratum is less than 30% ..... go to **U14**

U14A. The combined individual cover of *Jatropha dioica* (leatherstem), *Agave lechuguilla* (lechuguilla), *Fouquieria splendens* (ocotillo), *Bernardia myricifolia* (mouse's eye), and/or *Ferocactus hamatacanthus* (turk's head cactus) is greater than or equal to 3% ..... **Dry Mixed Thornscrub Shrubland**

U14B. The combined individual cover of *Jatropha dioica* (leatherstem), *Agave lechuguilla* (lechuguilla), *Fouquieria splendens* (ocotillo), *Bernardia myricifolia* (mouse's eye), and/or *Ferocactus hamatacanthus* (turk's head cactus) is less than 3% ..... go to **U15**

U15A. The ***relative*** cover of *Vachellia vernicosa* (viscid acacia) in the shrub stratum is greater than or equal to 25% of the total shrub stratum cover ..... **Viscid Acacia Shrubland**

U15B. The ***relative*** cover of *Vachellia vernicosa* (viscid acacia) in the shrub stratum is less than 25% of the total shrub stratum cover ..... go to **U16**

U16A. The combined ***relative*** cover of *Vitex agnus-castus* (lilac chaste tree) and/or *Nicotiana glauca* (tree-tobacco) in the shrub stratum is greater than or equal to 50% of the total shrub stratum cover ..... **Lilac Chaste Tree Shrubland**

U16B. The combined ***relative*** cover of *Vitex agnus-castus* (lilac chaste tree) and/or *Nicotiana glauca* (tree-tobacco) in the shrub stratum is less than 50% of the total shrub stratum cover..... go to **U17**

U17A. The ***relative*** cover of *Leucophyllum frutescens* (cenizo) in the shrub stratum is greater than or equal to 50% of the total shrub stratum cover .... **Cenizo Shrubland**

U17B. The ***relative*** cover of *Leucophyllum frutescens* (cenizo) in the shrub stratum is less than 50% of the total shrub stratum cover ..... go to **U18**

U18A. The combined individual cover of *Vachellia rigidula* (blackbrush) and/or *Mahonia trifoliolata* (agarito) is greater than the combined individual cover of *Senegalia berlandieri* (guajillo) and/or *Salvia ballotiflora* (shrubby blue sage) .... go to **U19**

U19A. The cover of *Leucophyllum frutescens* (cenizo) is greater than 1% .... **Blackbrush - Cenizo Shrubland**

U19B. The cover of *Leucophyllum frutescens* (cenizo) is less than or equal to 1% ..... to **U20**

U20A. The cover of *Dasylirion texanum* (Texas sotol) is greater than 1%..... ..... **Blackbrush - Texas Persimmon - Texas Sotol Shrubland**

U20B. The cover of *Dasylirion texanum* (Texas sotol) is less than or equal to 1%. ..... **Blackbrush - Mesquite - Texas Persimmon Shrubland**

U18B. The combined individual cover of *Vachellia rigidula* (blackbrush) and/or *Mahonia trifoliolata* (agarito) is less than or equal to the combined individual cover of *Senegalia berlandieri* (guajillo) and/or *Salvia ballotiflora* (shrubby blue . go to **U21**

U21A. The combined individual cover of *Opuntia engelmannii* var. *lindheimeri* (Texas pricklypear), *Prosopis glandulosa* (honey mesquite), *Lippia graveolens* (Mexican oregano), and/or *Guaiacum angustifolium* (guayacan) is greater than or equal to the combined individual cover of *Vachellia rigidula* (blackbrush), *Karwinskia humboldtiana* (coyotillo), and/or *Croton incanus* (Torrey's croton ..... **Guajillo - Cenizo Shrubland**

U21B. The combined individual cover of *Opuntia engelmannii* var. *lindheimeri* (Texas pricklypear), *Prosopis glandulosa* (honey mesquite), *Lippia graveolens* (Mexican oregano), and/or *Guaiacum angustifolium* (guayacan) is less than the

combined individual cover of *Vachellia rigidula* (blackbrush), *Karwinskia humboldtiana* (coyotillo), and/or *Croton incanus* (Torrey's croton)..... .....**Guajillo - Blackbrush - Torrey Yucca Shrubland**

U1B. Total vascular plant cover is less than 5%..... go to **U22**

U22A. No vascular plants are visible within observation area ..... go to **U23**

U23A. Surface is comprised mainly of bedrock and is above or near the upper limits of the reservoir inundation zone ..... **Xeric Outcrop Sparse Vegetation**

U23B. Surface is comprised mainly of sediment and is below the upper limits of the reservoir inundation zone ....**Water Hyssop - Bermuda Grass - Fogfruit Sparse Riparian Herbaceous Vegetation**

U22B. At least some vascular plants are visible within observation area..... go to **U24**

U24A. The combined individual ***relative*** cover of *Porophyllum scoparium* (Trans-Pecos poreleaf), *Heterotheca fulcrata* rockyscree false goldenaster), and/or *Penstemon baccharifolius* (baccharisleaf beardtongue) is greater than or equal to the combined individual ***relative*** cover of *Vitex agnus-castus* (lilac chaste tree) *Nicotiana glauca* (tree-tobacco) and/or *Phyla nodiflora* (turkey tangle fogfruit) .... **Xeric Outcrop Sparse Vegetation**

U24B. The combined individual ***relative*** cover of *Porophyllum scoparium* (Trans-Pecos poreleaf), *Heterotheca fulcrata* rockyscree false goldenaster), and/or *Penstemon baccharifolius* (baccharisleaf beardtongue) is less than the combined individual ***relative*** cover of *Vitex agnus-castus* (lilac chaste tree) *Nicotiana glauca* (tree-tobacco) and/or *Phyla nodiflora* (turkey tangle fogfruit) .....go to **R4** (**Riparian Vegetation Key**)

Appendix D. AMIS Plant Association List and Descriptions

AMIS Plant Association rUSNVC List and Descriptions

List of Plant Associations within the rUSNVC Hierarchy for Amistad National Recreation Area

Vegetation associations are indicated by either (1) a global identification code assigned by NatureServe and beginning with the letters "CEGL", if the local association matches an association currently recognized by the USNVC or (2) a NPS identification code assigned by this project and beginning with the letters "NPS" (Lea 2011). Associations are grouped within their currently recognized (http:/usnvc.org) or projected USNVC hierarchy assignments. At this time, all alliances that have been recognized by the USNVC to date are under review and revision and descriptions are not available from or through usnvc.org. *Note: Represent associations that are derived from the Poole (2013) classification and are not represented by recent plot data.

USNVC Class: Forest and Woodland (1)

USNVC Subclass: Temperate & Boreal Forest & Woodland (1.B)

USNVC Formation: Warm Temperate Forest & Woodland (1.B.1)

USNVC Division: Madrean - Balconian Forest & Woodland (D060)

USNVC Macrogroup: Balconian Forest and Woodland (M015)

USNVC Group: Balconian Dry Hardwood Forest (G126)

USNVC Alliance: *Quercus fusiformis* - *Juniperus ashei* Woodland Alliance (A0477)

NPS Association: *Quercus fusiformis / Vachellia rigidula* Woodland (NPSAMIS004)

(Park Name: Texas Live Oak Woodland)

USNVC Alliance: *Juniperus ashei* Woodland Alliance (A3212)

NPS Association: *Quercus vaseyana – Fraxinus greggii – Celtis* spp. Woodland (NPSAMIS005)
(Park Name: Vasey Scrub Oak – Littleleaf Ash - Hackberry Woodland)

USNVC Group: Balconian Dry-Mesic Hardwood Forest (G028)

USNVC Alliance: Acer grandidentatum - Quercus muehlenbergii - Juglans major Forest & Woodland Alliance (A3214)

NPS Association: *Quercus gravesii* / *Pistacia mexicana* Woodland (NPSAMIS012)

(Park Name: Graves' Oak – Texas Pistachio Woodland) *

USNVC Formation: Temperate Flooded and Swamp Forest (1.B.3)

USNVC Division: Western North American Interior Flooded Forest (D062)

USNVC Macrogroup: Interior Warm & Cool Desert Riparian Forest (M036)

USNVC Group: Tamaulipan Riparian Scrub Forest (G549)

USNVC Alliance: *Vachellia farnesiana* - *Celtis ehrenbergiana* Riparian Scrub Alliance (A3841)

USNVC Association: *Vachellia farnesiana* - (*Prosopis glandulosa*) Riparian Woodland (CEGL002131)

(Park Name: Huisache Riparian Woodland)

USNVC Association: *Prosopis glandulosa* Riparian Woodland (NPSAMIS033)

(Park Name: Mesquite Riparian Woodland)

USNVC Alliance: *Celtis laevigata - Ulmus crassifolia / Urvillea ulmacea* Tamaulipan Riparian Scrub Alliance (A3842)

NPS Association: *Salix gooddingii - Salix thurberi - Fraxinus berlandieri* Woodland (NPSAMIS035)

(Park Name: Willow Riparian Woodland) *

USNVC Macrogroup: Interior West Ruderal Flooded & Swamp Forest & Woodland (M298)

USNVC Group: Interior West Ruderal Riparian Forest & Scrub (G510)

USNVC Alliance: *Tamarix* spp. Ruderal Riparian Scrub Alliance (A0842)

USNVC Association: *Tamarix* spp. Ruderal Riparian Shrubland (CEGL003114)

(Park Name: Tamarisk Riparian Shrubland)

USNVC Class: Shrub and Herb Vegetation (2)

USNVC Subclass: Shrub & Herb Wetland (2.C)

USNVC Formation: Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland (2.C.4)

USNVC Division: Eastern North America Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland (D323)

USNVC Macrogroup: Great Plains Marsh, Wet Meadow Shrubland & Playa (M071)

USNVC Group: Great Plains Riverscour Vegetation (G568)

USNVC Alliance: *Panicum virgatum - Andropogon glomeratus* Riverscour Wet Meadow Alliance (A4115)

USNVC Association: P*anicum virgatum - Andropogon glomeratus - Cladium mariscus* ssp. *jamaicense* Riverbank Herbaceous Vegetation (CEGL004928)

(Park Name: Edwards Plateau Stream Scoured Grassland) *

USNVC Group: Great Plains Freshwater Marsh (G325)

USNVC Alliance: *Eleocharis palustris* Great Plains Marsh Alliance (A3489)

NPS Association: *Eleocharis spp*. Comanchian - Tamaulipan Herbaceous Vegetation (NPSAMIS029)

(Park Name: Spikerush Herbaceous Vegetation) *

USNVC Macrogroup: Eastern North American Wet Shoreline Vegetation (M880)

USNVC Group: Eastern North American Riverine Wetland Vegetation (G755)

USNVC Alliance: *Justicia americana* Edwards Plateau Riverbed Alliance (A3853)

USNVC Association: *Justicia americana - Bacopa monnieri* Edwards Plateau Herbaceous Vegetation (CEGL004926)

(Park Name: Water-willow Riparian Herbaceous Vegetation) *

USNVC Division: Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland (D031)

USNVC Macrogroup: Western North American Ruderal Marsh, Wet Meadow & Shrubland (M301)

USNVC Group: Western North American Ruderal Marsh, Wet Meadow & Shrubland (G524)

USNVC Alliance: *Phragmites australis - Arundo donax - Alopecurus pratensis* Ruderal Marsh Alliance (A3847)

USNVC Association: *Arundo donax* Riverbank Herbaceous Vegetation (CEGL004101)

(Park Name: Giant Cane Riparian Herbaceous Vegetation) *

USNVC Association: *Phragmites australis* ssp. *berlandieri* Riverbank Wet Meadow (CEGL004115)

(Park Name: Common Reed Riparian Herbaceous Vegetation) *

NPS Association: *Cynodon dactylon - Phyla nodiflora* - (*Heliotropium curassavicum*) Riparian Herbaceous Vegetation (NPSAMIS002)

(Park Name: Bermuda Grass - Fogfruit Riparian Herbaceous Vegetation)

NPS Association: *Baccharis neglecta - Nicotiana glauca* Shrubland (NPSAMIS007)

(Park Name: Rooseveltweed - Tree-tobacco Riparian Shrubland)

NPS Association: *Bacopa monnieri* - (*Cynodon dactylon*, *Phyla nodiflora*) Herbaceous Vegetation (NPSAMIS031)

(Park Name: Water Hyssop - Bermuda Grass - Fogfruit Sparse Riparian Herbaceous Vegetation)

USNVC Macrogroup: Arid West Interior Freshwater Marsh (M888)

USNVC Group: Arid West Interior Freshwater Marsh (G531)

USNVC Alliance: Schoenoplectus americanus - Schoenoplectus acutus - Schoenoplectus californicus Marsh Alliance (A3895)

NPS Association: *Schoenoplectus californicus* Tamaulipan Riparian Herbaceous Vegetation (NPSAMIS030)
(Park Name: California Bulrush Riparian Herbaceous Vegetation)

USNVC Class: Semi-Desert (3)

USNVC Subclass: Warm Semi-Desert Scrub & Grassland (3.A)

USNVC Formation: Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)

USNVC Division: North American Warm Desert Scrub & Grassland (D039)

USNVC Macrogroup: Tamaulipan Scrub and Grassland (M130)

USNVC Group: Tamaulipan Dry Mesquite and Thornscrub (G099)

USNVC Alliance: *Tamaulipan Vachellia rigidula - Leucophyllum frutescens - Senegalia berlandieri* Calcareous Thornscrub Alliance (A3191)

USNVC Association: *Leucophyllum frutescens* Shrubland (CEGL002168)

(Park Name: Cenizo Shrubland)

USNVC Association: *Vachellia rigidula* Shrubland (CEGL003874)

(Park Name: Blackbrush - Cenizo Shrubland)

USNVC Association: *Senegalia berlandieri - Leucophyllum frutescens* Shrubland (CEGL007758)
(Park Name: Guajillo - Cenizo Shrubland)

USNVC Association: *Vachellia rigidula - Leucophyllum frutescens - Senegalia berlandieri* Shrubland (CEGL007759)

(Park Name: Guajillo - Blackbrush - Torrey Yucca Shrubland)

NPS Association: *Vachellia rigidula - Diospyros texana - Dasylirion texanum* Shrubland (NPSAMIS003)

(Park Name: Blackbrush - Texas Persimmon - Texas Sotol Shrubland)

NPS Association: *Vachellia rigidula - Prosopis glandulosa - Diospyros texana* Shrubland (NPSAMIS032)

(Park Name: Blackbrush - Mesquite - Persimmon Shrubland)

NPS Association: *Vachellia rigidula - Opuntia engelmannii var. lindheimeri- Jatropha dioica-Lippia graveolens* Shrubland (NPSAMIS026)

(Park Name: Dry Mixed Thornscrub Shrubland)

NPS Association: *Mimosa borealis* Dwarf-shrubland (NPSAMIS013)

(Park Name: Mimosa Dwarf-shrubland)

USNVC Alliance: *Prosopis glandulosa* Tamaulipan Mixed Deciduous Thornscrub Alliance (A3169)

USNVC Association: Prosopis glandulosa var. glandulosa - Parkinsonia texana var. macra - (Cordia boissieri, Koeberlinia spinosa) Shrubland (CEGL007762)

(Park Name: Mesquite Upland Shrubland)

NPS Association: Vitex agnus-castus Shrubland (NPSAMIS009)

(Park Name: Lilac Chaste Tree Riparian Shrubland)

USNVC Group: Tamaulipan Dry Grassland (G100)

USNVC Alliance: *Schizachyrium scoparium - Bothriochloa barbinodis* Tamaulipan Grassland Alliance (A3138)

NPS Association: (*Pennisetum ciliare*, *Bothriochloa spp*., *Aristida purpurea*) Tamaulipan Herbaceous Vegetation (NPSAMIS006)

(Park Name: Ruderal Mixed Grassland)

NPS Association: (*Bouteloua* spp., *Pappophorum bicolor*, *Tiquilia canescens*) Tamaulipan Herbaceous Vegetation (NPSAMIS034)

(Park Name: Dry Native Mixed Grassland)

USNVC Macrogroup: Chihuahuan Desert Scrub (M086)

USNVC Group: Chihuahuan Creosotebush - Mixed Desert Scrub (G288)

USNVC Alliance: *Vachellia constricta - Vachellia vernicosa* Thornscrub Alliance (A3166)

NPS Association: *Vachellia vernicosa - Calliandra conferta* Shrubland (NPSAMIS014)

(Park Name: Viscid Acacia Shrubland)

USNVC Macrogroup: North American Warm Semi-Desert Cliff, Scree & Rock Vegetation (M117)

USNVC Group: North American Warm Semi-Desert Cliff, Scree & Pavement Sparse Vegetation (G569)

USNVC Alliance: *Aloysia wrightii - Pericome caudata - Ephedra nevadensis* Sparsely Vegetated Bedrock Cliff & Lava Field Alliance (A4025)

NPS Association: *Porophyllum scoparium* – (*Heterotheca fulcrata, Penstemon baccharifolius*) Sparse Vegetation (NPSAMIS016)

(Park Name: Xeric Outcrop Sparse Vegetation) *

USNVC Class: Aquatic Vegetation (5)

USNVC Subclass: Freshwater Aquatic Vegetation (5.B)

USNVC Formation: Temperate & Boreal Freshwater Aquatic Vegetation (5.B.2)

USNVC Division: North American Freshwater Aquatic Vegetation (D049)

USNVC Macrogroup: North American Temperate Ruderal Aquatic Vegetation (M401)

USNVC Group: Eastern North American Ruderal Aquatic Vegetation (G595)

USNVC Alliance: *Hydrilla verticillata* - *Myriophyllum spicatum* Ruderal Aquatic Vegetation Alliance (A1745)

[USNVC Association: *Hydrilla verticillata* Ruderal Aquatic Vegetation (CEGL004702)

(Park Name: Hydrilla Submerged Aquatic Vegetation) *

Amistad National Recreation Area Plant Association Descriptions

Texas Live Oak Woodland

Local Type Concept:
Woodlands with *Quercus fusiformis* (Texas live oak) dominant in the tree stratum, with at least 15% cover and usually more than 25% cover.

Classification Plots Represented By Concept:
AMIS354.

Vegetation:
Quercus fusiformis (Texas live oak) typically is the sole dominant in an open tree stratum. The most frequent shrubs (some can attain the height of understory trees) include *Diospyros texana* (Texas persimmon), *Karwinskia humboldtiana* (coyotillo), *Sophora secundiflora* (mescal bean), *Celtis laevigata* var. *reticulata* (netleaf hackberry), and *Juglans microcarpa* (little walnut). Less frequent shrubs include *Cephalanthus occidentalis* (buttonbush), *Vachellia rigidula* (blackbrush), *Bernardia myricifolia* (mouse's eye), *Indigofera lindheimeriana* (Lindheimer's indigo), and *Prosopis glandulosa* (honey mesquite). *Penstemon baccharifolius* (baccharisleaf beardtongue) and *Senna lindheimeriana* (velvetleaf senna) are frequent subshrubs, and *Toxicodendron radicans* (eastern poison ivy) and *Vitis monticola* (sweet mountain grape) are frequent scrambling or climbing woody vines. The herbaceous stratum has low to moderately high overall cover, with *Bothriochloa ischaemum* (yellow bluestem) and *Phyla nodiflora* (switchgrass) the most frequent and abundant species. Stratum and substrate cover for Texas Live Oak Woodland are shown in Table D-1.

Table D-1. Stratum and substrate cover recorded for Texas Live Oak Woodland at Amistad National Recreation Area (# plots=1).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	24	10-35
	Tall Shrub	18	17-18
	Short Shrub	42	25-60
	Herb	8	5-10
Substrate	Bedrock	0	0-0
	Large/Small Rocks	90	90-90
	Litter/Duff	5	5-5

Environment:
This vegetation occurs in protected (mesic) uplands. During the accuracy assessment, it was found along the Devils River and in Seminole Canyon.

USNVC Crosswalk:
USNVC Class: Forest and Woodland (1)
USNVC Subclass: Temperate and Boreal Forest & Woodland (1.B)
USNVC Formation: Warm Temperate Forest & Woodland (1.B.1)
USNVC Division: Madrean - Balconian Forest & Woodland (D060)
USNVC Macrogroup: Balconian Forest & Woodland (M015)
USNVC Group: Balconian Dry Forest & Woodland (G126)
USNVC Alliance: *Quercus fusiformis - Juniperus ashei* Woodland Alliance (A0477)
NPS Association: *Quercus fusiformis / Vachellia rigidula* Woodland (NPSAMIS004)

All plant taxa recorded in Texas Live Oak Woodland are shown in Table D-2.

Table D-2. Synthesis table for all plant taxa recorded in Texas Live Oak Woodland at Amistad National Recreation Area (# plots=1).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Quercus fusiformis	Tree	100.0%	23.7	15-35
Juniperus pinchotii	Tree	100.0%	0.1	trace
Diospyros texana	Shrub	100.0%	14.1	9-20
Vachellia rigidula (=Acacia rigidula)	Shrub	100.0%	10.3	6-15
Forestiera acuminata	Shrub	100.0%	2.0	1-3
Celtis laevigata var. *reticulata*	Shrub	100.0%	1.1	few-2
Eysenhardtia texana	Shrub	100.0%	1.1	few-2
Karwinskia humboldtiana	Shrub	100.0%	1.0	few-2
Celtis ehrenbergiana	Shrub	100.0%	0.6	few-2
Condalia hookeri var. *hookeri*	Shrub	100.0%	0.5	few-2
Opuntia engelmannii var. *lindheimeri*	Shrub	100.0%	0.5	few-1
Indigofera lindheimeriana	Shrub	100.0%	0.5	few-1
Prosopis glandulosa	Shrub	100.0%	0.2	trace
Sophora secundiflora	Shrub	100.0%	0.2	trace
Passiflora tenuiloba	Vine	100.0%	0.1	trace
Smilax bona-nox	Vine	100.0%	0.1	trace
Bothriochloa ischaemum	Herb	100.0%	3.5	2-5
Phyla nodiflora	Herb	100.0%	1.5	1-2
Bothriochloa laguroides ssp. *torreyana*	Herb	100.0%	0.5	few-1

Table D-2 (continued). Synthesis table for all plant taxa recorded in Texas Live Oak Woodland at Amistad National Recreation Area (# plots=1).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Bouteloua curtipendula	Herb	100.0%	0.5	few-1
Croton monanthogynus	Herb	100.0%	0.5	few-1
Dyschoriste linearis	Herb	100.0%	0.5	few-1
Hedeoma sp.	Herb	100.0%	0.5	few-1
Palafoxia sp.	Herb	100.0%	0.5	few-1
Pennisetum ciliare	Herb	100.0%	0.5	few-1
Ratibida columnifera	Herb	100.0%	0.5	few-1
Ruellia sp.	Herb	100.0%	0.5	few-1
Sida sp.	Herb	100.0%	0.5	few-1
Acalypha sp.	Herb	100.0%	0.1	trace



Photo 1. Texas Live Oak Woodland, Devils River, near Lowry Springs (LBJWC) (AMIS0354).



Photo 2. Texas Live Oak Woodland, Devils River, near Lowry Springs (LBJWC) (AMIS0354).

Vasey Scrub Oak - Littleleaf Ash - Hackberry Woodland

Local Type Concept:
Open woodlands with Vasey scrub oak (*Quercus vaseyana*) dominant in the tree stratum.

Classification Plots Represented By Concept:
AMIS213, AMIS217.

Vegetation:
Quercus vaseyana (Vasey scrub oak) is dominant in a short tree stratum and usually the most abundant species. *Diospyros texana* (Texas persimmon) and *Fraxinus greggii* (littleleaf or Gregg's ash) usually are present and sometimes abundant as small trees or tall shrubs, and the latter is characteristic of this vegetation within AMIS. Other constant, and sometimes co-dominant tree or tall shrub species are *Celtis laevigata* var. *reticulata* (netleaf hackberry), and *Celtis ehrenbergiana* (spiny hackberry). Typical medium height to tall shrubs are *Sophora secundiflora* (mescal bean), *Karwinskia humboldtiana* (coyotillo), *Ungnadia speciosa* (Mexican buckeye), Senegalia berlandieri (guajillo), *Mahonia trifoliolata* (agarito), *Bernardia myricifolia* (mouse's eye), *Prosopis glandulosa* (honey mesquite), and *Aloysia gratissima* (whitebrush). Woody and herbaceous vines often are present at low cover; species include *Passiflora tenuiloba* (birdwing passionflower), *Vitis rupestris* (sand grape), and *Passiflora tenuiloba* (Texas milkpea). Herbaceous cover usually is sparse to low, with no notable constant or characteristic species. Stratum and substrate cover for Vasey Scrub Oak - Littleleaf Ash - Hackberry Woodland are shown in Table D-3.

Table D-3. Stratum and substrate cover recorded for Vasey Scrub Oak - Littleleaf Ash - Hackberry Woodland at Amistad National Recreation Area (# plots=2).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	24	10-52
	Tall Shrub	23	5-50
	Short Shrub	42	25-100
	Herb	1	few-1
Substrate	Bedrock	15	0-30
	Large/Small Rocks	75	55-95
	Litter/Duff	8	0-15

Environment:
This vegetation is of limited extent at AMIS and occupies mesic sites in canyons, often on steep slopes. Most known stands are along and west of the Pecos River, but stands were also observed along California Creek. The substrate is usually rocky, with bedrock sometimes exposed.

USNVC Crosswalk:
USNVC Class: Forest and Woodland (1)
USNVC Subclass: Temperate and Boreal Forest & Woodland (1.B)
USNVC Formation: Warm Temperate Forest & Woodland (1.B.1)
USNVC Division: Madrean - Balconian Forest & Woodland (D060)
USNVC Macrogroup: Balconian Forest & Woodland (M015)
USNVC Group: Balconian Dry Forest & Woodland (G126)
USNVC Alliance: *Juniperus ashei* Woodland Alliance (A3212)
NPS Association: *Quercus vaseyana - Fraxinus greggii - Celtis* spp. Woodland (NPSAMIS005)

All plant taxa recorded in Vasey Scrub Oak - Littleleaf Ash - Hackberry Woodland are shown in Table D-4.

Table D-4. Synthesis table for all plant taxa recorded in Vasey Scrub Oak - Littleleaf Ash - Hackberry Woodland at Amistad National Recreation Area (# plots=2).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Quercus vaseyana	Tree	100.0%	12.5	5-25
Fraxinus greggii	Tree	100.0%	9.4	trace-27
Celtis laevigata var. *reticulata*	Tree	100.0%	3.0	few-7
Celtis ehrenbergiana	Tree	50.0%	4.4	0-12
Diospyros texana	Tree	50.0%	2.2	0-7
Karwinskia humboldtiana	Shrub	100.0%	12.8	2-30
Sophora secundiflora	Shrub	100.0%	12.1	3-28
Senegalia berlandieri (=Acacia berlandieri)	Shrub	100.0%	5.5	2-10
Ungnadia speciosa	Shrub	100.0%	2.8	few-7
Mahonia trifoliolata	Shrub	100.0%	0.5	few-1
Bernardia myricifolia	Shrub	100.0%	0.1	trace
Nicotiana glauca	Shrub	50.0%	2.2	0-6
Prosopis glandulosa	Shrub	50.0%	1.0	0-3
Guaiacum angustifolium	Shrub	50.0%	0.5	0-2
Vachellia rigidula (=Acacia rigidula)	Shrub	50.0%	0.3	0-1
Condalia hookeri var. hookeri	Shrub	50.0%	0.3	0-1
Lippia graveolens	Shrub	50.0%	0.0	0-trace
Lycium berlandieri	Shrub	50.0%	0.0	0-trace

Table D-4 (continued). Synthesis table for all plant taxa recorded in Vasey Scrub Oak - Littleleaf Ash - Hackberry Woodland at Amistad National Recreation Area (# plots=2).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Ziziphus obtusifolia	Shrub	50.0%	0.0	0-trace
Passiflora tenuiloba	Vine	100.0%	0.1	trace
Matelea sagittifolia	Vine	50.0%	0.3	0-1
Cucurbita foetidissima	Vine	50.0%	0.1	0-trace
Eupatorium serotinum	Herb	50.0%	5.4	0-15
Croton incanus	Herb	50.0%	0.3	0-1
Carex sp.	Herb	50.0%	0.3	0-1
Tragia sp.	Herb	50.0%	0.3	0-1



Photo 3. Vasey Scrub Oak - Littleleaf Ash - Hackberry Woodland, Pecos River, near High Bridge (LBJWC) (AMIS0213).



Photo 4. Vasey Scrub Oak - Littleleaf Ash - Hackberry Woodland, Pecos River, near High Bridge (LBJWC) (AMIS0213).

Graves' Oak Woodland

Local Type Concept:
Woodlands dominated by Graves' Oak (*Quercus gravesii*) in relatively mesic (e.g., canyon bottom) settings.

Classification Plots Represented By Concept:
No plots. The description is based on data from three accuracy assessment plots and the *Quercus gravesii - Pistacia mexicana* Woodland of Poole (2013).

Vegetation:
The tree canopy is open (7 to 50% cover), with *Quercus gravesii* (Graves' oak) dominant in a tree or tall shrub stratum. *Celtis* sp. (hackberries), *Ungnadia speciosa* (Mexican buckeye), and *Vachellia farnesiana* (huisache) often are present as tall shrubs or short trees. Other frequent shrubs observed include *Diospyros texana* (Texas persimmon), *Prosopis glandulosa* (honey mesquite), *Senegalia berlandieri* (guajillo), *Celtis laevigata* var. *reticulata* (netleaf hackberry), and *Sophora secundiflora* (mescal bean). *Pistacia mexicana* (Mexican pistachio) is a shrub species of limited distribution in the United States that is known to occur in this vegetation. The herbaceous stratum has low to high overall cover and is inversely proportional to tree canopy cover. For the two sites for which the tree canopy was open, native grasses were the most abundant species, with *Nassella leucotricha* (Texas wintergrass) was found to be dominant at one site and was co-dominant with *Pappophorum bicolor* (pink pappusgrass) at another.

Environment:
This vegetation is very limited in extent at AMIS and occupies mesic sites in canyons or other drainages. Known locations are Rough Canyon, California Creek and several tributary canyons west of Seminole Canyon, including Pink Cave Cove.

USNVC Crosswalk:
USNVC Class: Forest and Woodland (1)
USNVC Subclass: Temperate and Boreal Forest & Woodland (1.B)
USNVC Formation: Warm Temperate Forest & Woodland (1.B.1)
USNVC Division: Madrean - Balconian Forest & Woodland (D060)
USNVC Macrogroup: Balconian Forest & Woodland (M015)
USNVC Group: Balconian Dry-Mesic Hardwood Forest (G028)
USNVC Alliance: *Acer grandidentatum - Quercus muehlenbergii - Juglans major* Forest & Woodland Alliance (A3214)
NPS Association: *Quercus gravesii / Pistacia mexicana* Woodland (NPSAMIS012)

Comments:
Currently, the concept provisionally applies to all Quercus gravesii dominated [relatively mesic] woodlands, forests, and tall shrublands at AMIS; Pistacia mexicana need not be present.



Photo 5. Graves Oak Woodland, upper Devils River (LBJWC).

Huisache Riparian Woodland

Local Type Concept:
Riparian woodlands or tall shrublands within the former inundation zone of Amistad Reservoir, with huisache (*Vachellia farnesiana*, = *Acacia farnesiana*) dominant in the uppermost stratum.

Classification Plots Represented By Concept:
AMIS533, AMIS849, AMIS1089, AMIS1159, AMIS1248, AMIS1599, AMIS1645, AMIS1670, AMIS1707.

Vegetation:
Vachellia farnesiana (= *Acacia farnesiana*, huisache) usually is the sole dominant in the uppermost (tree or tall shrub) stratum, which can be relatively open (7% cover) to closed (near 100% cover) and can be of variable height (saplings to taller trees). Shrub stratum composition is variable, with few species other than *V. farnesiana* constant, and can include *Diospyros texana* (Texas persimmon*), Prosopis glandulosa* (honey mesquite), *Baccharis neglecta* (Rooseveltweed), *Parkinsonia aculeata* (retama), Vitex agnus-castus (lilac chaste tree), *Opuntia engelmannii* var. *lindheimeri* (Texas pricklypear), and *Vachellia rigidula* (=*Acacia rigidula*, blackbrush). Ruderal, including non-native, species characterize the herbaceous stratum, with *Cynodon dactylon* (Bermuda grass) the most constant species. *Phyla nodiflora* (turkey tangle fogfruit), *Digitaria pubiflora* (Carolina crabgrass), *Parietaria pensylvanica* (Pennsylvania pellitory), *Pennisetum ciliare* (buffelgrass), and/or *Bothriochloa ischaemum* (yellow bluestem) may be present, with the latter two species occasionally attaining high cover along with C. dactylon. Stratum and substrate cover for Huisache Riparian Woodland are shown in Table D-5.

Table D-5. Stratum and substrate cover recorded for Huisache Riparian Woodland at Amistad National Recreation Area (# plots=9).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	17	0-100
	Tall Shrub	19	0-95
	Short Shrub	3	0-20
	Herb	37	2-95
Substrate	Bedrock	0	0-0
	Large/Small Rocks	24	0-60
	Litter/Duff	27	0-98

Environment:
This vegetation occurs throughout AMIS, generally within the former inundation zone of Amistad Reservoir. It is most abundant east of Amistad Dam, in the lower Devils River, San Pedro Canyon, and Castle canyon drainages, where there are large areas of formerly inundated flats. Soils are of a

variety of textures, from silty clays to sandy loams. This vegetation grades into the Riparian Mesquite Woodland, which evidently occupies somewhat higher (less frequently or less recently inundated) areas.

Throughout the riparian zones of AMIS, there is a pattern of several vegetation associations being more characteristic of higher gradient stream reaches (i.e., the upstream reaches of the major streams and the Rio Grande below Amistad Dam). These reaches are dominated more by natural fluvial processes. These include the Willow Riparian Woodland, the Tamarisk Riparian Shrubland, the Giant Cane Herbaceous Vegetation, the Common Reed Herbaceous Vegetation, and (along the Devils River only), the Edwards Plateau Stream Scoured Sparse Woodland. These associations contrast with others that are more characteristic of low gradient reaches of the lower reservoir, opportunistically colonize these anthropogenic surfaces, and are more influenced by reservoir inundation, drawdown, and sedimentation processes. The latter associations include the Huisache Riparian Woodland, the Bermuda Grass - Fogfruit Riparian Herbaceous Vegetation, and the Water-hyssop - Bermuda Grass - Fogfruit Sparse Riparian Herbaceous Vegetation.

USNVC Crosswalk:
USNVC Class: Forest and Woodland (1)
USNVC Subclass: Temperate and Boreal Forest & Woodland (1.B)
USNVC Formation: Temperate Flooded & Swamp Forest (1.B.3)
USNVC Division: Western North American Interior Flooded Forest (D062)
USNVC Macrogroup: Interior Warm & Cool Desert Riparian Forest (M036)
USNVC Group: Tamaulipan Riparian Scrub Forest (G549)
USNVC Alliance: *Vachellia farnesiana - Celtis ehrenbergiana* Riparian Scrub Alliance (A3841)
USNVC Association: *Vachellia farnesiana - (Prosopis glandulosa)* Riparian Woodland (CEGL002131)

Most frequent plant taxa recorded in Huisache Riparian Woodland are shown in Table D-6.

Table D-6. Synthesis table for the most frequent plant taxa recorded in Huisache Riparian Woodland at Amistad National Recreation Area (# plots=9).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Vachellia farnesiana (=Acacia farnesiana)	Tree/Shrub	100.0%	46.8	10-96
Prosopis glandulosa	Tree/Shrub	44.4%	1.6	0-5
Parkinsonia aculeata	Tree	22.2%	2.1	0-25
Diospyros texana	Shrub	55.6%	0.1	0-1
Baccharis neglecta	Shrub	33.3%	1.1	0-10
Vitex agnus-castus	Shrub	33.3%	0.8	0-9

Table D-6 (continued). Synthesis table for the most frequent plant taxa recorded in Huisache Riparian Woodland at Amistad National Recreation Area (# plots=9).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Opuntia engelmannii var. *lindheimeri*	Shrub	33.3%	0.6	0-5
Vachellia rigidula (=Acacia rigidula)	Shrub	33.3%	0.0	0-trace
Tamarix ramosissima	Shrub	22.2%	0.1	0-15
Celtis ehrenbergiana	Shrub	22.2%	0.0	0-trace
Salix nigra	Shrub	11.1%	0.8	0-10
Senegalia berlandieri (=Acacia berlandieri)	Shrub	11.1%	0.1	0-1
Colubrina texensis	Shrub	11.1%	0.1	0-1
Cynodon dactylon	Herb	66.7%	9.9	0-95
Phyla nodiflora	Herb	55.6%	0.6	0-2
Digitaria pubiflora	Herb	55.6%	0.2	0-1
Bothriochloa ischaemum	Herb	44.4%	2.9	0-25
Pennisetum ciliare	Herb	44.4%	1.1	0-10
Verbesina encelioides	Herb	44.4%	0.4	0-2
Panicum hallii	Herb	44.4%	0.3	0-2
Croton monanthogynus	Herb	44.4%	0.2	0-1
Malvastrum coromandelianum	Herb	44.4%	0.2	0-1
Marrubium vulgare	Herb	33.3%	0.2	0-1
Verbena neomexicana	Herb	33.3%	0.2	0-1
Nassella leucotricha	Herb	22.2%	7.8	0-75
Arundo donax	Herb	22.2%	2.3	0-25
Ratibida columnifera	Herb	22.2%	0.4	0-5
Senna lindheimeriana	Herb	22.2%	0.1	0-1
Ruellia nudiflora	Herb	22.2%	0.1	0-1
Sida abutifolia	Herb	22.2%	0.1	0-1
Solanum elaeagnifolium	Herb	22.2%	0.1	0-1
Setaria grisebachii	Herb	11.1%	4.2	0-50
Buchloe dactyloides	Herb	11.1%	0.2	0-2

Table D-6 (continued). Synthesis table for the most frequent plant taxa recorded in Huisache Riparian Woodland at Amistad National Recreation Area (# plots=9).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Abutilon incanum	Herb	11.1%	0.1	0-1
Allowissadula holosericea	Herb	11.1%	0.1	0-1
Aristida sp.	Herb	11.1%	0.1	0-1
Bouteloua curtipendula	Herb	11.1%	0.1	0-1
Calyptocarpus vialis	Herb	11.1%	0.1	0-1
Croton dioicus	Herb	11.1%	0.1	0-1
Erioneuron pilosum	Herb	11.1%	0.1	0-1
Heliotropium curassavicum	Herb	11.1%	0.1	0-1
Polygala lindheimeri	Herb	11.1%	0.1	0-1
Senecio flaccidus var. *flaccidus*	Herb	11.1%	0.1	0-1
Tridens eragrostoides	Herb	11.1%	0.1	0-1
Tridens muticus var. *muticus*	Herb	11.1%	0.1	0-1
Verbena halei	Herb	11.1%	0.1	0-1
Wedelia texana	Herb	11.1%	0.1	0-1

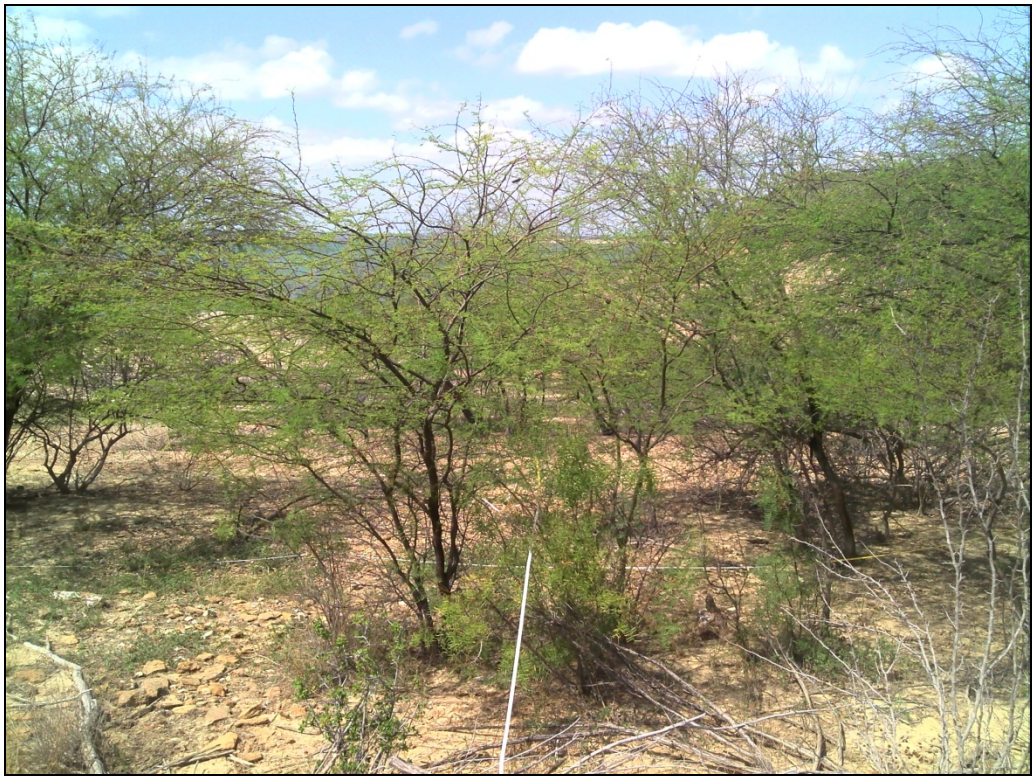


Photo 6. Huisache Riparian Woodland, along Amistad Reservoir, near San Pedro Drive and Blue Ridge Drive (LBJWC) (AMIS1599).



Photo 7. Huisache Riparian Woodland, along Amistad Reservoir, north side of San Pedro Canyon (LBJWC) (AMIS1089).

Mesquite Riparian Woodland

Local Type Concept:
Tall shrublands or woodlands, generally within the former inundation zone of Amistad Reservoir, with honey mesquite (*Prosopis glandulosa*) dominant in the uppermost stratum.

Classification Plots Represented By Concept:
AMIS197, AMIS478, AMIS837, AMIS994, AMIS1439, AMIS1679.

Vegetation:
Prosopis glandulosa (honey mesquite) is dominant in the uppermost (tree or tall shrub) stratum, which can be relatively open to closed. *Vachellia farnesiana* (= *Acacia farnesiana*, huisache) is constant at lower cover and can occasionally co-dominate with *P. glandulosa*. Few other shrubs are highly constant; *Opuntia engelmannii* var. *lindheimeri* (Texas pricklypear), *Diospyros texana* (Texas persimmon), *Baccharis neglecta* (Rooseveltweed*), Tamarix ramosissima* (tamarisk), and/or *Nicotiana glauca* (tree-tobacco) may occur. The herbaceous stratum is dominated by ruderal species. *Cynodon dactylon* (Bermuda grass) and *Pennisetum ciliare* (buffelgrass) are the most frequent species and often are locally abundant. *Phyla nodiflora* (turkey tangle fogfruit) and/or *Arundo donax* (giant cane) also may be present. Stratum and substrate cover for Mesquite Riparian Woodland are shown in Table D-7.

Table D-7. Stratum and substrate cover recorded for Mesquite Riparian Woodland at Amistad National Recreation Area (# plots=6).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	3	0-25
	Tall Shrub	29	trace-95
	Short Shrub	21	5-100
	Herb	13	1-50
Substrate	Bedrock	3	0-15
	Large/Small Rocks	18	1-60
	Litter/Duff	25	1-70

Environment:
Stands occur throughout AMIS, generally within the former inundation zone of Amistad Reservoir. The setting (e.g., terraces, slopes, benches) usually is higher than that of the Huisache Riparian Woodland (CEGL002131). The Mesquite Riparian Woodland may represent a less frequently inundated and more stabilized association than the Huisache Riparian Woodland.

USNVC Crosswalk:
USNVC Class: Forest and Woodland (1)

USNVC Subclass: Temperate and Boreal Forest & Woodland (1.B)
USNVC Formation: Temperate Flooded & Swamp Forest (1.B.3)
USNVC Division: Western North American Interior Flooded Forest (D062)
USNVC Macrogroup: Interior Warm & Cool Desert Riparian Forest (M036)
USNVC Group: Tamaulipan Riparian Scrub Forest (G549)
USNVC Alliance: *Vachellia farnesiana - Celtis ehrenbergiana* Riparian Scrub Alliance (A3841)
NPS Association: *Prosopis glandulosa* Riparian Woodland (NPSAMIS033)

Comments:
This AMIS vegetation association was not cross-walked to any published USNVC associations (USNVC 2017) that have *P. glandulosa* dominant (e.g., *Prosopis glandulosa* Wet Scrub (CEGL004934) or *Prosopis glandulosa - Ulmus crassifolia / Nassella leucotricha* Riparian Ruderal Woodland (CEGL004180)). A major reason was that those published units are in different USNVC divisions from that in which the USNVC places the very closely related (at AMIS*) Vachellia farnesiana* - (*Prosopis glandulosa*) Riparian Woodland (CEGL002131) (= Huisache Riparian Woodland). A local unit was created to (1) avoid an unnatural degree of USNVC hierarchy separation of two closely related AMIS units and (2) to create a placeholder for the current (2018) absence of any *P. glandulosa* dominated woodland association within the USNVC Western North American Interior Flooded Forest (D062), including the Tamaulipan Riparian Scrub Forest Group (G549)

At AMIS, the Mesquite Riparian Woodland is distinguished from another association that is dominated by honey mesquite, the Mesquite Upland Shrubland, by the prevalence of riparian species as associates of mesquite in the former association versus the prevalence of upland (arid thornscrub) associates in the latter association. The upper strata of stands of both associations can be variable, and individual stands of either might be regarded as either woodlands or shrublands. Most frequent plant taxa recorded in Mesquite Riparian Woodland are shown in Table D-8.

Table D-8. Synthesis table for the most frequent plant taxa recorded in Mesquite Riparian Woodland at Amistad National Recreation Area (# plots=6).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Prosopis glandulosa	Shrub/Tree	100.0%	29.0	3-75
Vachellia farnesiana (=Acacia farnesiana)	Shrub/Tree	100.0%	8.0	2-27
Parkinsonia aculeata	Tree	16.7%	1.8	0-15
Fraxinus sp.	Tree	16.7%	0.6	0-5
Opuntia engelmannii var. *lindheimeri*	Shrub	50.0%	7.6	0-55
Diospyros texana	Shrub	50.0%	1.9	0-15

Table D-8 (continued). Synthesis table for the most frequent plant taxa recorded in Mesquite Riparian Woodland at Amistad National Recreation Area (# plots=6).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Leucophyllum frutescens	Shrub	33.3%	0.7	0-6
Nicotiana glauca	Shrub	33.3%	0.5	0-2
Tamarix ramosissima	Shrub	16.7%	1.8	0-15
Baccharis neglecta	Shrub	16.7%	1.8	0-15
Colubrina texensis	Shrub	16.7%	1.3	0-11
Celtis ehrenbergiana	Shrub	16.7%	0.6	0-5
Aloysia gratissima	Shrub	16.7%	0.1	0-1
Cylindropuntia leptocaulis	Shrub	16.7%	0.1	0-1
Nicotiana repanda	Shrub	16.7%	0.0	0-trace
Jatropha dioica	Shrub	16.7%	0.0	0-trace
Karwinskia humboldtiana	Shrub	16.7%	0.0	0-trace
Cynodon dactylon	Herb	66.7%	2.8	0-10
Pennisetum ciliare	Herb	50.0%	12.1	0-50
Phyla nodiflora	Herb	50.0%	0.6	0-2
Tiquilia canescens	Herb	33.3%	0.5	0-2
Croton dioicus	Herb	33.3%	0.2	0-1
Croton monanthogynus	Herb	33.3%	0.2	0-1
Setaria sp.	Herb	33.3%	0.2	0-1
Bouteloua sp.	Herb	16.7%	0.6	0-5
Senna lindheimeriana	Herb	16.7%	0.6	0-5
Argemone mexicana	Herb	16.7%	0.1	0-1
Bothriochloa ischaemum	Herb	16.7%	0.1	0-1
Chamaesyce sp.	Herb	16.7%	0.1	0-1
Chenopodium berlandieri var. berlandieri	Herb	16.7%	0.1	0-1
Chloris sp.	Herb	16.7%	0.1	0-1
Eragrostis barrelieri	Herb	16.7%	0.1	0-1
Eragrostis sp.	Herb	16.7%	0.1	0-1
Hedeoma sp.	Herb	16.7%	0.1	0-1

Table D-8 (continued). Synthesis table for the most frequent plant taxa recorded in Mesquite Riparian Woodland at Amistad National Recreation Area (# plots=6).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Helenium sp.	Herb	16.7%	0.1	0-1
Portulaca pilosa	Herb	16.7%	0.1	0-1
Rivina humilis	Herb	16.7%	0.1	0-1
Teucrium canadense	Herb	16.7%	0.1	0-1
Verbena sp.	Herb	16.7%	0.1	0-1



Photo 8. Mesquite Riparian Woodland, Castle Canyon at California Creek (LBJWC) (AMIS0837).



Photo 9. Mesquite Riparian Woodland, Pecos River north of High Bridge (LBJWC) (AMIS0197).

Willow Riparian Woodland

Local Type Concept:
Tall shrublands or woodlands within the former inundation zone of Amistad Reservoir and possibly along tributary streams, with black willow (*Salix nigra*) or Goodding willow *(Salix gooddingii*) dominant in the uppermost stratum.

Classification Plots Represented By Concept:
No plots. The Association is recognized based on accuracy assessment observations and on community types with *Salix nigra* and *Salix gooddingii* as described by Poole (2013).

Vegetation:
The tree stratum is relatively open to dense (7-90% cover) and is dominated by some combination of *Salix* (willow) species, which may include *Salix nigra* (black willow), *Salix gooddingii* (Goodding willow), and/or *Salix thurberi* (= *Salix exigua*, in part) (Thurber's willow). In a minority of stands, other tree species, such as *Fraxinus berlandieri* (Mexican ash), *Prosopis glandulosa* (honey mesquite), or *Celtis laevigata* var. *laevigata* (sugarberry), may occur and, in a minority of stands, may co-dominate and even exceed *Salix* in abundance. *Tamarix ramosissima* (tamarisk), *Baccharis neglecta* (Rooseveltweed), *Baccharis salicifolia* (seep-willow), and/or *Cephalanthus occidentalis* (common buttonbush) are the most constant shrub stratum species. *Arundo donax* (giant cane) and *Phragmites australis* (common reed) are frequent herbaceous stratum species, and either can dominate that stratum. *Cynodon dactylon* (Bermuda grass), *Bowlesia incana* (hoary bowlesia), and/or *Parietaria pensylvanica* (Pennsylvania pellitory) may also occur in the herbaceous stratum. Vines such as *Melothria pendula* (Guadeloupe cucumber) and *Cocculus carolinus* (Carolina coralbead) also may occur.

Environment:
This vegetation occurs along frequently flooded floodplains and alluvial bars along the Rio Grande. Although it may occur throughout AMIS, it is most abundant along the Rio Grande upstream from the Pecos River, where it is abundant.

Throughout the riparian zones of AMIS, there is a pattern of several vegetation associations being more characteristic of higher gradient stream reaches (i.e., the upstream reaches of the major streams and the Rio Grande below Amistad Dam), dominated more by natural fluvial processes. These include the Willow Riparian Woodland, the Tamarisk Riparian Shrubland, the Giant Cane Herbaceous Vegetation, the Common Reed Herbaceous Vegetation, and (along the Devils River only), the Edwards Plateau Stream Scoured Sparse Woodland. These associations contrast with others that are more characteristic of low gradient reaches of the lower reservoir, opportunistically colonize these anthropogenic surfaces, and are more influenced by reservoir inundation, drawdown, and sedimentation processes. The latter associations include the Huisache Riparian Woodland, the Bermuda Grass - Fogfruit Riparian Herbaceous Vegetation, and the Water-hyssop - Bermuda Grass - Fogfruit Sparse Riparian Herbaceous Vegetation.

USNVC Crosswalk:
USNVC Class: Forest and Woodland (1)

USNVC Subclass: Temperate and Boreal Forest & Woodland (1.B)
USNVC Formation: Temperate Flooded & Swamp Forest (1.B.3)
USNVC Division: Western North American Interior Flooded Forest (D062)
USNVC Macrogroup: Interior Warm & Cool Desert Riparian Forest (M036)
USNVC Group: Tamaulipan Riparian Scrub Forest (G549)
USNVC Alliance*: Celtis laevigata - Ulmus crassifolia / Urvillea ulmacea* Tamaulipan Riparian Scrub Alliance (A3842)
USNVC Association: *Salix gooddingii - Salix thurberi - Fraxinus berlandieri* Woodland (NPSAMIS035)

Comments:
This composition of this unit is somewhat unclear due to uncertainty about the identities of the willow species involved and their distribution throughout AMIS. It may represent more than one association, and the resolution of the situation probably would require more targeted plot data collection from willow-dominated stands. AMIS is situated within the transition zone from the range of *Salix gooddingii*, which has a primary distribution in arid areas of western North America, and *Salix nigra*, which is primarily in temperate eastern North America (see Powell 1998). The two species, which often are trees, are very similar to each other in appearance and have been considered nonspecific (as *Salix nigra*, in the broad sense, e.g. Turner et al. 2003). While there may be a change in frequency of the respective species across Amistad from western to east, Poole (2013) did not describe such a distinction, and willow-dominated woodlands within AMIS presently are treated as a single association. *Salix thurberi*, which grows more often as a shrub or shorter tree, is the only other willow known from AMIS (Poole 2013). While *S. thurberi* is distinct from the other two species, its taxonomic treatment has varied. It has been treated as part *of Salix exigua* (coyote willow) and listed by that name (e.g., Turner et al. 2003, Poole 2013). More recently, it has been considered to be a distinct species that is believed to be the sole entity of the *S. exigua* species complex known from southeastern Texas and northeastern Mexico, including the eastern portion of Trans-Pecos Texas (e.g., Argus 2007, Argus 2010, Powell and Worthington 2018).

Neither of the two most similar USNVC associations provided an adequate crosswalk. The Tamaulipan *Salix nigra – Celtis laevigata* var. *laevigata* / *Baccharis neglecta* Forest (CEGL007754) appears to have a more eastern distribution than the AMIS vegetation and has no written description (USNVC 2017), and the nominal species would be inconsistent for AMIS. The *Salix gooddingii* / *Salix exigua* Riparian Woodland (CEGL003778) has similar nominal species but is clearly a Colorado Plateau unit.



Photo 10. Willow Riparian Woodland, near Langtry (CTI 2017).

Tamarisk Riparian Shrubland

Local Type Concept:
Shrublands or short-statured woodlands dominated or co-dominated by tamarisk (*Tamarix ramosissima*) within the Amistad Reservoir former inundation zone and possibly along tributary streams.

Classification Plots Represented By Concept:
AMIS993.

Vegetation:
Tamarix ramosissima (tamarisk) is dominant in a tall shrub or short tree stratum, which can be relatively open to dense (7-90% cover). *Salix* (willows) of various species may be present and may co-dominate this uppermost stratum. *Vachellia farnesiana* (= *Acacia farnesiana*, huisache) or *Prosopis glandulosa* (honey mesquite) may be present at lower cover. The most constant shrub species include *Tamarix ramosissima*, *Salix* spp., *Baccharis neglecta* (Rooseveltweed), *Baccharis salicifolia* (seep-willow), and *Nicotiana glauca* (tree-tobacco). *Arundo donax* (giant cane) is a constant herbaceous stratum species and may dominate this stratum. Other herbaceous species include *Cynodon dactylon* (Bermuda grass), *Bowlesia incana* (hoary bowlesia), *Phyla nodiflora* (turkey tangle fogfruit), and *Phragmites australis* (common reed). Stratum and substrate cover for Tamarisk Riparian Shrubland are shown in Table D-9.

Table D-9. Stratum and substrate cover recorded for Tamarisk Riparian Shrubland at Amistad National Recreation Area (# plots=1).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	0	0-0
	Tall Shrub	38	37-38
	Short Shrub	2	1-3
	Herb	63	50-75
Substrate	Bedrock	0	0-0
	Large/Small Rocks	43	43-43
	Litter/Duff	5	5-5

Environment:
This vegetation occurs along frequently flooded floodplains, alluvial bars, and within the former inundation zone along the Rio Grande. Although individual stands were observed in San Pedro Canyon and the lower Devils River, it appears to be most abundant along the Rio Grande upstream from the Pecos River.

Throughout the riparian zones of AMIS, there is a pattern of several vegetation associations being more characteristic of higher gradient stream reaches (i.e., the upstream reaches of the major streams and the Rio Grande below Amistad Dam), dominated more by natural fluvial processes. These include the Willow Riparian Woodland, the Tamarisk Riparian Shrubland, the Giant Cane Herbaceous Vegetation, the Common Reed Herbaceous Vegetation, and (along the Devils River only), the Edwards Plateau Stream Scoured Sparse Woodland. These associations contrast with others that are more characteristic of low gradient reaches of the lower reservoir, opportunistically colonize these anthropogenic surfaces, and are more influenced by reservoir inundation, drawdown, and sedimentation processes. The latter associations include the Huisache Riparian Woodland, the Bermuda Grass - Fogfruit Riparian Herbaceous Vegetation, and the Water-hyssop - Bermuda Grass - Fogfruit Sparse Riparian Herbaceous Vegetation.

USNVC Crosswalk:
USNVC Class: Forest and Woodland (1)
USNVC Subclass: Temperate Forest (1.C)
USNVC Formation: Temperate Flooded and Swamp Forest (1.C.3)
USNVC Division: Southwestern North American Warm Temperate Flooded & Swamp Forest (D013)
USNVC Macrogroup: Western North American Warm Temperate Ruderal Flooded & Swamp Forest (M298)
USNVC Group: Southwest North American Ruderal Riparian Scrub (G510)
USNVC Alliance: *Tamarix* spp. Ruderal Riparian Scrub Alliance (A0842)
USNVC Association: *Tamarix* spp. Temporarily Flooded Semi-natural Shrubland (CEGL003114)

All plant taxa recorded in Tamarisk Riparian Shrubland are shown in Table D-10.

Table D-10. Synthesis table for all plant taxa recorded in Tamarisk Riparian Shrubland at Amistad National Recreation Area (# plots=1).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Tamarix ramosissima	Shrub	100.0%	18.7	11-27
Vachellia farnesiana (=Acacia farnesiana)	Shrub	100.0%	3.5	2-5
Prosopis glandulosa	Shrub	100.0%	3.5	2-5
Phyla nodiflora	Shrub	100.0%	37.5	25-50
Cynodon dactylon	Shrub	100.0%	17.5	10-25
Heliotropium curassavicum	Shrub	100.0%	3.5	2-5
Bacopa monnieri	Shrub	100.0%	0.5	few-1
Pluchea odorata	Shrub	100.0%	0.5	few-1

Table D-10 (continued). Synthesis table for all plant taxa recorded in Tamarisk Riparian Shrubland at Amistad National Recreation Area (# plots=1).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Samolus ebracteatus ssp. cuneatus	Shrub	100.0%	0.5	few-1
Nicotiana repanda	Shrub	100.0%	0.1	trace
Solanum rostratum	Shrub	100.0%	0.1	trace



Photo 11. Tamarisk Riparian Shrubland, along Amistad Reservoir near mouth of Cow Creek Canyon (LBJWC) (AMIS0993).



Photo 12. Tamarisk Riparian Shrubland, along Amistad Reservoir near mouth of Cow Creek Canyon (LBJWC) (AMIS0993).

Edwards Plateau Stream Scoured Sparse Woodland

Local Type Concept:
Graminoid herbaceous vegetation with variable shrub and tree cover in scoured channels, primarily along the Devils River.

Classification Plots Represented By Concept:
No plots. The association is recognized based on accuracy assessment observations and on several community types of Poole (2013).

Vegetation:
A tree stratum may or may not be present; if present, it is sparse to somewhat open (near 0-50% cover). *Platanus occidentalis* (eastern sycamore) is the most and its prominence is diagnostic. Less constant tree or tall shrub stratum species include *Carya illinoinensis* (pecan), *Fraxinus albicans* (Texas ash), *Juglans microcarpa* (little walnut), and *Quercus vaseyana* (Vasey scrub oak). Constant shrub stratum species include *Diospyros texana* (Texas persimmon), *Cephalanthus occidentalis* (common buttonbush), *Baccharis neglecta* (Rooseveltweed), *Sophora secundiflora* (mescal bean), *Vachellia rigidula* (=*Acacia rigidula*, blackbrush), and *Indigofera lindheimeriana* (Lindheimer's indigo). The herbaceous stratum is often dense and is graminoid-dominated. *Cladium mariscus* ssp. *jamaicense* (swamp sawgrass) (highly diagnostic), *Panicum virgatum* (switchgrass), *Phragmites australis* (common reed), and *Teucrium canadense* (Canada germander) are among the most constant and abundant species.

Environment:
This vegetation occurs on low riverbanks, evidently where river scour processes predominate somewhat over the depositional effects of the reservoir. Within AMIS, the vegetation appears to be limited to the upper Devils River corridor (above Satan Canyon). Platanus occidentalis appears to approach the westernmost limits of its natural distribution within the United States in this area.

USNVC Crosswalk:
USNVC Class: Shrub and Herb Vegetation (2)
USNVC Subclass: Shrub & Herb Wetland (2.C)
USNVC Formation: Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland (2.C.4)
USNVC Division: Eastern North America Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland (D323)
USNVC Macrogroup: Great Plains Marsh, Wet Meadow Shrubland & Playa (M071)
USNVC Group: Great Plains Riverscour Vegetation (G568)
USNVC Alliance: *Panicum virgatum - Andropogon glomeratus* Riverscour Wet Meadow Alliance (A4115)
USNVC Association: *Panicum virgatum - Andropogon glomeratus - Cladium mariscus* ssp. *jamaicense* Riverbank Herbaceous Vegetation (CEGL004928)

Comments:
This type may include the *Platanus occidentalis-Cladium mariscus* subsp. *jamaicensis* [sic]-*Phragmites australis - Panicum virgatum* very sparse woodland, the *Chilopsis linearis - Indigofera*

lindheimeri shrubland, *Phragmites australis* - *Panicum virgatum* grassland, and/or the *Indigofera lindheimeri* - *Senna lindheimeri* shrubland as recognized by Poole (2013). The type is physiognomically variable (grasslands with scattered trees to shrublands to woodlands), but the floristic composition is very characteristic and unique within AMIS.



Photo 13. Edwards Plateau Stream Scoured Sparse Woodland, upper Devils River (LBJWC 2017).

Spikerush Herbaceous Vegetation

Local Type Concept:
Herbaceous vegetation dominated by spikerushes (*Eleocharis* spp.) and/or other wetland herbs, associated with wet riverbanks and/or springs.

Classification Plots Represented By Concept:
No plots. This vegetation was not observed during this study and is based on Poole (2013).

Vegetation:
One or more of several species of *Eleocharis* (spikerushes) (e.g., *Eleocharis montevidensis*, *E. celluosa, E. geniculata*) may contribute cover. Other wetland sedges may be present.

Environment:
Stands would be expected on rocky, silty, or gravelly riverbanks or bars outside the former inundation zone of Amistad Reservoir or around springs (Poole 2013). This vegetation is recognized as probably occurring in AMIS and is based on the *Eleocharis* spp. Herbaceous Vegetation of Poole (2013). It is likely to occur in small and/or linear (riparian) stands.

USNVC Crosswalk:
USNVC Class: Shrub and Herb Vegetation (2)
USNVC Subclass: Shrub & Herb Wetland (2.C)
USNVC Formation: Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland (2.C.4)
USNVC Division: Eastern North America Temperate & Boreal Freshwater Marsh, Wet Meadow and Shrubland (D323)
USNVC Macrogroup: Great Plains Marsh, Wet Meadow Shrubland & Playa (M071)
USNVC Group: Great Plains Freshwater Marsh (G325)
USNVC Alliance: *Eleocharis palustris* Great Plains Marsh Alliance (A3489)
NPS Association: *Eleocharis* spp. Comanchian –Tamaulipan Herbaceous Vegetation (NPSAMIS029)



Photo 14. Spikerush Herbaceous Vegetation, Amistad National Recreation Area (CTI 2017).

Water-Willow Riparian Herbaceous Vegetation

Local Type Concept:
Streambed vegetation dominated by American water-willow (*Justicia americana*) generally on tributary streams to the Rio Grande.

Classification Plots Represented By Concept:
No plots. This association is recognized as probable and is based on the *Justicia americana* emergent aquatic vegetation of Poole (2013).

Vegetation:
Justicia americana (American water-willow) is dominant and often the only dominant species.

Environment:
Seasonally flooded to semi permanently flooded streambeds of larger tributary streams to the Rio Grande, particularly along the Devils River (Poole 2013) and possibly limited to that area within AMIS.

USNVC Crosswalk:
USNVC Class: Shrub and Herb Vegetation (2)
USNVC Subclass: Shrub & Herb Wetland (2.C)
USNVC Formation: Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland (2.C.4)
USNVC Division: Eastern North America Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland (D323)
USNVC Macrogroup: Eastern North American Wet Shoreline Vegetation (M880)
USNVC Group: Eastern North American Riverine Wetland Vegetation (G755)
USNVC Alliance: *Justicia americana* Edwards Plateau Riverbed Alliance (A3853)
USNVC Association: *Justicia americana – Bacopa monnieri* Edwards Plateau Herbaceous Vegetation (CEGL004926)



Photo 15. Water-willow Riparian Herbaceous Vegetation, Amistad National Recreation Area (CTI 2017).

Giant Cane Riparian Herbaceous Vegetation

Local Type Concept:
Tall, somewhat woody, herbaceous vegetation, with giant cane (*Arundo donax*) dominant and usually strongly so. Associated with the former inundation zone of Amistad Reservoir and possibly with other riparian sites.

Classification Plots Represented By Concept:
No plots. The association is described from accuracy assessment observations.

Vegetation:
Arundo donax (giant cane) is dominant or strongly dominant (usually, 25-95% cover) in a very tall, somewhat woody, herbaceous stratum. *Phragmites australis* (common reed) and *Cynodon dactylon* (Bermuda grass) often occur at lower cover in this stratum. A sparse woody stratum (generally less than 10% total cover) may be present, with *Baccharis neglecta* (Rooseveltweed), *Tamarix ramosissima* (tamarisk), and/or *Nicotiana glauca* (tree-tobacco) the most constant species. The strong dominance of *A. donax* generally limits species richness in this vegetation.

Environment:
This vegetation was observed in two areas of AMIS along the Rio Grande: the uppermost reaches (above Pump Canyon) of the river and the lowermost reaches (below the Amistad Dam). While it potentially could occur throughout AMIS, it is likely most abundant where flows of substantial velocities occur, and likely much less prevalent along much of the former inundation zone.

USNVC Crosswalk
USNVC Class: Shrub and Herb Vegetation (2)
USNVC Subclass: Shrub & Herb Wetland (2.C)
USNVC Formation: Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland (2.C.4)
USNVC Division: Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland (D031)
USNVC Macrogroup: Western North American Ruderal Marsh, Wet Meadow & Shrubland Group (M301)
USNVC Group: Western North American Ruderal Marsh, Wet Meadow & Shrubland (G524)
USNVC Alliance: *Phragmites australis - Arundo donax - Alopecurus pratensis* Ruderal Marsh Alliance (A3847)
USNVC Association: *Arundo donax* Riverbank Herbaceous Vegetation (CEGL004101)



Photo 16. Giant Cane Riparian Herbaceous Vegetation, along Upper Rio Grande (CTI 2017).

Common Reed Riparian Herbaceous Vegetation

Local Type Concept:
Tall herbaceous stands with high cover of common reed (*Phragmites australis*) with low cover by other species, occurring within the former inundation zone of Amistad Reservoir and possibly along tributary stream.

Classification Plots Represented By Concept:
No plots. This vegetation is described from accuracy assessment observations.

Vegetation:
Phragmites australis (common reed) is dominant or strongly dominant (usually, 15-95% cover) in a tall herbaceous stratum. *Arundo donax* (giant cane), *Cynodon dactylon* (Bermuda grass) and/or *Pennisetum ciliare* (buffelgrass), often occur in this stratum and occasionally achieve moderately high cover. A sparse woody stratum (generally less than 15% total cover) usually is present, with *Baccharis neglecta* (Rooseveltweed), *Tamarix ramosissima* (tamarisk), *Nicotiana glauca* (tree-tobacco), *Prosopis glandulosa* (honey mesquite), and/or *Celtis laevigata* var. *laevigat*a (sugarberry) the most frequently observed species. The usual strong dominance of *P. australis* generally limits species richness in this vegetation.

Environment:
This vegetation was observed in the upper reaches of all three major streams (the Rio Grande near Langtry and above, the Pecos River above Deadman's Canyon, and the Devil's River above Satan Canyon). As with the Tamarisk Riparian Shrubland, the Giant Cane Herbaceous Vegetation, and the Edwards Plateau Stream Scoured Sparse Woodland, it appears to favor the higher gradient reaches of the AMIS riparian zone.

USNVC Crosswalk:
USNVC Class: Shrub and Herb Vegetation (2)
USNVC Subclass: Shrub & Herb Wetland (2.C)
USNVC Formation: Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland (2.C.4)
USNVC Division: Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland (D031)
USNVC Macrogroup: Western North American Ruderal Marsh, Wet Meadow & Shrubland (M301)
USNVC Group: Western North American Ruderal Marsh, Wet Meadow & Shrubland Group (G524)
USNVC Alliance: *Phragmites australis - Arundo donax - Alopecurus pratensis* Ruderal Marsh Alliance (A3847)
USNVC Association: *Phragmites australis* ssp. *berlandieri* Riverbank Wet Meadow (CEGL0041015)

Comments:
The native status of *Phragmites australis* at AMIS is uncertain because plants were not identified to subspecies. The native ssp. berlandieri of primarily Gulf Coast distribution) and non-native ssp. australis (of wide distribution) may occur in south Texas. Powell and Worthington (2018) indicate that Trans-Pecos Texas P. australis appear to be the non-native ssp. australis.



Photo 17. Common Reed Riparian Herbaceous Vegetation, along Upper Rio Grande (CTI 2017).

Bermuda Grass - Fogfruit Riparian Herbaceous Vegetation

Local Type Concept:
Herbaceous vegetation, with Bermuda Grass (*Cynodon dactylon* and/or fogfruit (*Phyla nodiflora*) dominant or important, occurring within the former inundation zone of Amistad Reservoir.

Classification Plots Represented By Concept:
AMIS194, AMIS298, AMIS335, AMIS347, AMIS385, AMIS476, AMIS969, AMIS995, AMIS1014, AMIS1117, AMIS1257, AMIS1431, AMIS1445, AMIS1610, AMIS1437, AMIS1674.

Vegetation:
Cynodon dactylon (Bermuda grass) and/or *Phyla nodiflora* (turkey tangle fogfruit) are constant and individually or together are dominant or important in the herbaceous stratum. Less constant species include *Heliotropium curassavicum* (salt heliotrope), *Alternanthera caracasana* (mat chaff-flower), and *Senna lindheimeriana* (velvetleaf senna). A variety of other, mostly ruderal, herbaceous species, including hydrophytes, may be present, usually at low cover. A sparse shrub or short tree stratum (usually less than 10% cover) may be present, with *Vachellia farnesiana* (= *Acacia farnesiana*, huisache), *Prosopis glandulosa* (honey mesquite), *Baccharis neglecta* (Rooseveltweed), *Leucophyllum frutescens* (cenizo), and *Nicotiana glauca* (tree-tobacco) the most constant woody species present. Stratum and substrate cover for Bermuda Grass - Fogfruit Riparian Herbaceous Vegetation are shown in Table D-11.

Table D-11. Stratum and substrate cover recorded for Bermuda Grass - Fogfruit Riparian Herbaceous Vegetation at Amistad National Recreation Area (# plots=16).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	0	0-trace
	Tall Shrub	0	0-0
	Short Shrub	2	0-10
	Herb	74	25-98
Substrate	Bedrock	9	0-95
	Large/Small Rocks	15	0-50
	Litter/Duff	17	0-100

Environment:
This vegetation occurs throughout the former inundation zone of Amistad Reservoir, extending into the upper stream reaches along banks. Throughout the riparian zones of AMIS, there is a pattern of several vegetation associations being more characteristic of higher gradient stream reaches (i.e., the upstream reaches of the major streams and the Rio Grande below Amistad Dam), dominated more by natural fluvial processes. These include the Willow Riparian Woodland, the Tamarisk Riparian Shrubland, the Giant Cane Herbaceous Vegetation, the Common Reed Herbaceous Vegetation, and

(along the Devils River only), the Edwards Plateau Stream Scoured Sparse Woodland. These associations contrast with others that are more characteristic of low gradient reaches of the lower reservoir, opportunistically colonize these anthropogenic surfaces, and are more influenced by reservoir inundation, drawdown, and sedimentation processes. The latter associations include the Huisache Riparian Woodland, the Bermuda Grass - Fogfruit Riparian Herbaceous Vegetation, and the Water-hyssop - Bermuda Grass - Fogfruit Sparse Riparian Herbaceous Vegetation.

USNVC Crosswalk:
USNVC Class: Shrub and Herb Vegetation (2)
USNVC Subclass: Shrub & Herb Wetland (2.C)
USNVC Formation: Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland (2.C.4)
USNVC Division: Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland (D031)
USNVC Macrogroup: Western North American Ruderal Marsh, Wet Meadow & Shrubland (M301)
USNVC Group: Western North American Ruderal Marsh, Wet Meadow & Shrubland Group (G524)
USNVC Alliance: *Phragmites australis - Arundo donax - Alopecurus pratensis* Ruderal Marsh Alliance (A3847)
NPS Association: *Cynodon dactylon - Phyla nodiflora* - (*Heliotropium curassavicum*) Riparian Herbaceous Vegetation (NPSAMIS002)

All plant taxa recorded in Bermuda Grass - Fogfruit Riparian Herbaceous Vegetation are shown in Table D-12.

Table D-12. Synthesis table for all plant taxa recorded in Bermuda Grass - Fogfruit Riparian Herbaceous Vegetation at Amistad National Recreation Area (# plots=11).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Vachellia farnesiana (=Acacia farnesiana)	Shrub	56.3%	0.6	0-10
Nicotiana glauca	Shrub	25.0%	0.2	0-2
Tamarix ramosissima	Shrub	25.0%	0.1	0-1
Prosopis glandulosa	Shrub	18.8%	0.1	0-1
Vachellia vernicosa (=Acacia neovernicosa)	Shrub	6.3%	0.1	0-1
Parkinsonia aculeata	Shrub	6.3%	0.1	0-1
Salix nigra	Shrub	6.3%	0.1	0-trace
Ipomoea cordatotriloba var. *cordatotriloba*	Vine	9.1%	0.1	0-1
Cynodon dactylon	Herb	100.0%	35.0	1-100
Phyla nodiflora	Herb	93.8%	28.2	0-95

Table D-12 (continued). Synthesis table for all plant taxa recorded in Bermuda Grass - Fogfruit Riparian Herbaceous Vegetation at Amistad National Recreation Area (# plots=11).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Heliotropium curassavicum	Herb	43.8%	0.8	0-10
Alternanthera caracasana	Herb	37.5%	1.5	0-25
Senna lindheimeriana	Herb	31.2%	0.7	0-10
Bothriochloa ischaemum	Herb	18.8%	0.5	0-2
Fimbristylis vahlii	Herb	18.8%	0.5	0-10
Croton sp.	Herb	18.8%	0.1	0-1
Polygonum punctatum	Herb	12.5%	2.4	0-50
Cyperus sp.	Herb	12.5%	2.4	0-50
Pluchea sp.	Herb	12.5%	1.0	0-10
Cyperus odoratus	Herb	12.5%	0.5	0-10
Vitex agnus-castus	Herb	12.5%	0.5	0-10
Malvastrum coromandelianum	Herb	12.5%	0.1	0-2
Heliotropium procumbens	Herb	6.3%	5.3	0-95
Cyperus erythrorhizos	Herb	6.3%	1.1	0-25
Melilotus officinalis	Herb	6.3%	1.1	0-25
Pennisetum ciliare	Herb	6.3%	1.1	0-25
Fuirena simplex	Herb	6.3%	0.2	0-5
Indigofera lindheimeriana	Herb	6.3%	0.1	0-2
Aristida sp.	Herb	6.3%	0.1	0-1
Bacopa monnieri	Herb	6.3%	0.1	0-1
Cenchrus sp.	Herb	6.3%	0.1	0-1
Chamaesyce sp.	Herb	6.3%	0.1	0-1
Croton monanthogynus	Herb	6.3%	0.1	0-1
Hedeoma sp.	Herb	6.3%	0.1	0-1
Leucospora multifida	Herb	6.3%	0.1	0-1
Senna sp.	Herb	6.3%	0.1	0-1
Thymophylla sp.	Herb	6.3%	0.1	0-1
Arundo donax	Herb	6.3%	0.1	0-trace

Table D-12 (continued). Synthesis table for all plant taxa recorded in Bermuda Grass - Fogfruit Riparian Herbaceous Vegetation at Amistad National Recreation Area (# plots=11).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Calibrachoa parviflora	Herb	6.3%	0.1	0-trace
Croton sp.	Herb	6.3%	0.1	0-trace
Helenium microcephalum	Herb	6.3%	0.1	0-trace
Nama parvifolium	Herb	6.3%	0.1	0-trace
Xanthium strumarium	Herb	6.3%	0.1	0-trace



Photo 18. Bermuda Grass - Fogfruit Riparian Herbaceous Vegetation, along Amistad Reservoir west of Salem Point (LBJWC) (AMIS1431).

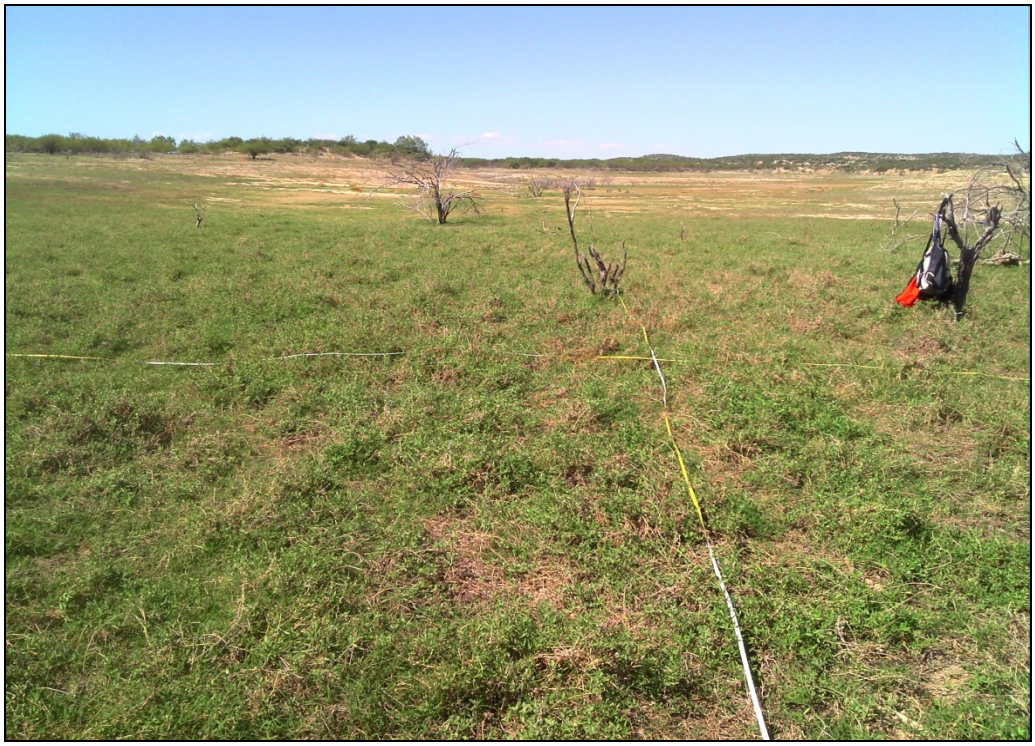


Photo 19. Bermuda Grass - Fogfruit Riparian Herbaceous Vegetation, along Amistad Reservoir near mouth of Cow Creek Canyon (LBJWC) (AMIS0969).

Rooseveltweed - Tree-Tobacco Riparian Shrubland

Local Type Concept:
Stands with Rooseveltweed (*Baccharis neglecta*) (usually), *Baccharis salicifolia* (seep-willow), and/or tree-tobacco (*Nicotiana glauca*) dominant in a shrub stratum within the former inundation zone of Amistad Reservoir or along tributary streams to the Rio Grande.

Classification Plots Represented By Concept:
AMIS479.

Vegetation:
Some combination of *Baccharis neglecta* (Rooseveltweed) (most frequently), *Baccharis salicifolia* (seep-willow), and/or *Nicotiana glauca* (tree-tobacco) (mixed or monospecific) dominates a somewhat open to dense (25 to 85% cover) tall shrub stratum. Less constant and generally low cover woody species include *Vachellia farnesiana* (= *Acacia farnesiana*, huisache), *Prosopis glandulosa* (honey mesquite), *Tamarix ramosissima* (tamarisk), *Salix* (willows) of various species, and/or *Parkinsonia aculeata* (retama). The herbaceous stratum may be sparse to dense, has relatively high cover, with *Cynodon dactylon* (Bermuda grass) and *Phyla nodiflora* (turkey tangle fogfruit) the most abundant species. Stratum and substrate cover for Rooseveltweed - Tree-tobacco Riparian Shrubland are shown in Table D-13.

Table D-13. Stratum and substrate cover recorded for Rooseveltweed - Tree-tobacco Riparian Shrubland at Amistad National Recreation Area (# plots=1).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	0	0-0
	Tall Shrub	18	10-25
	Short Shrub	9	5-12
	Herb	85	75-95
Substrate	Bedrock	0	0-0
	Large/Small Rocks	0	0-0
	Litter/Duff	95	95-95

Environment:
This vegetation is well distributed within the former inundation zone of Amistad Reservoir (where B. neglecta is the primary shrub), extending into the upper reaches of the main streams along banks (where *B. salicifolia* may occur with increasing importance). Some stands, especially those with *Nicotiana glauca* prominent, may occur on rocky surfaces.

USNVC Crosswalk:
USNVC Class: Shrub and Herb Vegetation (2)

USNVC Subclass: Shrub & Herb Wetland (2.C)
USNVC Formation: Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland (2.C.4)
USNVC Division: Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland (D031)
USNVC Macrogroup: Western North American Ruderal Marsh, Wet Meadow & Shrubland Group (M301)
USNVC Group: Western North American Ruderal Marsh, Wet Meadow & Shrubland (G524)
USNVC Alliance: *Phragmites australis - Arundo donax - Alopecurus pratensis* Ruderal Marsh Alliance (A3847)
NPS Association: *Baccharis neglecta - Nicotiana glauca* Shrubland (NPSAMIS007)

Comments:
Either *Baccharis neglecta* or *Baccharis salicifolia* may occur, and field staff expressed some difficulty in assigning some plants, due to the leaf width characters, which at AMIS often are intermediate between the narrower-leaved former species and the wider-leaved latter species. The season of accuracy assessment observations was early, which precluded observing mature fruits. Stands over rocky substrates, especially those with *Nicotiana glauca* prominent, may represent a distinct type, but are included here until additional plot documentation is available. All plant taxa recorded in Rooseveltweed - Tree-tobacco Riparian Shrubland are shown in Table D-14.

Table D-14. Synthesis table for all plant taxa recorded in Rooseveltweed - Tree-tobacco Riparian Shrubland at Amistad National Recreation Area (# plots=1).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Baccharis neglecta	Shrub	100.0%	21.0	12-30
Cephalanthus occidentalis	Shrub	100.0%	1.1	few-2
Vachellia farnesiana (=Acacia farnesiana)	Shrub	100.0%	0.7	few-1
Celtis laevigata var. laevigata	Shrub	100.0%	0.1	trace
Nicotiana glauca	Shrub	100.0%	0.1	trace
Sophora secundiflora	Shrub	100.0%	0.1	trace
Phyla nodiflora	Herb	100.0%	37.5	25-50
Cynodon dactylon	Herb	100.0%	17.5	10-25
Setaria scheelei	Herb	100.0%	7.5	5-10
Senna lindheimeriana	Herb	100.0%	1.5	1-2
Indigofera lindheimeriana	Herb	100.0%	0.5	0-1
Marrubium vulgare	Herb	100.0%	0.5	0-1
Verbesina encelioides	Herb	100.0%	0.5	0-1



Photo 20. Rooseveltweed - Tree-Tobacco Riparian Shrubland, along Amistad Reservoir near mouth of Live Oak Creek Canyon (LBJWC) (AMIS0479).



Photo 21. Rooseveltweed - Tree-Tobacco Riparian Shrubland, along Amistad Reservoir near mouth of Live Oak Creek Canyon (LBJWC) (AMIS0479).

Water Hyssop - Bermuda Grass - Fogfruit Sparse Riparian Herbaceous Vegetation

Local Type Concept:
Very sparse to somewhat dense wetland herbaceous vegetation with variable dominance and coastal water hyssop (*Bacopa monnieri*) important or dominant.

Classification Plots Represented By Concept:
No plots. The association was developed in order to describe the concept wettest and most newly exposed sediment flats within the inundation zone of Amistad Reservoir. It is expected to be approximately equivalent to *the Bacopa monnieri - Cynodon dactylon - Phyla nodiflora* Herbaceous Vegetation recorded by Poole (2013). After multiple years of exposure, this vegetation may succeed to more densely vegetated herbaceous or shrubland associations (e.g., the Bermuda grass - Fogfruit Herbaceous Vegetation or the Rooseveltweed - Tree-tobacco Riparian Shrubland.

Vegetation:
The vegetation is comprised primarily of low-growing herbaceous species and may be extremely sparse (appearing unvegetated early in the growing season or after recent exposure) to moderately dense. Wetland species such as *Bacopa monnieri* (coastal water hyssop) are usually important and may be dominant. *Cynodon dactylon* (Bermuda grass) and *Phyla nodiflora* (turkey tangle fogfruit) often are present. Other species that may be present and locally important include *Heliotropium curassavicum* (salt heliotrope), *Alternanthera caracasana* (mat chaff-flower), *Cyperus* spp. (flatsedges), *Polygonum punctatum* (dotted smartweed), *Fuirena simplex* (western umbrella-sedge), *Xanthium strumarium* (rough cocklebur), and others.

Environment:
This association represents vegetation on newly exposed sediment flats within the inundation zone of Amistad Reservoir. Many mapped stands may be inundated for long periods during the year or for multiple years. The vegetation is probably well distributed within the former inundation zone.

USNVC Crosswalk:
USNVC Class: Shrub and Herb Vegetation (2)
USNVC Subclass: Shrub & Herb Wetland (2.C)
USNVC Formation: Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland (2.C.4)
USNVC Division: Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland (D031)
USNVC Macrogroup: Western North American Ruderal Marsh, Wet Meadow & Shrubland Group (M301)
USNVC Group: Western North American Ruderal Marsh, Wet Meadow & Shrubland (G524)
USNVC Alliance: *Phragmites australis - Arundo donax - Alopecurus pratensis* Ruderal Marsh Alliance (A3847)
NPS Association: *Bacopa monnieri* - (*Cynodon dactylon, Phyla nodiflora*) Herbaceous Vegetation (NPSAMIS031)



Photo 22. Water Hyssop - Bermuda Grass - Fogfruit Sparse Riparian Herbaceous Vegetation, along Amistad Reservoir shoreline (CTI 2017).

California Bulrush Riparian Herbaceous Vegetation

Local Type Concept:
Herbaceous vegetation dominated by California bulrush (*Schoenoplectus californicus*) along the Rio Grande and perhaps in other wet riparian settings.

Classification Plots Represented By Concept:
No plots. The vegetation was observed after plot sampling had been completed and apparently also was recorded by Poole (2013).

Vegetation:
Schoenoplectus californicus (California bulrush) is dominant and usually strongly so in dense stands, with associated species usually few and at low cover. Physiognomy is tall (2-3 meters) graminoid herbaceous vegetation.

Environment:
Stands were seen in low-lying, wet depressions in the alluvial corridor of the Rio Grande, below Amistad Dam. The same or similar vegetation was noted by Poole (2013). It may occur within the inundation zone of Amistad Reservoir or elsewhere along large rivers. Stands likely are limited in size.

USNVC Crosswalk:
USNVC Class: Shrub and Herb Vegetation (2)
USNVC Subclass: Shrub & Herb Wetland (2.C)
USNVC Formation: Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland (2.C.4)
USNVC Division: Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland (D031)
USNVC Macrogroup: Arid West Interior Freshwater Marsh (M888)
USNVC Group: Arid West Interior Freshwater Marsh (G531)
USNVC Alliance: *Schoenoplectus americanus* - *Schoenoplectus acutus* - *Schoenoplectus californicus* Marsh Alliance (A3895)
NPS Association: *Schoenoplectus californicus* Tamaulipan Riparian Herbaceous Vegetation (NPSAMIS030)



Photo 23. California Bulrush Riparian Herbaceous Vegetation, along Rio Grande below Amistad Dam (CTI 2017).

Cenizo Shrubland

Local Type Concept:
Upland thornscrub shrublands with cenizo (*Leucophyllum frutescens*) strongly dominant (45% or more of relative cover in the shrub stratum.

Classification Plots Represented By Concept:
AMIS463, AMIS1156, AMIS1583, AMIS1612, AMIS1702, AMIS1712.

Vegetation:
Leucophyllum frutescens (cenizo) is strongly dominant in the shrub stratum; other than the dominance by this species, composition is variable. *Senegalia berlandieri* (=*Acacia berlandieri*, guajillo) usually is present at moderate or low cover. Other shrub species may include *Lippia graveolens* (Mexican oregano), *Vachellia rigidula* (=*Acacia rigidula*, blackbrush), *Calliandra conferta* (Rio Grande stickpea), *Opuntia engelmannii* var. *lindheimeri* (Texas pricklypear), *Cylindropuntia leptocaulis* (Christmas cactus), *Heliotropium torreyi* (slimleaf heliotrope), *Prosopis glandulosa* (honey mesquite), *Forestiera angustifolia* (desert olive), *Diospyros texana* (Texas persimmon), *Croton dioicus* (grassland croton), and/or *Opuntia engelmannii* var. *lindheimeri* (Texas pricklypear). The herbaceous stratum is dominated by grasses and has low overall cover. *Bouteloua curtipendula* (sideoats grama), *Bouteloua trifida* (red grama), *Aristida purpurea* (purple threeawn), and *Panicum hallii* (Hall's panicgrass) are the most frequent and abundant grass species present, and the forb/sub-shrub *Tiquilia canescens* (woody crinklemat) is constant. Stratum and substrate cover for Cenizo Shrubland are shown in Table D-15.

Table D-15. Stratum and substrate cover recorded for Cenizo Shrubland at Amistad National Recreation Area (# plots=6).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	0	0-0
	Tall Shrub	4	0-25
	Short Shrub	45	24-61
	Herb	4	few-10
Substrate	Bedrock	8	0-50
	Large/Small Rocks	57	4-85
	Litter/Duff	2	0-5

Environment:
This vegetation was found to be common in AMIS from Zuberbueler Bend east. It generally occupies upland landforms, mostly outside the former inundation zone of Amistad Reservoir, and may be most abundant on ridge crests and hilltops.

USNVC Crosswalk:
USNVC Class: Semi-Desert (3)
USNVC Subclass: Warm Semi-Desert Scrub & Grassland (3.A)
USNVC Formation: Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
USNVC Division: North American Warm Desert Scrub & Grassland (D039)
USNVC Macrogroup: Tamaulipan Scrub and Grassland (M130)
USNVC Group: Tamaulipan Dry Mesquite and Thornscrub (G099)
USNVC Alliance: Tamaulipan *Vachellia rigidula - Leucophyllum frutescens - Senegalia berlandieri* Calcareous Thornscrub Alliance (A3191)
USNVC Association: USNVC Association*: Leucophyllum frutescens* Shrubland (CEGL002168)

Comments:
The Cenizo Shrubland, Blackbrush - Cenizo Shrubland, Guajillo - Cenizo Shrubland, Guajillo - Blackbrush - Torrey Yucca Shrubland, Blackbrush - Texas Persimmon - Texas Sotol Shrubland, Blackbrush - Mesquite - Texas Persimmon Shrubland, Dry Mixed Thornscrub Shrubland, and Mimosa Dwarf-Shrubland are closely related thornscrub types at AMIS. Most of these had approximately equal taxonomic rank from cluster analysis results. At this point, they are treated as individual associations within a single USNVC alliance. At a larger geographic scale, it may prove best to treat them as variants or phases of a single association (e.g., the USNVC *Vachellia rigidula - Leucophyllum frutescens - Senegalia berlandieri* shrubland CEGL007759). Most frequent plant taxa recorded in Cenizo Shrubland are shown in Table D-16.

Table D-16. Synthesis table for the most frequent plant taxa recorded in Cenizo Shrubland at Amistad National Recreation Area (# plots=6).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Leucophyllum frutescens	Shrub	100.0%	27.0	5-55
Senegalia berlandieri (=Acacia berlandieri)	Shrub	83.3%	6.5	0-25
Lippia graveolens	Shrub	66.7%	0.6	0-2
Vachellia rigidula (=Acacia rigidula)	Shrub	50.0%	4.0	0-25
Calliandra conferta	Shrub	50.0%	1.3	0-5
Opuntia engelmannii var. *lindheimeri*	Shrub	50.0%	0.9	0-5
Tiquilia canescens	Shrub	50.0%	0.4	0-2
Cylindropuntia leptocaulis	Shrub	50.0%	0.1	0-5
Heliotropium torreyi	Shrub	33.3%	0.7	0-5
Jatropha dioica	Shrub	33.3%	0.5	0-2
Meximalva filipes	Shrub	33.3%	0.2	0-1
Echinocereus coccineus var. *paucispinus*	Shrub	33.3%	0.2	0-1

Table D-16 (continued). Synthesis table for the most frequent plant taxa recorded in Cenizo Shrubland at Amistad National Recreation Area (# plots=6).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Ferocactus hamatacanthus	Shrub	33.3%	0.2	0-1
Yucca torreyi	Shrub	33.3%	0.1	0-1
Diospyros texana	Shrub	33.3%	0.1	0-trace
Vachellia vernicosa (=Acacia neovernicosa)	Shrub	16.7%	1.3	0-11
Castela erecta ssp. *texana*	Shrub	16.7%	0.6	0-5
Parkinsonia texana	Shrub	16.7%	0.6	0-5
Agave lechuguilla	Shrub	16.7%	0.3	0-2
Gutierrezia microcephala	Shrub	16.7%	0.3	0-5
Opuntia atrispina	Shrub	16.7%	0.3	0-2
Prosopis glandulosa	Shrub	16.7%	0.1	0-1
Mimosa borealis	Shrub	16.7%	0.1	0-2
Lycium berlandieri	Shrub	16.7%	0.1	0-1
Neolloydia conoidea	Shrub	16.7%	0.1	0-1
Yucca thompsoniana	Shrub	16.7%	0.1	0-1
Bouteloua curtipendula	Herb	66.7%	0.8	0-2
Panicum hallii	Herb	66.7%	0.3	0-2
Bouteloua trifida	Herb	33.3%	0.8	0-2
Aristida purpurea	Herb	33.3%	0.3	0-2
Pennisetum ciliare	Herb	33.3%	0.3	0-2
Thymophylla pentachaeta	Herb	33.3%	0.2	0-1
Tridens muticus var. *muticus*	Herb	33.3%	0.2	0-1
Croton dioicus	Herb	16.7%	0.1	0-1
Portulaca pilosa	Herb	16.7%	0.1	0-1
Sida abutifolia	Herb	16.7%	0.1	0-1



Photo 24. Cenizo Shrubland, north side of San Pedro Canyon (LBJWC) (AMIS1156).



Photo 25. Cenizo Shrubland, along Amistad Reservoir near Spur Road 454 (near Lake View Subdivision) (LBJWC) (AMIS1712).

Blackbrush - Cenizo Shrubland

Local Type Concept:
Upland thornscrub shrublands with both blackbrush (*Vachellia rigidula* (=*Acacia rigidula*)) and/or cenizo (*Leucophyllum frutescens*) present and individually or together dominant. Guajillo (*Senegalia berlandieri* (=*Acacia berlandieri*)) is either absent or present at low cover.

Classification Plots Represented By Concept:
AMIS340, AMIS352, AMIS581, AMIS992, AMIS1108, AMIS1138, AMIS1621.

Vegetation:
Vachellia rigidula (=*Acacia rigidula*, blackbrush) and *Leucophyllum frutescens* (cenizo) both have high constancy and are individually or together dominant. Other relatively constant low to moderate cover shrub species include *Forestiera angustifolia* (desert olive*), Opuntia engelmannii* var. *lindheimeri* (Texas pricklypear), *Calliandra conferta* (Rio Grande stickpea), *Cylindropuntia leptocaulis* (Christmas cactus*), Heliotropium torreyi* (slimleaf heliotrope), *Prosopis glandulosa* (honey mesquite), *Lippia graveolens* (Mexican oregano), *Cylindropuntia leptocaulis* (Christmas cactus), *Aloysia gratissima* (whitebrush), *Diospyros texana* (Texas persimmon, *Heliotropium torreyi* (slimleaf heliotrope), and the sub-shrub *Senna lindheimeriana* (velvetleaf senna). The herbaceous stratum has low overall cover; the grasses *Bouteloua trifida* (red grama), *Aristida purpurea* (purple threeawn), and *Erioneuron pilosum* (hairy woollygrass) are the most frequent and abundant grass species, and the forb/sub-shrub *Tiquilia canescens* (woody crinklemat) is constant. Stratum and substrate cover for Blackbrush - Cenizo Shrubland are shown in Table D-17.

Table D-17. Stratum and substrate cover recorded for Blackbrush - Cenizo Shrubland at Amistad National Recreation Area (# plots=7).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	0	0-trace
	Tall Shrub	7	0-50
	Short Shrub	38	10-50
	Herb	2	few-5
Substrate	Bedrock	10	0-30
	Large/Small Rocks	48	15-80
	Litter/Duff	4	1-15

Environment:
This vegetation was found to be common in AMIS from Zuberbueler Bend east. It generally occupies upland landforms, mostly above the former inundation zone of Amistad Reservoir.

USNVC Crosswalk:
USNVC Class: Semi-Desert (3)
USNVC Subclass: Warm Semi-Desert Scrub & Grassland (3.A)
USNVC Formation: Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
USNVC Division: North American Warm Desert Scrub & Grassland (D039)
USNVC Macrogroup: Tamaulipan Scrub and Grassland (M130)
USNVC Group: Tamaulipan Dry Mesquite and Thornscrub (G099)
USNVC Alliance: Tamaulipan *Vachellia rigidula - Leucophyllum frutescens - Senegalia berlandieri* Calcareous Thornscrub Alliance (A3191)
USNVC Association: USNVC Association: *Vachellia rigidula* Shrubland (CEGL003874)

Comments:
The Cenizo Shrubland, Blackbrush - Cenizo Shrubland, Guajillo - Cenizo Shrubland, Guajillo - Blackbrush - Torrey Yucca Shrubland, Blackbrush - Texas Persimmon - Texas Sotol Shrubland, Blackbrush - Mesquite - Texas Persimmon Shrubland, Dry Mixed Thornscrub Shrubland, and Mimosa Dwarf-Shrubland are closely related thornscrub types at AMIS. Most of these had approximately equal taxonomic rank from cluster analysis results. At this point, they are treated as individual associations within a single USNVC alliance. At a larger geographic scale, it may prove best to treat them as variants or phases of a single association (e.g., the USNVC *Vachellia rigidula - Leucophyllum frutescens - Senegalia berlandieri* shrubland CEGL007759). Most frequent plant taxa recorded in Blackbrush - Cenizo Shrubland are shown in Table D-18.

Table D-18. Synthesis table for the most frequent plant taxa recorded in Blackbrush - Cenizo Shrubland at Amistad National Recreation Area (# plots=7).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Vachellia rigidula (=Acacia rigidula)	Shrub	100.0%	12.3	trace-70
Leucophyllum frutescens	Shrub	100.0%	5.1	1-26
Forestiera angustifolia	Shrub	85.7%	1.5	0-11
Opuntia engelmannii var. *lindheimeri*	Shrub	71.4%	4.5	0-27
Calliandra conferta	Shrub	71.4%	2.1	0-10
Prosopis glandulosa	Shrub	71.4%	1.8	0-10
Lippia graveolens	Shrub	71.4%	1.5	0-10
Cylindropuntia leptocaulis	Shrub	71.4%	1.0	0-3
Aloysia gratissima	Shrub	57.1%	0.6	0-2
Heliotropium torreyi	Shrub	57.1%	0.5	0-5
Diospyros texana	Shrub	42.9%	0.5	0-3
Tiquilia canescens	Shrub	42.9%	0.2	0-1

Table D-18 (continued). Synthesis table for the most frequent plant taxa recorded in Blackbrush - Cenizo Shrubland at Amistad National Recreation Area (# plots=7).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Yucca torreyi	Shrub	42.9%	0.1	0-2
Krameria sp.	Shrub	28.6%	0.7	0-5
Castela erecta ssp. texana	Shrub	28.6%	0.3	0-2
Senegalia berlandieri (=Acacia berlandieri)	Shrub	28.6%	0.2	0-2
Lycium berlandieri	Shrub	28.6%	0.2	0-1
Agave lechuguilla	Shrub	28.6%	0.1	0-2
Echinocactus texensis	Shrub	28.6%	0.1	0-1
Echinocereus enneacanthus var. *enneacanthus*	Shrub	28.6%	0.1	0-1
Karwinskia humboldtiana	Shrub	28.6%	0.1	0-1
Lantana achyranthifolia	Shrub	28.6%	0.1	0-1
Wedelia texana	Shrub	28.6%	0.1	0-1
Senna roemeriana	Herb	71.4%	0.2	0-1
Panicum hallii	Herb	57.1%	0.3	0-1
Thymophylla pentachaeta	Herb	57.1%	0.2	0-1
Ruellia sp.	Herb	42.9%	0.2	0-1
Croton monanthogynus	Herb	28.6%	0.6	0-5
Tragia sp.	Herb	28.6%	0.3	0-2
Aristida sp.	Herb	28.6%	0.1	0-1
Sida abutifolia	Herb	28.6%	0.1	0-1
Aristida purpurea	Herb	28.6%	0.1	0-2
Boerhavia coccinea	Herb	28.6%	0.1	0-1
Bouteloua sp.	Herb	28.6%	0.1	0-1
Evolvulus sericeus	Herb	28.6%	0.1	0-1



Photo 26. Blackbrush - Cenizo Shrubland, west side of Zuberbueler Bend (LBJWC) (AMIS0340).



Photo 27. Blackbrush - Cenizo Shrubland, west side of Zuberbueler Bend (LBJWC) (AMIS0352).

Guajillo - Cenizo Shrubland

Local Type Concept:
Upland thornscrub shrublands (occasionally, short-statured woodlands) with both guajillo (*Senegalia berlandieri* (=*Acacia berlandieri*)) and/or cenizo (*Leucophyllum frutescens*) present and individually or together dominant. Blackbrush *(Vachellia rigidula* (=*Acacia rigidula*)) is unimportant or absent.

Classification Plots Represented By Concept:
AMIS192, AMIS472, AMIS527, AMIS829, AMIS985, AMIS1003, AMIS1122, AMIS1132, AMIS1464, AMIS1557, AMIS1568, AMIS1570, AMIS1664, AMIS1715, AMIS1720.

Vegetation:
Senegalia berlandieri (=*Acacia berlandieri*, guajillo) and *Leucophyllum frutescens* (cenizo) both have high constancy and are individually or together dominant. Relatively constant shrubs that occur, usually at low cover, include *Prosopis glandulosa* (honey mesquite), *Cylindropuntia leptocaulis* (Christmas cactus), *Opuntia engelmannii* var. *lindheimeri* (Texas pricklypear), and *Forestiera angustifolia* (desert olive). *Lippia graveolens* (Mexican oregano), *Condalia ericoides* (javelina bush), *Diospyros texana* (Texas persimmon), *Celtis ehrenbergiana* (spiny hackberry), and *Guaiacum angustifolium* (guayacan) are less constant shrubs that occasionally attain high cover locally. Some shrub species, particularly *P. glandulosa* and/or *C. ehrenbergiana*, may attain tree stature. The non-native *Pennisetum ciliare* (buffelgrass) occasionally dominates the herbaceous stratum, which otherwise tends to have low cover and few constant species; the grasses *Bouteloua trifida* (red grama), *Aristida purpurea* (purple threeawn), and *Erioneuron pilosum* (hairy woollygrass) are the most frequent. The forb/sub-shrub *Tiquilia canescens* (woody crinklemat) is constant. Stratum and substrate cover for Guajillo - Cenizo Shrubland are shown in Table D-19.

Table D-19. Stratum and substrate cover recorded for Guajillo - Cenizo Shrubland at Amistad National Recreation Area (# plots=15).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	3	0-38
	Tall Shrub	10	trace-38
	Short Shrub	34	7-100
	Herb	4	1-15
Substrate	Bedrock	2	0-15
	Large/Small Rocks	36	1-95
	Litter/Duff	4	0-25

Environment:
This vegetation was found to be common in AMIS, west at least to the Pecos River. It generally occupies upland landforms, mostly outside the former inundation zone of Amistad Reservoir. Some

stands that were observed may have resulted from the former brush removal efforts (chaining, etc.). In such situations, *S. berlandieri* (guajillo) appears to have a greater ability to withstand or respond to such disturbances than does *V. rigidula* (blackbrush).

USNVC Crosswalk:
USNVC Class: Semi-Desert (3)
USNVC Subclass: Warm Semi-Desert Scrub & Grassland (3.A)
USNVC Formation: Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
USNVC Division: North American Warm Desert Scrub & Grassland (D039)
USNVC Macrogroup: Tamaulipan Scrub and Grassland (M130)
USNVC Group: Tamaulipan Dry Mesquite and Thornscrub (G099)
USNVC Alliance: Tamaulipan *Vachellia rigidula - Leucophyllum frutescens - Senegalia berlandieri* Calcareous Thornscrub Alliance (A3191)
USNVC Association: *Senegalia berlandieri - Leucophyllum* frutescens Shrubland (CEGL007758)

Comments:
The Cenizo Shrubland, Blackbrush - Cenizo Shrubland, Guajillo - Cenizo Shrubland, Guajillo - Blackbrush - Torrey Yucca Shrubland, Blackbrush - Texas Persimmon - Texas Sotol Shrubland, Blackbrush - Mesquite - Texas Persimmon Shrubland, Dry Mixed Thornscrub Shrubland, and Mimosa Dwarf-Shrubland are closely related thornscrub types at AMIS. Most of these had approximately equal taxonomic rank from cluster analysis results. At this point, they are treated as individual associations within a single USNVC alliance. At a larger geographic scale, it may prove best to treat them as variants or phases of a single association (e.g., the USNVC *Vachellia rigidula - Leucophyllum frutescens - Senegalia berlandieri* shrubland CEGL007759). Most frequent plant taxa recorded in Guajillo - Cenizo Shrubland are shown in Table D-20.

Table D-20. Synthesis table for the most frequent plant taxa recorded in Guajillo - Cenizo Shrubland at Amistad National Recreation Area (# plots=15).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Senegalia berlandieri (=Acacia berlandieri)	Shrub	100.0%	10.1	few-50
Leucophyllum frutescens	Shrub	93.3%	5.9	0-26
Prosopis glandulosa	Shrub	87.5%	3.6	0-16
Cylindropuntia leptocaulis	Shrub	80.0%	0.8	0-5
Tiquilia canescens	Shrub	80.0%	0.6	0-2
Opuntia engelmannii var. *lindheimeri*	Shrub	73.3%	2.4	0-11
Lippia graveolens	Shrub	53.3%	3.2	0-35
Forestiera angustifolia	Shrub	53.3%	1.2	0-10

Table D-20 (continued). Synthesis table for the most frequent plant taxa recorded in Guajillo - Cenizo Shrubland at Amistad National Recreation Area (# plots=15).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Condalia ericoides	Shrub	46.7%	1.6	0-25
Diospyros texana	Shrub	46.7%	1.5	0-3
Guaiacum angustifolium	Shrub	46.7%	0.4	0-20
Yucca torreyi	Shrub	46.7%	0.1	0-12
Karwinskia humboldtiana	Shrub	40.0%	1.1	0-2
Aloysia gratissima	Shrub	40.0%	0.4	0-2
Heliotropium torreyi	Shrub	40.0%	0.2	0-10
Mahonia trifoliolata	Shrub	40.0%	0.2	0-2
Castela erecta ssp. texana	Shrub	33.3%	0.8	0-2
Condalia spathulata	Shrub	33.3%	0.8	0-2
Lycium berlandieri	Shrub	33.3%	0.4	0-1
Ephedra antisyphilitica	Shrub	33.3%	0.2	0-5
Celtis ehrenbergiana	Shrub	26.7%	0.5	0-2
Calliandra conferta	Shrub	26.7%	0.4	0-10
Ziziphus obtusifolia	Shrub	26.7%	0.3	0-5
Grusonia schottii	Shrub	20.0%	0.3	0-5
Colubrina texensis	Shrub	20.0%	0.1	0-2
Yucca thompsoniana	Shrub	20.0%	0.1	0-1
Parthenium sp.	Shrub	20.0%	0.1	0-1
Cynanchum sp.	Vine	33.3%	0.1	0-1
Aristida sp.	Herb	53.3%	0.9	0-10
Aristida purpurea	Herb	33.3%	0.2	0-2
Croton sp.	Herb	33.3%	0.2	0-1
Pennisetum ciliare	Herb	26.7%	0.8	0-10
Panicum hallii	Herb	20.0%	0.2	0-2
Polygala sp.	Herb	20.0%	0.1	0-2
Hedeoma sp.	Herb	20.0%	0.1	0-1
Sporobolus sp.	Herb	20.0%	0.1	0-1
Cooperia sp.	Herb	20.0%	0.1	0-1



Photo 28. Guajillo - Cenizo Shrubland, west side of Zuberbueler Bend (LBJWC) (AMIS0527).



Photo 29. Guajillo - Cenizo Shrubland, vicinity of Amistad Acres (LBJWC) (AMIS1122).

Guajillo - Blackbrush - Torrey Yucca Shrubland

Local Type Concept:
Upland thornscrub shrublands with Guajillo (*Senegalia berlandieri* (=*Acacia berlandieri*)) at high cover, and blackbrush (*Vachellia rigidula* (=*Acacia rigidula*)) constant and sometimes co-dominant.

Classification Plots Represented By Concept:
AMIS301, AMIS349, AMIS541, AMIS567, AMIS588, AMIS1663.

Vegetation:
Senegalia berlandieri (=*Acacia berlandieri*, guajillo) is dominant and generally exceeds 20% cover. *Vachellia rigidula* (=*Acacia rigidula*, blackbrush), *Karwinskia humboldtiana* (coyotillo), *Leucophyllum frutescens* (cenizo), *Diospyros texana* (Texas persimmon), and *Croton incanus* (grassland croton) also are constant and can be co-dominant with *S. berlandieri*. Other relatively constant, mostly low cover, shrubs include *Yucca torreyi* (Torrey yucca), *Opuntia engelmannii* var. *lindheimeri* (Texas pricklypear), and *Meximalva filipes* (texasfan). Additional shrub species include *Sophora secundiflora* (mescal bean), *Prosopis glandulosa* (honey mesquite), *Croton incanus* (Torrey's croton), *Calliandra conferta* (Rio Grande stickpea), and *Salvia ballotiflora* (shrubby blue sage). Moderately diagnostic (highly diagnostic when occurring together) species include *Meximalva filipes*, *Sophora secundiflora, Karwinskia humboldtiana*, *Salvia ballotiflora*, and *Croton incanus*. The herbaceous stratum has generally low cover; *Aristida purpurea*, (purple threeawn) is the most constant, and often the most abundant, species. Stratum and substrate cover for Guajillo - Blackbrush - Torrey Yucca Shrubland are shown in Table D-21.

Table D-21. Stratum and substrate cover recorded Guajillo - Blackbrush - Torrey Yucca Shrubland at Amistad National Recreation Area (# plots=6).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	0	0-0
	Tall Shrub	16	2-50
	Short Shrub	59	25-100
	Herb	4	few-10
Substrate	Bedrock	21	0-88
	Large/Small Rocks	47	6-90
	Litter/Duff	6	1-15

Environment:
This vegetation was observed throughout AMIS, west at least to the Pecos River, but is most prevalent within the Devils River corridor. It generally occupies upland landforms, mostly above the former inundation zone of Amistad Reservoir.

USNVC Crosswalk:
USNVC Class: Semi-Desert (3)
USNVC Subclass: Warm Semi-Desert Scrub & Grassland (3.A)
USNVC Formation: Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
USNVC Division: North American Warm Desert Scrub & Grassland (D039)
USNVC Macrogroup: Tamaulipan Scrub and Grassland (M130)
USNVC Group: Tamaulipan Dry Mesquite and Thornscrub (G099)
USNVC Alliance: *Tamaulipan Vachellia rigidula - Leucophyllum frutescens - Senegalia berlandieri* Calcareous Thornscrub Alliance (A3191)
USNVC Association: *Vachellia rigidula - Leucophyllum frutescens - Senegalia berlandieri* Shrubland (CEGL007759)

Comments:
AMIS stands are translated as the USNVC *Vachellia rigidula - Leucophyllum frutescens - Senegalia berlandieri* Shrubland (CEGL007759), which is likely a more broadly circumscribed concept (USNVC 2016). Stands of this AMIS unit tend to be most strongly dominated by *Senegalia berlandieri*, with *Vachellia rigidula* equal or secondary in importance, and *Leucophyllum frutescens* usually at low cover, when present. The Cenizo Shrubland, Blackbrush - Cenizo Shrubland, Guajillo - Cenizo Shrubland, Guajillo - Blackbrush - Torrey Yucca Shrubland, Blackbrush - Texas Persimmon - Texas Sotol Shrubland, Blackbrush - Mesquite - Texas Persimmon Shrubland, Dry Mixed Thornscrub Shrubland, and Mimosa Dwarf-Shrubland are closely related thornscrub types at AMIS. Most of these had approximately equal taxonomic rank from cluster analysis results. At this point, they are treated as individual associations within a single USNVC alliance. At a larger geographic scale, it may prove best to treat them as variants or phases of a single association (e.g., the USNVC *Vachellia rigidula - Leucophyllum frutescens - Senegalia berlandieri* shrubland CEGL007759). Most frequent plant taxa recorded in Guajillo - Blackbrush - Torrey Yucca Shrubland are shown in Table D-22.

Table D-22. Synthesis table for the most frequent plant taxa recorded in Guajillo - Blackbrush - Torrey Yucca Shrubland at Amistad National Recreation Area (# plots=6).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Senegalia berlandieri (=Acacia berlandieri)	Shrub	100.0%	34.0	10-77
Vachellia rigidula (=Acacia rigidula)	Shrub	100.0%	9.8	few-37
Yucca torreyi	Shrub	100.0%	1.3	few-5
Karwinskia humboldtiana	Shrub	83.3%	6.2	0-27
Opuntia engelmannii var. *lindheimeri*	Shrub	83.3%	2.3	0-12
Meximalva filipes	Shrub	83.3%	0.5	0-2

Table D-22 (continued). Synthesis table for the most frequent plant taxa recorded in Guajillo - Blackbrush - Torrey Yucca Shrubland at Amistad National Recreation Area (# plots=6).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Leucophyllum frutescens	Shrub	66.7%	4.3	0-31
Diospyros texana	Shrub	66.7%	4.3	0-32
Sophora secundiflora	Shrub	66.7%	0.5	0-2
Prosopis glandulosa	Shrub	66.7%	0.4	0-2
Croton incanus	Shrub	50.0%	10.0	0-60
Salvia ballotiflora	Shrub	50.0%	1.3	0-6
Forestiera angustifolia	Shrub	50.0%	1.0	0-7
Cylindropuntia leptocaulis	Shrub	50.0%	0.9	0-5
Agave lechuguilla	Shrub	50.0%	0.4	0-2
Echinocereus enneacanthus var. *enneacanthus*	Shrub	50.0%	0.3	0-1
Heliotropium torreyi	Shrub	50.0%	0.2	0-1
Dasylirion texanum	Shrub	33.3%	1.5	0-10
Mahonia trifoliolata	Shrub	33.3%	0.3	0-2
Jatropha dioica	Shrub	33.3%	0.2	0-1
Krameria ramosissima	Shrub	33.3%	0.2	0-1
Coryphantha sp.	Shrub	33.3%	0.1	0-1
Opuntia sp.	Shrub	33.3%	0.1	0-1
Aloysia gratissima	Shrub	16.7%	0.9	0-8
Calliandra conferta	Shrub	16.7%	0.3	0-2
Opuntia atrispina	Shrub	16.7%	0.3	0-2
Vitex agnus-castus	Shrub	16.7%	0.1	0-1
Condalia hookeri var. *hookeri*	Shrub	16.7%	0.1	0-1
Eysenhardtia texana	Shrub	16.7%	0.1	0-1
Gutierrezia microcephala	Shrub	16.7%	0.1	0-1
Coryphantha sulcata	Shrub	16.7%	0.1	0-1
Galphimia angustifolia	Shrub	16.7%	0.1	0-1
Cynanchum sp.	Vine	66.7%	0.1	0-1
Aristida sp.	Herb	83.3%	1.6	0-5

Table D-22 (continued). Synthesis table for the most frequent plant taxa recorded in Guajillo - Blackbrush - Torrey Yucca Shrubland at Amistad National Recreation Area (# plots=6).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Bouteloua curtipendula	Herb	50.0%	0.3	0-1
Acleisanthes sp.	Herb	50.0%	0.2	0-1
Croton monanthogynus	Herb	33.3%	0.2	0-1
Bouteloua trifida	Herb	33.3%	0.2	0-1
Croton sp.	Herb	33.3%	0.2	0-1
Sporobolus sp.	Herb	33.3%	0.2	0-1
Argythamnia neomexicana	Herb	16.7%	0.1	0-1
Aristida purpurea	Herb	16.7%	0.1	0-1
Astrolepis integerrima	Herb	16.7%	0.1	0-1
Croton dioicus	Herb	16.7%	0.1	0-1
Pellaea ovata	Herb	16.7%	0.1	0-1
Polygala lindheimeri	Herb	16.7%	0.1	0-1
Rivina humilis	Herb	16.7%	0.1	0-1



Photo 30. Guajillo - Blackbrush - Torrey Yucca Shrubland, Devils River, upriver from Rough Canyon Campground (LBJWC) (AMIS0567).

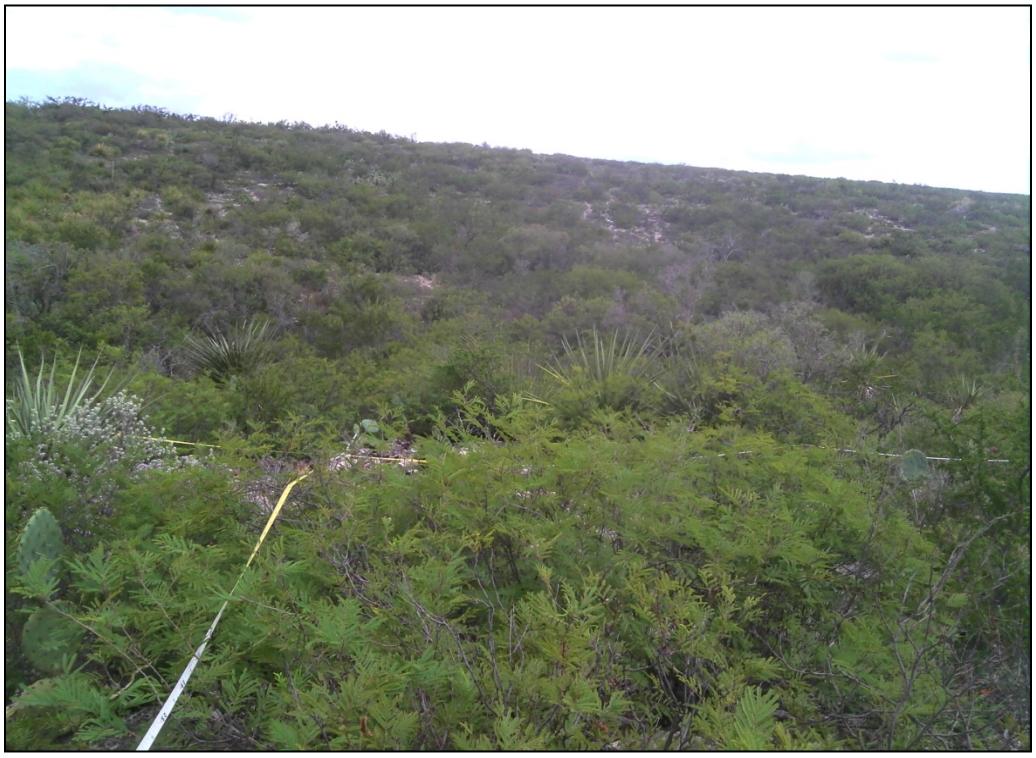


Photo 31. Guajillo - Blackbrush - Torrey Yucca Shrubland, Diablo Road area (LBJWC) (AMIS1663).

Blackbrush - Texas Persimmon - Texas Sotol Shrubland

Local Type Concept:
Fairly open to moderately closed cover shrublands, with strong dominance by blackbrush (*Vachellia rigidula* (=*Acacia rigidula*)) or a by a mix of shrub species, including *V. rigidula*. Texas persimmon (*Diospyros texana*), and Texas sotol (*Dasylirion texanum*) all constant and often co-dominant. Cenizo (*Leucophyllum frutescens*) is absent or unimportant.

Classification Plots Represented By Concept:
AMIS689, AMIS700, AMIS704, AMIS705, AMIS728, AMIS741, AMIS759, AMIS1430.

Vegetation:
The degree of canopy closure and the dominance patterns are variable among plots, but the species composition is consistent among plots. *Vachellia rigidula* (=*Acacia rigidula*, blackbrush), *Diospyros texana* (Texas persimmon), *Dasylirion texanum* (Texas sotol), *Heliotropium torreyi* (slimleaf heliotrope), and *Mahonia trifoliolata* (agarito) all are highly constant at least as minor species. All except *M. trifoliata* can be co-dominants, and *V. rigidula* is strongly dominant in several plots. Other relatively constant, mostly low cover shrubs include *Castela erecta* ssp. *texana* (Texas goatbush), *Senegalia berlandieri* (=*Acacia berlandieri*, guajillo), *Karwinskia humboldtiana* (coyotillo), *Calliandra conferta* (Rio Grande stickpea), *Lippia graveolens* (Mexican oregano), *Opuntia engelmannii* var. *lindheimeri* (Texas pricklypear) and *Yucca torreyi* (Torrey yucca). The herbaceous stratum has low to moderate overall cover; *Aristida purpurea* (purple threeawn), *Erioneuron pilosum* (hairy woollygrass), *Tridens muticus* (slim tridens*), Bouteloua trifida* (red grama), and *Croton* spp. (crotons) are moderately constant. Stratum and substrate cover for Blackbrush - Texas Persimmon - Texas Sotol Shrubland are shown in Table D-23.

Table D-23. Stratum and substrate cover recorded for Blackbrush - Texas Persimmon - Texas Sotol Shrubland at Amistad National Recreation Area (# plots=8).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	0	0-0
	Tall Shrub	13	2-75
	Short Shrub	50	7-100
	Herb	5	1-25
Substrate	Bedrock	0	0-0
	Large/Small Rocks	45	5-95
	Litter/Duff	19	1-70

Environment:
In AMIS, this vegetation was found occur from Live Oak Creek east. It appears to be most common in the Rough Canyon area. It generally occupies upland landforms, mostly outside the former inundation zone of Amistad Reservoir.

USNVC Crosswalk:
USNVC Class: Semi-Desert (3)
USNVC Subclass: Warm Semi-Desert Scrub & Grassland (3.A)
USNVC Formation: Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
USNVC Division: North American Warm Desert Scrub & Grassland (D039)
USNVC Macrogroup: Tamaulipan Scrub and Grassland (M130)
USNVC Group: Tamaulipan Dry Mesquite and Thornscrub (G099)
USNVC Alliance: *Tamaulipan Vachellia rigidula - Leucophyllum frutescens - Senegalia berlandieri* Calcareous Thornscrub Alliance (A3191)
NPS Association: *Vachellia rigidula - Diospyros texana - Dasylirion texanum* Shrubland (NPSAMIS003)

Comments:
The species composition is an odd mix of elements that are primarily Balconian-Chihuahuan (e.g., *Dasylirion texanum, Mahonia trifoliolata, Nolina texana*), primarily Balconian-Tamaulipan (e.g., *Diospyros texana, Forestiera angustifolia, Parkinsonia texana*), primarily Chihuahuan -Tamaulipan (*Calliandra conferta, Heliotropium torreyi*), primarily Tamaulipan (e.g., *Vachellia rigidula, Senegalia berlandieri, Jatropha dioica* var. *dioica*, *Castela erecta* ssp. *texana*), and primarily Chihuahuan *(Krameria erecta*), yet plots form a distinct unit in cluster analysis. The low constancy and cover of *Leucophyllum frutescens* is somewhat diagnostic for both plot data and from field observations. Val Verde County is the only Texas county in which all species are known to co-occur (Turner et al. 2003). Therefore, at least as described here, this vegetation would be expected to have an extremely limited United States distribution. Additional data may be needed in order to confirm its proper taxonomic disposition.

The Cenizo Shrubland, Blackbrush - Cenizo Shrubland, Guajillo - Cenizo Shrubland, Guajillo - Blackbrush - Torrey Yucca Shrubland, Blackbrush - Texas Persimmon - Texas Sotol Shrubland, Blackbrush - Mesquite - Texas Persimmon Shrubland, Dry Mixed Thornscrub Shrubland, and Mimosa Dwarf-Shrubland are closely related thornscrub types at AMIS. Most of these had approximately equal taxonomic rank from cluster analysis results. At this point, they are treated as individual associations within a single USNVC alliance. At a larger geographic scale, it may prove best to treat them as variants or phases of a single association (e.g., the USNVC *Vachellia rigidula - Leucophyllum frutescens - Senegalia berlandieri* shrubland CEGL007759). Most frequent plant taxa recorded in Blackbrush - Texas Persimmon - Texas Sotol Shrubland are shown in Table D-24.

Table D-24. Synthesis table for the most frequent plant taxa recorded in Blackbrush - Texas Persimmon - Texas Sotol Shrubland at Amistad National Recreation Area (# plots=8).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Vachellia rigidula (=Acacia rigidula)	Shrub	100.0%	29.8	few-100
Dasylirion texanum	Shrub	100.0%	10.3	1-50
Diospyros texana	Shrub	100.0%	7.6	few-21
Mahonia trifoliolata	Shrub	100.0%	1.8	few-11
Heliotropium torreyi	Shrub	87.5%	6.9	0-25
Castela erecta ssp. *texana*	Shrub	62.5%	1.7	0-10
Senegalia berlandieri (=Acacia berlandieri)	Shrub	62.5%	1.4	0-11
Karwinskia humboldtiana	Shrub	62.5%	0.7	0-3
Calliandra conferta	Shrub	50.0%	2.7	0-25
Lippia graveolens	Shrub	50.0%	0.9	0-6
Opuntia engelmannii var. lindheimeri	Shrub	50.0%	0.8	0-5
Parkinsonia texana	Shrub	37.5%	0.7	0-7
Prosopis glandulosa	Shrub	37.5%	0.6	0-5
Nolina texana	Shrub	37.5%	0.4	0-2
Jatropha dioica	Shrub	37.5%	0.3	0-2
Leucophyllum frutescens	Shrub	37.5%	0.2	0-2
Krameria erecta	Shrub	25.0%	2.4	0-25
Forestiera angustifolia	Shrub	25.0%	2.3	0-15
Guaiacum angustifolium	Shrub	25.0%	0.7	0-7
Mimosa borealis	Shrub	25.0%	0.6	0-4
Juniperus pinchotii	Shrub	25.0%	0.1	0-1
Colubrina texensis	Shrub	25.0%	0.1	0-1
Yucca torreyi	Shrub	25.0%	0.1	0-1
Gymnosperma glutinosum	Shrub	12.5%	0.2	0-2
Gutierrezia microcephala	Shrub	12.5%	0.2	0-2
Aristida sp.	Herb	50.0%	0.5	0-2
Croton sp.	Herb	50.0%	0.3	0-1
Aristida purpurea	Herb	37.5%	0.4	0-2

Table D-24 (continued). Synthesis table for the most frequent plant taxa recorded in Blackbrush - Texas Persimmon - Texas Sotol Shrubland at Amistad National Recreation Area (# plots=8).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Setaria sp.	Herb	37.5%	0.2	0-1
Polygala lindheimeri	Herb	37.5%	0.1	0-1
Erioneuron pilosum	Herb	37.5%	0.1	0-1
Pennisetum ciliare	Herb	25.0%	0.6	0-5
Croton dioicus	Herb	25.0%	0.1	0-1
Phyla nodiflora	Herb	25.0%	0.1	0-1
Argythamnia neomexicana	Herb	12.5%	0.2	0-2
Bouteloua trifida	Herb	12.5%	0.2	0-2



Photo 32. Blackbrush - Texas Persimmon - Texas Sotol Shrubland, Rough Canyon (LBJWC) (AMIS0689).



Photo 33. Blackbrush - Texas Persimmon - Texas Sotol Shrubland, Rough Canyon (LBJWC) (AMIS0704).

Blackbrush - Mesquite - Texas Persimmon Shrubland

Local Type Concept:
Fairly open to relatively closed cover shrublands (occasionally woodlands), usually along washes or other mesic settings, such as cliff basins or infrequently flooded terraces, with strong dominance by tall stature (usually > 2 meters tall) blackbrush (*Vachellia rigidula* (=*Acacia rigidula*)), usually with some combination of honey mesquite (*Prosopis glandulosa*) and/or Texas persimmon (*Diospyros texana*). Cenizo (*Leucophyllum frutescens*) is unimportant.

Classification Plots Represented By Concept:
No plots. This vegetation is described from accuracy assessment observations.

Vegetation:
Stands are tall shrublands (occasionally woodlands), with dominance by tall (> 2 meters) Vachellia rigidula (=*Acacia rigidula*, blackbrush), typically from 5-90% cover. *Prosopis glandulosa* (honey mesquite) (usually up to 10% cover, when present, occasionally to 60%) and/or *Diospyros texana* (Texas persimmon) (up to 20% cover), together or individually, often are co-dominant, but may not occur in all stands. The rest of the composition of the shrub stratum is variable; the most frequent species observed includes *Karwinskia humboldtiana* (coyotillo), and *Opuntia engelmannii* var. *lindheimeri* (Texas pricklypear). The herbaceous stratum has low to moderate (up to 25%) overall cover, with *Bouteloua trifida* (red grama) and *Aristida purpurea* (purple threeawn) the most constant species. The forb/subshrub *Tiquilia canescens* (woody crinklemat) is constant.

Environment:
The vegetation occurs throughout AMIS, usually along ephemeral washes, but also occurs on low slopes and terraces above Amistad Reservoir.

USNVC Crosswalk:
USNVC Class: Semi-Desert (3)
USNVC Subclass: Warm Semi-Desert Scrub & Grassland (3.A)
USNVC Formation: Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
USNVC Division: North American Warm Desert Scrub & Grassland (D039)
USNVC Macrogroup: Tamaulipan Scrub and Grassland (M130)
USNVC Group: Tamaulipan Dry Mesquite and Thornscrub (G099)
USNVC Alliance: Tamaulipan *Vachellia rigidula - Leucophyllum frutescens - Senegalia berlandieri* Calcareous Thornscrub Alliance (A3191)
NPS Association: *Vachellia rigidula - Prosopis glandulosa - Diospyros texana* Shrubland (NPSAMIS032)

Comments:
Although not represented by classification plots, this vegetation was observed during mapping reconnaissance, was found frequently during the accuracy assessment, and seems to be a regularly occurring vegetation type along dry washes.



Photo 34. Blackbrush - Mesquite - Texas Persimmon Shrubland, near Amistad National Recreation Area Headquarters (CTI 2017).

Dry Mixed Thornscrub Shrubland

Local Type Concept:
Shrublands of relatively short stature and mixed dominance by several species, occurring on shallow soils on upper slopes and hills and drier than most other thornscrub associations.

Classification Plots Represented By Concept:
AMIS187, AMIS193, AMIS195, AMIS215, AMIS216, AMIS317, AMIS495, AMIS1002, AMIS1488, AMIS1496, AMIS1607, AMIS1609, AMIS1669.

Vegetation:
The shrub stratum usually has mixed species dominance, usually with a combination of *Lippia graveolens* (Mexican oregano), *Jatropha dioica* (leatherstem*), Vachellia rigidula* (*=Acacia rigidula*, blackbrush), *Senegalia berlandieri* (*=Acacia berlandieri*, guajillo), *Opuntia engelmannii* var. *lindheimeri* (Texas pricklypear), *Karwinskia humboldtiana* (coyotillo), and/or *Cylindropuntia leptocaulis* (Christmas cactus). *Leucophyllum frutescens* (cenizo*), Calliandra conferta* (Rio Grande stickpea), and *Agave lechuguilla* (lechuguilla) often are present and may co-dominate. Relatively constant minor shrub species include *Diospyros texana* (Texas persimmon), *Yucca torreyi* (Torrey yucca), *Prosopis glandulosa* (honey mesquite), *Karwinskia humboldtiana* (coyotillo), *Echinocereus coccineus* var. *paucispinus* (scarlet hedgehog cactus), and *Yucca thompsoniana* (Thompson's yucca). The herbaceous stratum has low to moderate overall cover; *Erioneuron pilosum* (hairy woollygrass), *Bouteloua curtipendula* (sideoats grama), *Aristida purpurea* (purple threeawn), *Croton monanthogynus* (prairie tea), *Selaginella* spp. (spikemosses), and *Panicum hallii* (Hall's panicgrass) are the most constant taxa. This vegetation has a moderately significant component of species with a Chihuahuan distribution, especially in the westernmost stands at AMIS. These species include *Agave lechuguilla, Fouquieria splendens* (ocotillo), *Yucca torreyi*, *Yucca thompsoniana*, *Echinocereus coccineus* var. paucispinus, *Echinocereus enneacanthus* var. *enneacanthus* (pitaya cactus), and *Ferocactus hamatacanthus* (turk's head cactus). Stratum and substrate cover for Dry Mixed Thornscrub Shrubland are shown in Table D-25.

Table D-25. Stratum and substrate cover recorded for Dry Mixed Thornscrub Shrubland at Amistad National Recreation Area (# plots=13).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	0	0-2
	Tall Shrub	2	0-10
	Short Shrub	37	2-80
	Herb	6	1-50
Substrate	Bedrock	30	0-94
	Large/Small Rocks	51	4-95
	Litter/Duff	4	0-15

Environment:
This vegetation was found to be frequent throughout AMIS, west at least to the Pecos River. In the eastern part of the recreation area, it occurs in smaller patches, usually on the most xeric sites (e.g., over shallow bedrock, on ridgetops, and on south to west-facing exposures. In the western portion of AMIS, it is the matrix forming upland vegetation and usually dominates on all but the most mesic (protected) upland settings.

USNVC Crosswalk:
USNVC Class: Semi-Desert (3)
USNVC Subclass: Warm Semi-Desert Scrub & Grassland (3.A)
USNVC Formation: Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
USNVC Division: North American Warm Desert Scrub & Grassland (D039)
USNVC Macrogroup: Tamaulipan Scrub and Grassland (M130)
USNVC Group: Tamaulipan Dry Mesquite and Thornscrub (G099)
USNVC Alliance: Tamaulipan *Vachellia rigidula - Leucophyllum frutescens - Senegalia berlandieri* Calcareous Thornscrub Alliance (A3191)
NPS Association: *Vachellia rigidula - Opuntia engelmannii* var. *lindheimeri - Jatropha dioica - Lippia graveolens* Shrubland (NPSAMIS026)

Comments:
The plot locations suggest a bimodal distribution within AMIS, and the western plots, which have a stronger Chihuahuan species influence may represent a separate association or phase. Poole (2013) noted that parts of the *Vachellia rigidula - Leucophyllum frutescens - Senegalia berlandieri* Shrubland type occurred on rock outcrops. Such an intersection might define the concept described here. The Cenizo Shrubland, Blackbrush - Cenizo Shrubland, Guajillo - Cenizo Shrubland, Guajillo - Blackbrush - Torrey Yucca Shrubland, Blackbrush - Texas Persimmon - Texas Sotol Shrubland, Blackbrush - Mesquite - Texas Persimmon Shrubland, Dry Mixed Thornscrub Shrubland, and Mimosa Dwarf-Shrubland are closely related thornscrub types at AMIS. Most of these had approximately equal taxonomic rank from cluster analysis results. At this point, they are treated as individual associations within a single USNVC alliance. At a larger geographic scale, it may prove best to treat them as variants or phases of a single association (e.g., the USNVC *Vachellia rigidula - Leucophyllum frutescens - Senegalia berlandieri* shrubland CEGL007759). Most frequent plant taxa recorded in Dry Mixed Thornscrub Shrubland are shown in Table D-26.

Table D-26. Synthesis table for the most frequent plant taxa recorded in Dry Mixed Thornscrub Shrubland at Amistad National Recreation Area (# plots=13).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Vachellia rigidula (=Acacia rigidula)	Shrub	100.0%	4.1	1-12
Opuntia engelmannii var. *lindheimeri*	Shrub	92.3%	5.4	0-35
Jatropha dioica	Shrub	76.9%	5.8	0-25
Cylindropuntia leptocaulis	Shrub	76.9%	1.1	0-7
Lippia graveolens	Shrub	69.2%	6.8	0-50
Karwinskia humboldtiana	Shrub	69.2%	4.0	0-5
Senegalia berlandieri (=Acacia berlandieri)	Shrub	69.2%	2.8	1-50
Diospyros texana	Shrub	53.8%	0.2	0-2
Calliandra conferta	Shrub	46.2%	1.2	0-10
Prosopis glandulosa	Shrub	46.2%	0.5	0-5
Yucca torreyi	Shrub	46.2%	0.4	0-2
Agave lechuguilla	Shrub	38.5%	1.8	0-10
Leucophyllum frutescens	Shrub	38.5%	1.1	0-36
Echinocereus enneacanthus var. *enneacanthus*	Shrub	38.5%	0.2	0-1
Dasylirion texanum	Shrub	30.8%	0.2	0-2
Echinocereus coccineus var. *paucispinus*	Shrub	30.8%	0.2	0-2
Yucca thompsoniana	Shrub	30.8%	0.1	0-1
Bernardia myricifolia	Shrub	23.1%	0.3	0-6
Ferocactus hamatacanthus	Shrub	23.1%	0.1	0-trace
Fouquieria splendens	Shrub	15.4%	0.5	0-5
Heliotropium torreyi	Shrub	15.4%	0.4	0-5
Condalia hookeri var. *hookeri*	Shrub	15.4%	0.3	0-5
Opuntia atrispina	Shrub	15.4%	0.3	0-5
Condalia spathulata	Shrub	15.4%	0.3	0-5
Schaefferia cuneifolia	Shrub	15.4%	0.2	0-2
Celtis ehrenbergiana	Shrub	15.4%	0.1	0-2
Aloysia gratissima	Shrub	15.4%	0.1	0-1
Forestiera angustifolia	Shrub	15.4%	0.1	0-1

Table D-26 (continued). Synthesis table for the most frequent plant taxa recorded in Dry Mixed Thornscrub Shrubland at Amistad National Recreation Area (# plots=13).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Erioneuron pilosum	Herb	53.8%	0.2	0-1
Bouteloua curtipendula	Herb	38.5%	0.3	0-2
Pennisetum ciliare	Herb	30.8%	4.2	0-25
Croton monanthogynus	Herb	38.5%	0.4	0-5
Panicum hallii	Herb	30.8%	0.2	0-2
Selaginella sp.	Herb	30.8%	0.8	0-10
Aristida purpurea	Herb	30.8%	0.2	0-2
Aristida sp.	Herb	30.8%	0.2	0-1
Cooperia sp.	Herb	30.8%	0.1	0-1
Bouteloua sp.	Herb	23.1%	0.2	0-1
Thymophylla pentachaeta	Herb	23.1%	0.2	0-2
Hedeoma sp.	Herb	23.1%	0.1	0-1
Portulaca pilosa	Herb	23.1%	0.1	0-1
Wedelia texana	Herb	15.4%	0.1	0-1
Ruellia sp.	Herb	23.1%	0.1	0-1
Chloris sp.	Herb	15.4%	0.1	0-1
Selaginella wrightii	Herb	15.4%	0.1	0-1
Astrolepis integerrima	Herb	15.4%	0.1	0-1
Evolvulus sericeus	Herb	15.4%	0.1	0-1
Senna lindheimeriana	Herb	15.4%	0.1	0-1



Photo 35. Dry Mixed Thornscrub Shrubland, Pecos River north of High Bridge (LBJWC) (AMIS0195).



Photo 36. Dry Mixed Thornscrub Shrubland, west side of Zuberbueler Bend (LBJWC) (AMIS0495).

Mimosa Dwarf-Shrubland

Local Type Concept:
Low statured shrublands dominated by *Mimosa* spp.

Classification Plots Represented By Concept:
AMIS467.

Vegetation:
A species of *Mimosa* (mimosa), including *Mimosa aculeaticarpa* var. *biuncifera* (catclaw mimosa), *M. borealis* (fragrant mimosa), *or M. texana* (Texas mimosa) is the leading dominant in a low shrub stratum. Other shrub species are inconstant: *Diospyros texana* (Texas persimmon), *Krameria* sp. (ratany), and *Calliandra conferta* (Rio Grande stickpea) are among those recorded. The herbaceous stratum is usually sparse and occasionally moderately dense, with the grasses *Aristida purpurea* (purple threeawn), *Nassella leucotricha* (Texas wintergrass), and *Pappophorum bicolor* (pink pappusgrass) and the forb/subshrub *Tiquilia canescens* (woody crinklemat) among the species observed. Stratum and substrate cover for Mimosa Dwarf-shrubland are shown in Table D-27.

Table D-27. Stratum and substrate cover recorded for Mimosa Dwarf-shrubland at Amistad National Recreation Area (# plots=1).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	0	0-0
	Tall Shrub	0.1	trace
	Short Shrub	45	30-60
	Herb	4	2-5
Substrate	Bedrock	0	0-0
	Large/Small Rocks	99	99-99

Environment:
Stands occur in small patches in upland settings and were observed from Live Oak Creek Canyon east. Soil surfaces often have gravelly surface material, and the vegetation has been observed on road cuts.

USNVC Crosswalk:
USNVC Class: Semi-Desert (3)
USNVC Subclass: Warm Semi-Desert Scrub & Grassland (3.A)
USNVC Formation: Warm Semi-Desert Scrub & Grassland (3.A.1)
USNVC Division: North American Warm Desert Scrub & Grassland (D039)
USNVC Macrogroup: Tamaulipan Scrub and Grassland (M130)

USNVC Group: Tamaulipan Dry Mesquite and Thornscrub (G099)
USNVC Alliance: Tamaulipan *Vachellia rigidula - Leucophyllum frutescens - Senegalia berlandieri* Calcareous Thornscrub Alliance (A3191)
NPS Association: *Mimosa borealis* Dwarf-shrubland (NPSAMIS013)

Comments:
The *Dalea formosa - Mimosa borealis* Dwarf-shrubland (CEGL005009) of the Texas Panhandle is ecologically similar and analogous to this vegetation, but its placement in the USNVC Great Plains Shortgrass Prairie Group (G144) makes its application at AMIS inappropriate. The Cenizo Shrubland, Blackbrush - Cenizo Shrubland, Guajillo - Cenizo Shrubland, Guajillo - Blackbrush - Torrey Yucca Shrubland, Blackbrush - Texas Persimmon - Texas Sotol Shrubland, Blackbrush - Mesquite - Texas Persimmon Shrubland, Dry Mixed Thornscrub Shrubland, and Mimosa Dwarf-Shrubland are closely related thornscrub types at AMIS. Most of these had approximately equal taxonomic rank from cluster analysis results. At this point, they are treated as individual associations within a single USNVC alliance. At a larger geographic scale, it may prove best to treat them as variants or phases of a single association (e.g., the USNVC *Vachellia rigidula - Leucophyllum frutescens - Senegalia berlandieri* shrubland CEGL007759). All plant taxa recorded in Mimosa Dwarf-shrubland are shown in Table D-28.

Table D-28. Synthesis table for all plant taxa recorded in Mimosa Dwarf-shrubland at Amistad National Recreation Area (# plots=1).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Mimosa borealis	Shrub	100.0%	8.0	5-11
Krameria grayi	Shrub	100.0%	4.0	2-6
Calliandra conferta	Shrub	100.0%	3.5	2-5
Cylindropuntia leptocaulis	Shrub	100.0%	0.6	few-1
Senegalia berlandieri (=Acacia berlandieri)	Shrub	100.0%	0.5	few-1
Tiquilia canescens	Shrub	100.0%	0.5	few-1
Heliotropium torreyi	Shrub	100.0%	0.5	few-1
Grusonia schottii	Shrub	100.0%	0.5	few-1
Opuntia atrispina	Shrub	100.0%	0.5	few-1
Wedelia texana	Shrub	100.0%	0.5	few-1
Mammillaria sp.	Shrub	100.0%	0.5	few-1
Forestiera angustifolia	Shrub	100.0%	0.2	trace-trace
Diospyros texana	Shrub	100.0%	0.2	trace-trace

Table D-28 (continued). Synthesis table for all plant taxa recorded in Mimosa Dwarf-shrubland at Amistad National Recreation Area (# plots=1).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Leucophyllum frutescens	Shrub	100.0%	0.1	trace-trace
Guaiacum angustifolium	Shrub	100.0%	0.1	trace-trace
Mahonia trifoliolata	Shrub	100.0%	0.1	trace-trace
Vachellia rigidula (=Acacia rigidula)	Shrub	100.0%	0.1	trace-trace
Vachellia vernicosa (=Acacia neovernicosa)	Shrub	100.0%	0.1	trace-trace
Allionia incarnata	Herb	100.0%	0.5	few-1
Bouteloua sp.	Herb	100.0%	0.5	few-1
Cevallia sinuata	Herb	100.0%	0.5	few-1
Croton sp.	Herb	100.0%	0.5	few-1
Erioneuron pilosum	Herb	100.0%	0.5	few-1
Nassella leucotricha	Herb	100.0%	0.5	few-1
Panicum hallii	Herb	100.0%	0.5	few-1
Polygala sp.	Herb	100.0%	0.5	few-1
Tragia sp.	Herb	100.0%	0.5	few-1
Acourtia runcinata	Herb	100.0%	0.1	trace-trace
Macrosiphonia lanuginosa var. macrosiphon	Herb	100.0%	0.1	trace-trace



Photo 37. Mimosa Dwarf-shrubland, near mouth of Live Oak Creek Canyon (LBJWC) (AMIS0467).



Photo 38. Mimosa Dwarf-shrubland, near mouth of Live Oak Creek Canyon (LBJWC) (AMIS0467).

Mesquite Upland Shrubland

Local Type Concept:
Thorny shrubland in non-riparian settings with honey mesquite (*Prosopis glandulosa*) dominant or co-dominant in a tall shrub (occasionally, short tree) substratum and associated with upland thornscrub (rather than riparian) species.

Classification Plots Represented By Concept:
AMIS322, AMIS323, AMIS360, AMIS584, AMIS603, AMIS1102.

Vegetation:
Prosopis glandulosa (honey mesquite) is solely dominant or co-dominant in a tall shrub (or short tree) substratum. Other shrub species are less constantly co-dominant; these include *Vachellia rigidula* (=*Acacia rigidula*, blackbrush*), Karwinskia humboldtiana* (coyotillo), *Aloysia gratissima* (whitebrush), *Lippia graveolens* (Mexican oregano), *Celtis ehrenbergiana* (spiny hackberry), *Croton dioicus* (grassland croton), *Diospyros texana* (Texas persimmon), and *Ziziphus obtusifolia* (lotebush). *Cylindropuntia leptocaulis* (Christmas cactus) and/or *Opuntia engelmannii* var. *lindheimeri* (Texas pricklypear) often have high cover in a shorter shrub substratum. Other relatively constant shrubs include *Castela erecta* ssp. *texana* (Texas goatbush), *Guaiacum angustifolium* (guayacan), *Colubrina texensis* (Texan hogplum), and *Lantana achyranthifolia* (brushland shrub verbena) The herbaceous stratum has low to moderate overall cover; the grasses *Aristida purpurea* (purple threeawn) and *Bouteloua trifida* (red grama) and the forb or woody subshrub *Tiquilia canescens* (woody crinklemat) are the most constant species. Stratum and substrate cover for Mesquite Upland Shrubland are shown in Table D-29.

Table D-29. Stratum and substrate cover recorded for Mesquite Upland Shrubland at Amistad National Recreation Area (# plots=6).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	0	0-trace
	Tall Shrub	20	2-50
	Short Shrub	43	10-100
	Herb	8	2-25
Substrate	Bedrock	22	0-90
	Large/Small Rocks	16	0-60
	Litter/Duff	3	0-10

Environment:
This vegetation was found to be common throughout AMIS. Stands tend to occur on lower slopes, near or in the former inundation zone of the Amistad Reservoir, often along alluvial flats and terraces. The abundance of *Prosopis glandulosa* (honey mesquite) and, sometimes, Aloysia

gratissima (whitebrush) suggests that this association may represent thornscrub that has undergone past soil disturbance.

USNVC Crosswalk:
USNVC Class: Semi-Desert (3)
USNVC Subclass: Warm Semi-Desert Scrub & Grassland (3.A)
USNVC Formation: Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
USNVC Division: North American Warm Desert Scrub & Grassland (D039)
USNVC Macrogroup: Tamaulipan Scrub and Grassland (M130)
USNVC Group: Tamaulipan Dry Mesquite and Thornscrub (G099)
USNVC Alliance: *Prosopis glandulosa* Tamaulipan Mixed Deciduous Thornscrub Alliance (A3169)
USNVC Association: *Prosopis glandulosa* var. *glandulosa* - *Parkinsonia texana* var. *macra* – (*Cordia boissieri, Koeberlinia spinosa*) Shrubland (CEGL007762)

Comments:
Although three of the nominal species for the USNVC association CEGL007762 do not represent floristic patterns in the AMIS plots well, the described concept can probably be applied at AMIS. An appropriate local floristic name might be *Prosopis glandulosa* var. *glandulosa* / *Cylindropuntia leptocaulis* Shrubland. This vegetation is floristically like other thornscrub types and is distinguished from them primarily by higher cover of *Prosopis glandulosa*. Most frequent plant taxa recorded in Mesquite Upland Shrubland are shown in Table D-30.

Table D-30. Synthesis table for the most frequent plant taxa recorded in Mesquite Upland Shrubland at Amistad National Recreation Area (# plots=6).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Prosopis glandulosa	Shrub	100.0%	17.4	5-55
Cylindropuntia leptocaulis	Shrub	83.3%	8.3	0-30
Vachellia rigidula (=Acacia rigidula)	Shrub	83.3%	5.2	0-27
Aloysia gratissima	Shrub	83.3%	2.6	0-11
Castela erecta ssp. *texana*	Shrub	83.3%	1.3	0-7
Opuntia engelmannii var. *lindheimeri*	Shrub	66.7%	10.1	0-52
Lippia graveolens	Shrub	66.7%	3.4	0-12
Guaiacum angustifolium	Shrub	66.7%	1.8	0-10
Tiquilia canescens	Shrub	66.7%	0.3	0-1
Colubrina texensis	Shrub	50.0%	1.1	0-5
Lantana achyranthifolia	Shrub	50.0%	0.9	0-5
Karwinskia humboldtiana	Shrub	33.3%	3.1	0-26

Table D-30 (continued). Synthesis table for the most frequent plant taxa recorded in Mesquite Upland Shrubland at Amistad National Recreation Area (# plots=6).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Krameria sp.	Shrub	33.3%	0.4	0-2
Leucophyllum frutescens	Shrub	33.3%	0.3	0-2
Condalia spathulata	Shrub	33.3%	0.2	0-1
Celtis ehrenbergiana	Shrub	33.3%	0.2	0-2
Yucca torreyi	Shrub	33.3%	0.0	0-trace
Diospyros texana	Shrub	16.7%	0.8	0-7
Mimosa borealis	Shrub	16.7%	0.6	0-5
Jatropha dioica	Shrub	16.7%	0.6	0-5
Lycium berlandieri	Shrub	16.7%	0.3	0-3
Mimosa sp.	Shrub	16.7%	0.3	0-2
Vitex agnus-castus	Shrub	16.7%	0.3	0-2
Calliandra conferta	Shrub	16.7%	0.3	0-2
Forestiera angustifolia	Shrub	16.7%	0.2	0-2
Senegalia berlandieri (=Acacia berlandieri)	Shrub	16.7%	0.2	0-2
Ziziphus obtusifolia	Shrub	16.7%	0.2	0-2
Aristida purpurea	Herb	50.0%	0.3	0-1
Bouteloua trifida	Herb	50.0%	0.3	0-1
Gymnosperma glutinosum	Herb	33.3%	0.7	0-6
Pennisetum ciliare	Herb	33.3%	0.7	0-5
Solanum rostratum	Herb	33.3%	0.7	0-5
Aristida sp.	Herb	33.3%	0.5	0-2
Senna roemeriana	Herb	33.3%	0.2	0-1
Bothriochloa ischaemum	Herb	33.3%	0.2	0-1
Croton dioicus	Herb	16.7%	1.3	0-10
Calyptocarpus vialis	Herb	16.7%	0.6	0-5
Panicum hallii	Herb	16.7%	0.3	0-2
Ruellia sp.	Herb	16.7%	0.3	0-2



Photo 39. Mesquite Upland Shrubland, east side of Zuberbueler Bend (LBJWC) (AMIS0322).



Photo 40. Mesquite Upland Shrubland, east side of Zuberbueler Bend (LBJWC) (AMIS0584).

Lilac Chaste Tree Shrubland

Local Type Concept:
Shrublands dominated by non-native (escaped ornamental) lilac chaste tree (*Vitex agnus-castus*).

Plots Included in Concept:
AMIS594.

Vegetation:
Vitex agnus-castus (lilac chaste tree) dominates a moderately dense shrub stratum. *Diospyros texana* (Texas persimmon) and *Nicotiana glauca* (tobacco-tree) are the next most abundant shrub species. The herbaceous stratum is sparse, and a few low cover species are present. Stratum and substrate cover for Lilac Chaste Tree Shrubland are shown in Table D-31.

Table D-31. Stratum and substrate cover recorded for Lilac Chaste Tree Shrubland at Amistad National Recreation Area (# plots=1).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	0	0-0
	Tall Shrub	18	17-18
	Short Shrub	40	27-55
	Herb	2	1-2
Substrate	Bedrock	0	0-0
	Large/Small Rocks	13	13-13
	Litter/Duff	3	3-3

Environment:
This extent of this vegetation is limited in AMIS, probably to where *V. agnus-castus* has invaded other thornscrub associations, including the Blackbrush - Mesquite - Texas Persimmon Shrubland. It may occur in dry washes or within the former inundation zone of the Amistad Reservoir.

USNVC Crosswalk:
USNVC Class: Semi-Desert (3)
USNVC Subclass: Warm Semi-Desert Scrub & Grassland (3.A)
USNVC Formation: Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
USNVC Division: North American Warm Desert Scrub & Grassland (D039)
USNVC Macrogroup: Tamaulipan Scrub and Grassland (M130)
USNVC Group: Tamaulipan Dry Mesquite and Thornscrub (G099)
USNVC Alliance: *Prosopis glandulosa* Tamaulipan Mixed Deciduous Thornscrub Alliance (A3169)
NPS Association: *Vitex agnus-castus* Shrubland (NPSAMIS009)

All plant taxa recorded in Lilac Chaste Tree Shrubland are shown in Table D-32.

Table D-32. Synthesis table for all plant taxa recorded in Lilac Chaste Tree Shrubland at Amistad National Recreation Area (# plots=1).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Vitex agnus-castus	Shrub	100.0%	24.8	16-37
Diospyros texana	Shrub	100.0%	3.5	2-5
Nicotiana glauca	Shrub	100.0%	3.0	2-4
Senegalia berlandieri (=Acacia berlandieri)	Shrub	100.0%	1.5	1-2
Vachellia rigidula (=Acacia rigidula)	Shrub	100.0%	1.5	1-2
Karwinskia humboldtiana	Shrub	100.0%	1.5	1-2
Leucophyllum frutescens	Shrub	100.0%	1.5	1-2
Prosopis glandulosa	Shrub	100.0%	1.5	1-2
Opuntia engelmannii var. *lindheimeri*	Shrub	100.0%	0.5	few-1
Ziziphus obtusifolia	Shrub	100.0%	0.5	few-1
Bothriochloa ischaemum	Herb	100.0%	0.5	few-1
Croton dioicus	Herb	100.0%	0.5	few-1
Datura wrightii	Herb	100.0%	0.5	few-1
Senna lindheimeriana	Herb	100.0%	0.5	few-1
Tiquilia canescens	Herb	100.0%	0.5	few-1
Verbena canescens	Herb	100.0%	0.5	few-1
Aristida purpurea	Herb	100.0%	0.1	trace
Nassella leucotricha	Herb	100.0%	0.1	trace



Photo 41. Lilac Chaste Tree Shrubland, Devils River, upriver from Rough Canyon Campground (LBJWC) (AMIS0594).



Photo 42. Lilac Chaste Tree Shrubland, Devils River, upriver from Rough Canyon Campground (LBJWC) (AMIS0594).

Ruderal Mixed Grassland

Local Type Concept:
Formerly disturbed or weed-invaded grasslands with taller grasses and a component of ruderal, often non-native, grass species.

Classification Plots Represented By Concept:
AMIS1379.

Vegetation:
Based on community patterns noted by Poole (2013) and field observations, this association is generalized by this study to include disturbed (often, heavily grazed) well-drained and mesic grasslands with some combination of disturbance-adapted grasses, including the non-native *Dichanthium annulatum* (Kleberg's bluestem*), Pennisetum ciliare*, (buffelgrass), and *Bothriochloa ischaemum* (yellow bluestem) and the native *Aristida purpurea* (purple threeawn) and *Heteropogon contortus* (tanglehead). *Pennisetum ciliare* and *Dichanthium annulatum* are co-dominant in the herbaceous stratum of the single sampled plot. Stratum and substrate cover for Ruderal Mixed Grassland are shown in Table D-33.

Table D-33. Stratum and substrate cover recorded for Ruderal Mixed Grassland at Amistad National Recreation Area (# plots=1).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	0	0-0
	Tall Shrub	1	few-1
	Short Shrub	19	10-27
	Herb	85	85-85
Substrate	Bedrock	0	0-0
	Large/Small Rocks	45	45-45
	Litter/Duff	5	5-5

Environment:
This vegetation was observed throughout AMIS, but it is mostly on well-drained surfaces of the former Amistad Reservoir inundation zone, with gentle slopes and on roadsides. It is on drier and less recently inundated surfaces than those that support the Bermuda Grass - Fogfruit Riparian Herbaceous Vegetation.

USNVC Crosswalk:
USNVC Class: Semi-Desert (3)
USNVC Subclass: Warm Semi-Desert Scrub & Grassland (3.A)
USNVC Formation: Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)

USNVC Division: North American Warm Desert Scrub & Grassland (D039)
USNVC Macrogroup: Tamaulipan Scrub and Grassland (M130)
USNVC Group: Tamaulipan Dry Grassland (G100)
USNVC Alliance: *Schizachyrium scoparium* - *Bothriochloa barbinodis* Tamaulipan Grassland Alliance (A3138)
NPS Association: (*Pennisetum ciliare, Bothriochloa* spp., *Aristida purpurea*) Tamaulipan Herbaceous Vegetation (NPSAMIS006)

Most frequent plant taxa recorded in Ruderal Mixed Grassland are shown in Table D-34.

Table D-34. Synthesis table for the most frequent plant taxa recorded in Ruderal Mixed Grassland at Amistad National Recreation Area (# plots=1).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Prosopis glandulosa	Shrub	100.0%	5.0	3-7
Leucophyllum frutescens	Shrub	100.0%	3.5	2-5
Lippia graveolens	Shrub	100.0%	1.5	1-2
Aloysia gratissima	Shrub	100.0%	0.6	0-1
Vachellia farnesiana (=Acacia farnesiana)	Shrub	100.0%	0.5	0-1
Tiquilia canescens	Shrub	100.0%	0.5	0-1
Diospyros texana	Shrub	100.0%	0.1	trace
Heliotropium torreyi	Shrub	100.0%	0.1	trace
Dichanthium annulatum	Herb	100.0%	37.5	25-50
Pennisetum ciliare	Herb	100.0%	37.5	25-50
Croton monanthogynus	Herb	100.0%	7.5	5-10
Phyla nodiflora	Herb	100.0%	1.5	1-2
Solanum elaeagnifolium	Herb	100.0%	1.5	1-2
Argythamnia neomexicana	Herb	100.0%	0.5	0-1
Digitaria pubiflora	Herb	100.0%	0.5	0-1
Nicotiana sp.	Herb	100.0%	0.5	0-1
Thymophylla sp.	Herb	100.0%	0.5	0-1
Verbena neomexicana	Herb	100.0%	0.5	0-1
Cevallia sinuata	Herb	100.0%	0.1	trace
Thamnosma texana	Herb	100.0%	0.1	trace



Photo 43. Ruderal Mixed Grassland, north side of San Pedro Canyon (LNJWC) (AMIS1379).

Dry Native Mixed Grassland

Local Type Concept:
Grasslands of dry upland areas with a predominance of native species.

Classification Plots Represented By Concept:
No plots. This vegetation is described from accuracy assessment observations and from vegetation association names given by Poole (2013).

Vegetation:
The herbaceous stratum is usually somewhat dense (somewhat sparse in a minority of observations) and comprised of some combination of native grasses adapted to dry (non-riparian) conditions, including *Bouteloua trifida* (red grama), *Aristida purpurea* (purple threeawn), *Pappophorum bicolor* (pink pappusgrass), *Bouteloua dactyloides* (buffalo grass), *Erioneuron pilosum* (hairy woollygrass), *Bothriochloa laguroides* (silver beardgrass), and/or possibly other species. The native, but disturbance favoring *Aristida purpurea* is characteristic of both this vegetation and the Ruderal Mixed Grassland. The forb/subshrub *Tiquilia canescens* (woody crinklemat) (at low to moderately high cover), and the tall shrub *Prosopis glandulosa* (honey mesquite) (at low cover) usually are present.

Environment:
This vegetation appears to be scattered in small patches within AMIS, probably where grasslands have been somewhat protected from grazing or shrub invasion. It was observed at Zuberbueler Bend and along the north side of San Pedro Canyon.

USNVC Crosswalk:
USNVC Class: Semi-Desert (3)
USNVC Subclass: Warm Semi-Desert Scrub & Grassland (3.A)
USNVC Formation: Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
USNVC Division: North American Warm Desert Scrub & Grassland (D039)
USNVC Macrogroup: Tamaulipan Scrub and Grassland (M130)
USNVC Group: Tamaulipan Dry Grassland (G100)
USNVC Alliance: *Schizachyrium scoparium - Bothriochloa barbinodis* Tamaulipan Grassland Alliance (A3138)
NPS Association: (*Bouteloua spp., Pappophorum bicolor, Tiquilia canescens*) Tamaulipan Herbaceous Vegetation (NPSAMIS034) (Park Name: Dry Native Mixed Grassland)



Photo 44. Dry Native Mixed Grasslands Along the East Side of AMIS (CTI 2017).

Viscid Acacia Shrubland

Local Type Concept:
Thornscrub shrublands co-dominated by viscid acacia (*Vachellia vernicosa* (=*Acacia neovernicosa*)).

Classification Plots Represented By Concept:
AMIS821.

Vegetation:
Vachellia vernicosa (=*Acacia neovernicosa*, viscid acacia) dominates the shrub stratum. Other shrubs present, including potential co-dominants include *Calliandra conferta* (Rio Grande stickpea), *Prosopis glandulosa* (honey mesquite), *Vachellia rigidula* (=*Acacia rigidula*, blackbrush), *Tiquilia canescens* (woody crinklemat), *Krameria grayi* (white ratany), *Guaiacum angustifolium* (guayacan), *Flourensia cernua* (tarbush), *Senegalia berlandieri* (=*Acacia berlandieri*, guajillo), *Senegalia greggii* (=*Acacia greggii*, catclaw acacia), *Forestiera angustifolia* (desert olive), *Celtis ehrenbergiana* (spiny hackberry), *Croton dioicus* (grassland croton), *Castela erecta* ssp. *texana* (Texas goatbush), *Schaefferia cuneifolia* (desert yaupon), and *Yucca torreyi* (Torrey yucca). The herbaceous stratum has low to moderate cover, with *Aristida purpurea* (purple threeawn), and *Tiquilia canescens* (woody crinklemat) the most constant species. Stratum and substrate cover for Viscid Acacia Shrubland are shown in Table D-35.

Table D-35. Stratum and substrate cover recorded for Viscid Acacia Shrubland at Amistad National Recreation Area (# plots=1).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	0	0-0
	Tall Shrub	0	0-0
	Short Shrub	48	25-75
	Herb	2	1-2
Substrate	Bedrock	0	0-0
	Large/Small Rocks	70	70-70
	Litter/Duff	5	5-5

Environment:
This vegetation appears to be limited in AMIS and was observed in the central part of the study area, including near lower California Creek and lower Cow Creek. V. vernicosa is a species of mostly Chihuahuan distribution.

USNVC Crosswalk:
USNVC Class: Semi-Desert (3)
USNVC Subclass: Warm Semi-Desert Scrub & Grassland (3.A)

USNVC Formation: Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
USNVC Division: North American Warm Desert Scrub & Grassland (D039)
USNVC Macrogroup: Chihuahuan Desert Scrub (M086)
USNVC Group: Chihuahuan Creosotebush - Mixed Desert Scrub Group (G288)
USNVC Alliance: *Vachellia constricta* - *Vachellia vernicosa* Thornscrub Alliance (A3166)
NPS Association: *Vachellia vernicosa* - *Calliandra conferta* Shrubland (NPSAMIS014)

Comments:
This vegetation might prove to be a variant of the Guajillo – Cenizo Shrubland (CEGL007759), with alternative dominants. Based on the dominance of the *Vachellia vernicosa* and the presence of some other characteristically Chihuahuan elements, this vegetation currently is treated as an "outlier" association of vegetation or more Chihuahuan influence. All plant taxa recorded in Viscid Acacia Shrubland are shown in Table D-36.

Table D-36. Synthesis table for all plant taxa recorded in Viscid Acacia Shrubland at Amistad National Recreation Area (# plots=1).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Vachellia vernicosa (=Acacia neovernicosa)	Shrub	100.0%	17.5	10-25
Calliandra conferta	Shrub	100.0%	17.5	10-25
Forestiera angustifolia	Shrub	100.0%	7.5	5-10
Grusonia schottii	Shrub	100.0%	1.5	1-2
Castela erecta ssp. texana	Shrub	100.0%	1.0	few-2
Senegalia berlandieri (=Acacia berlandieri)	Shrub	100.0%	0.5	few-1
Cylindropuntia leptocaulis	Shrub	100.0%	0.5	few-1
Mahonia trifoliolata	Shrub	100.0%	0.5	few-1
Jatropha dioica	Shrub	100.0%	0.5	few-1
Thymophylla sp.	Shrub	100.0%	0.5	few-1
Tiquilia sp.	Shrub	100.0%	0.5	few-1
Yucca torreyi	Shrub	100.0%	0.2	trace
Dalea sp.	Shrub	100.0%	0.1	trace
Krameria ramosissima	Shrub	100.0%	0.1	trace
Macrosiphonia lanuginosa var. *macrosiphon*	Shrub	100.0%	0.1	trace
Heliotropium torreyi	Shrub	100.0%	0.1	trace

Table D-36 (continued). Synthesis table for all plant taxa recorded in Viscid Acacia Shrubland at Amistad National Recreation Area (# plots=1).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Lippia graveolens	Shrub	100.0%	0.1	trace
Aristida sp.	Herb	100.0%	0.5	few-1
Bouteloua sp.	Herb	100.0%	0.5	few-1
Cooperia sp.	Herb	100.0%	0.5	few-1
Panicum hallii	Herb	100.0%	0.5	few-1
Sida abutifolia	Herb	100.0%	0.5	few-1
Tridens muticus var. *muticus*	Herb	100.0%	0.5	few-1



Photo 45. Viscid Acacia Shrubland, Castle Canyon at California Creek (LBJWC) (AMIS0821).



Photo 46. Viscid Acacia Shrubland, Castle Canyon at California Creek (LBJWC) (AMIS0821).

Xeric Outcrop Sparse Vegetation

Local Type Concept:
Sparse vascular vegetation on limestone cliffs and other outcrops above the former inundation zone of Amistad Reservoir.

Classification Plots Represented By Concept:
No plots. This vegetation is recognized as probable and is based on the *Porophyllum scoparium* sparsely vegetated rock outcrop and the *Porophyllum scoparium – Heterotheca fulcrata – Penstemon baccharifolius* sparsely vegetated rock outcrop of Poole (2013).

Vegetation:
Vascular vegetation is sparse and likely limited to crevices and small soil pockets in outcrops. *Porophyllum scoparium* (Trans-Pecos poreleaf) is likely to be constant, and *Heterotheca fulcrata* (rockyscree false goldenaster) and *Penstemon baccharifolius* (baccharisleaf beardtongue) less so.

Environment:
Limestone cliffs and other rock outcrops above the former inundation zone of Amistad Reservoir (Poole 2013).

USNVC Crosswalk:
USNVC Class: Semi-Desert (3)
USNVC Subclass: Warm Semi-Desert Scrub & Grassland (3.A)
USNVC Formation: Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)
USNVC Division: North American Warm Desert Scrub & Grassland (D039)
USNVC Macrogroup: North American Warm Semi-Desert Cliff, Scree & Rock Vegetation (M117)
USNVC Group: North American Warm Semi-Desert Cliff, Scree & Pavement Sparse Vegetation (G569)
USNVC Alliance: *Aloysia wrightii* - *Pericome caudata* - *Ephedra nevadensis* Sparsely Vegetated Bedrock Cliff & Lava Field Alliance (A4025)
NPS Association: *Porophyllum scoparium* – (*Heterotheca fulcrata, Penstemon baccharifolius*) Sparse Vegetation (NPSAMIS016)

Comments:
The USNVC alliance to which the AMIS association is assigned is generalized to the entire southwestern United States.



Photo 47. Xeric Outcrop Sparse Vegetation near Langtry.

Hydrilla Submerged Aquatic Vegetation

Local Type Concept:
Submerged aquatic vegetation dominated by hydrilla (Hydrilla verticillata) generally within Amistad Reservoir.

Classification Plots Represented By Concept:
No plots. This vegetation was observed during the accuracy assessment.

Vegetation:
Hydrilla verticillata (hydrilla) is dominant and often the only species. *Potamogeton* spp. (pondweeds) may be present.

Environment:
Permanently flooded shallow waters of Amistad Reservoir (Poole 2013).

USNVC Crosswalk:
USNVC Class: Aquatic Vegetation (5)
USNVC Subclass: Freshwater Aquatic Vegetation (5.B)
USNVC Formation: Freshwater Aquatic Vegetation (5.B.1)
USNVC Division: North American Freshwater Aquatic Vegetation (D049)
USNVC Macrogroup: Eastern North American Freshwater Aquatic Vegetation (M108)
USNVC Group: Eastern North American Freshwater Aquatic Vegetation (G114)
USNVC Alliance: *Hydrilla verticillata - Myriophyllum spicatum* Ruderal Aquatic Vegetation Alliance (A1745)
USNVC Association: *Hydrilla verticillata* Ruderal Aquatic Vegetation (CEGL004702)



Photo 48. Exposed Hydrilla mats along the Amistad Reservoir (CTI 2017).

Appendix E. AMIS Mapping Unit Key

AMIS Mapping Conventions and Visual Key

Appendix E. describes the map units for the Amistad National Recreation Area (AMIS) Vegetation Inventory Project.

The purpose or this key is to:

- Provide a visual key to the AMIS map units;
- Describe the vegetation of each map unit;
- Provide a representative ground photograph(s) for each map unit;
- Describe the link between each map unit and the revised U.S. National Vegetation Classification (rUSNVC);
- Provide visual examples of each map unit with digital overhead images and delineated overlays.

The map units for AMIS were based on a combination of rUSNVC plant associations, local requests (i.e. Park Specials), the limitations of the digital imagery, and land use / land cover classes. The vegetation described in this section reflects the classification designed specifically for this project. Non-vegetated and land-use map units are not described in this key. For more information on the development of the mapping scheme for AMIS please reference the mapping sections of this report and the digital information (i.e. lookup tables, metadata) included in the digital project files.

This key follows the physiognomic grouping of each map unit starting with woodland types. Each map unit is fully described by a variety of characteristics and features. First, the common plant species and rUSNVC crosswalk (if applicable) is presented. Next is a description of the mapping concept and a representative ground photograph. A map of the distribution for each mapping unit across the study area follows along with an example of the 2015 Texas Orthoimagery Program (TOP) basemap ortho-imagery (color infrared bands are shown). The imagery snapshot examples also include representative polygon outlines that highlight the map unit signatures. Many of the map unit descriptions rely heavily on the vegetation field data collected in 2012, 2014, 2016, and 2017. The sample ground photographs were taken during the 2012 and 2017 field data collections.

Woodlands

Map Code ***Mixed Ornamental and Planted Shrubland / Woodland***
W_FOR

Common Species

- Palm Trees (*Areacaceae* spp.)
- Various Planted, and Cultivated Trees and Shrubs

rUSNVC Association
(No Association - Park Special Map Unit)



Example photo of Mixed Ornamental and Planted Shrubland / Woodland.

Description
Frequency: Various residential, commercial, and developed areas along the AMIS boundary were found to have trees and tall shrubs that were planted and/or maintained.

Physiognomy: W_FOR polygons contain moderate to dense stands of trees and shrubs that may contain both native and non-native evergreen and deciduous species. The understories for this map unit likely vary and contain mixes of planted and maintained grasses, forbs, shrubs and other landscape plants.

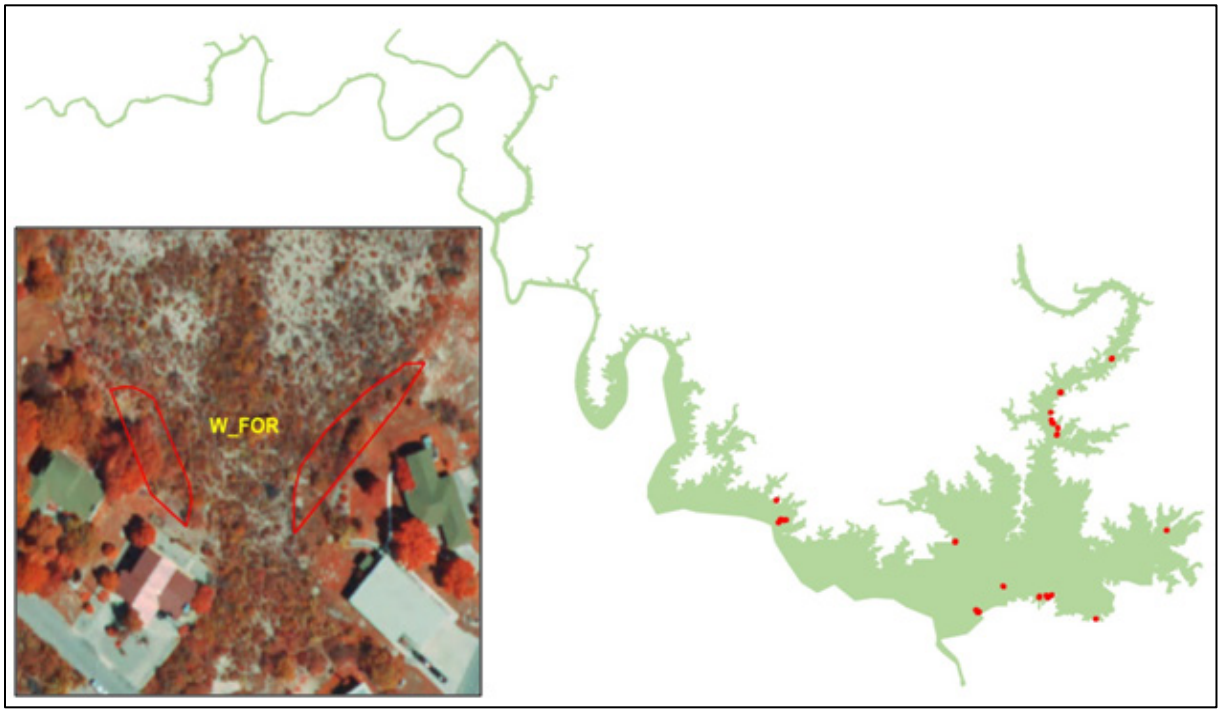
Condition: Poor. Planted and ornamental trees and shrubs likely represent non-native species and species that may spread and become problematic. Native and natural vegetation may be suppressed or displaced by these plants under the right conditions.

CIR Signature: On the imagery, canopies of W_FOR varied depending on the species present. Most contained large red, pink, and orange tuffs with either a mottled shrub understory of brown spots, white bare soil, or a smooth red undertone representing lawns and Bermuda grass. Dark shadows from the taller trees were often present.

Mapping Notes: The W_FOR map unit was created to address mostly AMIS boundary area encroachments. In some cases, these were thin slivers of overhanging branches or an outward

extension of landscaping. None of these areas were sampled during this project and some sites may have dominant native species like ones found in the other map units.

Photo Signature and Distribution



Example photo signature and distribution map for Mixed Ornamental and Planted Shrubland / Woodland.

Map Code ***Graves' Oak - Texas Pistachio Woodland***
W_GOAK ***Quercus gravesii* / *Pistacia mexicana* Woodland**

Common Species

- Graves' (Chisos) oak (*Quercus gravesii*)
- Texas pistachio (*Pistacia mexicana*)
- Hackberry (*Celti*s spp.)
- Honey mesquite (*Prosopis grandulosa*)
- Fragrant mimosa (*Mimosa borealis*)
- Mexican buckeye (*Ungnadia speciosa*)
- Evergreen sumac (*Rhys virens*)
- Texas persimmon (*Diospyros texana*)

rUSNVC Association
Quercus gravesii / *Pistacia mexicana* Woodland (NPSAMIS012) [Provisional]



Example photo of Graves' Oak - Texas Pistachio Woodland.

Description
Frequency: Woodland stands dominated by Graves or Chisos red oak where only found in two known locations representing six polygons. Other locations may occur in AMIS but were not sampled or were not apparent on the imagery.

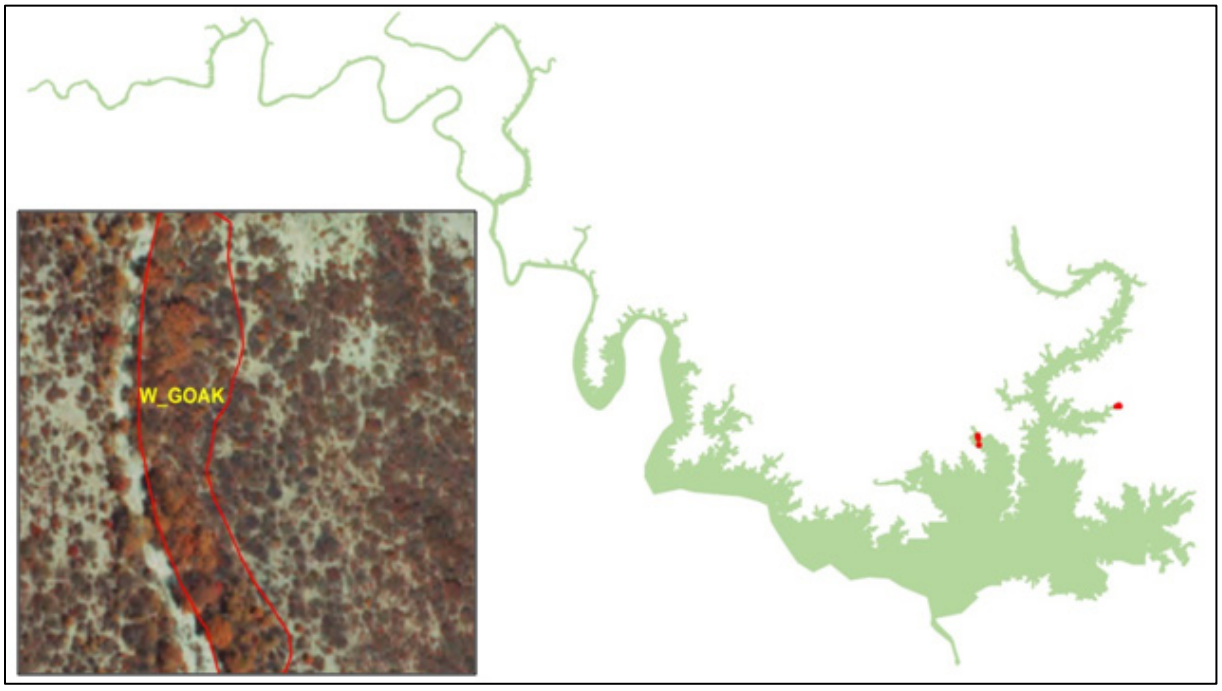
Physiognomy: W_GOAK polygons contained moderate to dense stands of tall, semi-evergreen trees (5-15 meters) with a mix of thick deciduous and evergreen tall shrubs and shorter trees. Understory composition was diverse and varied with the presence of different mixes of thick short shrubs, forbs, and grasses.

Condition: Fair. Graves oak stands in AMIS likely represent the farthest limits of larger oak groves present outside the project area. All of the W_GOAK stands were in drainages and mesic areas that might be prone to wildlife and human pressure (shade, water, forage, etc.). Little if any regeneration of the oak trees was documented.

CIR Signature: On the imagery canopies of W_GOAK appeared as large, rounded light brown circles with various understory colors ranging from dark brown (mesquite), red (other deciduous trees), and gray (short shrubs).

Mapping Notes: The W_GOAK was mapped based on where it was known to occur. Other stands of this type may be present or may mix with similar upland woodland types, especially the W_ST and other oak map units. More ground-truthing would likely help document the full distribution and abundance of this woodland map unit.

Photo Signature and Distribution



Example photo signature and distribution map for Graves' Oak - Texas Pistachio Woodland.

Map Code ***Periodically Submerged Inundation Zone and Shoreline***

W_HMX **Huisache - (Honey Mesquite) Woodland**
Periodically Submerged Inundation Zone and Shoreline
***Vachellia farnesiana* - (*Prosopis glandulosa*) Woodland**

Common Species

- Huisache (Sweet acacia) (*Acacia farnesiana*)
- Honey mesquite (*Prosopis grandulosa*)
- Tree tobacco (*Nicotiana glauca*)
- Bermuda grass (*Cynodon dactylon*)

rUSNVC Associations

Vachellia farnesiana - (*Prosopis glandulosa*) Riparian Woodland (CEGL002131)
Prosopis glandulosa Riparian Woodland (NPSAMIS033) [Provisional] [Park Special] [Map Unit Modifier]



Example photo of Periodically Submerged Inundation Zone and Shoreline.

Description

Frequency: Post flooded woodlands and tall shrublands were common throughout the inundation zone.

Physiognomy: W_HMX polygons contain sparse and moderate stands of died or dying evergreen trees/shrubs. Understories were absent or limited and varied depending on location. Bermuda grass, weedy forbs, and common inundation shrubs were usually present.

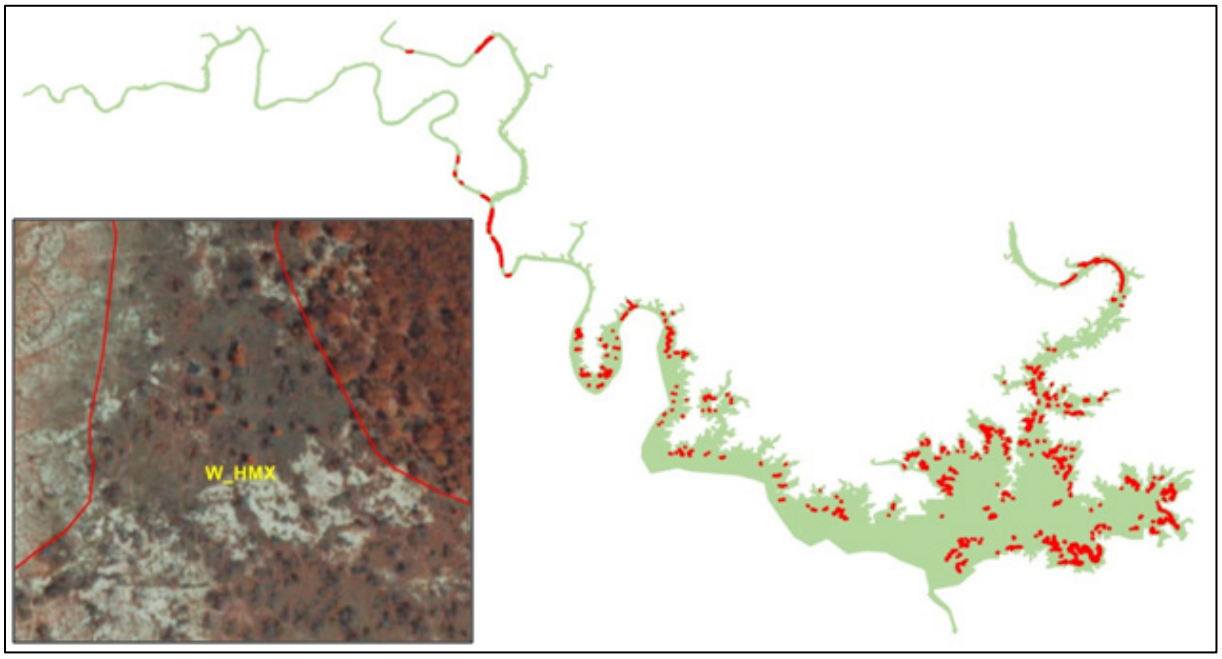
Condition: Poor. Post flooded woodlands and tall shrublands represent declining areas impacted by recent high-water levels. Dead trees and shrubs were apparent. New growth in the form of seedlings was common. Areas covered by W_HMX should be considered transitional due to the constant flood cycle of the reservoir.

CIR Signature: On the imagery, W_HMX had a scattered appearance with brown dots (living trees) and dark gray clumps and sticks (dead trees). Red (Bermuda grass), white (soil/rock), or gray (dead

grass/soil) were common understory colors. Shorter shrubs and seedlings appeared as small brown spots and splotches.

Mapping Notes: The W_HMX map unit was created especially for this project to differentiate woodland areas in the upper limits of the inundation zone from higher more stable woodlands. Non-impacted sites were mapped using the W_HR and W_MRIP map classes and some confusion along the borders with these likely occurred. W_HMX polygons may have no living trees and could also be described using the understory species such as H_BGFF

Photo Signature and Distribution



Example photo signature and distribution map for Periodically Submerged Inundation Zone and Shoreline.

Map Code ***Huisache - (Honey Mesquite) Riparian Woodland***
W_HR ***Vachellia farnesiana* - (*Prosopis glandulosa*) Riparian Woodland**

Common Species

- Huisache (Sweet acacia) (*Acacia farnesiana*)
- Honey mesquite (*Prosopis grandulosa*)
- Baccharis spp. (*Baccharis* spp.)
- Tree tobacco (*Nicotiana glauca*)
- Bermuda grass (*Cynodon dactylon*)

rUSNVC Association
Vachellia farnesiana - (*Prosopis glandulosa*) Riparian Woodland (CEGL002131)



Example photo of Huisache - (Honey Mesquite) Riparian Woodland.

Description
Frequency: Huisache woodlands and tall shrublands were common along the edges of the Amistad Reservoir. Short shrub variants and seedlings were also common in areas that were recently flooded.

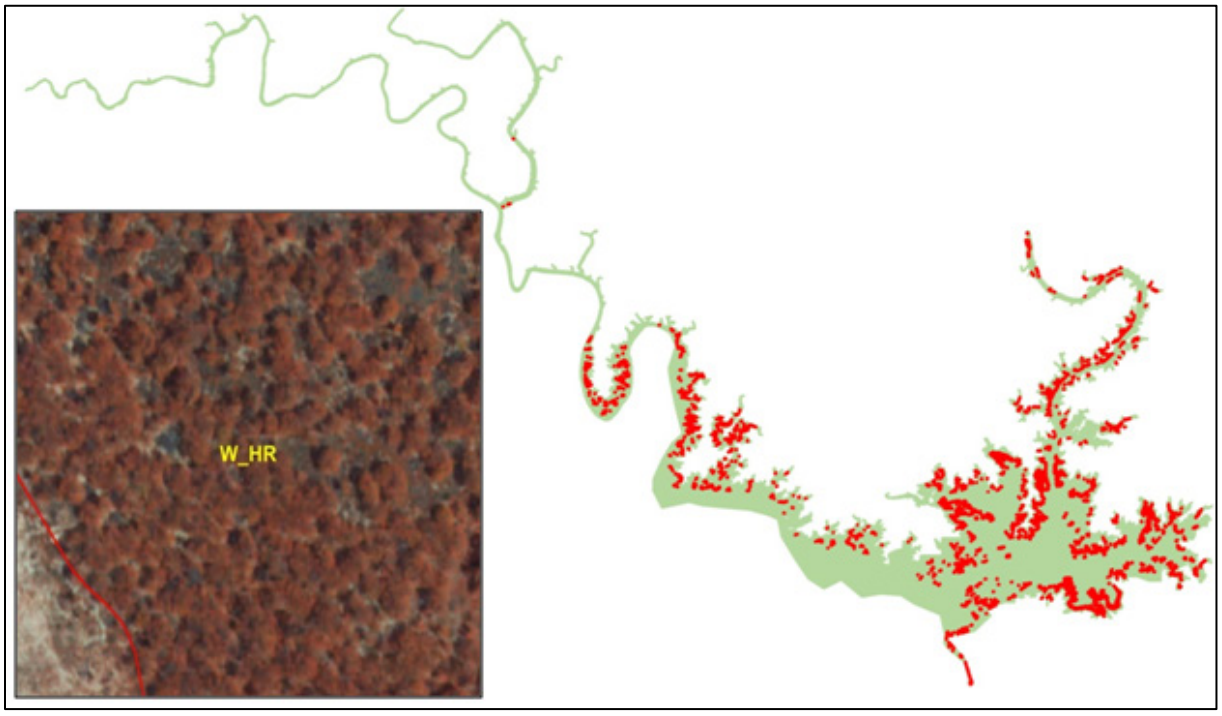
Physiognomy: W_HR polygons contain either moderate to dense stands of tall evergreen trees/shrubs or shorter and sparser shrubs and seedlings. Understories were limited and varied depending on location. Early successional grasses, forbs and common inundation shrubs were often present. Honey mesquite was a widespread associate.

Condition: Good. Huisache stands were common throughout the lower portions of AMIS and became less frequent along the rivers and tributaries. All forms of huisache, from large trees to seedlings, were found in the sampling and appeared to be extensive. Large floods and drought may kill or greatly reduce the presence of huisache at AMIS.

CIR Signature: On the imagery, canopies of W_HR appear as large, rounded brown tuffs with either red (Bermuda grass), white (soil/rock), or gray (dead grass/soil) understories. Shorter shrubs and seedlings appeared as small brown spots and splotches.

Mapping Notes: W_HR was very similar in appearance to the W_MRIP map unit and some confusion may have occurred during the mapping of these two types. Obvious flooded areas in the inundation zone with either living or dying huisache trees/shrubs were mapped using the W_HMX map class.

Photo Signature and Distribution



Example photo signature and distribution map for Huisache - (Honey Mesquite) Riparian Woodland.

Map Code ***Mixed Native Tree Woodland***
W_MNW

Common Species

- American sycamore (*Platanus occidentalis*)
- Mexican ash (*Fraxinus berlandieriana*)
- Pecan (*Carya illinoinensis*)
- Netleaf hackberry (*Celtis laevigata*)
- Texas ash (*Fraxinus albicans*)
- Texas persimmon (*Diospyros texana*)

rUSNVC Association
(No Association - Park Special Map Unit)



Example photo of Mixed Native Tree Woodland.

Description
Frequency: Various deciduous native trees formed large linear and bunched stands in the upper riparian zones along the northern portions of the Rio Grande, Pecos, and Devil's Rivers.

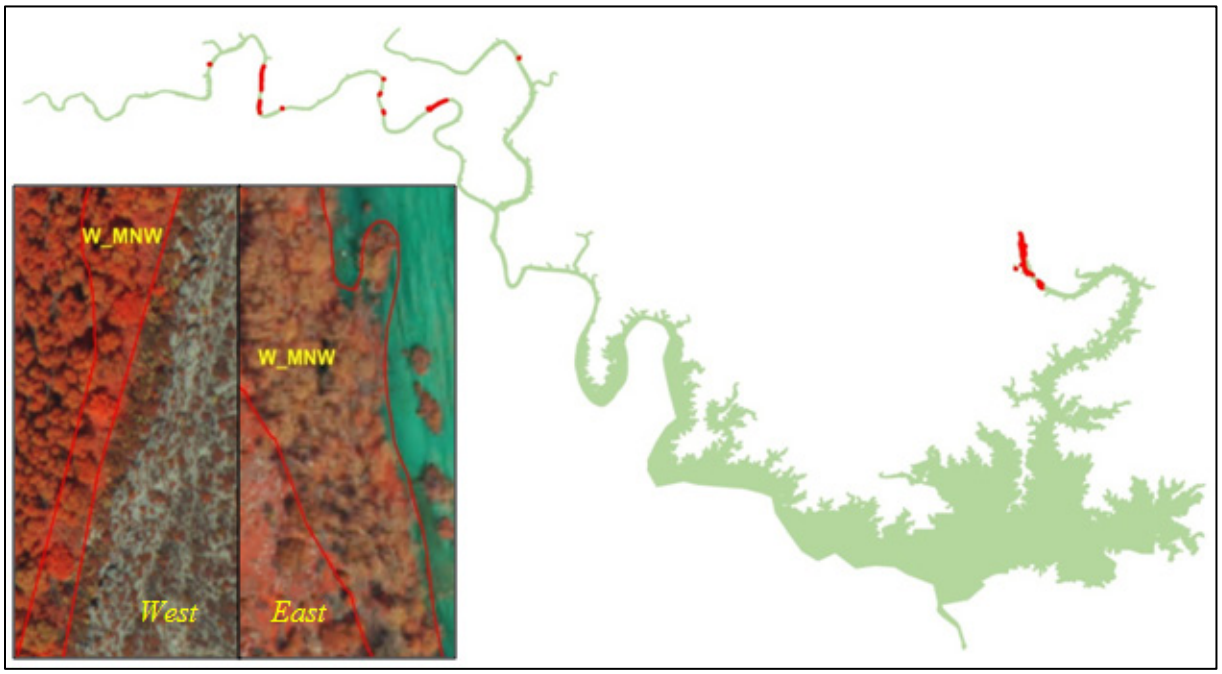
Physiognomy: W_MNW polygons contain dense stands of tall deciduous trees with other common deciduous riparian tree species, shrubs, and mesic grasses/forbs in the understory.

Condition: Good - Fair. W_MNW sites are rare but appear to be in good health. Their limited distribution and floodplain location make them prone to large floods and/or prolonged drought and water shortages. No regeneration was noted. Non-native species such as tamarisk were found close by.

CIR Signature: On the imagery, canopies of W_MNW were split between those that occurred in the east versus the west. In the east, the dominant tree was American sycamore and these appeared as bushy, light brown-orange tuffs against a bright orange background color (herbaceous vegetation). In the west, the dominant tree was Mexican ash. These appeared to be slightly smaller and redder. Polygons of W_MNW were usually linear.

Mapping Notes: The W_MNW map unit was created for this project to document the variation of riparian species at AMIS. A clear break occurs between the dominant species in the east and those in the west. Other riparian types, such as W_WIL and W_MRIP were similar in appearance and often located in close proximity.

Photo Signature and Distribution



Example photo signature and distribution map for Mixed Native Tree Woodland.

Map Code ***Honey Mesquite Riparian Woodland***
W_MRIP ***Prosopis glandulosa* Riparian Woodland**

Common Species

- Honey mesquite (*Prosopis glandulosa*)
- Huisache (Sweet acacia) (*Acacia farnesiana*)
- Whitebrush (*Aloysia gratissima*)
- Texas pricklypear (*Opuntia engelmannii*)
- Texas persimmon (*Diospyros texana*)
- Coyotillo (*Karwinskia humboldtiana*)

rUSNVC Association
Prosopis glandulosa Riparian Woodland (NPSAMIS033) [Provisional]



Example photo of Honey Mesquite Riparian Woodland.

Description
Frequency: Riparian stands of honey mesquite were common throughout AMIS along the edges of the reservoir, in riparian river corridors, and on floodplains.

Physiognomy: W_MRIP polygons contained moderate to dense stands of evergreen, medium sized trees and tall shrubs (3 - 5 meters). Understories varied by location with most having a sparse understory or a denser, mixed evergreen shrub component.

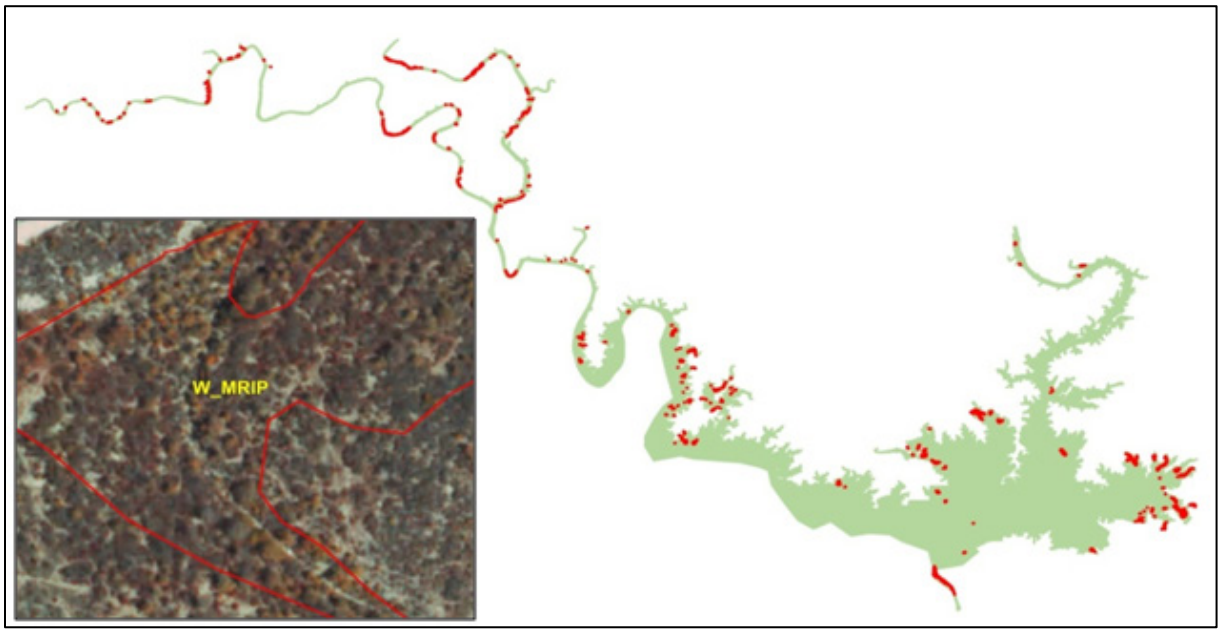
Condition: Good. Honey mesquite trees and tall shrubs at AMIS were widespread and appeared disease free. Fuel loading of dead woody material may present a fire hazard and most sites may be prone to flooding. Animal pressure and human disturbance are also potential threats to this type.

CIR Signature: On the imagery, canopies of W_MRIP had a very characteristic mix of light brown (living trees) and gray (dead or dying trees) colors. When present, the understory was often a mottled

gray color (whitebrush) or a mix of brown and red spots (thornscrub species). Even-aged stands of W_MRIP are smooth and solid, whereas stands with various tree sizes appeared coarser in texture.

Mapping Notes: The W_MRIP map unit was created to address riparian and mesic honey mesquite stands at AMIS as opposed to the drier, sparser and shorter mesquite shrubs (S_MUP). Some confusion likely occurred between the two honey mesquite map units in the mapping and also with the similar W_HR type.

Photo Signature and Distribution



Example photo signature and distribution map for Honey Mesquite Riparian Woodland.

Map Code	*Sugarberry / Thornscrub Mesic and Riparian Shrubland and Woodland*
W_ST	***Celtis laevigata* var. *laevigata* / Thornscrub Mesic and Riparian Shrubland and Woodland**

Common Species

- Sugarberry (*Celtis laevigata* var. *laevigata*)
- Spiny hackberry (*Celtis ehrenbergiana*)
- Honey mesquite (*Prosopis glandulosa*)
- Texas persimmon (*Diospyros texana*)
- Guajillo (*Senegalia berlandieri*)
- Blackbrush (*Vachellia rigidula*)

rUSNVC Alliance

Celtis laevigata - *Ulmus crassifolia* / *Urvillea ulmacea* Tamaulipan Riparian Scrub Alliance (A3842)



Example photo of Sugarberry / Thornscrub Mesic and Riparian Shrubland and Woodland.

Description

Frequency: Polygons of W_ST were found throughout the upland areas of AMIS, particularly in mesic drainages, draws, and depressions.

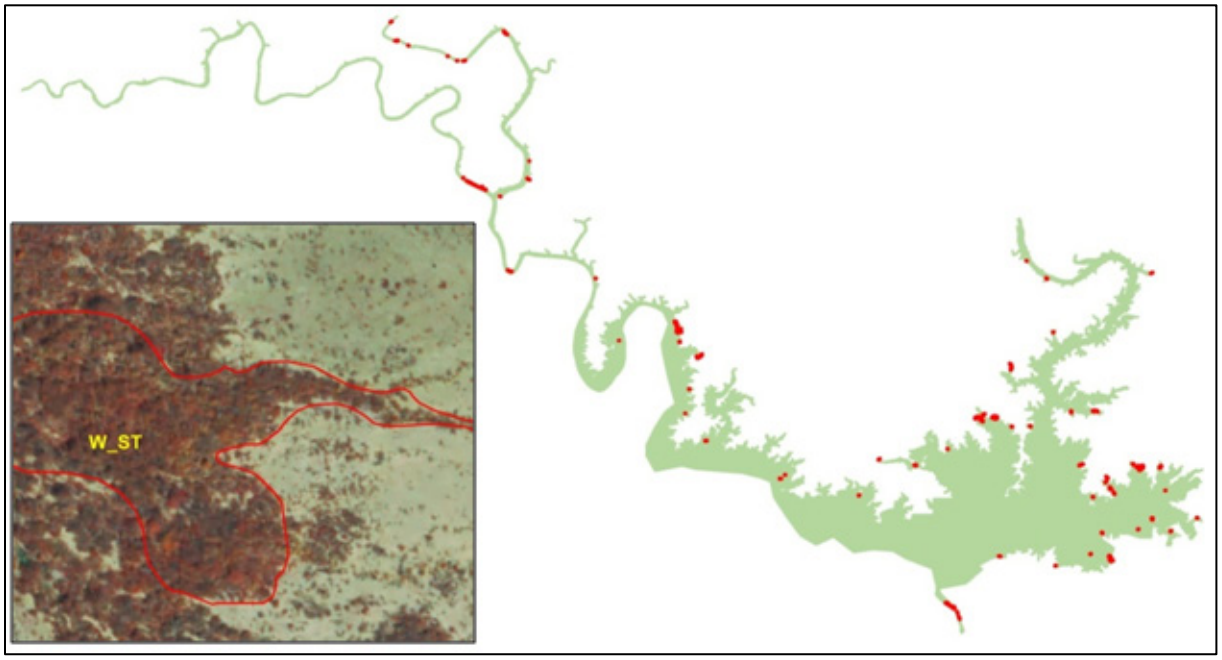
Physiognomy: W_ST stands contain dense, short to medium sized deciduous trees and evergreen tall shrubs (2 – 5 meters) with a mixed understory of shrubs and mesic herbaceous vegetation. Species composition varied by location and some sites were dominated by other hackberry species or by a mix of tall evergreen thornscrub species like guajillo and honey mesquite.

Condition: Good. Sugarberry and hackberry sites occurred in small riparian-like corridors and appeared overall healthy and stable. Encroachment of weedy species and animal pressure may be the biggest threats to this type.

CIR Signature: On the imagery, sugarberry/hackberry trees had a brick red color that contrasted with the brown color of mesquite and guajillo shrubs. Even-aged stands were smooth and solid, whereas stands with various tree sizes appeared coarser in texture. Polygons of W_ST may also have linear wash and drainage features within.

Mapping Notes: The W_ST type was used to delineate taller and thicker stands of thornscrub vegetation found in mesic upland sites. Some confusion may have occurred during the mapping of W_ST due to the common species overlap with the other thornscrub types especially S_BMP, S_BPTS, and W_MRIP map units.

Photo Signature and Distribution



Example photo signature and distribution map for Sugarberry / Thornscrub Mesic and Riparian Shrubland and Woodland.

Map Code ***Texas Live Oak / Blackbrush Woodland***
W_TOAK ***Quercus fusiformis* / *Vachellia rigidula* Woodland**

Common Species

- Texas live oak (*Quercus fusiformis*)
- Blackbrush (*Vachellia rigidula*)
- Texas persimmon (*Diospyros texana*)
- Gregg's ash (*Fraxinus greggii*)
- Hackberry (*Celtis laevigata*)

rUSNVC Association
Quercus fusiformis / Vachellia rigidula Woodland (NPSAMIS004) [Provisional]



Example photo of Texas Live Oak / Blackbrush Woodland.

Description
Frequency: Woodland stands dominated by Texas live oak where found in a few mesic canyons and upland drainages

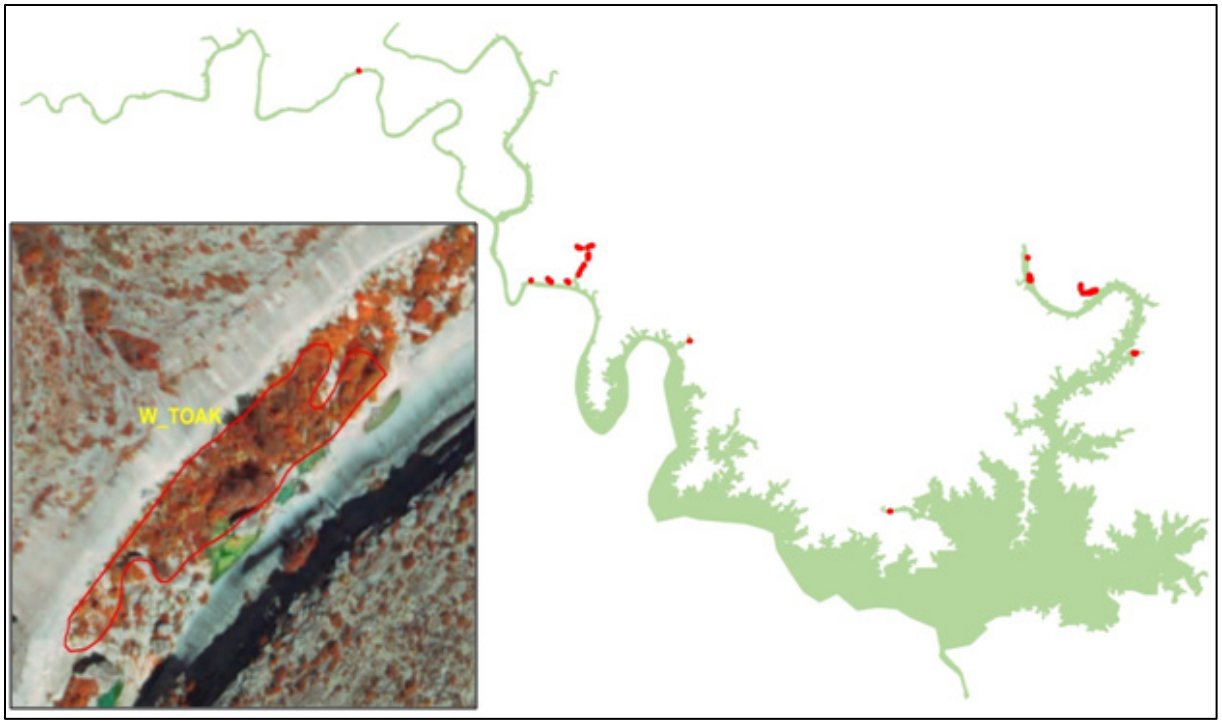
Physiognomy: W_TOAK polygons contained moderate to dense stands of tall evergreen trees (5-15 meters) with a mix of thick deciduous and evergreen tall shrubs and shorter trees. Understory composition was diverse and varied with the presence of thick short shrubs, forbs, and grasses.

Condition: Fair. Texas live oak stands in AMIS likely represent the lowest extensions of larger oak groves present in higher drainages outside of the boundary. W_TOAK stands were found in mesic areas that might be prone to wildlife and human pressure (shade, water, forage, etc.). Little if any regeneration of the oak trees was documented.

CIR Signature: On the imagery, canopies of W_TOAK appeared as large, rounded dark brown tuffs with various understory colors ranging from dark brown (mesquite), orange (willows), and red (herbaceous vegetation).

Mapping Notes: The W_TOAK was mapped primarily based on where it was known to occur and within similar nearby south-facing canyons and washes. Other stands of this type may be present or may mix with similar upland woodland types, especially the W_ST and other oak types. More ground-truthing would likely help with documenting the full distribution and abundance of Texas live oak in AMIS.

Photo Signature and Distribution



Example photo signature and distribution map for Texas Live Oak / Blackbrush Woodland.

Map Code ***Vasey Scrub Oak - Littleleaf Ash - Hackberry Woodland***
W_VOAK ***Quercus vaseyana - Fraxinus greggii - Celtis laevigata* var. *reticulata* Woodland**

Common Species

- Vasey scrub oak (*Quercus vaseyana*)
- Littleleaf ash (*Fraxinus greggii*)
- Gregg's ash (*Fraxinus greggii*)
- Hackberry (*Celtis laevigata*)
- Texas persimmon (*Diospyros texana*)
- Cenizo (*Leucophyllum frutescens*)

rUSNVC Association
Quercus vaseyana - Fraxinus greggii – Celtis ssp. Woodland (NPSAMIS005) [Provisional]



Example photo of Vasey Scrub Oak - Littleleaf Ash - Hackberry Woodland.

Description
Frequency: Woodland stands dominated by Vasey scrub oak where found in a few mesic canyons, along drainages, and other mesic sites in the uplands of AMIS.

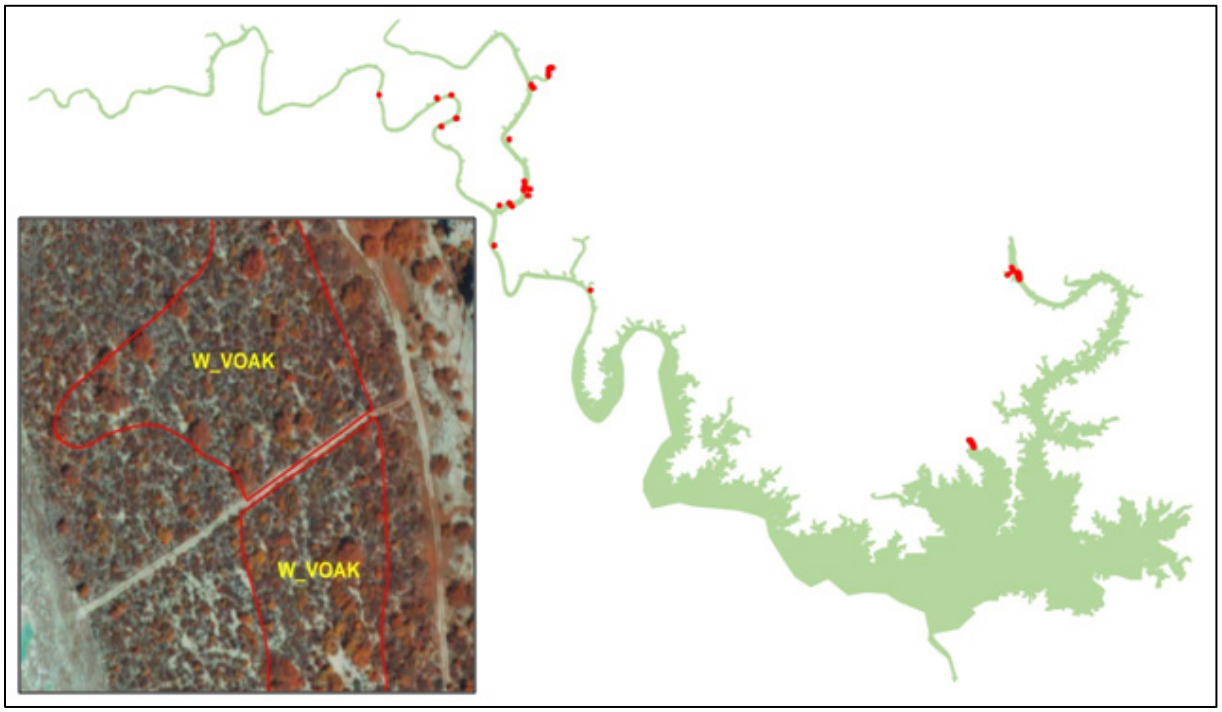
Physiognomy: W_VOAK polygons contained moderate to dense stands of short, semi-evergreen trees (< 5 meters) with evergreen tall shrubs and shorter trees in the understory. Canopy associates include honey mesquite and huisache.

Condition: Fair. Vasey scrub oak stands likely represent the lowest extensions of larger oak groves present in higher drainages outside of AMIS. W_VOAK stands were found in mesic areas that might be prone to wildlife and human pressure (shade, water, forage, etc.). Little if any regeneration of the oak trees was documented.

CIR Signature: On the imagery, canopies of W_VOAK appeared as medium-sized, rounded red/dark brown tuffs with various understory colors ranging from dark brown (mesquite) to gray and red dots and splotches (shrubs).

Mapping Notes: The W_VOAK type was mapped where it was known to occur. Other stands of this type may be present or may mix with similar upland woodland types, especially W_ST and the other oak map classes. More ground-truthing would likely help with documenting the full distribution and abundance of W_VOAK.

Photo Signature and Distribution



Example photo signature and distribution map for Vasey Scrub Oak - Littleleaf Ash - Hackberry Woodland.

Map Code ***Willow Riparian Woodland***
W_WIL ***Salix* spp. Riparian Woodland**

Common Species

- Black willow (*Salix nigra*)
- Goodding willow (*Salix gooddingii*)
- Thurber's willow (*Salix thurberi = S. exigua*)
- Honey mesquite (*Prosopis glandulosa*)
- Huisache (Sweet acacia) (*Acacia farnesiana*)
- Tamarisk (Salt cedar) (*Tamarix ramosissima*)
- Giant cane (*Arundo donax*)

rUSNVC Association
Salix gooddingii - Salix thurberi - Fraxinus berlandieri Woodland (NPSAMIS035) [Provisional]



Example photo of Willow Riparian Woodland.

Description
Frequency: Willow woodlands were found primarily along the Rio Grande and Pecos River portions of AMIS.

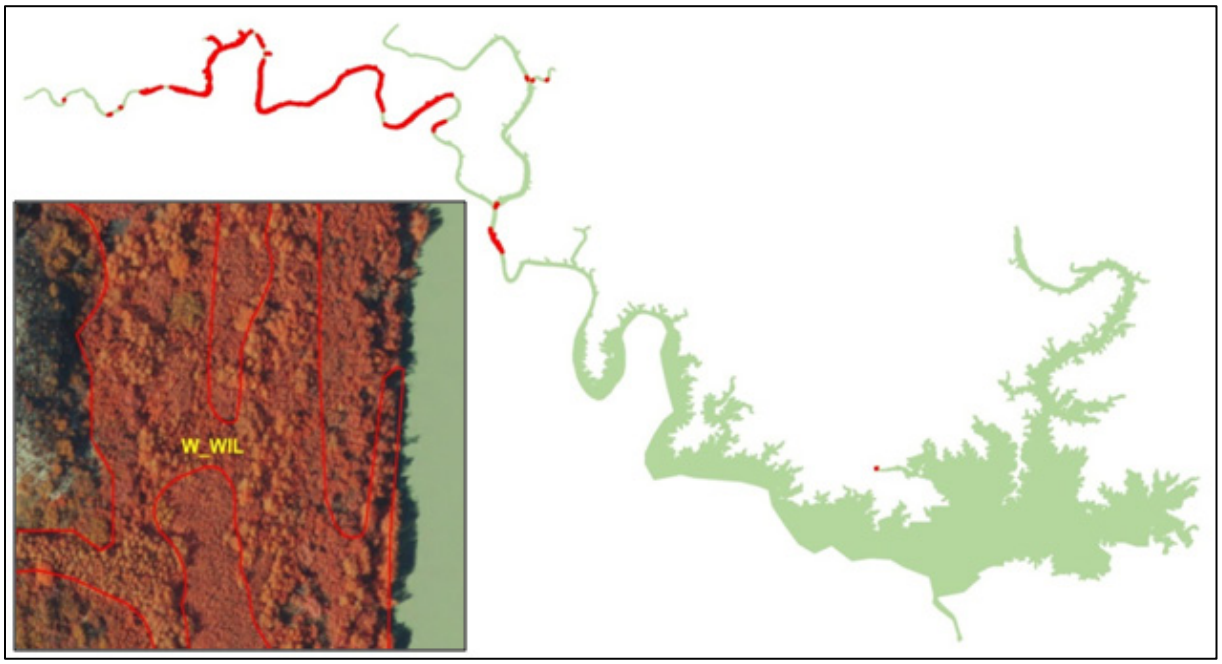
Physiognomy: W_WIL polygons contain dense stands of various sized deciduous trees, with some reaching over 15 meters in height. The understory and sub-canopy layers, if present, have a mix of evergreen and deciduous shrubs and weedy herbaceous vegetation.

Condition: Good- Fair. Willow woodlands are an important riparian habitat and are potentially threatened by prolonged flooding and drought. Willow regeneration was observed in some areas. Pressure from non-native species, especially tamarisk and giant cane was documented in many of the stands that were sampled.

CIR Signature: On the imagery, canopies of W_WIL had a feathery, orange, and light brown texture. If present, giant cane understories were pink, tamarisk dark red, and mesquite trees were brown. Polygons of W_WIL often were located between linear streams and canyon rock formations.

Mapping Notes: The W_WIL map unit included stands with mature trees, saplings, and willow regeneration. Polygons of this type often contained varying amounts of huisache, giant cane, mesquite, and tamarisk that led to some likely confusion during the mapping.

Photo Signature and Distribution



Example photo signature and distribution map for Willow Riparian Woodland.

Shrublands

Map Code ***Blackbrush - Cenizo Shrubland***
S_BB ***Vachellia rigidula - Leucophyllum frutescens* Shrubland**

Common Species

- Blackbrush (*Vachellia rigidula*)
- Cenizo (*Leucophyllum frutescens*)
- Guajillo (*Senegalia berlandieri*)
- Texas pricklypear (*Opuntia engelmannii*)
- Coyotillo (*Karwinskia humboldtiana*)

rUSNVC Association
Vachellia rigidula Shrubland (CEGL003874)



Example photo of Blackbrush - Cenizo Shrubland.

Description
Frequency: The S_BB was a common thornscrub type found throughout AMIS in uplands above the reservoir.

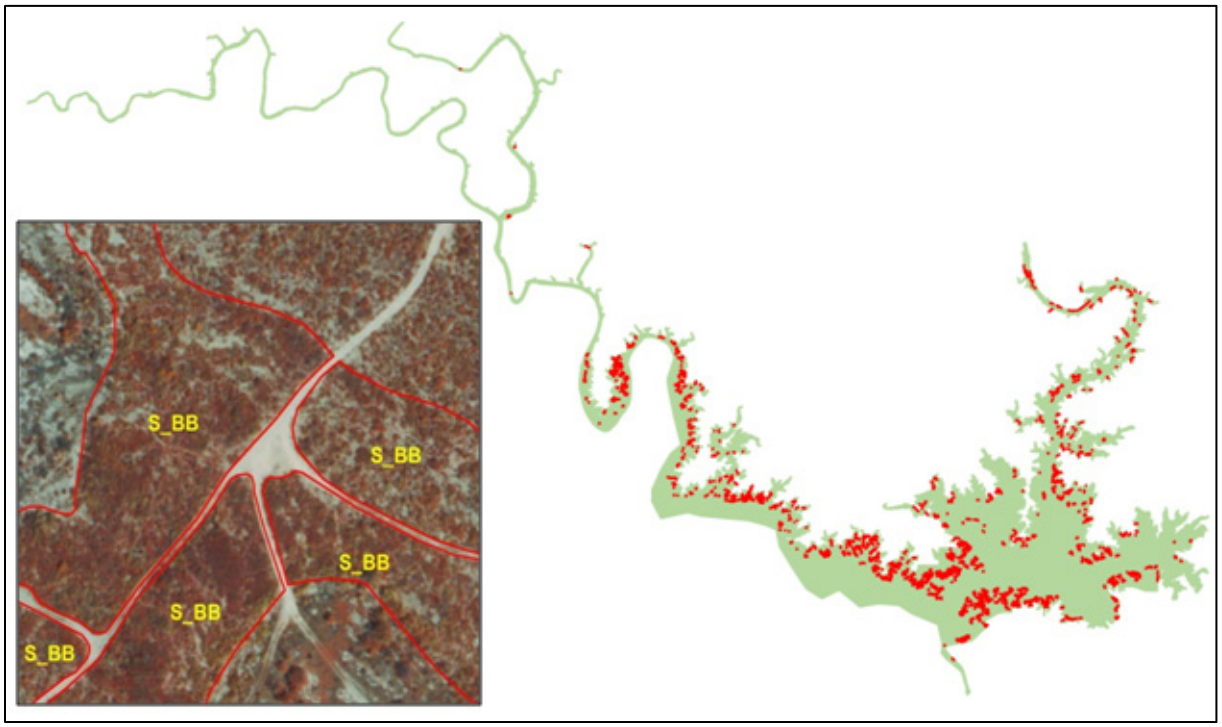
Physiognomy: S_BB contained tall (> 1 meter) evergreen shrubs with an understory of shorter, thornscrub species and sparse grasses and forbs.

Condition: Good. Threats to this map unit include invasion by non-native species, human and animal disturbance, and wildfires.

CIR Signature: On the imagery, the blackbrush shrubs had a diagnostic smooth purple reddish appearance against a gray/white (bare ground) background with brown and red spots and streaks (various thornscrub shrubs).

Mapping Notes: S_BB was very similar in appearance to the S_BMP and S_BPTS map units but had reduced levels of honey mesquite and Texas sotol. The S_BB map unit was used to map areas of thick and tall blackbrush that may be related to more mesic conditions.

Photo Signature and Distribution



Example photo signature and distribution map for Blackbrush - Cenizo Shrubland.

Map Code ***Blackbrush - Honey Mesquite - Texas Persimmon Shrubland***
S_BMP ***Vachellia rigidula - Prosopis glandulosa - Diospyros texana* Shrubland**

Common Species

- Blackbrush (*Vachellia rigidula*)
- Honey mesquite (*Prosopis glandulosa*)
- Texas persimmon (*Diospyros texana*)
- Cenizo (*Leucophyllum frutescens*)
- Guajillo (*Senegalia berlandieri*)
- Texas pricklypear (*Opuntia engelmannii*)

rUSNVC Association
Vachellia rigidula - Prosopis glandulosa - Diospyros texana Shrubland (NPSAMIS032) [Provisional]



Example photo of Blackbrush - Honey Mesquite - Texas Persimmon Shrubland.

Description
Frequency: The S_BMP was a common thornscrub type found throughout AMIS in shallow drainages, washes, and more mesic upland areas.

Physiognomy: S_BMP contained tall (> 1 meter) evergreen and deciduous shrubs with an understory of shorter, thornscrub species and sparse grasses and forbs.

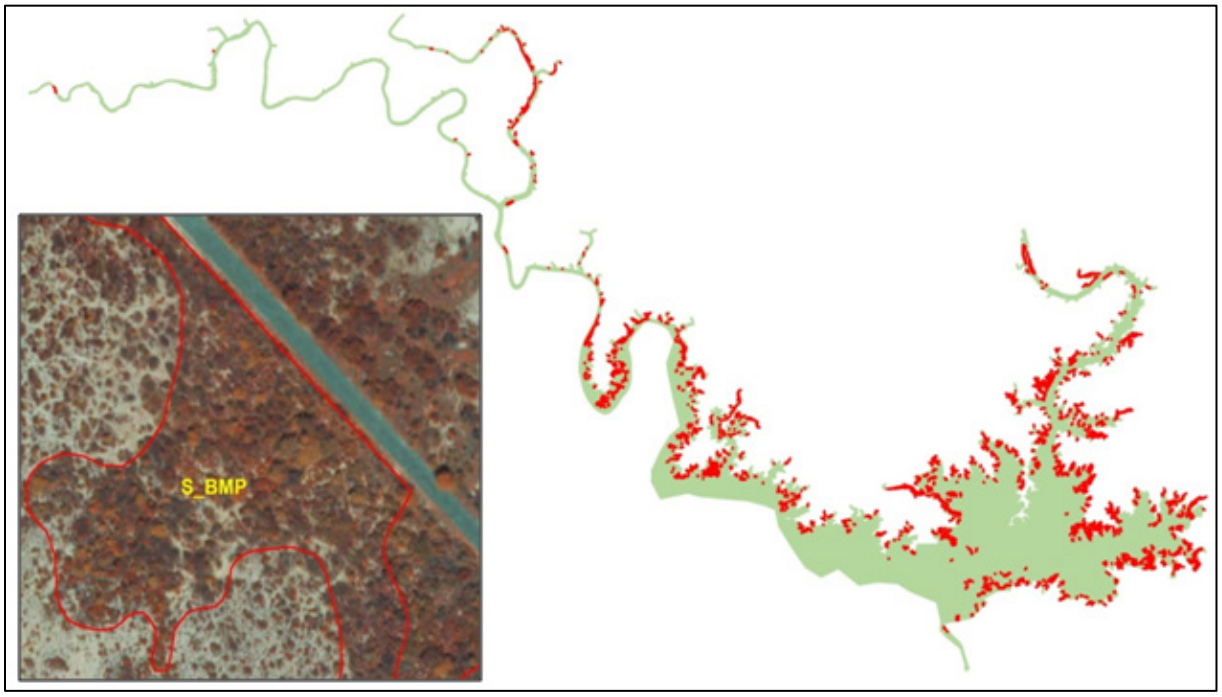
Condition: Good. Threats to this map unit include invasion by non-native species, human and animal disturbance, and wildfires.

CIR Signature: On the imagery, blackbrush shrubs had a diagnostic smooth purple reddish color and honey mesquite had a light to dark brown hue. Most S_BMP polygons contained a thick, almost even mix of blackbrush with honey mesquite, and were coarse in texture. Other thornscrub species were

also present and appeared as brown and red spots and streaks. Texas persimmon was usually a minor component and appeared as dark red spots.

Mapping Notes: The S_BMP map unit was very similar in appearance to the S_BB, S_BPTS, and S_MUP map units but was denser and had more of a mix of tall shrubs, primarily honey mesquite and blackbrush.

Photo Signature and Distribution



Example photo signature and distribution map for Blackbrush - Honey Mesquite - Texas Persimmon Shrubland.

Map Code ***Blackbrush - Texas Persimmon - Texas Sotol Shrubland***
S_BPTS ***Vachellia rigidula - Diospyros texana - Dasylirion texana* Shrubland**

Common Species

- Blackbrush (*Vachellia rigidula*)
- Texas persimmon (*Diospyros texana*)
- Texas sotol (*Dasylirion texana*)
- Cenizo (*Leucophyllum frutescens*)
- Guajillo (*Senegalia berlandieri*)
- Texas pricklypear (*Opuntia engelmannii*)

rUSNVC Association
Vachellia rigidula - Diospyros texana - Dasylirion texanum Shrubland (NPSAMIS003) [Provisional]



Example photo of Blackbrush - Texas Persimmon - Texas Sotol Shrubland.

Description
Frequency: The S_BPTS was a moderately common thornscrub type found throughout AMIS on dry and rocky sites especially in the north regions and along the Devil's River.

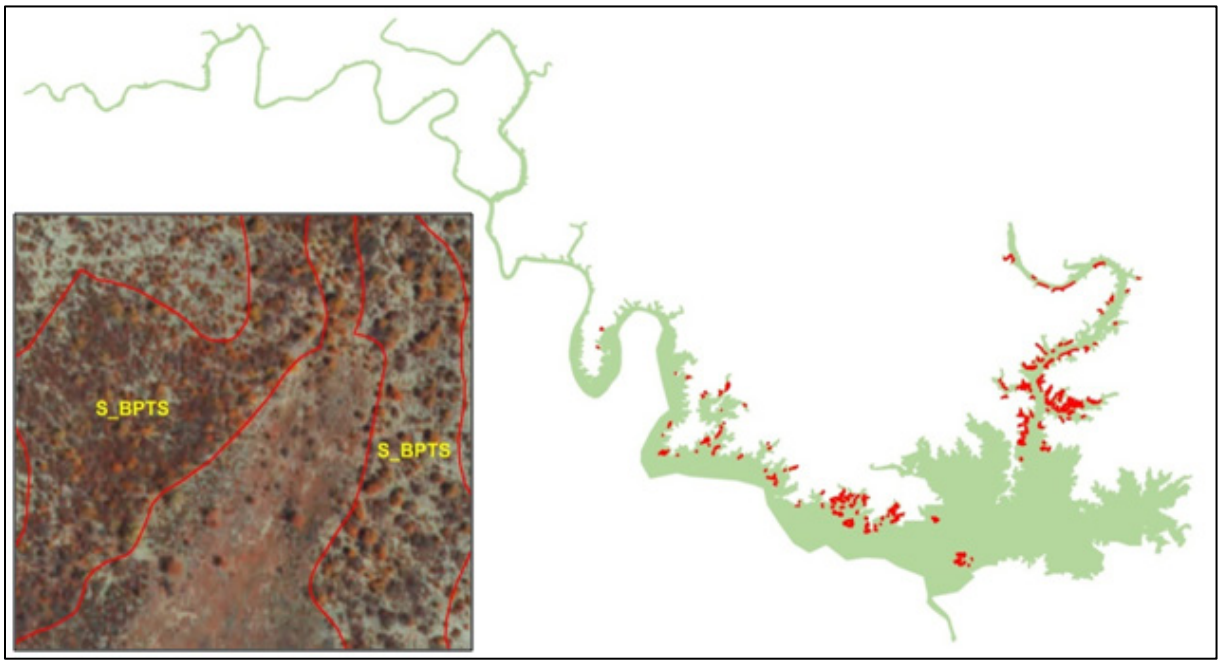
Physiognomy: S_BPTS contained a mix of tall and short evergreen and deciduous shrubs with an understory of grasses and forbs.

Condition: Good. Threats to this map unit include invasion by non-native species, human and animal disturbance, and wildfires.

CIR Signature: On the imagery, S_BPTS polygons had a mottled appearance typical of thornscrub-dominated lands. Blackbrush shrubs were smooth and purple reddish in color. Texas persimmon appeared as dark red spots and Texas sotol were seen as light brown smudges. Rocks and bare ground were common in the canopy openings and appeared gray and white in color.

Mapping Notes: The S_BPTS map unit was very similar in appearance to the S_BMP, S_BPTS, and S_GC types but most sites contained a significant amount of Texas persimmon along with sotol and yucca species. All of the thornscrub map units at AMIS had similar species composition with some distinctive differences in the density, height, and combination of the dominant species.

Photo Signature and Distribution



Example photo signature and distribution map for Blackbrush - Texas Persimmon - Texas Sotol Shrubland.

Map Code ***Cenizo Shrubland***
S_CEN ***Leucophyllum frutescens* Shrubland**

Common Species

- Cenizo (*Leucophyllum frutescens*)
- Whitebrush (*Aloysia gratissima*)
- Blackbrush (*Vachellia rigidula*)
- Guajillo (*Senegalia berlandieri*)
- Texas pricklypear (*Opuntia engelmannii*)
- Texas swamp privet (*Forestiera angustifolia*)
- Slimleaf heliotrope (*Heliotropium torreyi*)

rUSNVC Association
Leucophyllum frutescens Shrubland (CEGL002168)



Example photo of Cenizo Shrubland.

Description
Frequency: Dense and moderate stands of almost pure cenizo were common in the upland portions of AMIS, especially in the south and eastern portions of the study area.

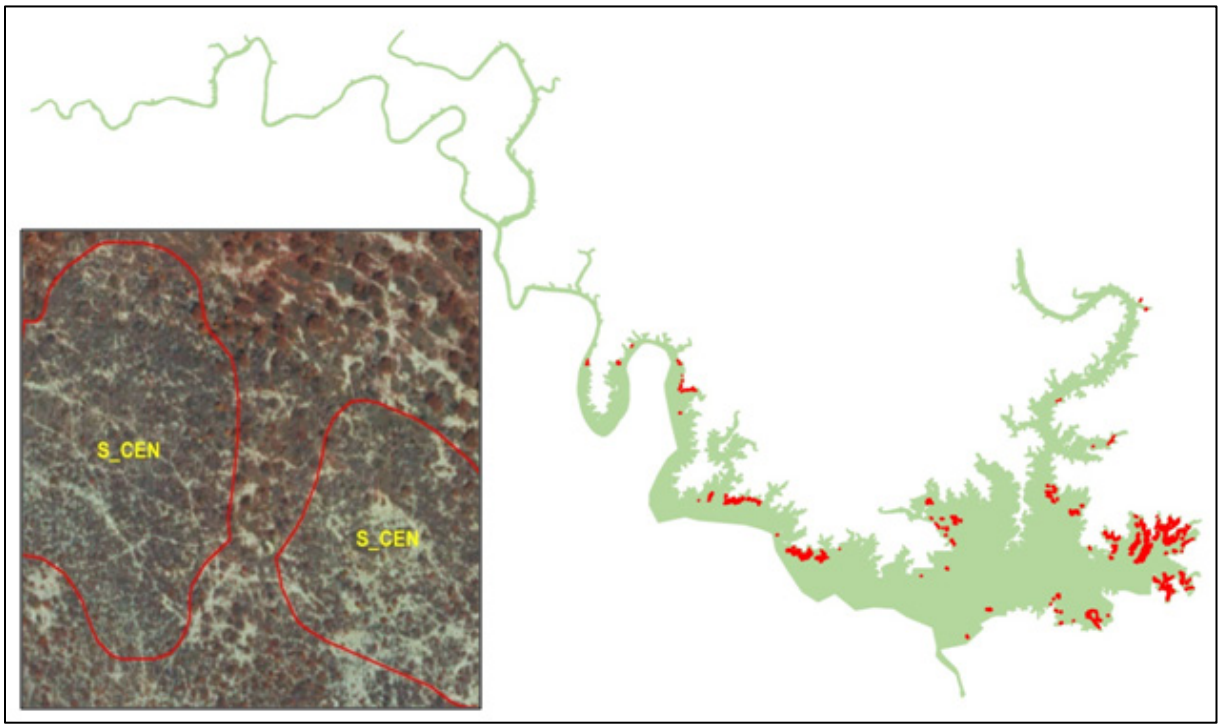
Physiognomy: Stands of S_CEN were dominated by low to medium-sized, evergreen shrubs with grass and forbs in the understory.

Condition: Fair. Cenizo shrublands may represent formally disturbed or grazed sites that are transitioning back to a more mixed thornscrub shrubland. Threats to this map unit include invasion by non-native species, human and animal disturbance, and wildfires.

CIR Signature: The S_CEN map unit had a highly recognizable signature consisting of overlapping gray splotches with a gray or white background color (bare ground).

Mapping Notes: Cenizo shrubs were common all through the upland areas of AMIS and were a widespread associate within the other thornscrub map units. Some areas mapped as S_CEN maybe dominated with similar shrubs that have a gray appearance such as whitebrush. More sampling of this type may help document the species diversity and range of this type.

Photo Signature and Distribution



Example photo signature and distribution map for Cenizo Shrubland.

Map Code ***Guajillo - Blackbrush - Torrey Yucca Shrubland***
S_GBTY ***Senegalia berlandieri - Vachellia rigidula - Yucca torreyi* Shrubland**

Common Species

- Guajillo (*Senegalia berlandieri*)
- Blackbrush (*Vachellia rigidula*)
- Torrey yucca (*Yucca torreyi*)
- Cenizo (*Leucophyllum frutescens*)
- Texas pricklypear (*Opuntia engelmannii*)
- Leatherstem (*Jatropha dioica*)
- Coyotillo (*Karwinskia humboldtiana*)

rUSNVC Association

Vachellia rigidula - Leucophyllum frutescens - Senegalia berlandieri Shrubland (CEGL007759)



Example photo of Guajillo - Blackbrush - Torrey Yucca Shrubland.

Description

Frequency: S_GBTY polygons were common on dry uplands around the reservoir and along the Devil's River drainage.

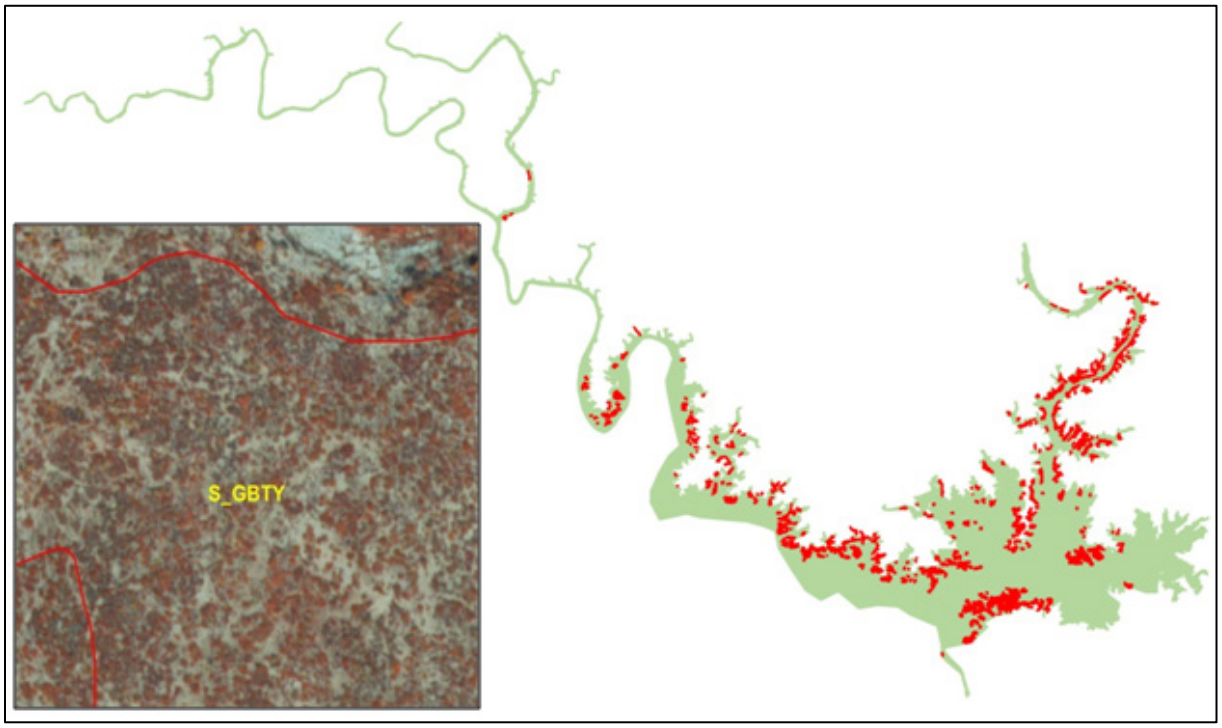
Physiognomy: S_GBTY sites were dominated by short to medium-sized evergreen and deciduous mixed shrubs with understories consisting of mainly grasses, forbs, and other minor short and dwarf-shrubs.

Condition: Good. Although widespread, disturbances such as prolonged drought, fire, and grazing are potential threats to this type.

CIR Signature: Polygons of S_GBTY had a textured appearance consisting of brown and orange spots with some gray and white splotches in the canopy openings. Guajillo and blackbrush shrubs may be large and robust creating large orange and red circles.

Mapping Notes: The S_GBTY map unit was very similar in appearance to the S_THRN, S_BPTS, and S_GC types. The presence of Torrey yucca plants helped to define this map unit. More ground-truthing of the thornscrub types at AMIS may allow for further refinement and increased accuracy in the mapping.

Photo Signature and Distribution



Example photo signature and distribution map for Guajillo - Blackbrush - Torrey Yucca Shrubland.

Map Code ***Guajillo - Cenizo Shrubland***
S_GC ***Senegalia berlandieri - Leucophyllum frutescens*** **Shrubland**

Common Species

- Guajillo (*Senegalia berlandieri*)
- Cenizo (*Leucophyllum frutescens*)
- Blackbrush (*Vachellia rigidula*)
- Texas pricklypear (*Opuntia engelmannii*)

rUSNVC Association
Senegalia berlandieri Stockton Plateau Shrubland (CEGL007758)



Example photo of Guajillo - Cenizo Shrubland.

Description
Frequency: S_GC polygons were common on dry uplands throughout the entire project area.

Physiognomy: S_GC sites were dominated by short to medium-sized evergreen and deciduous mixed shrubs with understories consisting of grasses, forbs, and other minor short and dwarf-shrubs.

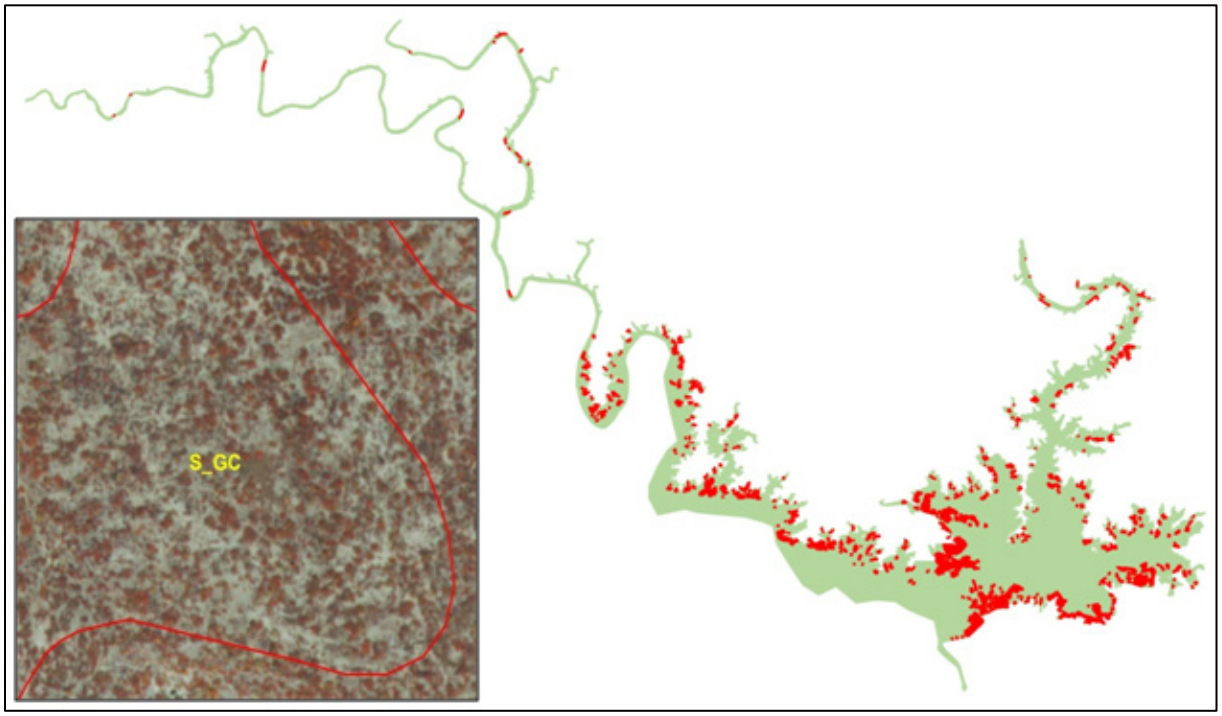
Condition: Good. Although widespread, disturbances such as prolonged drought, fire, and grazing are potential threats to this type.

CIR Signature: Polygons of S_GC had a textured appearance consisting of brown and orange spots with some gray (cenizo shrubs) and white (bare ground) splotches in the canopy openings. Guajillo shrubs may be large and robust creating large orange and brown circles.

Mapping Notes: The S_GC map unit was very similar in appearance to the S_THRN, S_BPTS, and S_GBTY types. The lack of blackbrush, honey mesquite and other large shrubs helped to define this

map unit. More ground-truthing of the thornscrub types at AMIS may allow for further refinement and increased accuracy in the mapping.

Photo Signature and Distribution



Example photo signature and distribution map for Guajillo - Cenizo Shrubland.

Map Code ***Lilac Chaste Tree Shrubland***
S_LCT ***Vitex agnus-castus* Shrubland**

Common Species

- Lilac chaste tree (*Vitex agnus-castus*)
- Guajillo (*Senegalia berlandieri*)
- Blackbrush (*Vachellia rigidula*)
- Texas persimmon (*Diospyros texana*)
- Texasfan (*Meximalva filipes*)
- Texas pricklypear (*Opuntia engelmannii*)

rUSNVC Association
Vitex agnus-castus Shrubland (NPSAMIS009) [Provisional]



Example photo of Lilac Chaste Tree Shrubland.

Description
Frequency: Lilac chaste tree shrublands were found in small pockets around the reservoir and rivers. Most sites were located on rock-outcrops and drainages where they could represent high water levels.

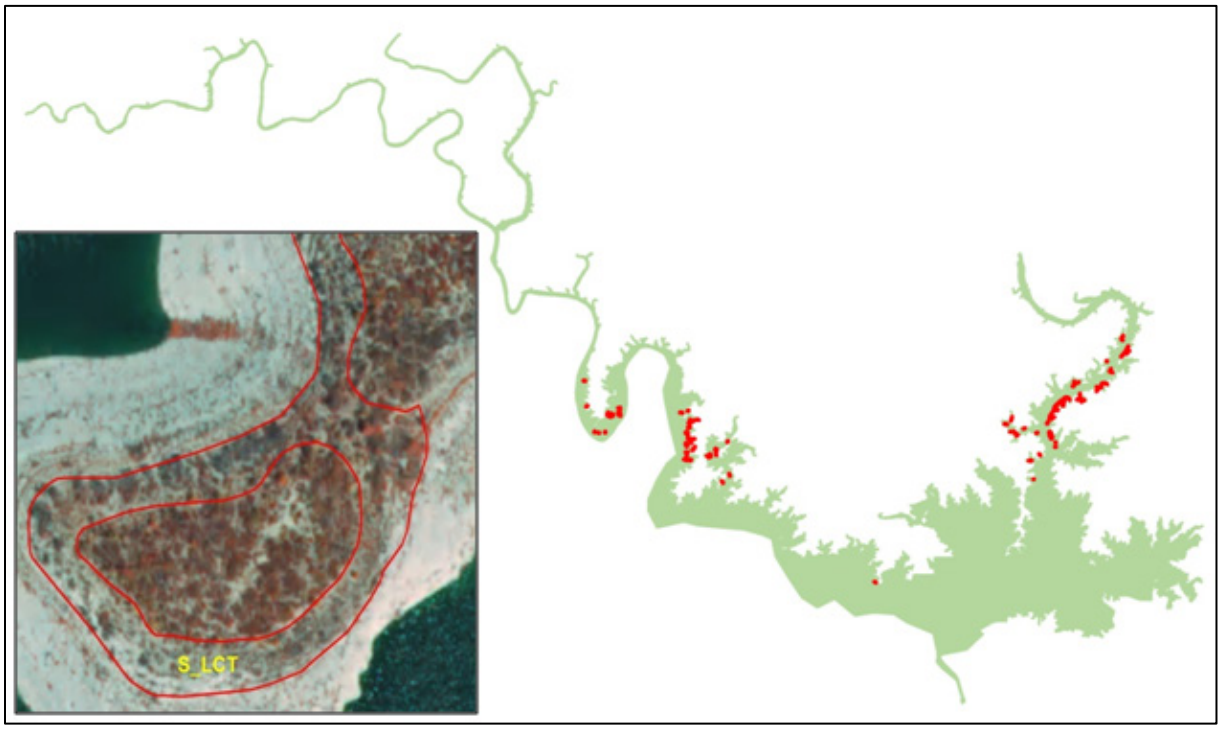
Physiognomy: S_LCT polygons were dominated by tall shrublands (short trees) with moderate to thick understories of shrubs, grasses, and forbs.

Condition: Fair-Poor. Lilac chaste tree maybe considered a semi-invasive species where it has spread from landscape plantings. Monitoring of the spread and invasiveness of this species may be warranted at AMIS.

CIR Signature: Polygons of S_LCT often occurred as linear bands just above the high-water mark of the reservoir. The signature of this type was variable and often contained dead or dying trees/shrubs that appeared as gray and black smudges. Other shrubs were noticeably absent.

Mapping Notes: The S_LCT type was difficult to map due to its thin, band-like patterns. More S_LCT likely occurred at AMIS but was obscured by surrounding vegetation. More ground-truthing may allow for further refinement and increased accuracy.

Photo Signature and Distribution



Example photo signature and distribution map for Lilac Chaste Tree Shrubland.

Map Code ***Honey Mesquite Upland Shrubland***
S_MUP ***Prosopis glandulosa* Upland Shrubland**

Common Species

- Honey mesquite (*Prosopis glandulosa*)
- Cenizo (*Leucophyllum frutescens*)
- Blackbrush (*Vachellia rigidula*)
- Guajillo (*Senegalia berlandieri*)
- Texas pricklypear (*Opuntia engelmannii*)
- Whitebrush (*Aloysia gratissima*)

rUSNVC Association
Prosopis glandulosa var. *glandulosa - Parkinsonia texana* var. *macra* - (*Cordia boissieri, Koeberlinia spinosa*) Shrubland (CEGL007762)



Example photo of Honey Mesquite Upland Shrubland.

Description
Frequency: S_MUP polygons were common on dry upland sites throughout AMIS.

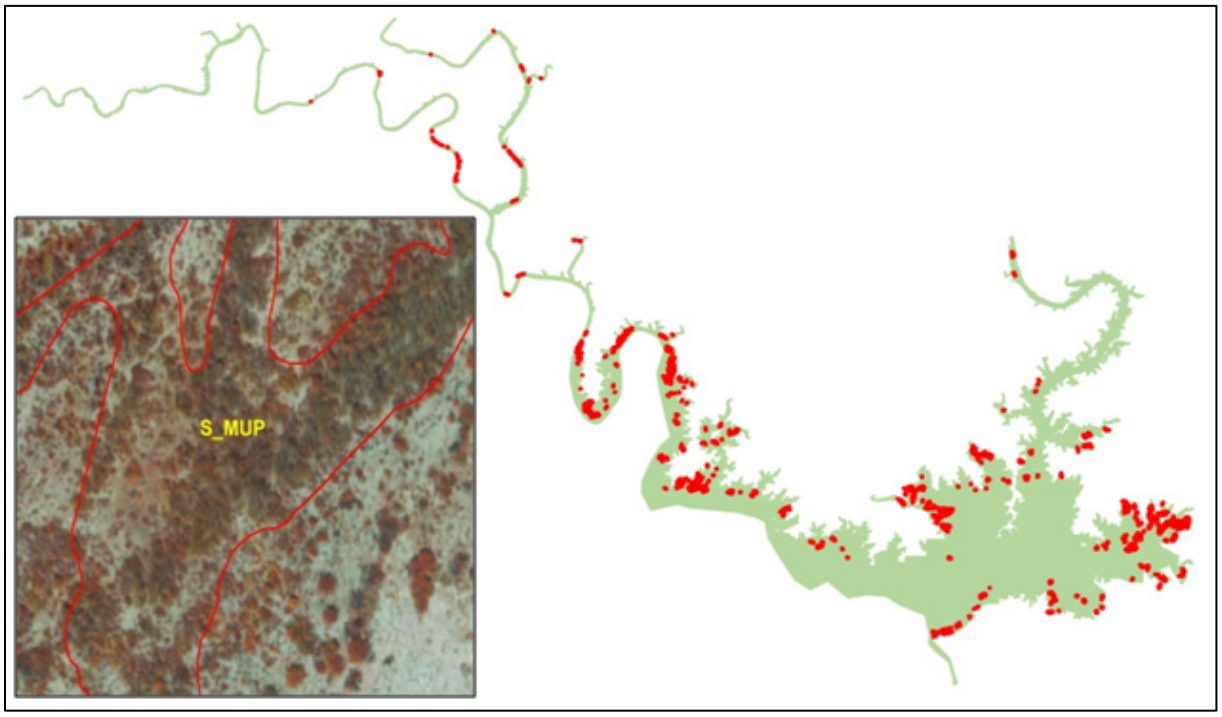
Physiognomy: S_MUP sites were dominated by short to medium-sized evergreen shrubs with sparse understories consisting of grasses, forbs, and other minor short and dwarf-shrubs.

Condition: Fair. S_MUP polygons likely indicate past disturbed areas that have been recently colonized by honey mesquite shrubs. Non-native species, fire, and animal/human pressure are potential threats.

CIR Signature: Polygons of S_MUP had a diagnostic light brown color with some texture consisting of dark brown and red spots (other shrubs) and white (bare ground) splotches in the canopy openings. Individual honey mesquite shrubs may be large and robust creating large circles.

Mapping Notes: The S_MUP map unit was created to address upland stands of honey mesquite as opposed to the more mesic and tall riparian stands (W_MRIP). Some confusion likely occurred between the two honey mesquite map units in the mapping and more ground-truthing may allow for further refinement and increased accuracy. The S_MUP map unit was very similar in appearance to the S_THRN, S_BPTS, and S_GC types. The heavy presence of honey mesquite shrubs helped to define this map unit.

Photo Signature and Distribution



Example photo signature and distribution map for Honey Mesquite Upland Shrubland.

Map Code ***Mixed Inundation Zone and Shoreline Shrubland***
S_SHR

Common Species

- Roosevelt Weed (*Baccharis neglecta*)
- Mule fat (*Baccharis salicifolia*)
- Tree tobacco (*Nicotiana glauca*)
- Tamarisk (Salt cedar) (*Tamarix ramosissima*)
- Bermuda grass (*Cynodon dactylon*)
- (Turkey tangle) Fogfruit (*Phyla nodiflora*)

rUSNVC Association
Baccharis neglecta - Nicotiana glauca Shrubland (NPSAMIS007) [Provisional]



Example photo of Mixed Inundation Zone and Shoreline Shrubland.

Description
Frequency: Early successional shrublands are common throughout the inundation zone of AMIS. Polygons of this type often occur as bands of vegetation growing from seeds deposited after flooding and can extend up drainages and washes. Larger areas may be less dense and occur as mixed pockets of shrubs within rocks and in shoreline cracks.

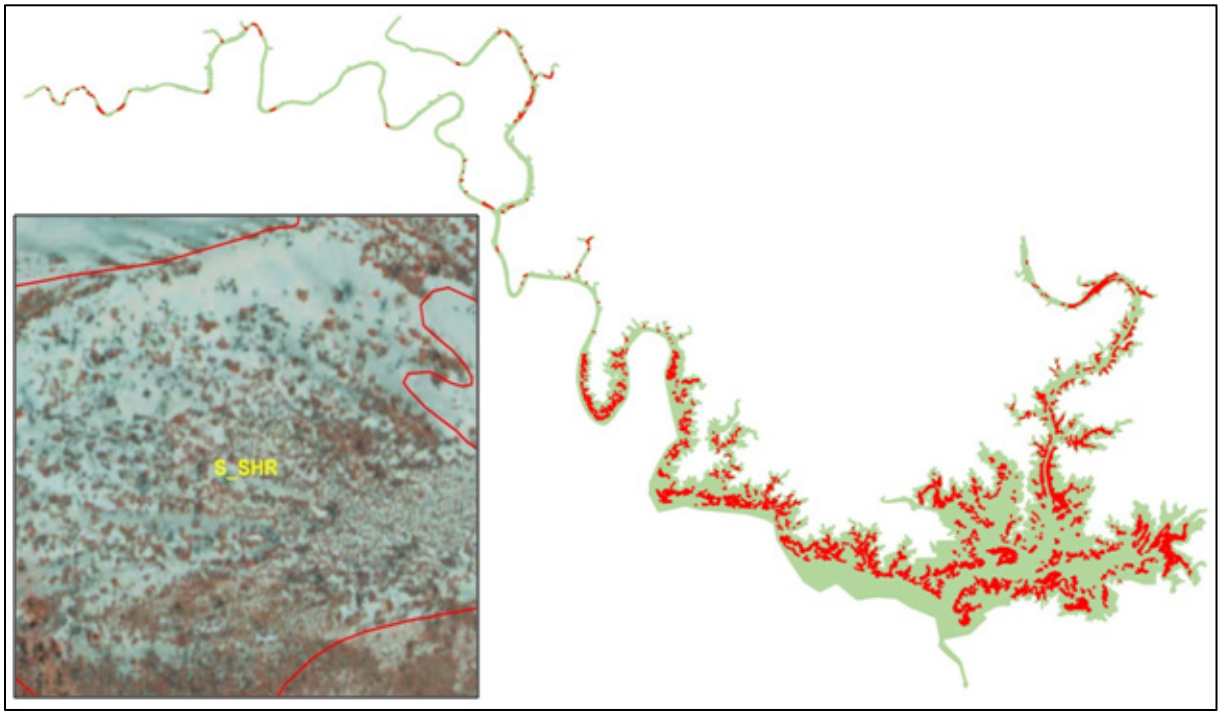
Physiognomy: Polygons of S_SHR vary in composition from sparse to moderate mixed stands of deciduous and evergreen shrubs on rocky shores to homogenous dense stands of one or two species on floodplain soils. Understories are often weedy or contain mats of lawn-like Bermuda grass.

Condition: Poor. S_SHR is a weedy successional type that can change dramatically with flooding events. More established stands of Baccharis spp. are present in the upper zones of the Rio Grande River and other streams.

CIR Signature: On the imagery, the S_SHR type varied from red and brown bands to stippled red and gray dots. Polygons of this type often had a white (rock/soil) or red/pink/orange (Bermuda grass) undertone.

Mapping Notes: The S_SHR map unit was used to map shrubs on dry shore lands as evident on the 2015 imagery. The S_SHRX map unit was used to delineate similar stands that were underwater. Due to the dieback and regrowth cycle from flooding, some confusion with the SP_SHR map unit likely occurred during mapping. Areas delineated as S_SHRX are dynamic and are subject to rapid change.

Photo Signature and Distribution



Example photo signature and distribution map for Mixed Inundation Zone and Shoreline Shrubland.

Map Code ***Periodically Submerged Inundation Zone and Shoreline Shrubland***
S_SHRX

Common Species

- Tree tobacco (*Nicotiana glauca*)
- Baccharis species (*Baccharis* spp.)
- Huisache (Sweet acacia) (*Acacia farnesiana*)
- Honey mesquite (*Prosopis glandulosa*)
- Tamarisk (Salt cedar) (*Tamarix ramosissima*)

rUSNVC Associations
Baccharis neglecta - Nicotiana glauca Shrubland (NPSAMIS007) [Provisional]
Tamarix ramosissima Riparian Shrubland (CEGL003114) [Park Special] [Map Unit Modifier]



Example photo of Periodically Submerged Inundation Zone and Shoreline Shrubland.

Description
Frequency: Shallow, underwater polygons that contain dead, dying, or recently flooded shrublands were common throughout the Amistad Reservoir.

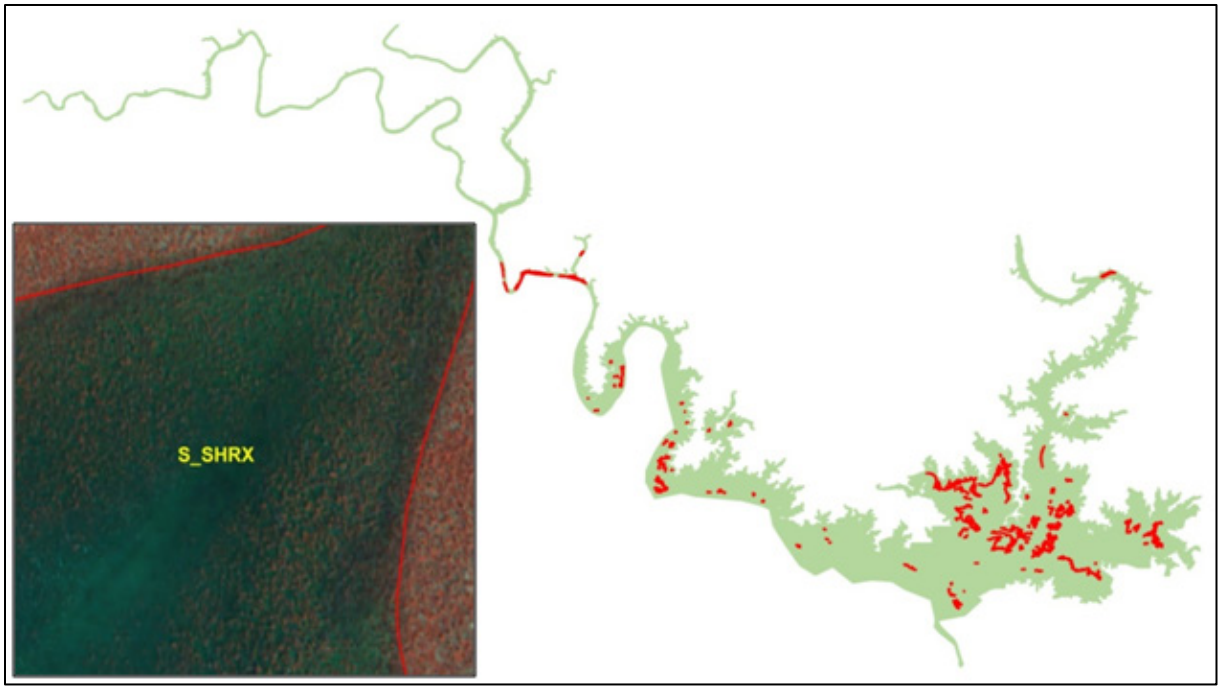
Physiognomy: The tops of medium to densely growing deciduous and evergreen shrubs and small trees are visible above the water line.

Condition: Poor. S_SHRX is a submerged successional type found on inundated shallows within the waters of the Amistad Reservoir.

CIR Signature: Flooded polygons appear blue green with some evidence of shallow lake and riverbed formations underneath (e.g. white reflectance). Thick, inundated shrubs and short trees appear as small, tightly clustered pink and red dots (living shrubs) and small sticks (dying shrubs) above the water and as dark dots, streaks, and smudges below.

Mapping Notes: The S_SHRX map unit represents shallow areas that were dry before the 2015 imagery, as shown on the 2012 NAIP ortho-imagery. This type was included in the mapping to show the total distribution of vegetation that could be possible at AMIS during lower water capacity. Areas delineated as S_SHRX are dynamic and with less flooding may revert to a dry S_TAM or S_SHR type depending on the duration of the flooding.

Photo Signature and Distribution



Example photo signature and distribution map for Periodically Submerged Inundation Zone and Shoreline Shrubland.

Map Code ***Tamarisk Riparian Shrubland***
S_TAM ***Tamarix ramosissima* Riparian Shrubland**

Common Species

- Tamarisk (Salt cedar) (*Tamarix ramosissima*)
- Tree tobacco (*Nicotiana glauca*)
- Baccharis spp. (*Baccharis* spp.)
- Huisache (Sweet acacia) (*Acacia farnesiana*)
- Honey mesquite (*Prosopis glandulosa*)
- Willows (*Salix* spp.)
- Giant Cane (*Arundo donax*)

rUSNVC Association
Tamarix ramosissima Riparian Shrubland (CEGL003114)



Example photo of Tamarisk Riparian Shrubland.

Description
Frequency: Tamarisk (salt cedar) was a common species in the inundation zone of AMIS. Distribution was spotty along the reservoir, common only in previously flooded drainages and established floodplains. In the upper rivers, S_TAM was more consistent, occurring in long riparian bands, broad floodplain swaths, and as thick clusters.

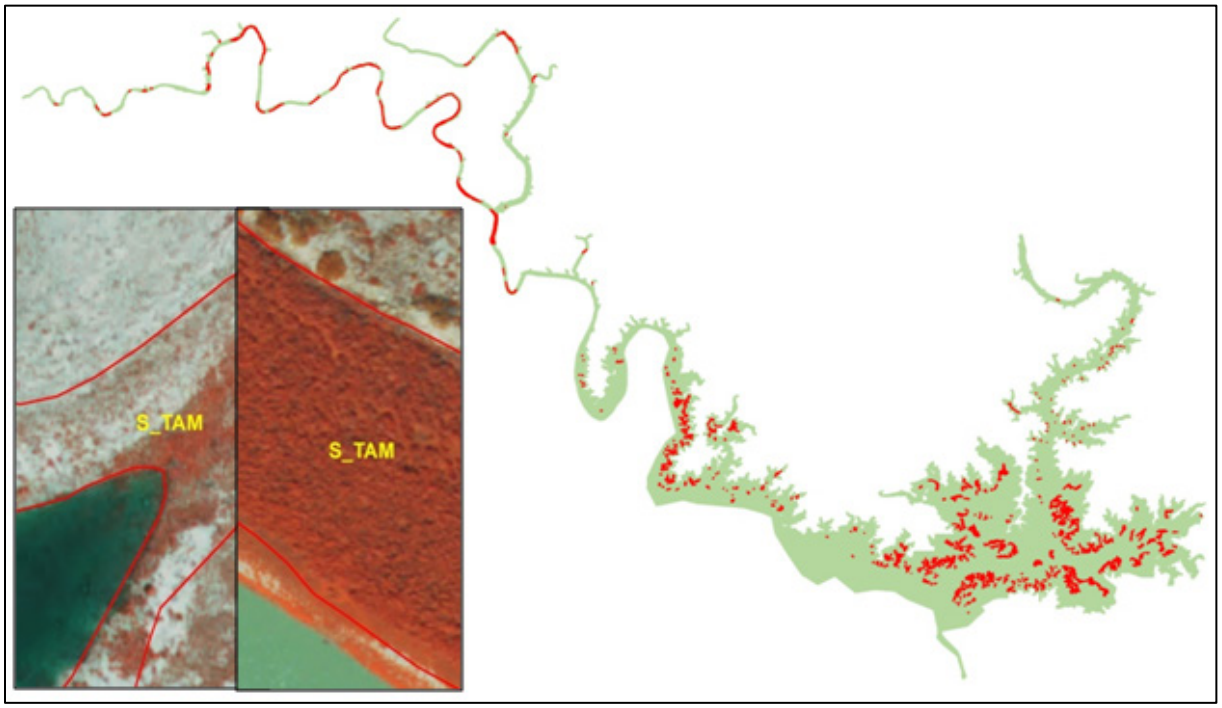
Physiognomy: S_TAM varied from thick, monotypic stands of evergreen tall shrub/short trees to sparse pockets of low growing seedlings. Barren understories were common in thick stands, whereas high levels of Bermuda grass, annual grasses, and weedy forbs were common when tamarisk was sparse.

Condition: Poor. S_TAM is a non-native species that can displace native shrubs and trees. Prolonged flooding may help to control or kill established tamarisk stands, but upstream locations may act as potential seed sources.

CIR Signature: On the imagery, S_TAM varied from solid, dark- red bands and clumps to open red splotches on gray and white backgrounds (bare soil/rock). Open and sparse polygons often had a red/pink/orange (Bermuda grass) undertone.

Mapping Notes: The S_TAM map unit represented areas clearly dominated by tamarisk. However, tamarisk may be more widespread occurring at reduced levels in some of the S_SHR, H_BGFF, and other inundation zone polygons. Due to similarities in density and height, S_TAM may have been confused with the H_CANE and W_WIL types during the mapping. Lower areas delineated as S_TAM are probably more dynamic and subject to rapid change.

Photo Signature and Distribution



Example photo signature and distribution map for Tamarisk Riparian Shrubland.

Map Code ***Dry Mixed Thornscrub Shrubland***
S_THRN

Common Species

- Coyotillo (*Karwinskia humboldtiana*)
- Blackbrush (*Vachellia rigidula*)
- Texas Pricklypear (*Opuntia engelmannii*)
- Leatherstem (*Jatropha dioica*)
- Mexican oregano (*Lippia graveolens*)
- Christmas cactus (*Cylindropuntia leptocaulis*)

rUSNVC Association
Vachellia rigidula - Opuntia engelmannii var. *lindheimeri - Jatropha dioica - Lippia graveolens* Shrubland (NPSAMIS026) [Provisional]



Example photo of Dry Mixed Thornscrub Shrubland.

Description
Frequency: S_THRN polygons were common on dry uplands throughout the entire project area.

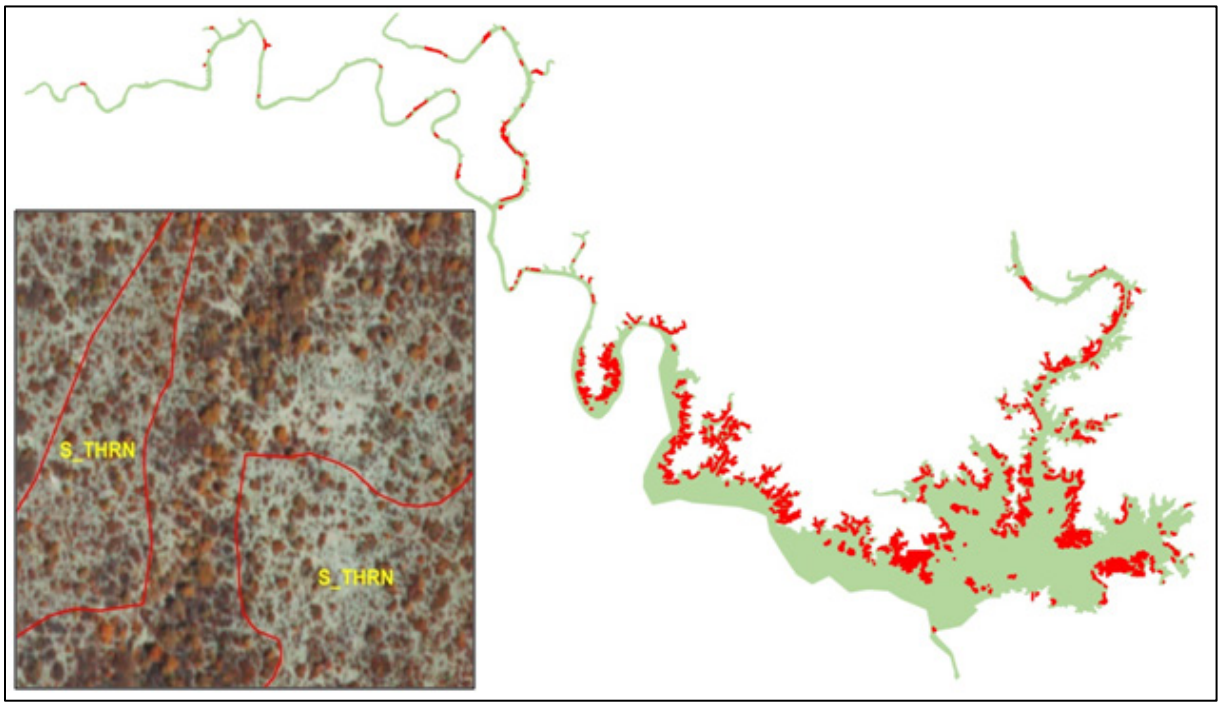
Physiognomy: S_THRN sites were dominated by sparse short to medium-sized evergreen and deciduous mixed shrubs with understories consisting of grasses, forbs, and other minor short and dwarf-shrubs.

Condition: Fair. Although widespread, disturbances such as prolonged drought, fire, and grazing are potential threats to this type. Some S_THRN sites may represent formally disturbed or grazed sites.

CIR Signature: S_THRN polygons had a textured appearance consisting of brown and orange spots with a high amount of white (bare ground) showing through the canopy.

Mapping Notes: The S_THRN map unit was very similar in appearance to the S_GC, S_MUP, and S_GBTY types. The lack of tall and dense blackbrush, guajillo, cenizo, and honey mesquite helped to define this map unit. More sampling of the thornscrub types at AMIS may allow for further refinement and increased accuracy in the mapping.

Photo Signature and Distribution



Example photo signature and distribution map for Dry Mixed Thornscrub Shrubland.

Map Code ***Viscid Acacia - Rio Grande Stickpea Shrubland***
S_VARG ***Vachellia vernicosa - Calliandra conferta* Shrubland**

Common Species

- Viscid acacia (*Vachellia vernicosa*)
- Rio Grande stickpea (*Calliandra conferta*)
- Texan goatbush (*Castela erecta*)
- Lechuguilla (*Agave lechuguilla*)
- Texas lignum-vitae (*Guaiacum angustifolium*)
- Purple threeawn (*Aristida purpurea*)
- Woody crinklemat (*Tiquilia canescens*)
- White ratany (*Krameria grayi*)
- Red grama (*Bouteloua trifida*)

rUSNVC Association
Vachellia vernicosa - *Calliandra conferta* Shrubland (NPSAMIS014) [Provisional]



Example photo of Viscid Acacia - Rio Grande Stickpea Shrubland.

Description
Frequency: S_VARG was only mapped in a few locations along the northern boundary of AMIS.

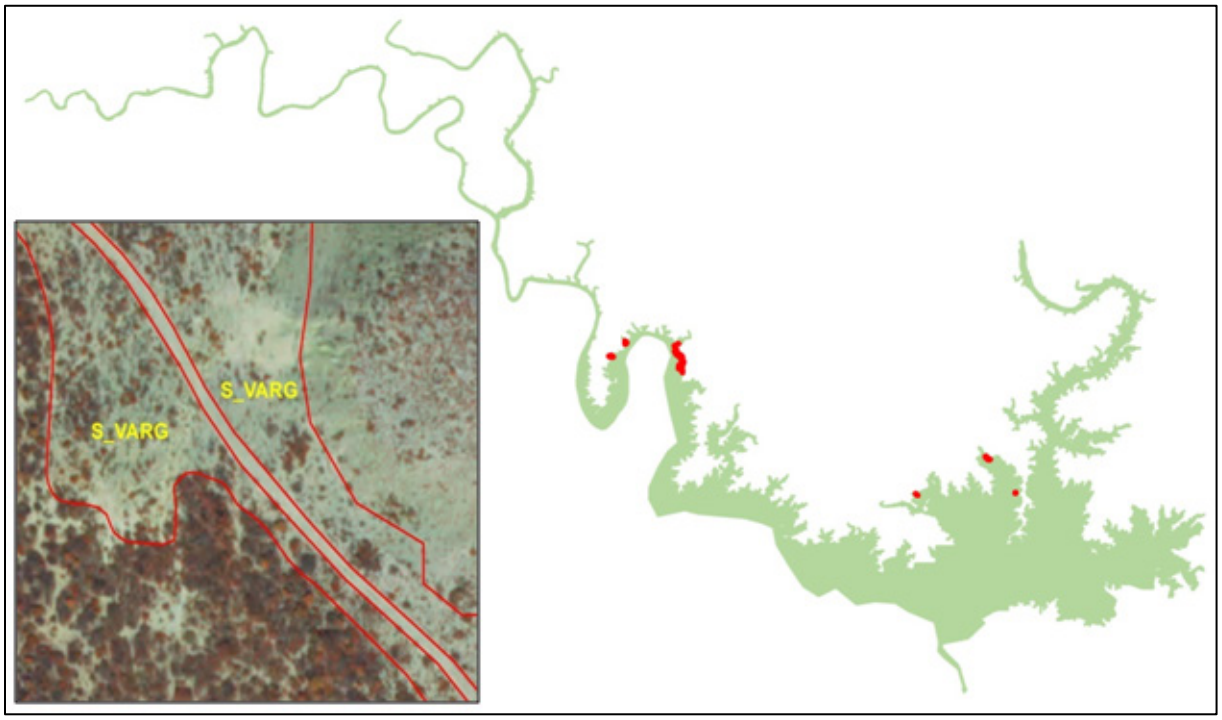
Physiognomy: S_VARG sites were sparsely vegetated and dominated by dwarf evergreen shrubs and sparse grasses.

Condition: Fair. This map unit was restricted, and polygons of this type may have weedy plant species present.

CIR Signature: On the imagery, the S_VARG map unit had a white background color representing bare and rocky soils with sparse red and orange dots indicating isolated shrubs and bunch grasses.

Mapping Notes: The S_VARG map unit was primarily used to map known areas dominated by viscid acacia shrubs. It is likely this type also occurs in other small pockets that were not mapped due to their limited size and the possible presence of other diagnostic species such as blackbrush and honey mesquite. Some confusion of S_VARG with similar S_THRN and DS_FM map units likely occurred during the mapping.

Photo Signature and Distribution



Example photo signature and distribution map for Viscid Acacia - Rio Grande Stickpea Shrubland.

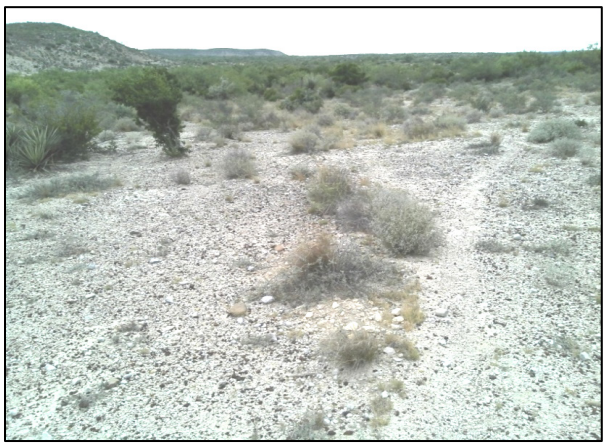
Dwarf Shrublands

Map Code ***Fragrant Mimosa Dwarf-Shrubland***
DS_FM **Mimosa borealis Dwarf-Shrubland**

Common Species

- Fragrant mimosa (*Mimosa borealis*)
- Texas mimosa (*Mimosa texana*)
- Cenizo (*Leucophyllum frutescens*)
- Grassland croton (*Croton dioicus*)
- Texas lignum-vitae (*Guaiacum angustifolium*)
- Rio Grande stickpea (*Calliandra conferta*)
- Texas wintergrass (*Nassella leucotricha*)
- Pink pappusgrass (*Pappophorum bicolor*)

rUSNVC Association
Mimosa borealis Dwarf-Shrubland Association (NPSAMIS013) [Provisional]



Example photo of Fragrant Mimosa Dwarf-Shrubland.

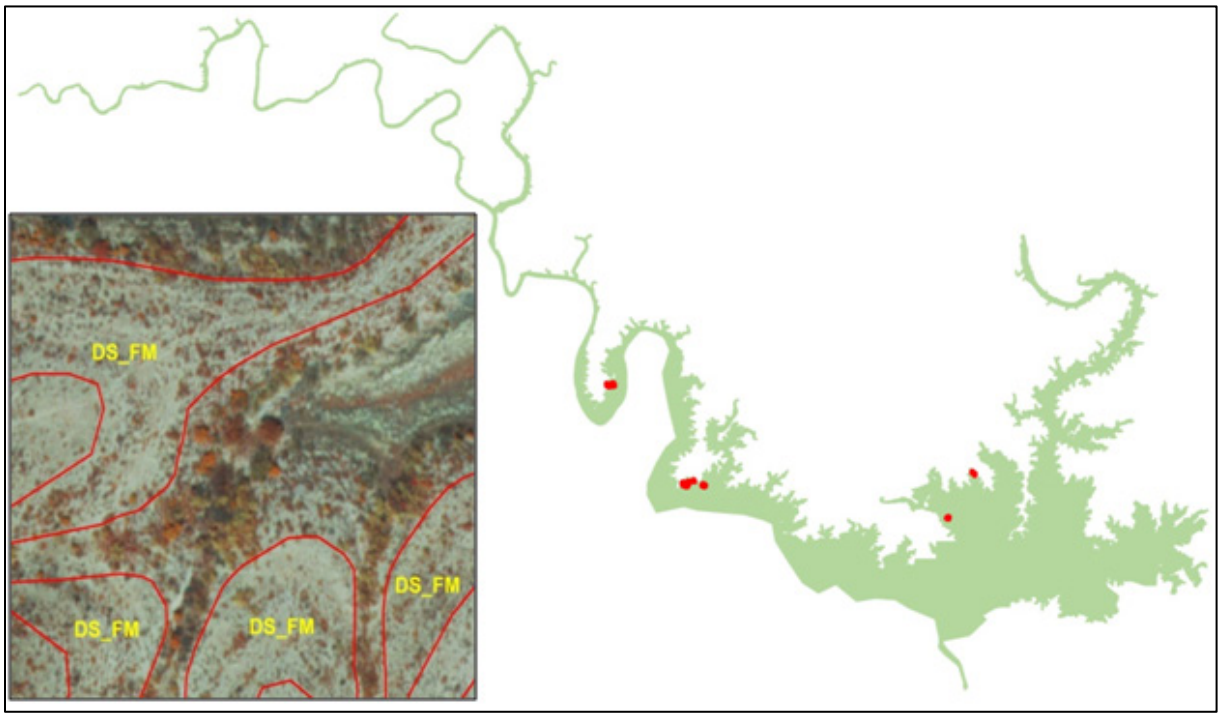
Description
Frequency: DS_FM was only mapped in a few locations along the northern border of AMIS.
Physiognomy: DS_FM polygons contain sparse vegetation dominated by dwarf shrubs and sparse grasses.

Condition: Fair - Poor. This map unit was restricted to a few known locations and may contain weedy plant species.

CIR Signature: On the imagery, the DS_FM map unit had a white background color representing bare and rocky soils with sparse red and orange dots representing isolated shrubs and bunch grasses.

Mapping Notes: The DS_FM map unit was primarily used to map known areas containing mimosa shrubs. Texas mimosa may replace fragrant mimosa as the dominant species. It is likely this type also occurs in small pockets that were not mapped. Confusion of DS_FM with similar S_THRN and S_VARG map units likely occurred during mapping.

Photo Signature and Distribution



Example photo signature and distribution map for Fragrant Mimosa Dwarf-Shrubland.

Herbaceous Vegetation

Map Code ***Bermuda Grass - Fogfruit Inundation Zone and Shoreline Herbaceous Vegetation***

H_BGFF ***Cynodon dactylon - Phyla nodiflora* Inundation Zone and Shoreline Herbaceous Vegetation**

Common Species

- Bermuda grass (*Cynodon dactylon*)
- (Turkey tangle) Fogfruit *(Phyla nodiflora*)
- Huisache (Sweet acacia) (*Acacia farnesiana*)
- Honey Mesquite (*Prosopis glandulosa*)
- Tree tobacco (*Nicotiana glauca*)
- Baccharis spp. (*Baccharis* spp.)

rUSNVC Association

Cynodon dactylon - Phyla nodiflora Herbaceous Vegetation (NPSAMIS02) [Provisional]



Example photo of Bermuda Grass - Fogfruit Inundation Zone and Shoreline Herbaceous Vegetation.

Description

Frequency: A very common type found in the inundation zone and along the shorelines of the AMIS reservoir.

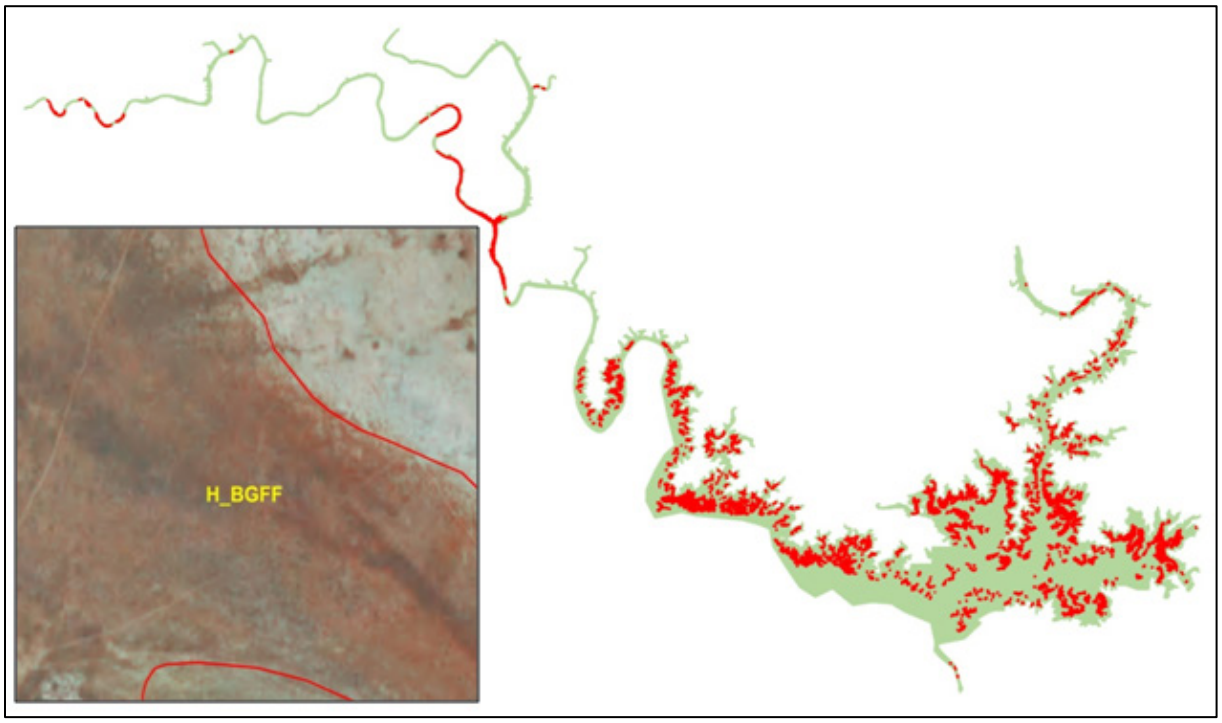
Physiognomy: H_BGFF polygons contain high cover of perennial grasses with some weedy forbs and short early successional shrubs and trees.

Condition: Poor. H_BGFF is an early successional type found on disturbed, previously inundated shorelines, drainages, and floodplains. The presence of this type likely indicates areas that were recently flooded or disturbed.

CIR Signature: On the imagery, the H_BGFF map unit had a characteristic smooth pink, red, and sometimes orange- brown color. Gray patches likely indicate dead grass or senescence. Pink and red spots were small shrubs, tree/shrub seedlings, and/or weedy forbs.

Mapping Notes: The H_BGFF and SP_SHR types are similar in species composition but the H_BGFF is usually larger and much denser. The dynamic H_BGFF type will likely change in abundance and its location with the seasonal flooding and receding of the reservoir.

Photo Signature and Distribution



Example photo signature and distribution map for Bermuda Grass - Fogfruit Inundation Zone and Shoreline Herbaceous Vegetation.

Map Code ***Giant Cane Riparian Herbaceous Vegetation***
H_CANE ***Arundo donax* Riparian Herbaceous Vegetation**

Common Species

- Giant cane (*Arundo donax*)
- Bermuda grass (*Cynodon dactylon*)
- Huisache (Sweet acacia) (*Acacia farnesiana*)
- Honey mesquite (*Prosopis glandulosa*)
- Tree tobacco (*Nicotiana glauca*)
- Baccharis species *(Baccharis* spp.)
- Tamarisk (Salt cedar) (*Tamarix ramosissima*)
- Willows (*Salix* spp.)

rUSNVC Association
Arundo donax Riparian Herbaceous Vegetation (CEGL004101)



Example photo of Giant Cane Riparian Herbaceous Vegetation.

Description
Frequency: Tall, thick stands of giant cane were common in the upper reaches of the Rio Grande, Pecos, and Devil's Rivers at AMIS.

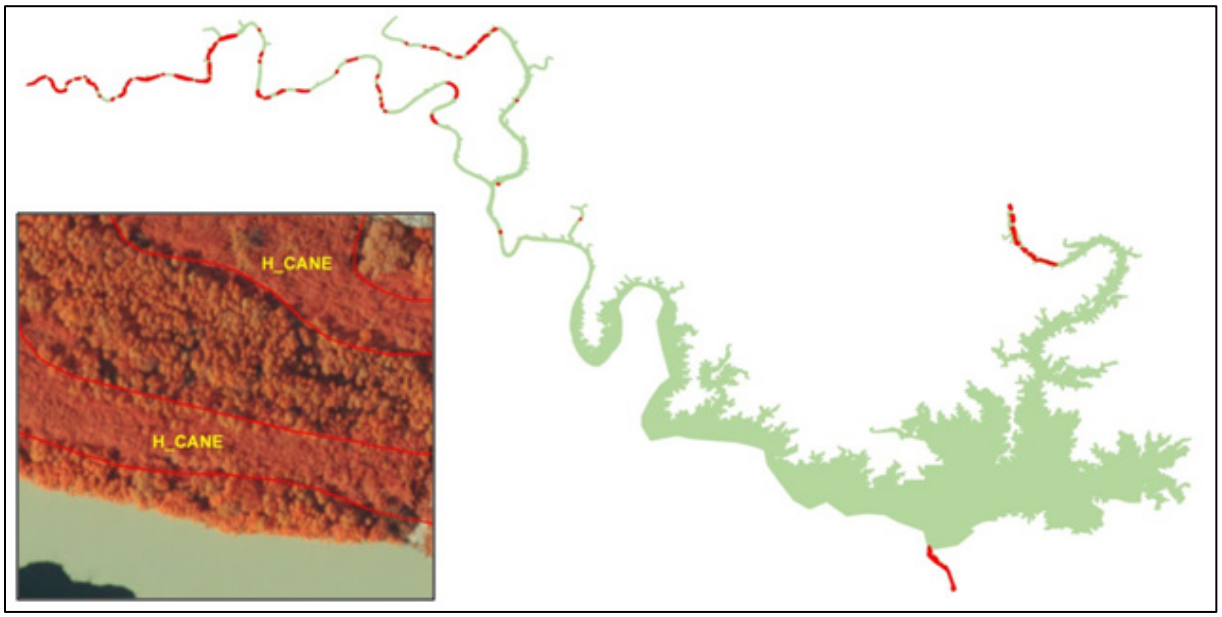
Physiognomy: Polygons of H_CANE contained linear bands and thick clumps of tall, perennial grasses. Other associated species were mostly absent due the density of the giant cane.

Condition: Poor. Giant cane is considered an invasive species that invades riparian corridors and floodplains. The thick and tall growth of this type displaces native species and prevents them from re-establishing. Monitoring and suppression of this type through fire and removal may be needed.

CIR Signature: On the imagery, the H_CANE type exhibited a very bright pink color that was taller than the other herbaceous riparian types (H_REED and H_BGFF) but shorter than the nearby willow and tamarisk woodlands. Polygons of this type were often linear in shape and were next to open water.

Mapping Notes: Mixing of the giant cane with tamarisk and willow trees presented some confusion during the mapping and more ground-truthing may help to improve the accuracy of this type.

Photo Signature and Distribution



Example photo signature and distribution map for Giant Cane Riparian Herbaceous Vegetation.

Map Code ***California Bulrush Riparian Herbaceous Vegetation***
H_CBUL ***Schoenoplectus californicus* Riparian Herbaceous Vegetation**

Common Species

- California Bulrush (*Schoenoplectus californicus*)
- Giant cane (*Arundo donax*)
- Common reed (*Phragmites australis*)

rUSNVC Association
Schoenoplectus californicus Tamaulipan Riparian Herbaceous Vegetation (NPSAMIS030) [Provisional]



Example photo of California Bulrush Riparian Herbaceous Vegetation.

Description
Frequency: Stands of California bulrush were only found on wetland sites below the Amistad Dam on the Rio Grande River shoreline and floodplain.

Physiognomy: Reconnaissance of these polygons confirmed the presence of almost monotypic stands of California bulrush, a wetland herbaceous species.

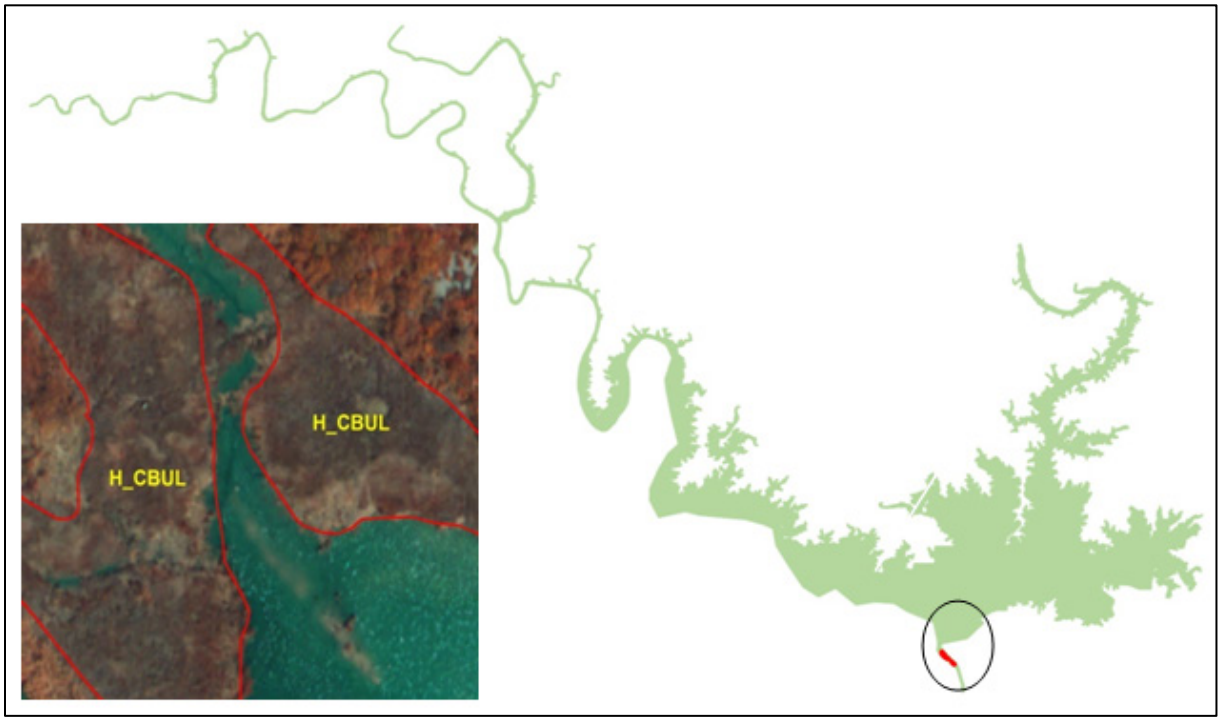
Condition: Fair –The limited distribution of this type may indicate that it is locally abundant and could be entirely removed from AMIS with either prolonged drought or flooding events. Its location below the dam may help protect and stabilize polygons of H_CBUL in normal years.

CIR Signature: On the imagery, the California bulrush has a very distinctive purple signature. Polygon texture is smooth and solid indicating dense herbaceous vegetation.

Mapping Notes: Stands of California bulrush were difficult to access by foot. H_CBUL was first discovered on the aerial imagery and was not sampled during this project. A trained botanist confirmed the presence of a unique wetland species at AMIS and identified it in the field as

California bulrush. Future field sampling in this type would help classify the association and identity any other wetland species present.

Photo Signature and Distribution



Example photo signature and distribution map for California Bulrush Riparian Herbaceous Vegetation.

Map Code ***Upland Mixed Native Grassland***
H_NAT

Common Species

- Dropseed species (*Sporobolus* spp.)
- Buffalo grass (*Bouteloua dactyloides*)
- Pink pappusgrass (*Pappophorum bicolor*)
- Threeawn (*Aristid*a spp.)
- Woody crinklemat (*Tiquilia canescens*)

rUSNVC Association
(*Bouteloua* spp., *Pappophorum bicolor, Tiquilia canescens*) Tamaulipan Herbaceous Vegetation (NPSAMIS006) [Provisional]



Example photo of Upland Mixed Native Grassland.

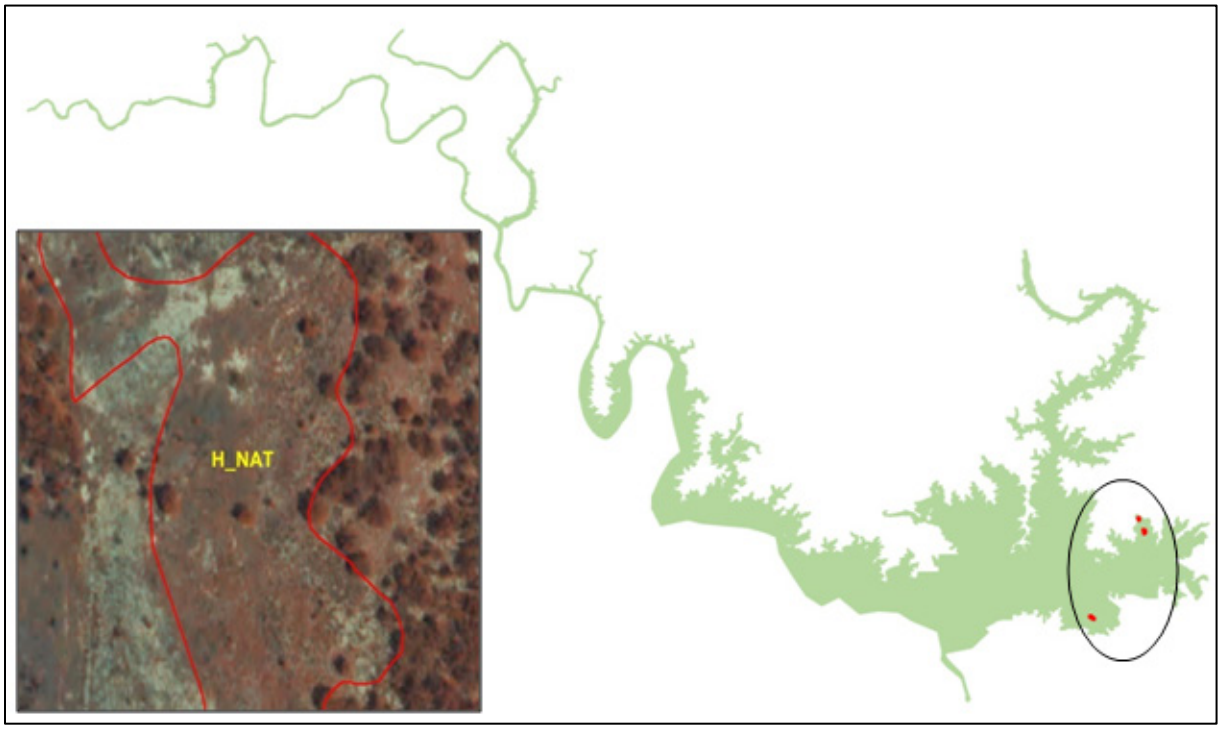
Description
Frequency: H_NAT native upland grasslands are rare at AMIS and were only found in few small locations during the accuracy assessment.

Physiognomy: This map unit consists of native, perennial grasses and forbs with some dwarf and short shrubs. Condition: Fair-Poor. Stands of this type are rare and some may be early successional variations of other types. Encroachment by non-native species is likely.

CIR Signature: The H_NAT type appeared as a smooth pink color with some isolated stipples caused by single trees and/or shrubs.

Mapping Notes: The H_NAT map class was created during the mapping to characterize upland grasslands that had a high native graminoid component. Included in this map class are thick stands of grasses and short, scabby stands of mixed forbs and grasses. The very limited distribution of this type made it hard to accurately classify.

Photo Signature and Distribution



Example photo signature and distribution map for Upland Mixed Native Grassland.

Map Code ***Common Reed Riparian Herbaceous Vegetation***
H_REED ***Phragmites australis* Riparian Herbaceous Vegetation**

Common Species

- Common reed (*Phragmites australis*)
- Giant cane (*Arundo donax*)
- Bermuda grass (*Cynodon dactylon*)
- Tree tobacco (*Nicotiana glauca*)
- Buffelgrass (*Pennisetum ciliare*)
- Willows (*Salix* spp.)

rUSNVC Association
Phragmites australis Riverbank Wet Meadow (CEGL004115)



Example photo of Common Reed Riparian Herbaceous Vegetation.

Description
Frequency: Common reed sites were only found in the upper reaches of the Rio Grande, Pecos, and Devil's River. Physiognomy: This type includes mostly perennial herbaceous vegetation consisting of various riparian grasses, sedges and other herbaceous species.

Condition: Good - Fair. Localized patches are likely prone to flooding and low water levels. Non-native species such as tamarisk and giant cane may invade these areas.

CIR Signature: Polygons of H_REED appeared as linear bands and clumps of low-growing orange and red colored grasses. Open water and rocks were usually present. Mapping Notes: H_REED was used to map riparian areas dominated by common reed. Other common species such as giant cane,

tamarisk, and willows were sometimes present. The H_RVR map unit likely contains some common reed but in lower abundance.

Photo Signature and Distribution



Example photo signature and distribution map for Common Reed Riparian Herbaceous Vegetation.

Map Code ***Mixed Riverbank Herbaceous Vegetation***
H_RVR

Common Species

- Switchgrass (*Panicum virgatum*)
- Yellow bluestem (*Bothriochloa ischaemum*)
- Swamp sawgrass (*Cladium mariscus*)
- Pink pappusgrass (*Pappophorum bicolor*)

rUSNVC Association
Porophyllum scoparium - (*Heterotheca fulcrata, Penstemon baccharifolius*) Sparse Vegetation (NPSAMIS016) [Provisional]



Example photo of Mixed Riverbank Herbaceous Vegetation.

Description
Frequency: H_RVR was common along the upper Rio Grande and Pecos river portions of AMIS in riparian and shoreline settings. Other polygons of H_RVR were only found scattered around the main reservoir portion of AMIS on mesic, possibly wetland sites.

Physiognomy: H_RVR polygons contain perennial grasses with some minor forb components. Most were near riparian woodlands and shrublands

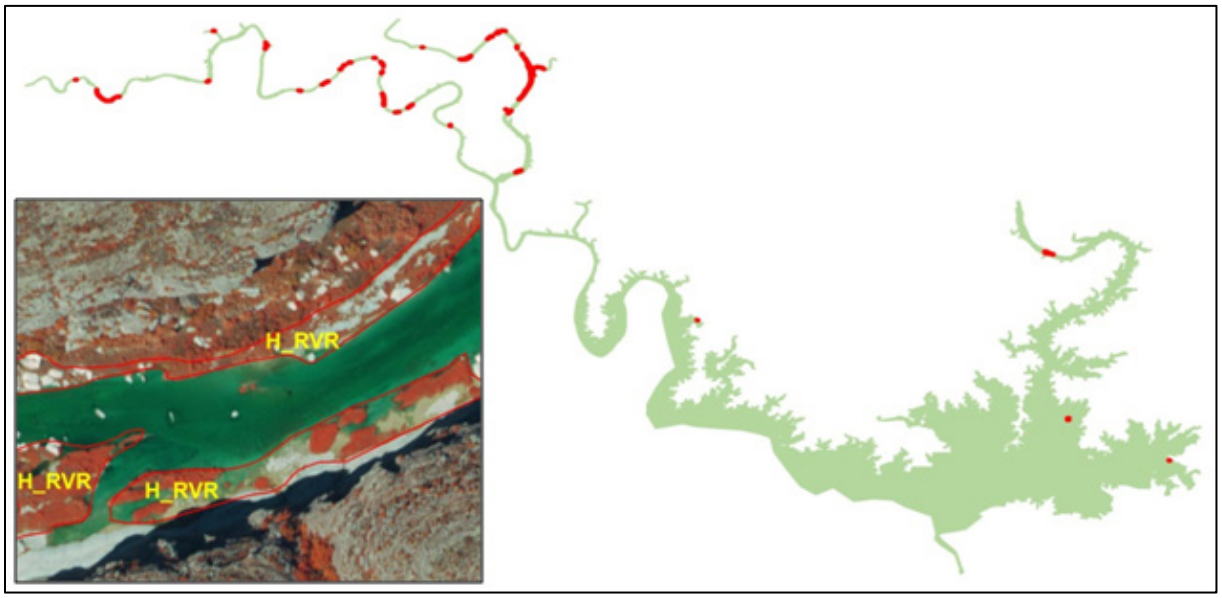
Condition: Fair -Poor. This map unit was only found in small pockets and in linear bands. Non-native grasses and weedy species heavily influenced the graminoid component of this type.

CIR Signature: On the imagery, the H_RVR map unit had a bright smooth dark red color with open water (blue) and bare shoreline (white). Upland sites were purple red in color and bunched around small ponds and wet areas.

Mapping Notes: The H_RVR map unit accounted for small polygons of graminoids in the uplands of AMIS and of mostly native grasses along the upper reaches of the major rivers and tributaries. This

map unit was used to separate denser pockets of the same herbaceous species from those found on mostly bare rock formations (SP_RCK). Further ground-truthing, especially in river corridors would help refine and improve the mapping of this type.

Photo Signature and Distribution



Example photo signature and distribution map for Mixed Riverbank Herbaceous Vegetation.

H_SUB Mixed *Hydrilla verticillata* and Other Submerged Aquatic Vegetation

Common Species

- Water thyme (*Hydrilla verticillata*)
- Tamarisk (Salt cedar) (*Tamarix ramosissima*)
- Huisache (Sweet acacia) (*Acacia farnesiana*)
- Bermuda grass (*Cynodon dactylon*)
- (Turkey tangle) Fogfruit (*Phyla nodiflora*)

rUSNVC Association

Hydrilla verticillata Ruderal Aquatic Vegetation (CEGL004702)



Example photo of Mixed Hydrilla and Other Submerged Aquatic Vegetation.

Description

Frequency: Submerged and aquatic vegetation were common along the shoreline of the Amistad Reservoir.

Waterthyme, or hydrilla is a submersed, rooted aquatic plant that can grow in water up to 20 feet or so in depth.

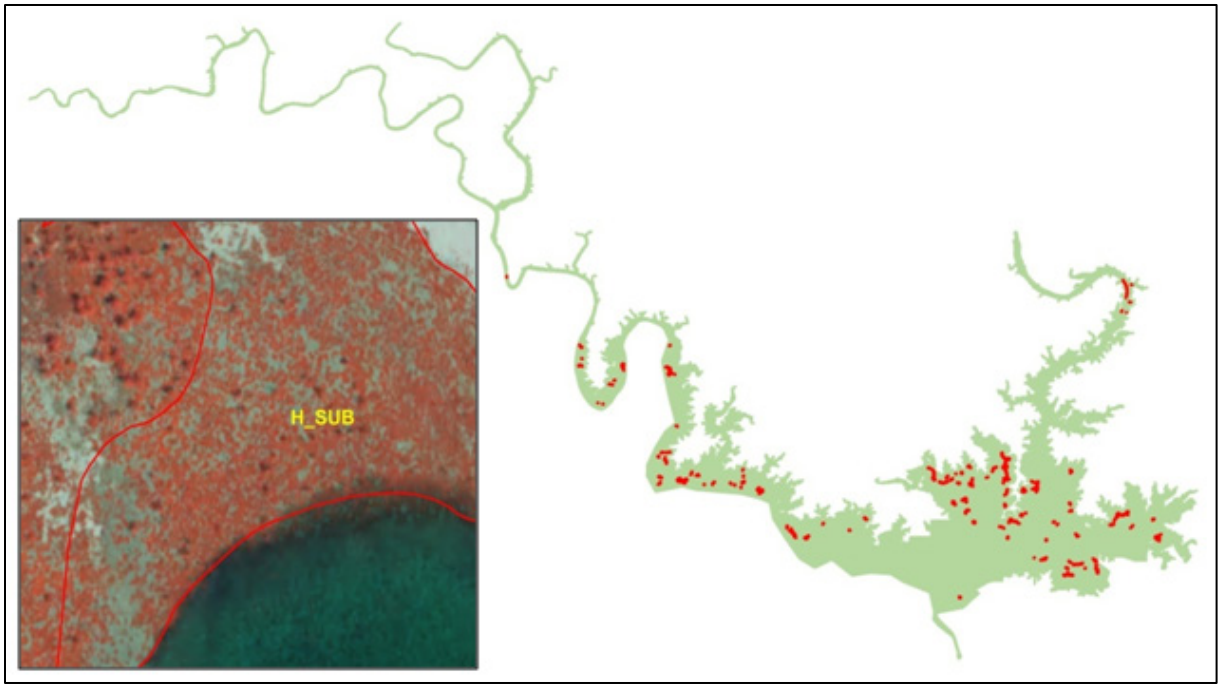
Physiognomy: Polygons of H_SUB contained herbaceous vegetation consisting mostly of hydrilla.

Condition: Poor. Hydrilla is a non-native plant that can form dense mats at the surface of water. The dense mats can restrict native vegetation, irrigation practices, recreation, hydroelectric production, and water flow. It can invade most slow-moving or still water systems.

CIR Signature: On the imagery, H_SUB was used to map both submerged mats as well as recently exposed areas. Submerged sites appeared blue with darker shapes just underneath. Exposed sites often had a bright red color.

Mapping Notes: The H_SUB map class was used to help locate and delineate dynamic levels of hydrilla present in the reservoir. Mapping of this type was likely highly accurate for areas were the water had recently receded. Submerged sites were probably not all mapped, as they could not be reliably discerned on the imagery. Areas mapped as SP_SHRX and S_SHRX are probably good candidates for other areas containing hydrilla.

Photo Signature and Distribution



Example photo signature and distribution map for Mixed Hydrilla and Other Submerged Aquatic Vegetation.

Map Code ***Upland Ruderal Mixed Grassland***
H_UPG

Common Species

- Buffelgrass (*Pennisetum ciliare*)
- Red grama (*Bouteloua trifida*)
- Hairy woollygrass (*Erioneuron pilosum*)
- Threeawn (*Aristida* spp.)
- Silver beardgrass (*Bothriochloa laguroides*)
- Bermuda grass (*Cynodon dactylon*)
- Woody crinklemat (*Tiquilia canescens*)

rUSNVC Association

Pennisetum ciliare, *Bothriochloa* spp., *Pappophorum bicolor*, *Aristida purpurea* Tamaulipan Herbaceous Vegetation (NPSAMIS006) [Provisional]



Example photo of Upland Ruderal Mixed Grassland.

Description

Frequency: Upland ruderal mixed grasslands were found throughout AMIS on disturbed lands, maintained lawns, and other transitional upland sites. Other common locations were along the high-water level of the reservoir.

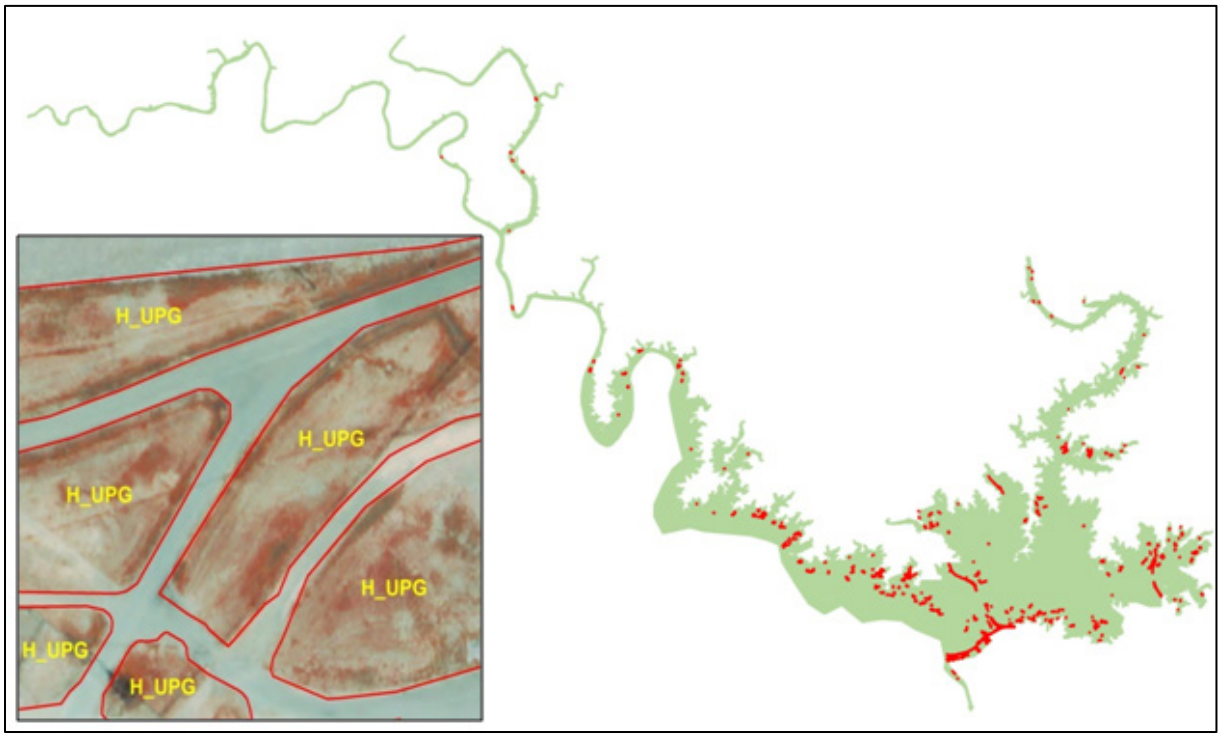
Physiognomy: Polygons of this type contained perennial grasses and forbs.

Condition: Poor. H_UPG represents mostly maintained lawns, weedy herbaceous sites, and other disturbed areas. Left alone these sites might revert to more natural shrublands or woodlands.

CIR Signature: On the imagery, polygons of H_UPG exhibited a range of smooth colors from orange and pink for healthy vegetation to gray and white for dead and bare areas. Mowed and maintained areas had stripes and bands.

Mapping Notes: The H_UPG map class was used to map both maintained areas and transitional upland grasslands. Some polygons of this type may have a significant native grass component and be better defined using the H_NAT map unit.

Photo Signature and Distribution



Example photo signature and distribution map for Upland Ruderal Mixed Grassland.

Sparse Vegetation, Geology, and Barren Lands

Map Code ***Xeric Rock Outcrop Sparse Vegetation***
SP_RCK

Common Species

- Trans-Pecos poreleaf (*Porophyllum scoparium*)
- Rockyscree false goldenaster (*Heterotheca fulcrata*)
- Baccharisleaf beardtongue (*Penstemon baccharifolius*)

rUSNVC Association
Porophyllum scoparium - (*Heterotheca fulcrata*, *Penstemon baccharifolius*) Sparse Vegetation (NPSAMIS016) [Provisional]



Example photo of Xeric Rock Outcrop Sparse Vegetation.

Description
Frequency: Barren and sparsely vegetated rock outcrops, cliffs, and upland geologic formations were common on the high ground immediately above the reservoir and streams. Oftentimes the sparse outcrops formed a band between the inundation zone and the vegetated upland types.

Physiognomy: Annual weedy forbs and early successional grasses, shrubs, and trees may be present as scattered or isolated patches.

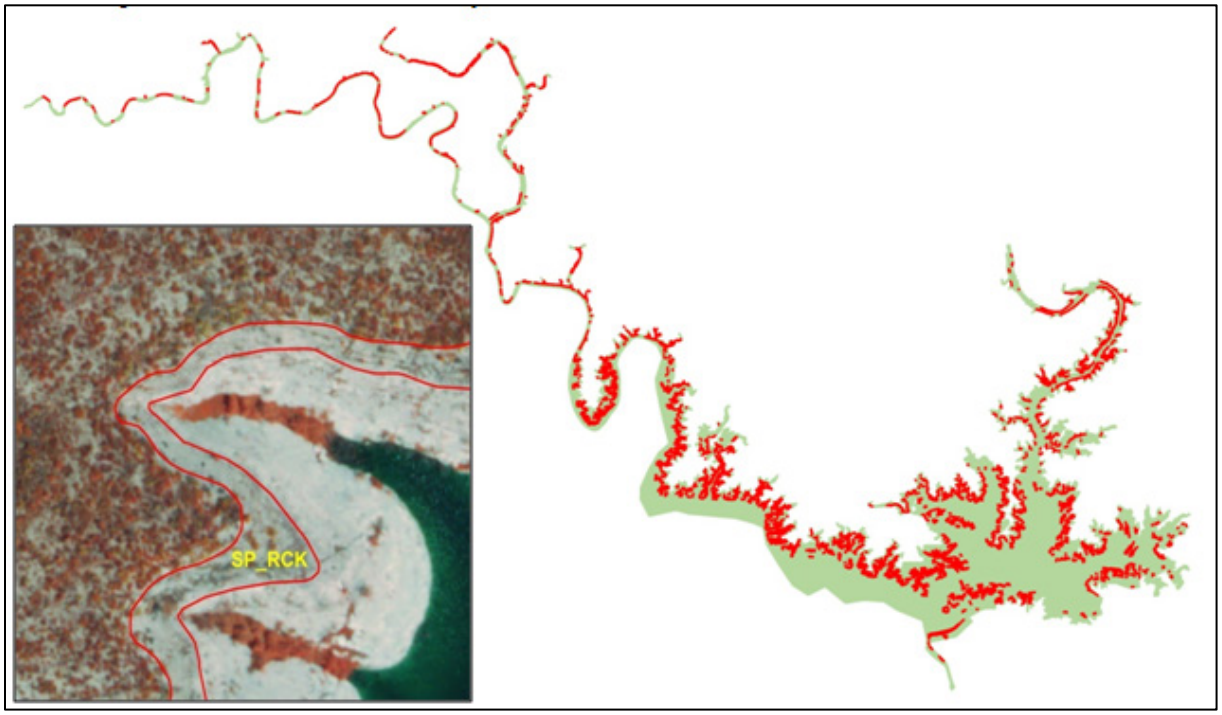
Condition: (N/A.)

CIR Signature: On the imagery, SP_RCK polygons were often linear in shape and appeared white and light gray in color. Vegetation was often sparse and bunched if any occurred at all. Bare bedrock was smooth, and boulders and cobbles were coarser in texture.

Mapping Notes: SP_RCK was used to map both the natural upland rock formations and the upper most bands of unvegetated lands surrounding the reservoir. The SP_SHR type can also be considered

a sparse, bare rock formation but was separated to describe more accurately the AMIS inundation zone.

Photo Signature and Distribution



Example photo signature and distribution map for Xeric Rock Outcrop Sparse Vegetation.

Map Code ***Mixed Inundation Zone and Shoreline Sparse Herbaceous Vegetation***
SP_SHR

Common Species

- Bermuda grass (*Cynodon dactylon*)
- (Turkey tangle) Fogfruit (*Phyla nodiflora*)
- Huisache (Sweet acacia) (*Acacia farnesiana*)
- Honey Mesquite (*Prosopis glandulosa*)
- Tree tobacco (*Nicotiana glauca*)
- Baccharis species. (*Baccharis* spp.)

rUSNVC Association
Bacopa monnieri - (*Cynodon dactylon*, *Phyla nodiflora*) Herbaceous Vegetation (NPSAMIS031) [Provisional]



Example photo of Mixed Inundation Zone and Shoreline Sparse Herbaceous Vegetation.

Description
Frequency: Polygons with sparse to moderate cover of herbaceous vegetation were common along the AMIS shorelines.

Physiognomy: SP_SHR polygons contained various mixes of perennial non-native grasses, annual grasses, forbs and some weedy early successional shrubs.

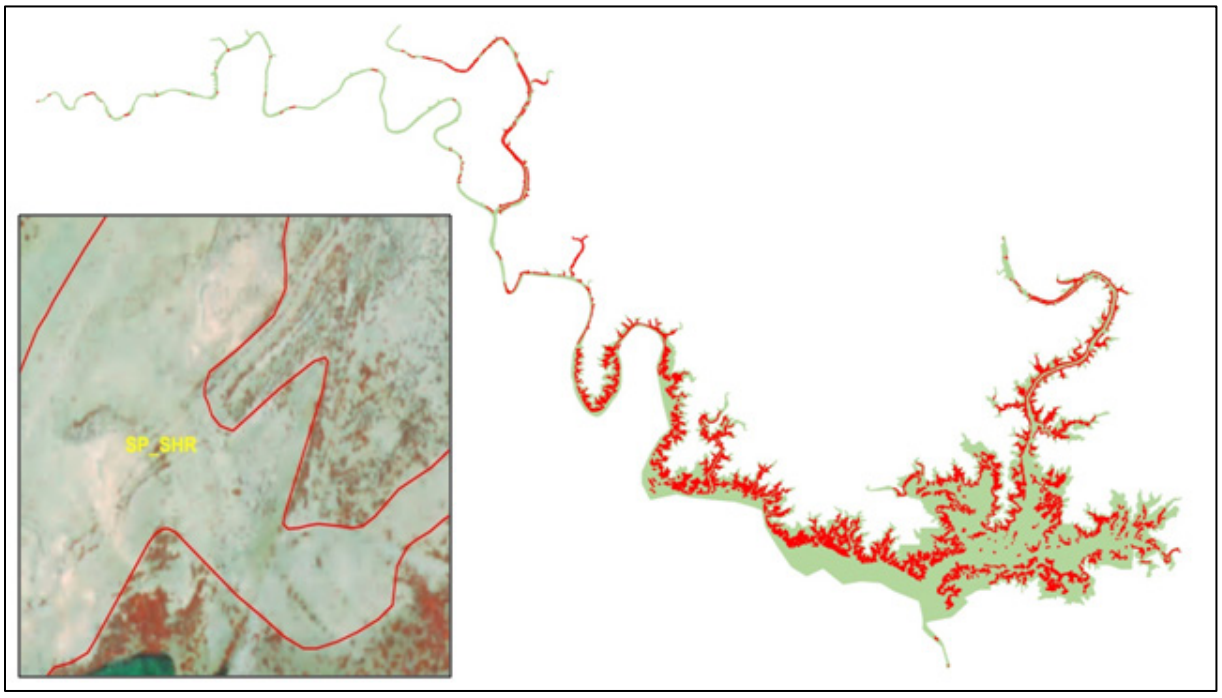
Condition: Poor. SP_SHR is an early successional type found on disturbed, previously inundated shorelines, drainages, and floodplains. The presence of this type likely indicates recent flooding or disturbance.

CIR Signature: On the imagery, the SP_SHR map unit has a strong soil and rock reflectance (usually white or gray) with scattered red, pink, and orange patches indicating low-growing vegetation.

Mapping Notes: The SP_SHR type has considerable species overlap with the other inundation zone map units (specifically H_BGFF, S_SHR, and W_HMX). Areas delineated as this type are dynamic

and with less flooding will evolve into denser grasslands (H_BGFF), contain more weedy shrubs (S_SHR) or with more flooding, may revert to bare shoreline. The SP_SHRX map unit was used to designate similar areas that were underwater at the time the imagery was acquired but were previously dry.

Photo Signature and Distribution



Example photo signature and distribution map for Mixed Inundation Zone and Shoreline Sparse Herbaceous Vegetation.

Map Code ***Periodically Submerged Sparsely Vegetated Inundation Zone and Shoreline***
SP_SHRX

Common Species

- Huisache (Sweet acacia) (*Acacia farnesiana*)
- Honey mesquite (*Prosopis glandulosa*)
- Tamarisk (Salt cedar) (*Tamarix ramosissima*)

rUSNVC Association
(No Association - Park Special Map Unit)



Example photo of Periodically Submerged Sparsely Vegetated Inundation Zone and Shoreline.

Description
Frequency: Shallow, underwater polygons that were previously barren or sparsely vegetated were common throughout the Amistad Reservoir.

Physiognomy: The tops of sparse shrubs and small trees (usually dead or dying) may be visible above the water line.

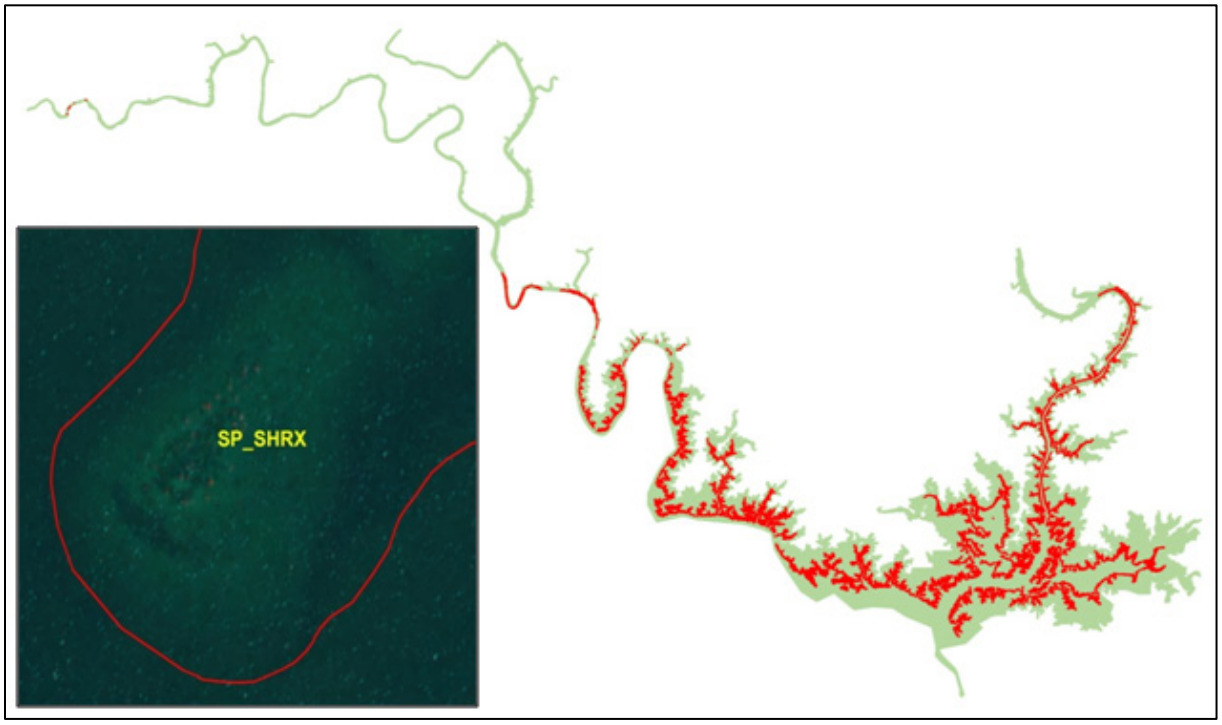
Condition: Poor. SP_SHRX is a submerged successional type found on inundated shallows within the waters of the Amistad Reservoir.

CIR Signature: Flooded polygons appear blue green with some evidence of shallow lake and riverbed formations underneath (e.g. white reflectance). Sparse, inundated shrubs and trees appear as small sticks above the water and as dark dots, streaks, and smudges below.

Mapping Notes: The SP_SHRX map unit represents shallow areas that were dry before the 2015 imagery, as shown on the 2012 NAIP ortho-imagery. This type was included in the mapping to show the total distribution of vegetation that could be possible at AMIS during drought and at low water levels. Areas delineated as SP_SHRX are dynamic and with less flooding may change to any of the

other inundation map units depending on seasonal flooding patterns, length of flooding, and water levels.

Photo Signature and Distribution



Example photo signature and distribution map for Periodically Submerged Sparsely Vegetated Inundation Zone and Shoreline.

Map Code ***Sparsely Vegetated Transitional and Disturbed Areas***
SP_TRAN

Common Species
N/A

rUSNVC Association
(No Association - Park Special Map Unit)



Example photo of Sparsely Vegetated Transitional and Disturbed Areas.

Description
Frequency: Transition areas were common throughout AMIS on recently disturbed or cleared areas.

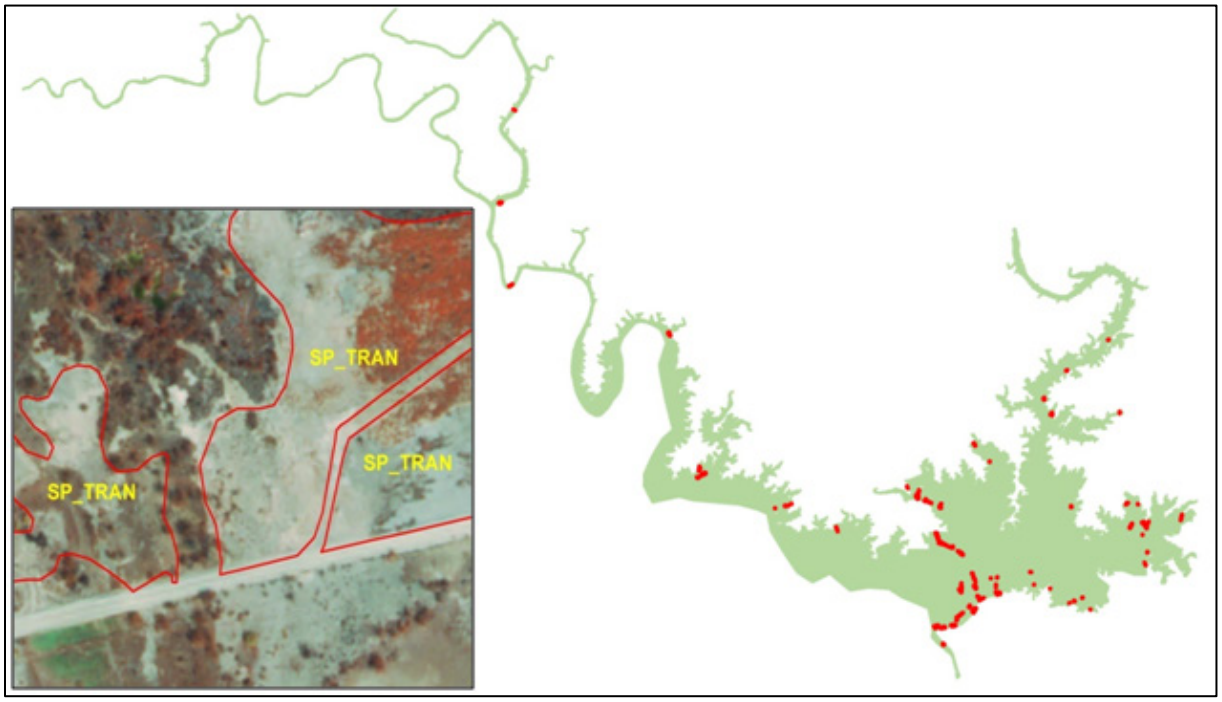
Physiognomy: None –unvegetated.

Condition: N/A.

CIR Signature: Polygons of SP_TRAN exhibited various colors depending on the geologic and/or soil material present. Colors ranged from gray to tan to white. Early successional grasses and forbs may create red and pink streaks. Textures were mostly smooth.

Mapping Notes: The SP_TRAN map unit was created for AMIS to accurately describe and document disturbed areas or sites were the vegetation has been cleared. Common areas included roadsides, areas adjacent to residential and commercial properties, and utility rights-of way. Early successional grasses and forbs were often present, and these sites may become more like the H_UPG map class in the future.

Photo Signature and Distribution



Example photo signature and distribution map for Sparsely Vegetated Transitional and Disturbed Areas.

Map Code ***Sparsely Vegetated Upland Washes and Drainages***
SP_WASH

Common Species
N/A

rUSNVC Association
(No Association - Park Special Map Unit)



Example photo of Sparsely Vegetated Upland Washes and Drainages.

Description
Frequency: Sparse drainage bottoms, dry streambeds, and arroyos were common along the AMIS boundary, as the tributaries entered the reservoir or into the various rivers and streams.

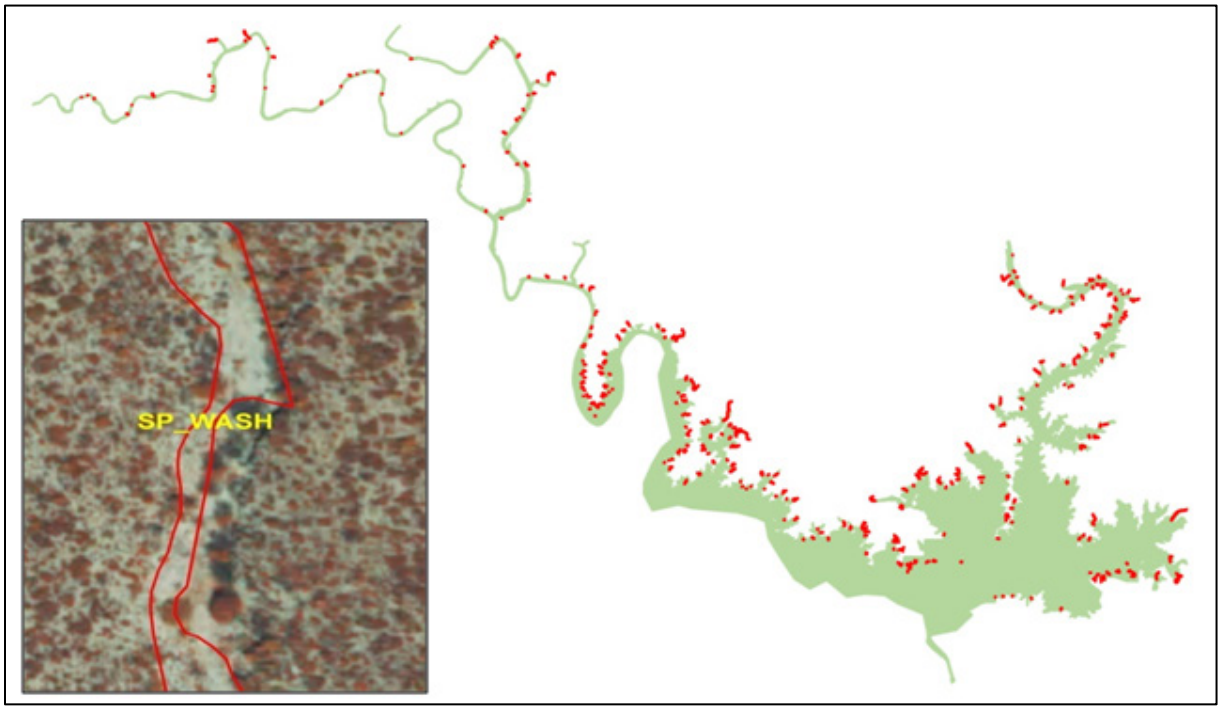
Physiognomy: None – unvegetated.

Condition: N/A.

CIR Signature: SP_WASH polygons were linear, white and mostly lacked vegetation. Textures were coarse for large cobbles and boulders and smooth for bedrock and gravel formations.

Mapping Notes: Washes with little (< 5% cover) or no vegetation cover were mapped using this map unit. Other sparsely vegetated units (SP_SHR and SP_RCK) often occurred nearby. The lack of vegetation in this type likely occurs due to periodic flooding events.

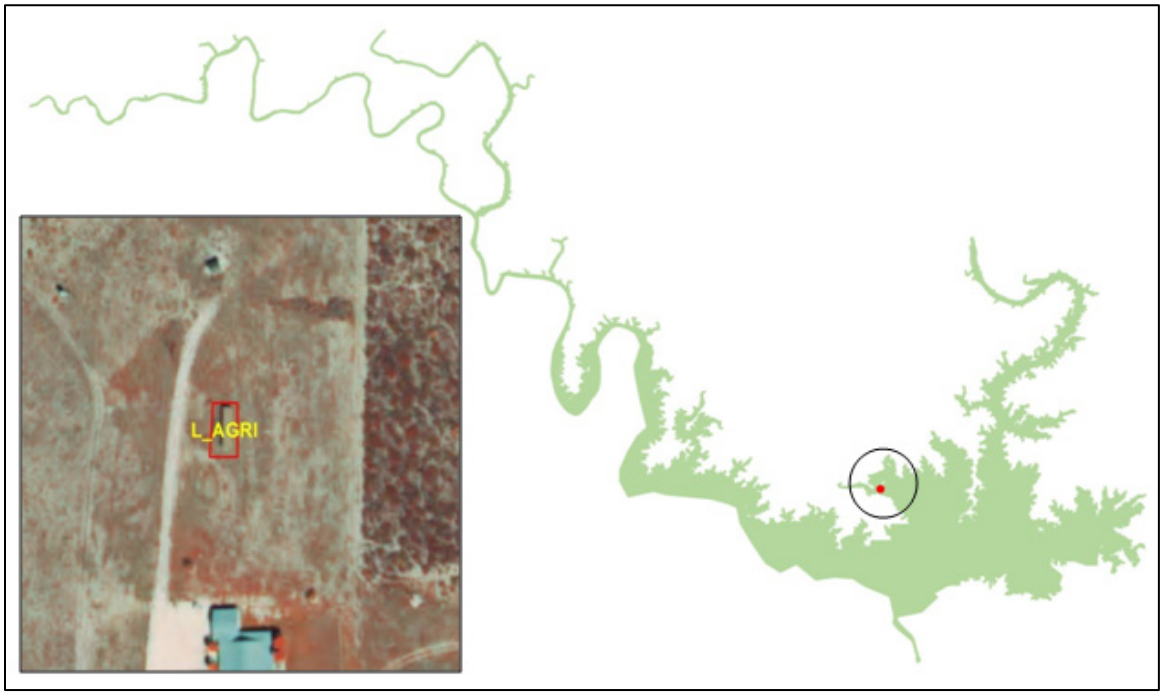
Photo Signature and Distribution



Example photo signature and distribution map for Sparsely Vegetated Upland Washes and Drainages.

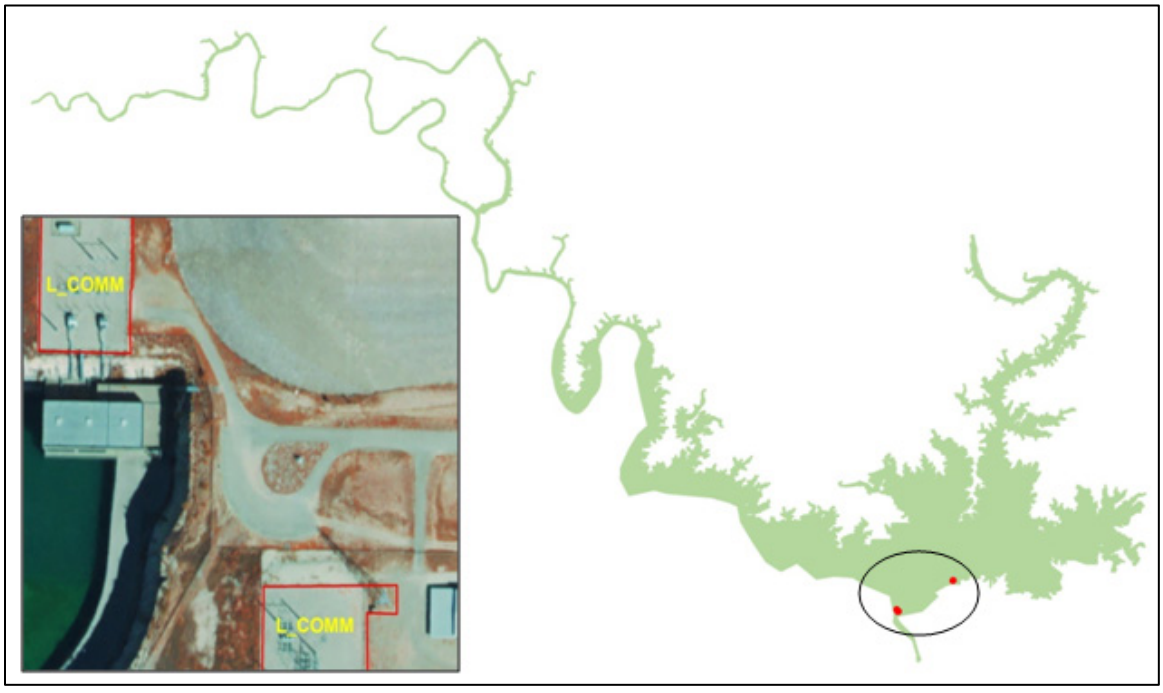
Land Use – Land Cover

L_AGRI Agricultural Business / Ranches



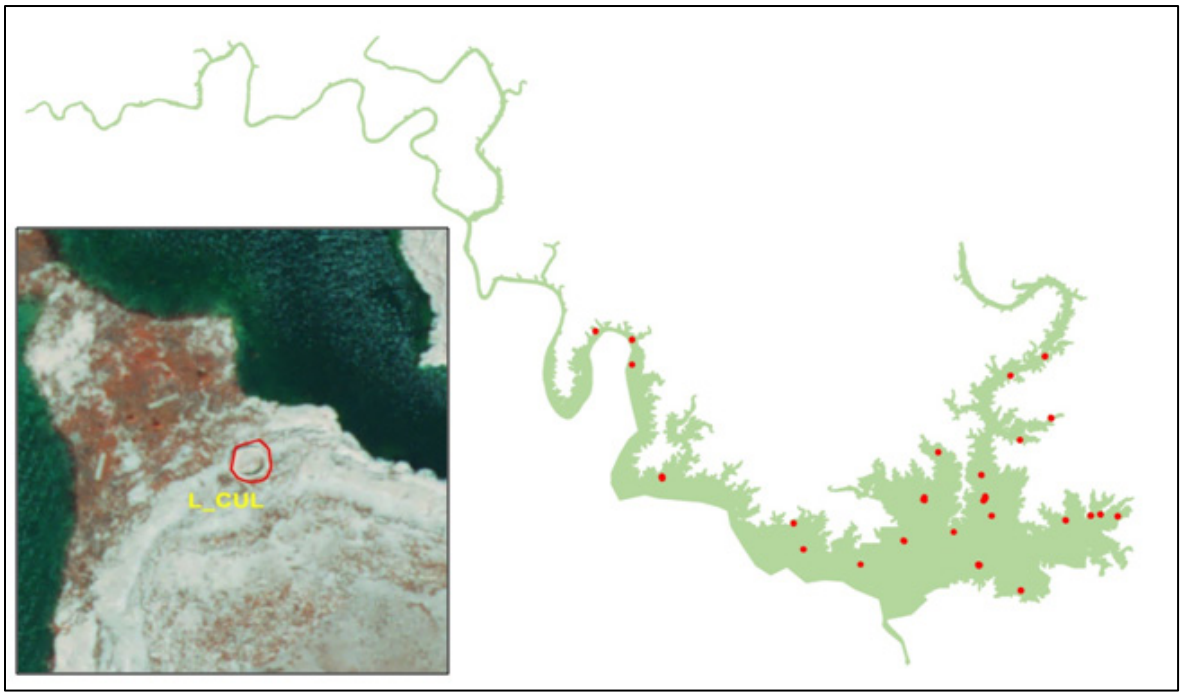
Example photo signature and distribution map for Agricultural Business / Ranches.

L_COMM Communications and Utilities



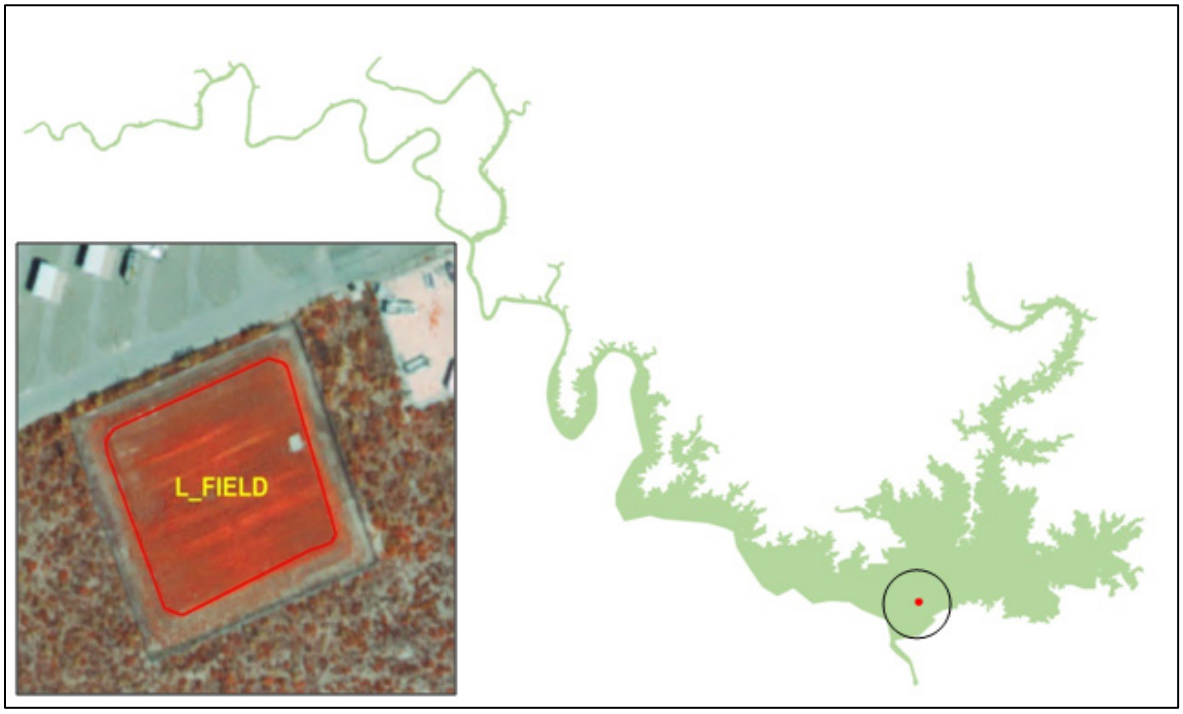
Example photo signature and distribution map for Communications and Utilities.

L_CUL Cultural and Historic Agricultural Remnants



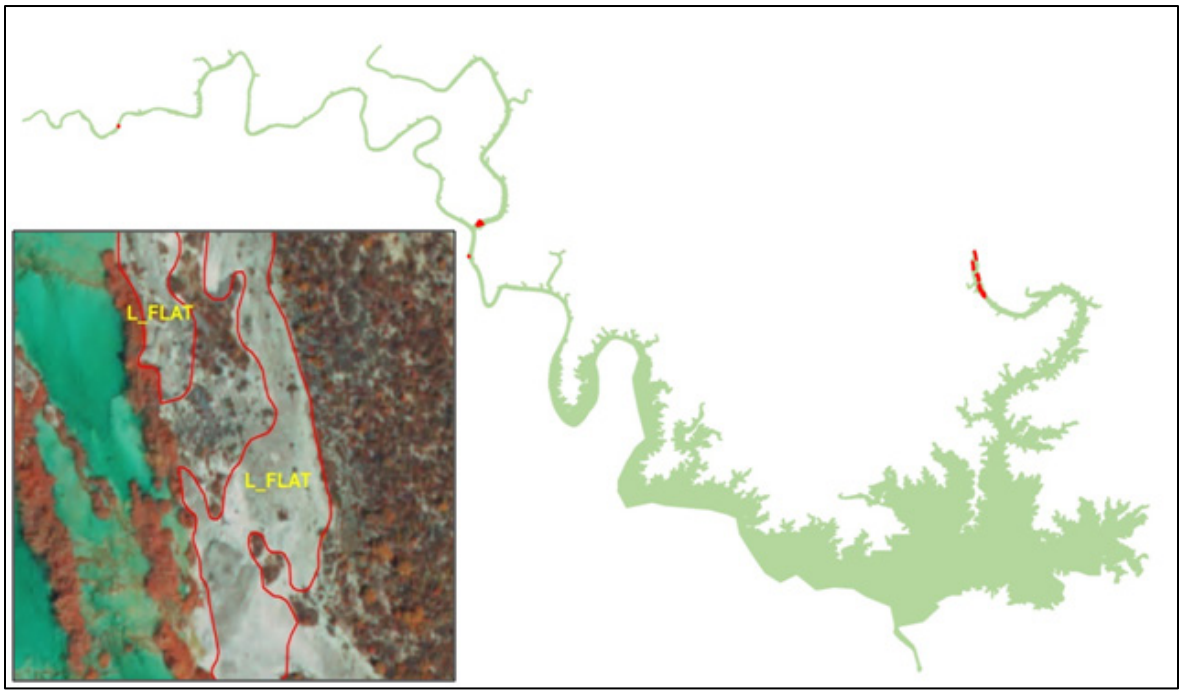
Example photo signature and distribution map for Cultural and Historic Agricultural Remnants.

L_FIELD Planted / Cultivated Fields



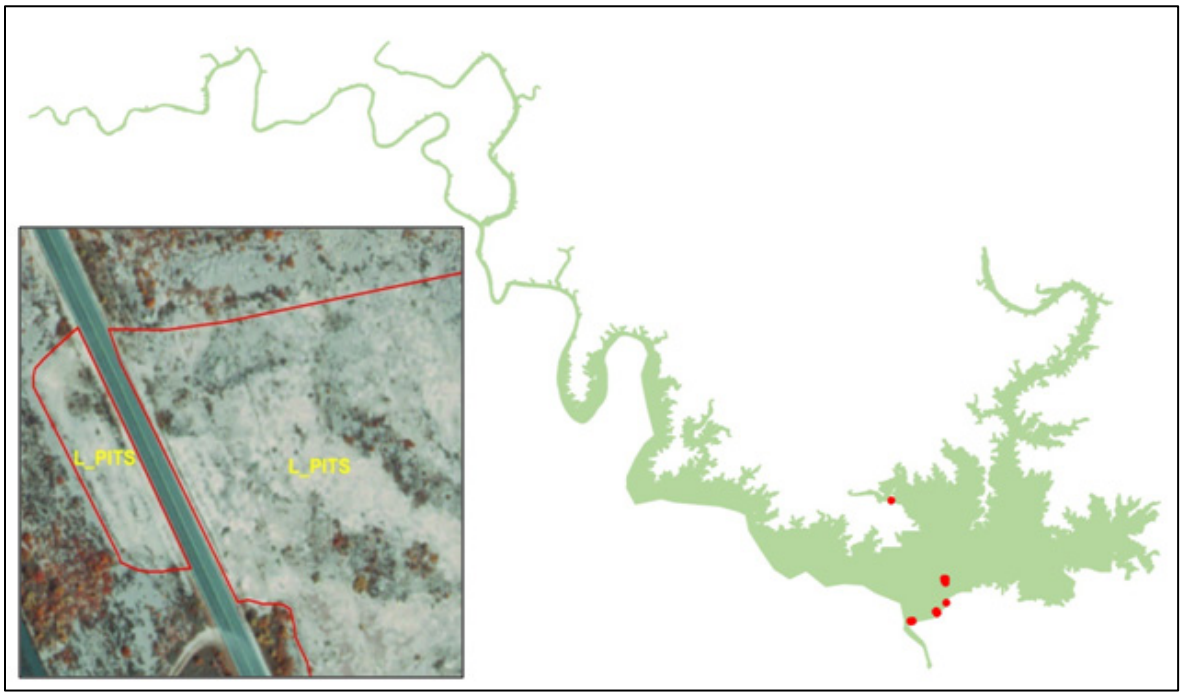
Example photo signature and distribution map for Planted / Cultivated Fields.

L_FLAT Barren Dirt and Rock Flats



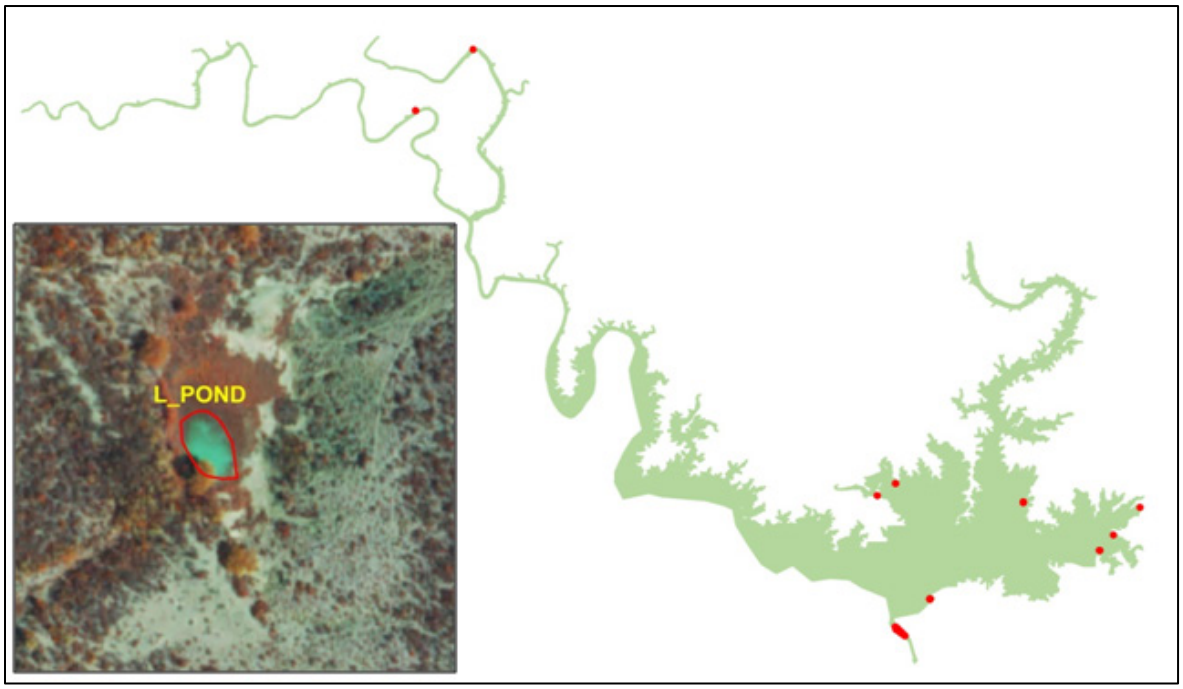
Example photo signature and distribution map for Barren Dirt and Rock Flats.

L_PITSQuarries / Strip Mines/ Gravel Pits



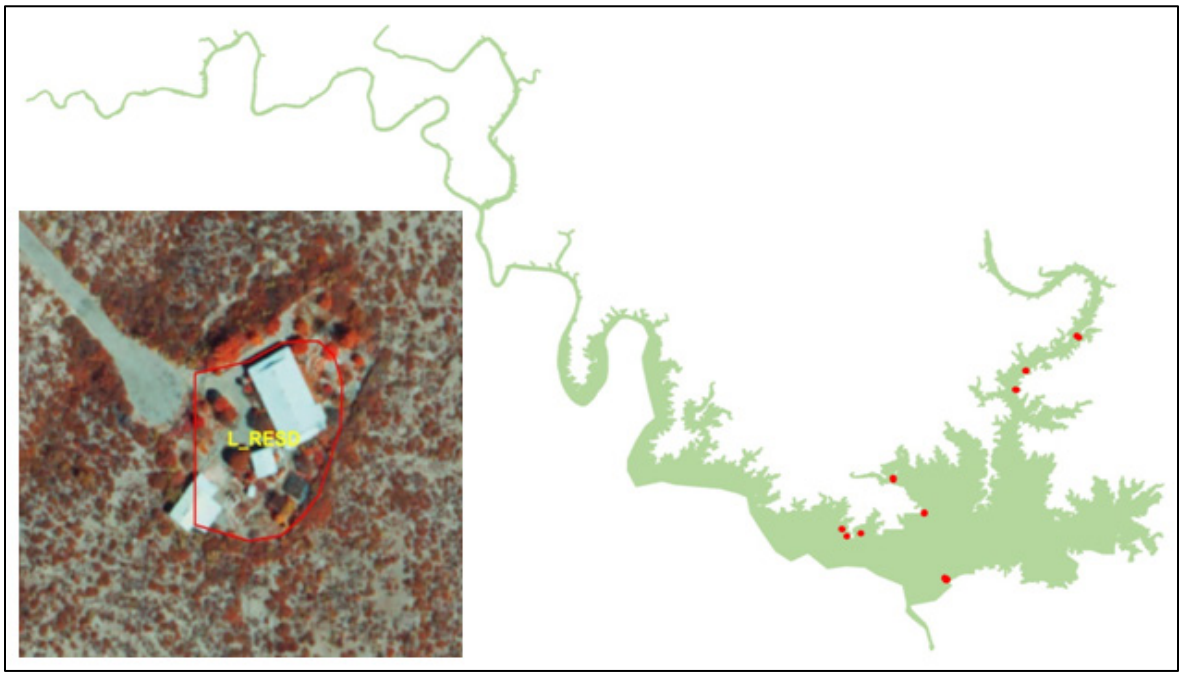
Example photo signature and distribution map for Quarries / Strip Mines/ Gravel Pits.

L_POND Small Lake / Pond



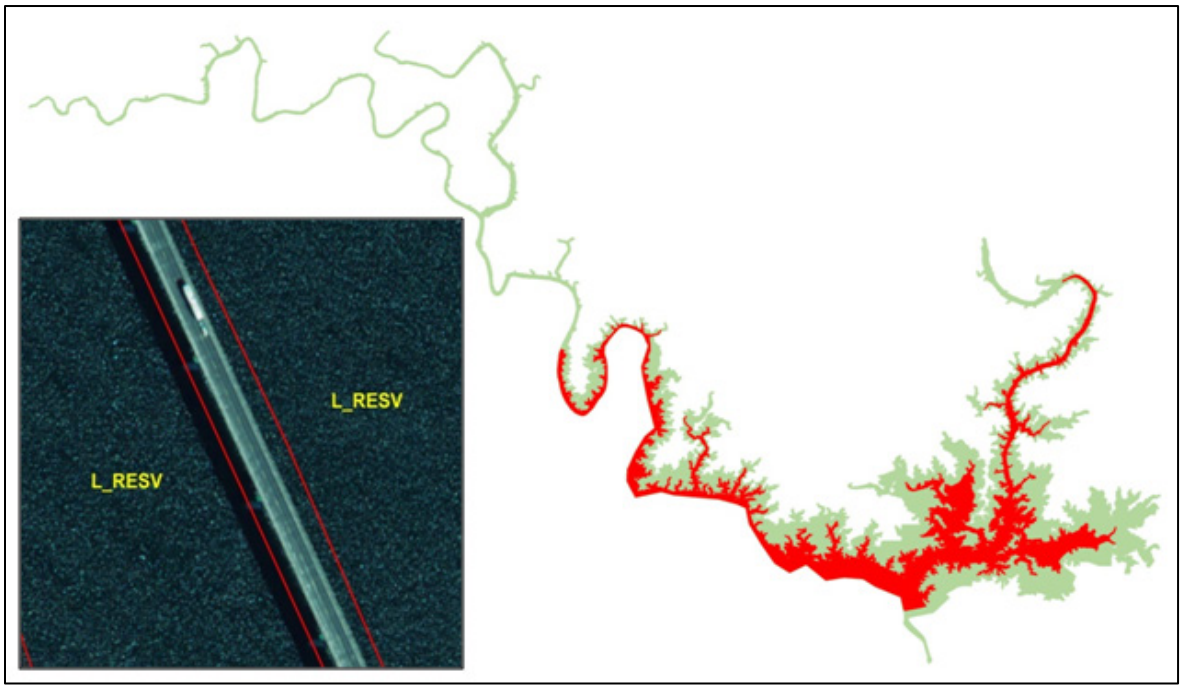
Example photo signature and distribution map for Small Lake / Pond.

L_RESD Residential Areas



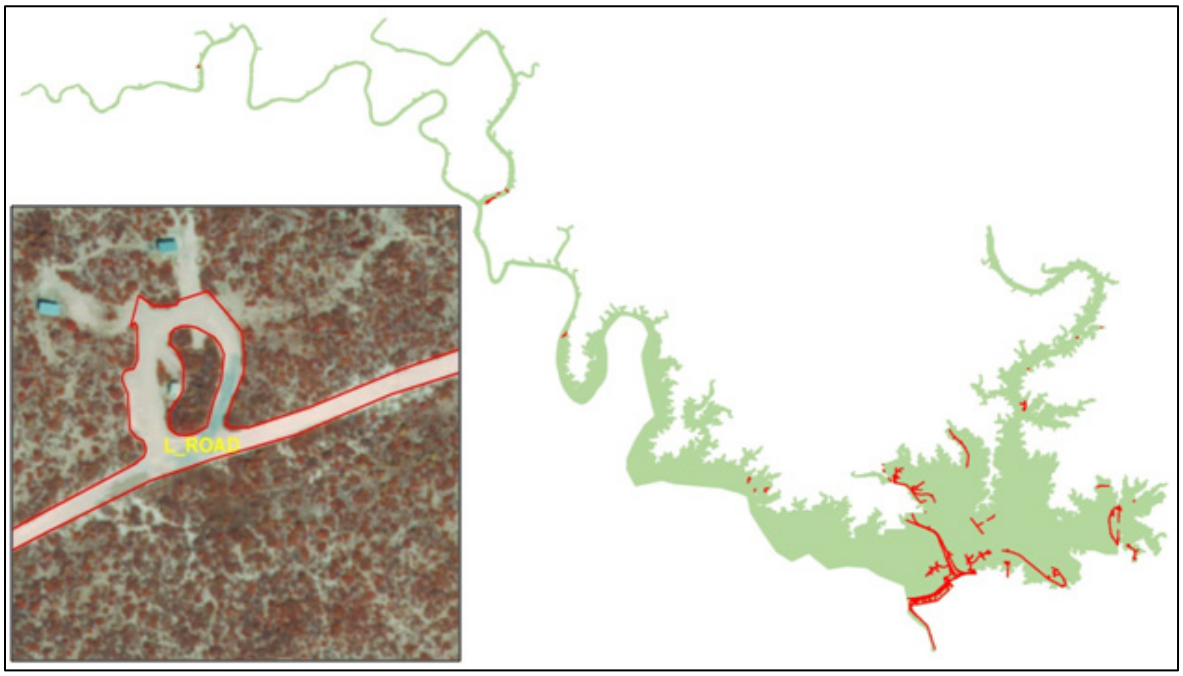
Example photo signature and distribution map for Residential Areas.

L_RESV Reservoir / Lake



Example photo signature and distribution map for Reservoir / Lake.

L_ROAD Main Roads and Transportation Structures



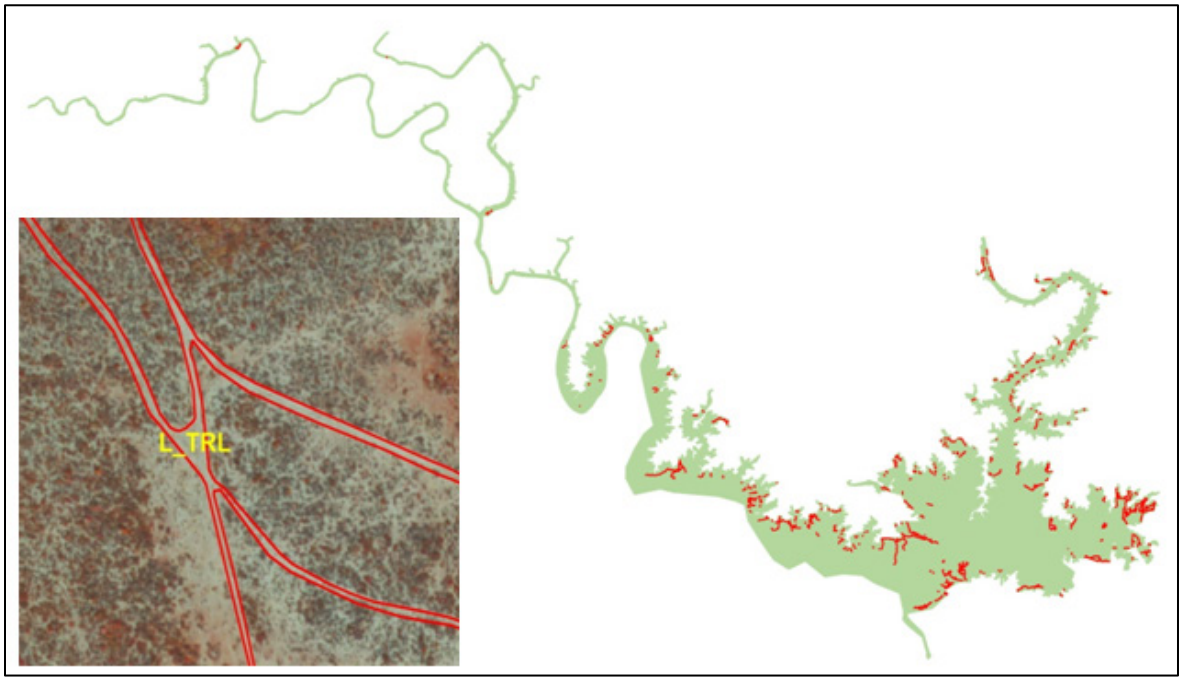
Example photo signature and distribution map for Main Roads and Transportation Structures.

L_STRM Stream / River



Example photo signature and distribution map for Stream / River.

L_TRL Trails and 2-Track Roads



Example photo signature and distribution map for Trails and 2-Track Roads.

Appendix F: AMIS Vegetation Maps

For illustration purposes, the AMIS Vegetation Inventory Map is presented in two versions. The first two are overview maps showing the full scale of the project. The subsequent maps have been tiled into smaller sections to show more detail. The following pages contain an index map, overview map, tile map legend, and seven individual tiled maps (Figures F-1 – F-10). The background imagery for the maps is the 2015 TOP imagery using the true color bands. Please note that the digital imagery does not extend into Mexico and only the hill shade features (as derived from digital elevation data) is shown for these areas outside of the U.S.

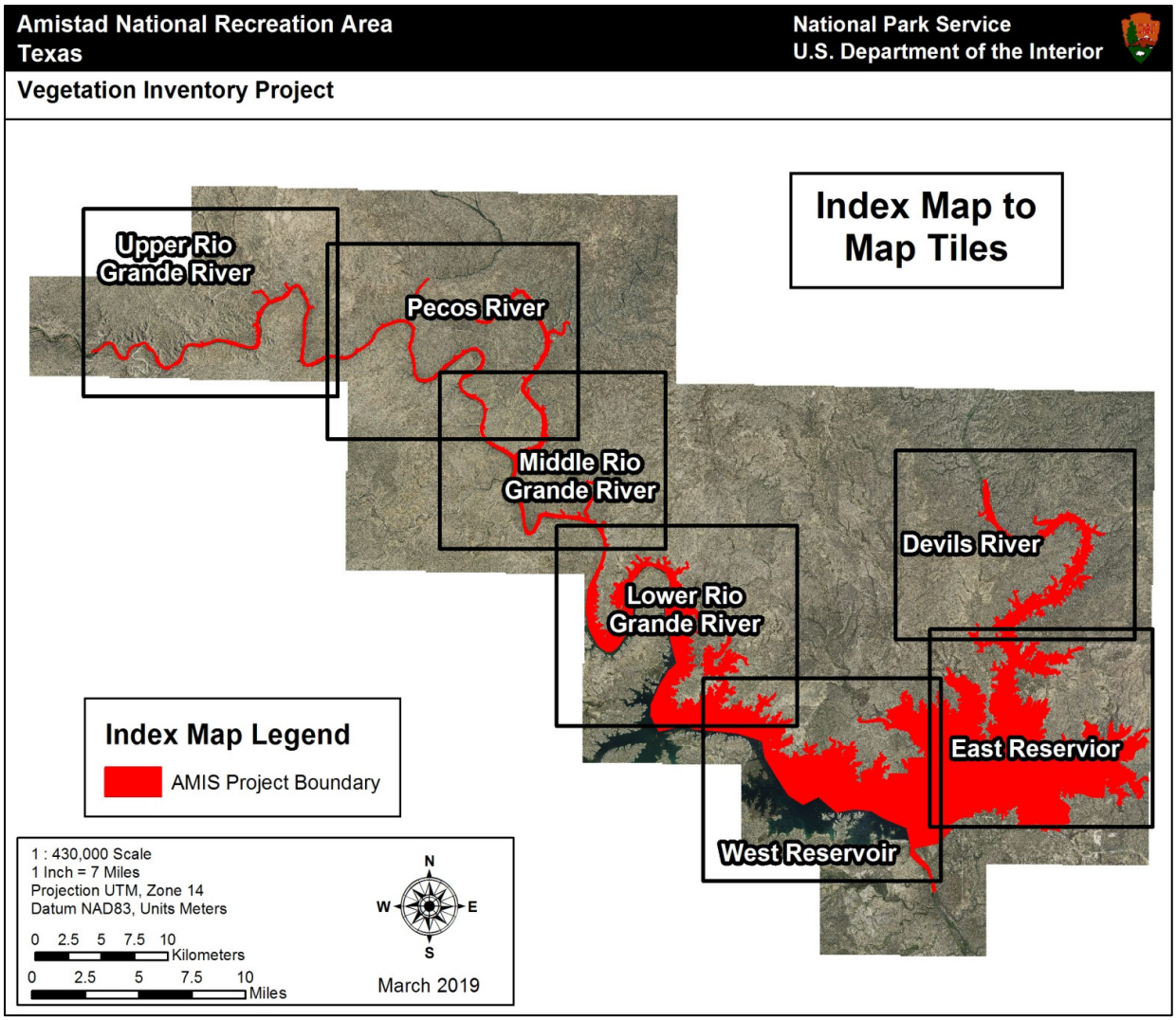


Figure F-1. AMIS Index Map to Vegetation Map Tiles.

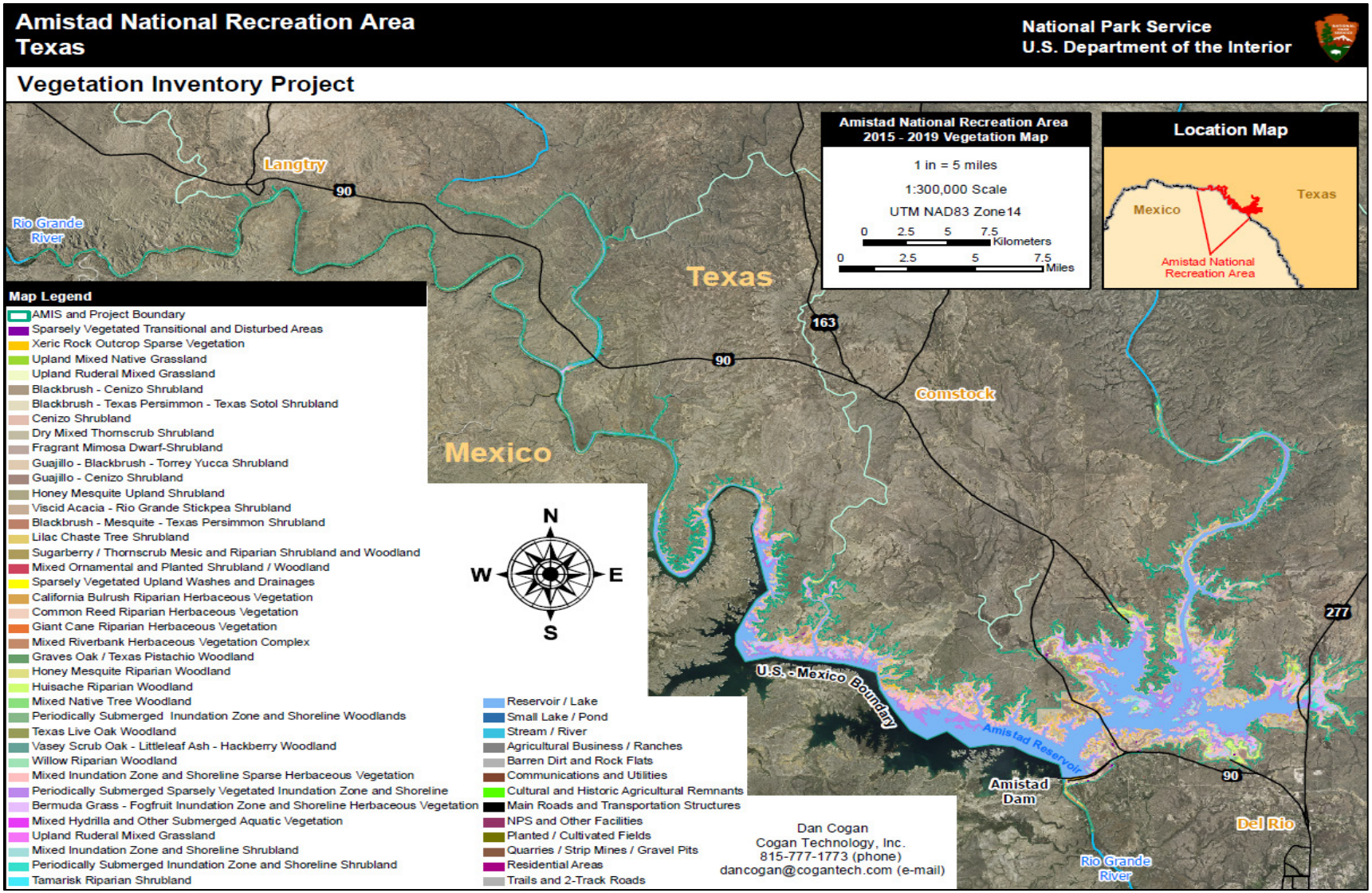


Figure F-2. AMIS Vegetation - Overview Map.

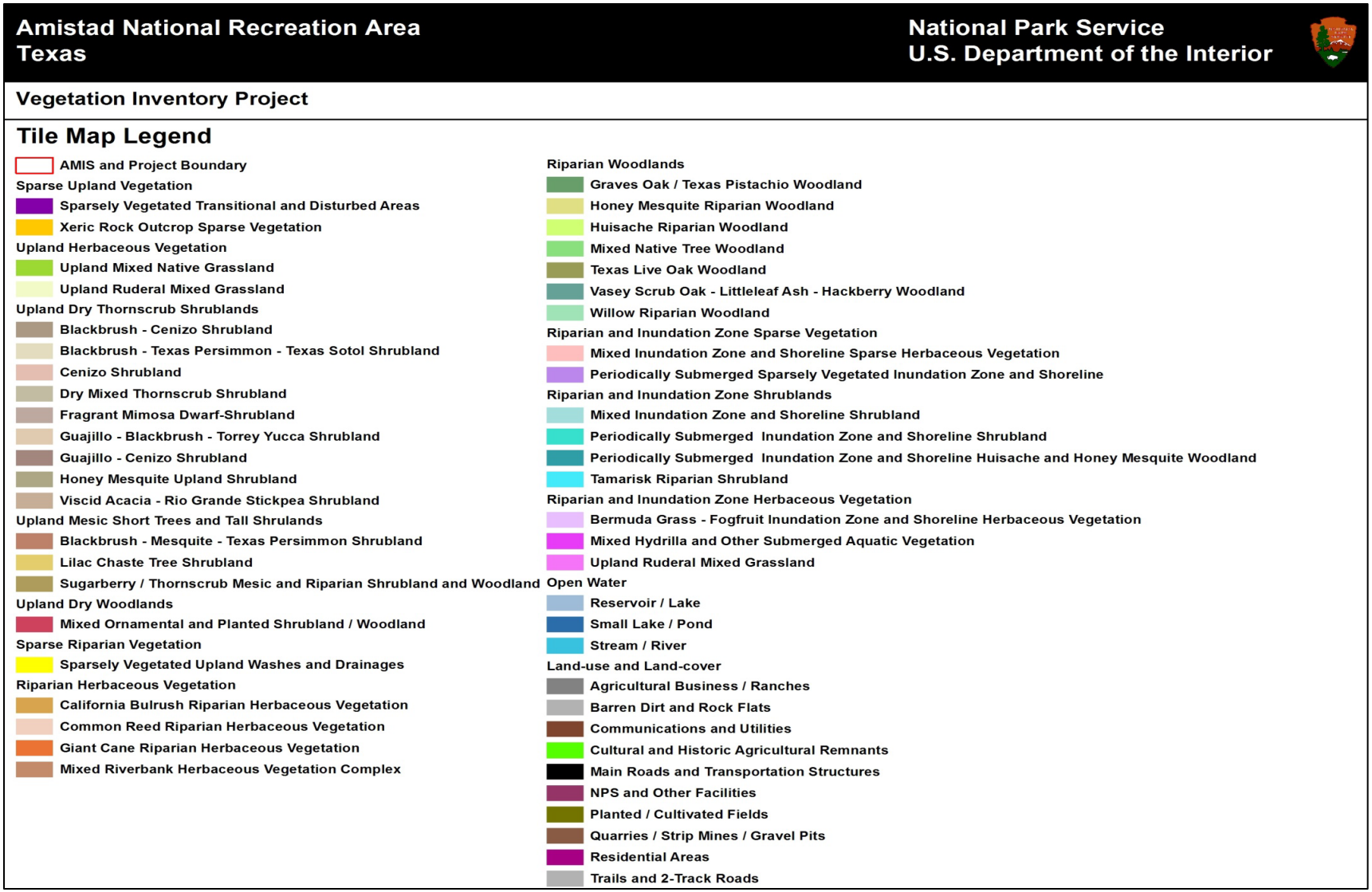


Figure F-3. AMIS Vegetation Tile Map Legend.

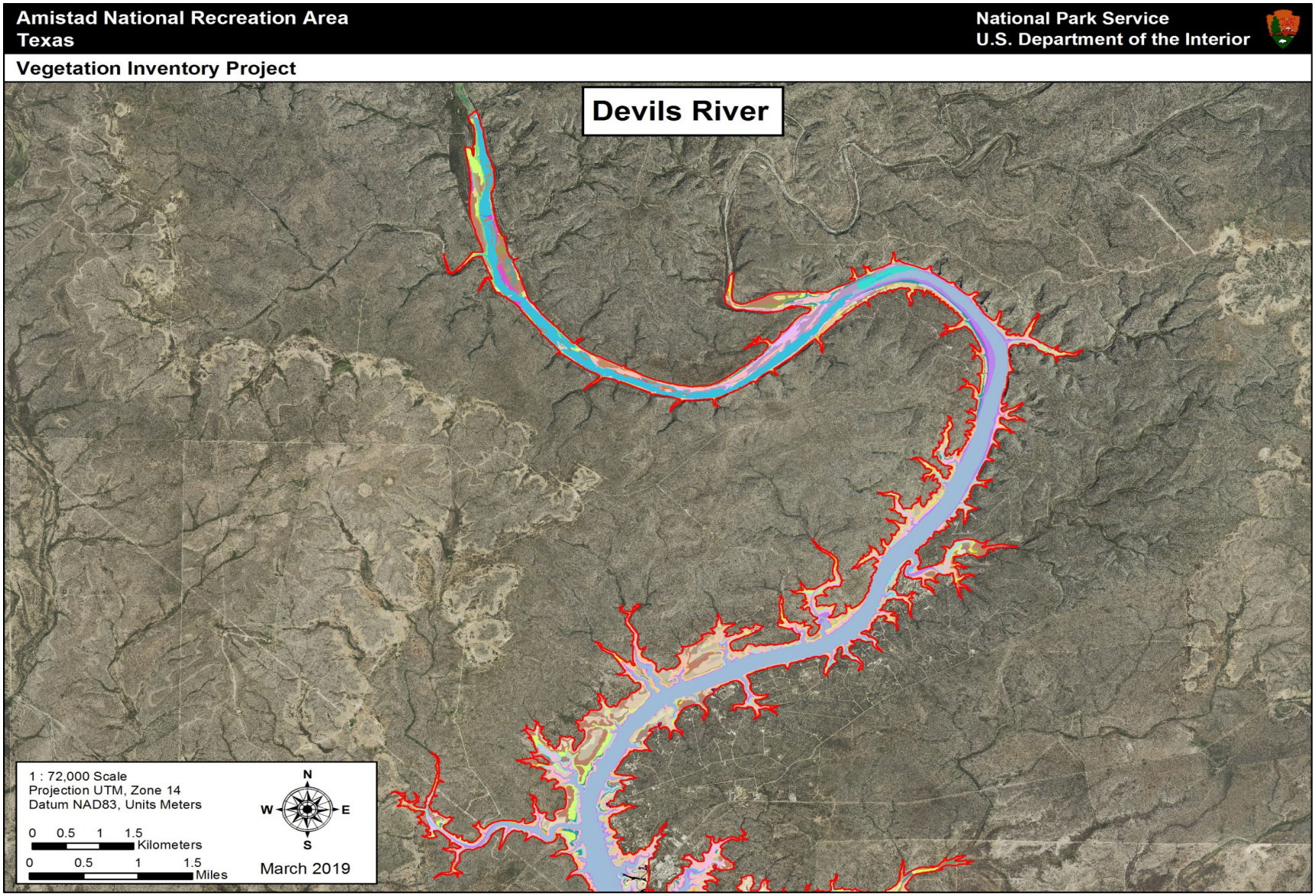


Figure F-4. AMIS Vegetation Tile Map 1 - Devils River Region.

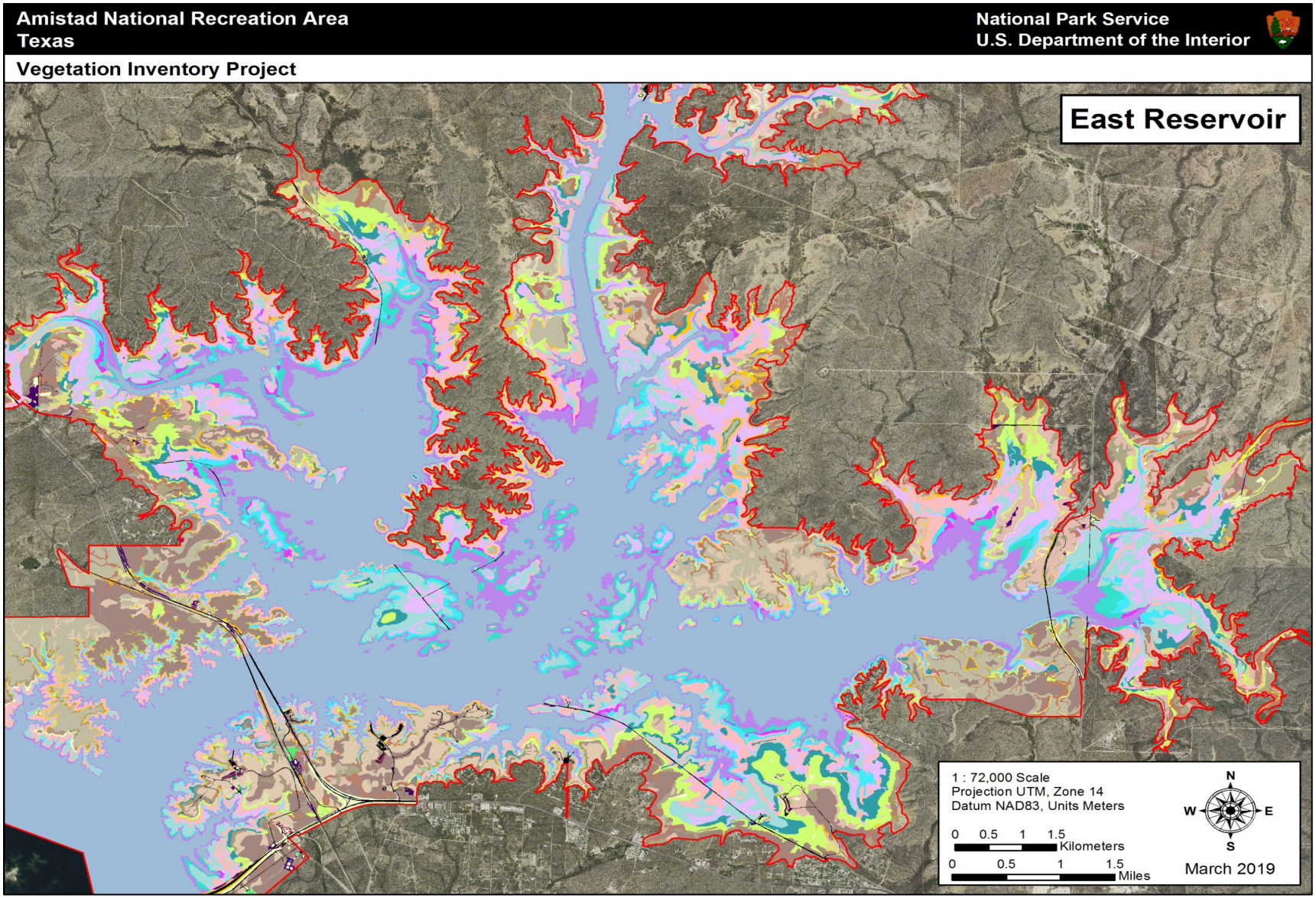


Figure F-5. AMIS Vegetation Tile Map 2 - East Reservoir Region.

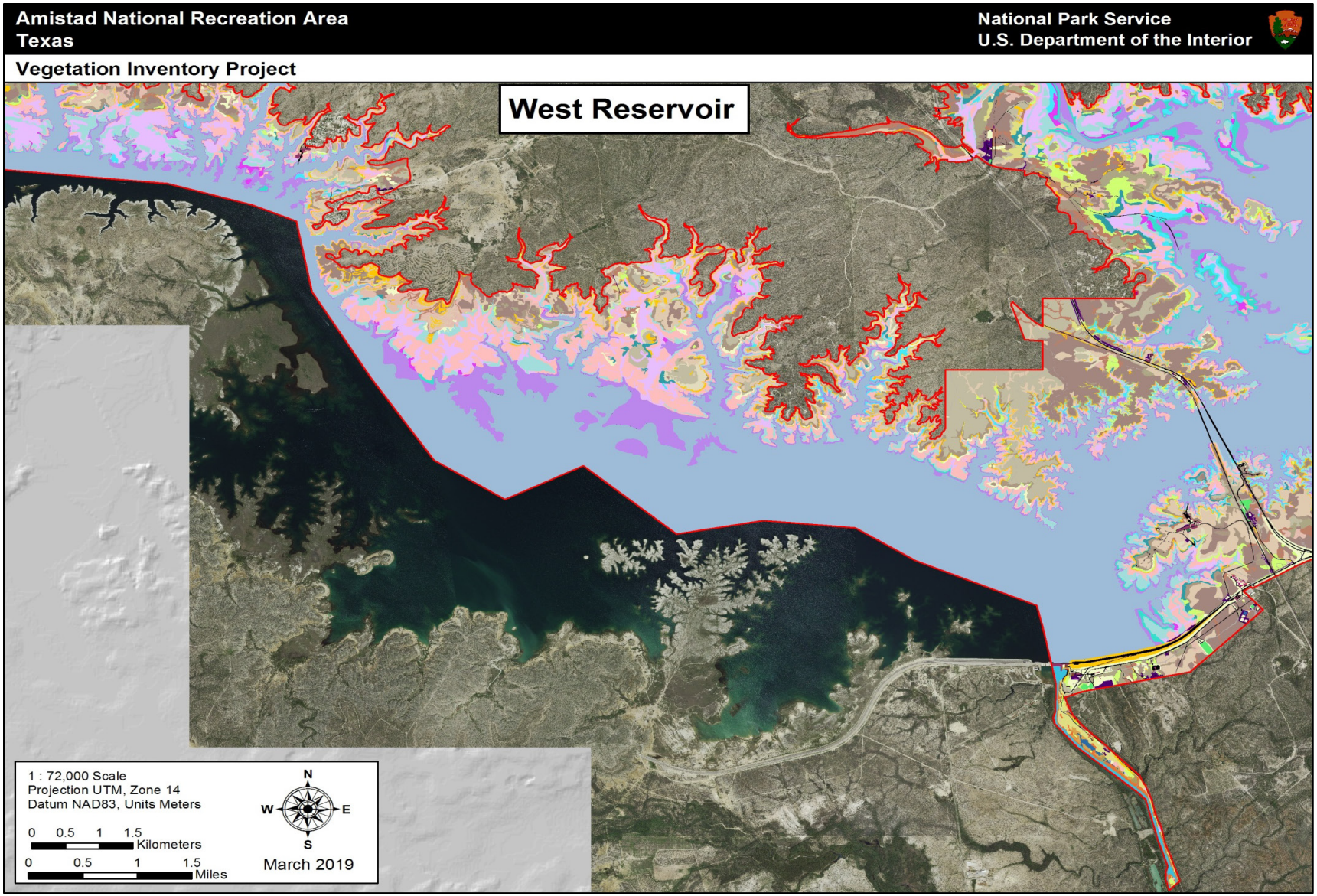


Figure F-6. AMIS Vegetation Tile Map 3 - West Reservoir Region.

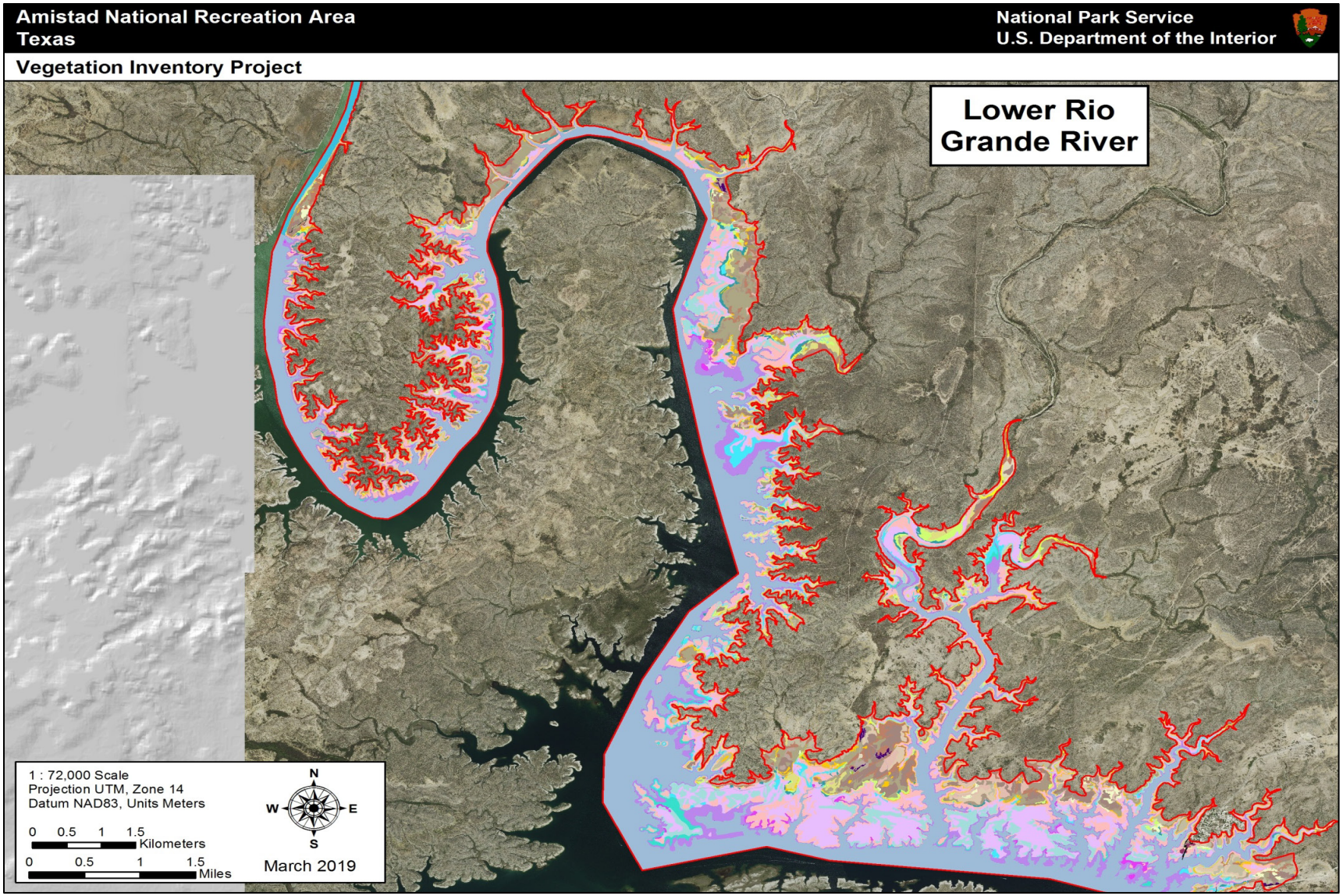


Figure F-7. AMIS Vegetation Tile Map 4 - Lower Rio Grande River Region.

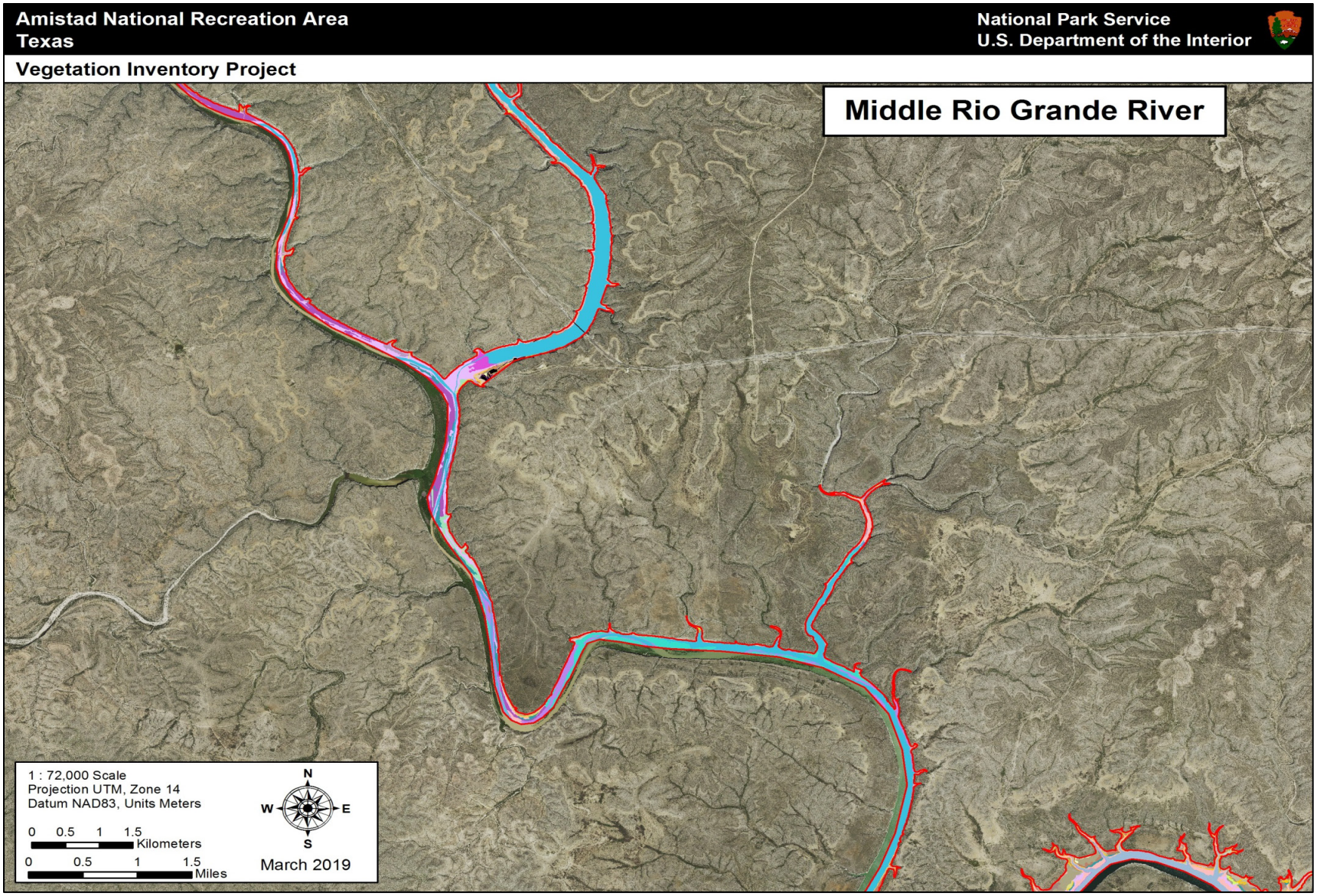


Figure F-8. AMIS Vegetation Tile Map 5 - Middle Rio Grande River Region.

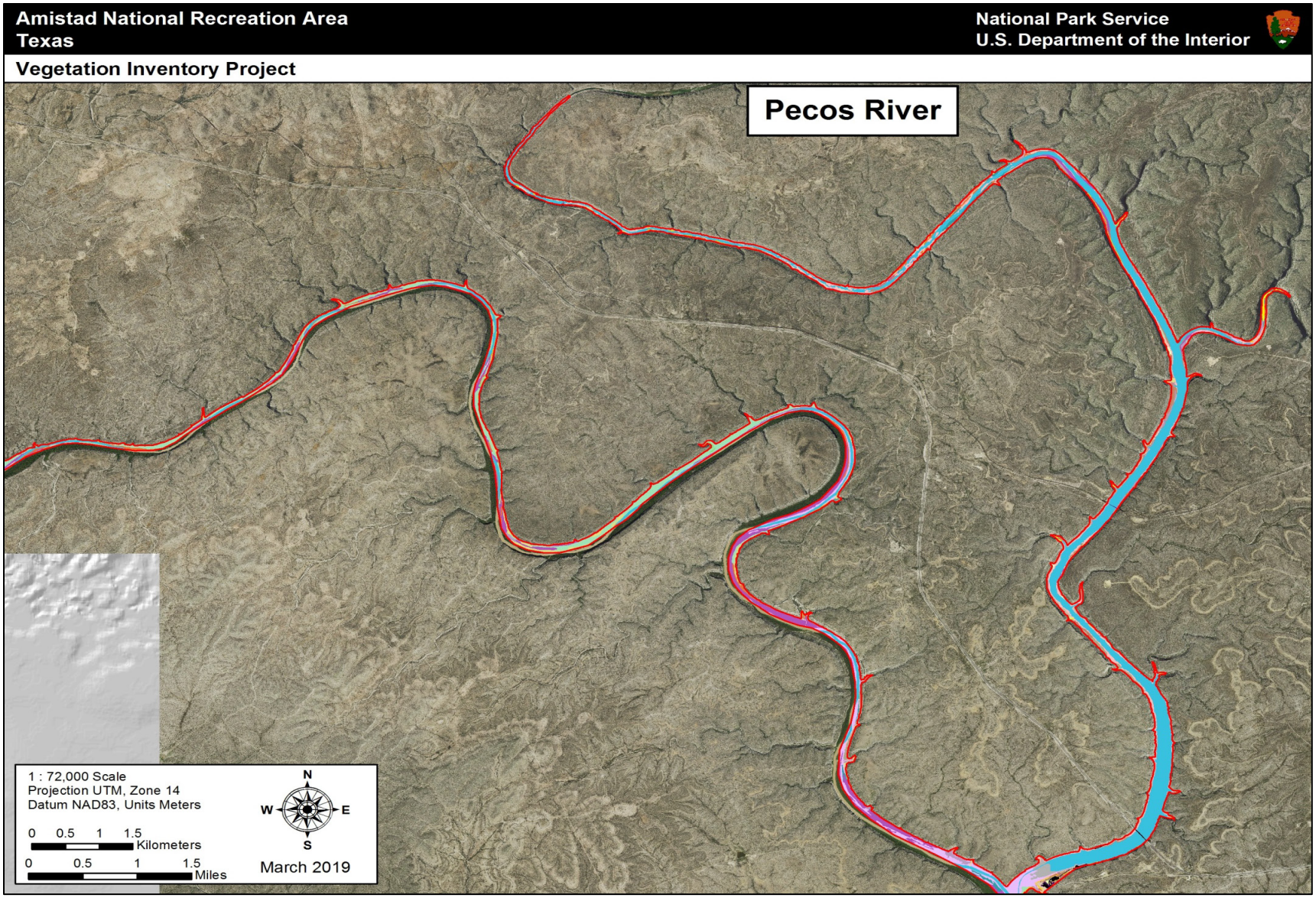


Figure F-9. AMIS Vegetation Tile Map 6 - Pecos River Region.

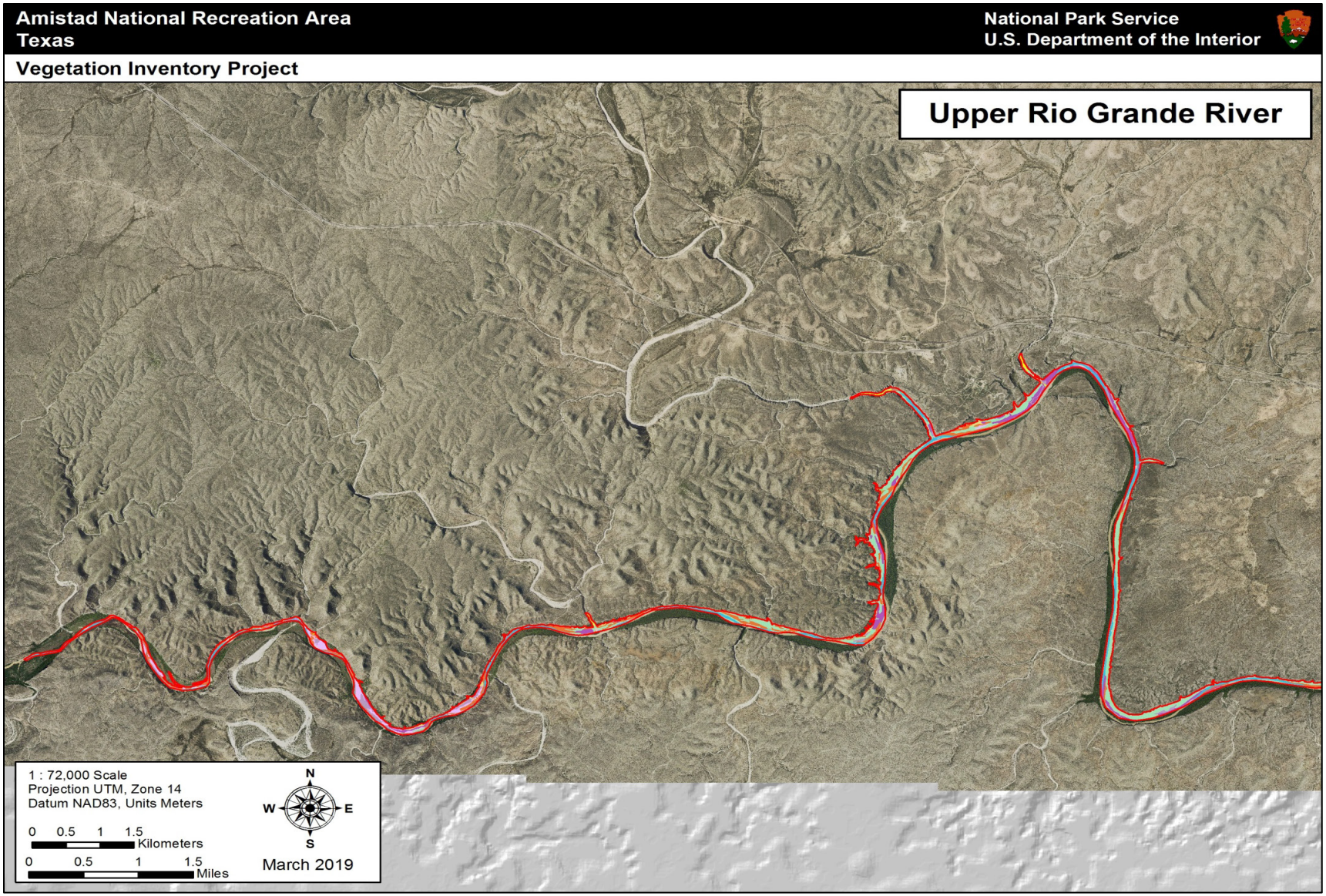


Figure F-10. AMIS Vegetation Tile Map 7 - Upper Rio Grande River Region.

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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