The San Saba River

Steep Rocky- Oak/Juniper/Woodland in foreground. Loamy Bottomland-San Saba River in background

The spring-fed San Saba River is a valuable resource to West-Central Texas. The relatively constant flows of the river provide recreational opportunities, habitat for unique plant and animal communities, and critical water supplies to local communities and ecosystems, especially during drought.

The San Saba River begins as an intermittent, or usually dry, stream bed east of Eldorado. Near Fort McKavett, springs emanating from sedimentary rocks of the Edwards Plateau provide approximately 75% of the total flow to the river downstream to its confluence with the Colorado River near San Saba.

The Edwards Plateau is a 30,000 square-mile region located west and north of Austin, San Antonio and Del Rio. Capping the plateau is thick limestone rock that dissolved over time to form what is considered the largest karst area in the United States. The thin soils atop the bedrock of the plateau hold little moisture, thus any precipitation runs off quickly, occasionally resulting in flash flooding. However, some precipitation finds its way through rock fractures, root zones, and karst features such as sinkholes, conduits, and caves, to recharge the underlying aquifer. Where canyons erode deeply enough into the margin of the Edwards Plateau to expose the aquifer, springs emerge.

The proactive protection and preservation of the San Saba River is an economic, cultural, and environmental concern. Subtle changes in spring flow are occurring resulting from shifts in climate and increased aquifer pumping, along with changes to the landscape due to land fragmentation, loss of riparian habitat, and encroachment of woody species on upland habitats. These changes have the potential to decrease the water quality and quantity of the river.

As the majority of the San Saba watershed is privately owned, effective methods for protecting the the river need to result from the coordinated actions of informed landowners at a local level. To facilitate these interactions, The Nature Conservancy has designed this on-line tool, the LandOwner Catchment Assessment (LOCA), for the Upper San Saba watershed. The LOCA helps inform landowners on effective stewardship practices, the best methods for implementing these practices, and potential funding sources for landowners working together to protect their resource.

Historical Perspective

Until the arrival of European settlers to the area in the mid 1800s, natural and anthropogenic events favored the development of prairies and savannas on the Edwards Plateau. Recurring grazing, frequent fires, and periodic long-term droughts helped develop a landscape predominantly covered with mid and tall grasses, but also containing forbs and woody plants.

Endemic antelope and white-tailed deer, along with migrating bison fed upon the grasses, forbs and woody plants found in the landscape. About every 7 to 12 years, wildfires, caused by lightning or set by indigenous tribes, blazed the grasslands and limited native woody species to areas sheltered from fire. About 3 - 4 times a century, long-term droughts curtailed vegetative growth to the advantage of grasses that withstood conditions due to their ability to go dormant or reseed following improved conditions.

Arriving settlers to the Edwards Plateau brought with them an understanding of agriculture, but as they originated from areas with moister environments, they were not understanding of rangeland productivity limits associated with drier conditions. Also, at the time of the settlers' arrival, grazing pressure on the landscape had been significantly reduced by the elimination of the buffalo in the 1870s, presenting a false perception about the productivity of the land. As a result, lands were overstocked with cattle, sheep, and goats, resulting in a reduction in grasses and other organic matter. Settlers also reduced the frequency of fires and what fires did occur were less intense due to lack of fuel. These activities upset the vegetative balance that had existed for centuries as the reference condition and resulted in today's current conditions that favor endemic woody-plant encroachment (*Ashe* juniper, mesquite, and oak) due to the lack of competition from mid and tall grasses.

Woody Plant Encroachment

The encroachment of woody plants across areas of the Edwards Plateau that once were prairies or savannahs decreases grassland productions and presents obstacles to landowners interested primarily in livestock production. With encroachment and the resulting grassland reduction comes more soil exposure, increasing opportunities for erosion. Interception rates of precipitation by woody canopy can approach 28%, and combined with increases in surface

evaporation and runoff, can greatly reduce the effectiveness of rainfall, resulting in a drier microclimate.

However, an increase in woody plant species can benefit landowners interested in the management of wildlife. *Ashe* juniper, for example, provides habitat, food, and nesting material for the endangered golden-cheek warbler, while an increase in woody plants and brush increases available browse and cover for white-tailed deer. *Ashe* juniper can also grow in areas where other vegetation is sparse, helping to provide organic material to stabilize soils, especially along steep slopes.

Landowner Goals

Ultimately, it is up to you, the landowner, to decide if the land is to be managed for agriculture, wildlife, a combination thereof, or something completely different. This on-line tool assists in understanding the degree to which the land has undergone changes from its reference (historic) condition, what stewardship practices can be implemented to undo some of the changes, and sources of funding to implement those practices. The tool also provides landowners a realistic expectation of the results from implementing these practices given the state of degradation from reference conditions.

Using the Tool

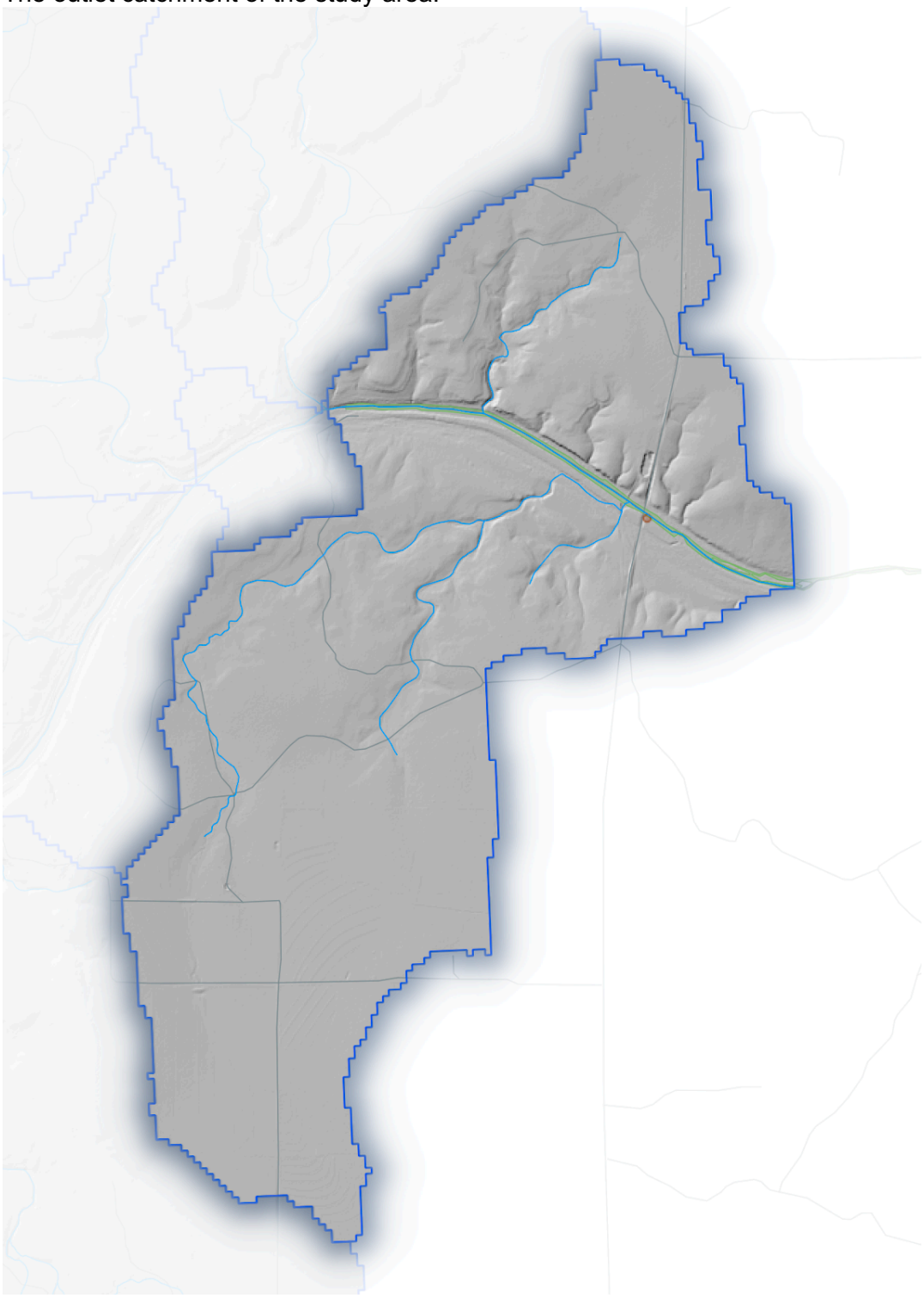
The Nature Conservancy's *LOCA* is unique compared to other watershed management tools based on its array of content and its scale. The content is based primarily on the Natural Resources Conservation Service's (NRCS) Ecological Site Assessments. These assessments, based on soils, utilize a model to describe the state of the plant communities and the potential pathways they may result given certain land-use practices. These unique assessments aid landowners to develop a better understanding of what the land looked like in pre-settlement times, how it has been transformed, and what appropriate management practices, if any, are available to help restore and improve their lands. The Ecological Site Assessments are primarily geared toward assisting agricultural producers, so additional information from Texas Parks and Wildlife, The Nature Conservancy, and other Texas conservation organizations, such as Hill Country Alliance and Texas Riparian Association are included to provide management strategies for landowners interested in an array of stewardship goals.

Traditional watershed plans provide owners with land stewardship suggestions for an entire watershed, one often at scales in excess of several thousand square miles. The LOCA provides landowners suggestions at the catchment, or sub-watershed scale. In the San Saba watershed, these catchments average about 2,000 acres in size.

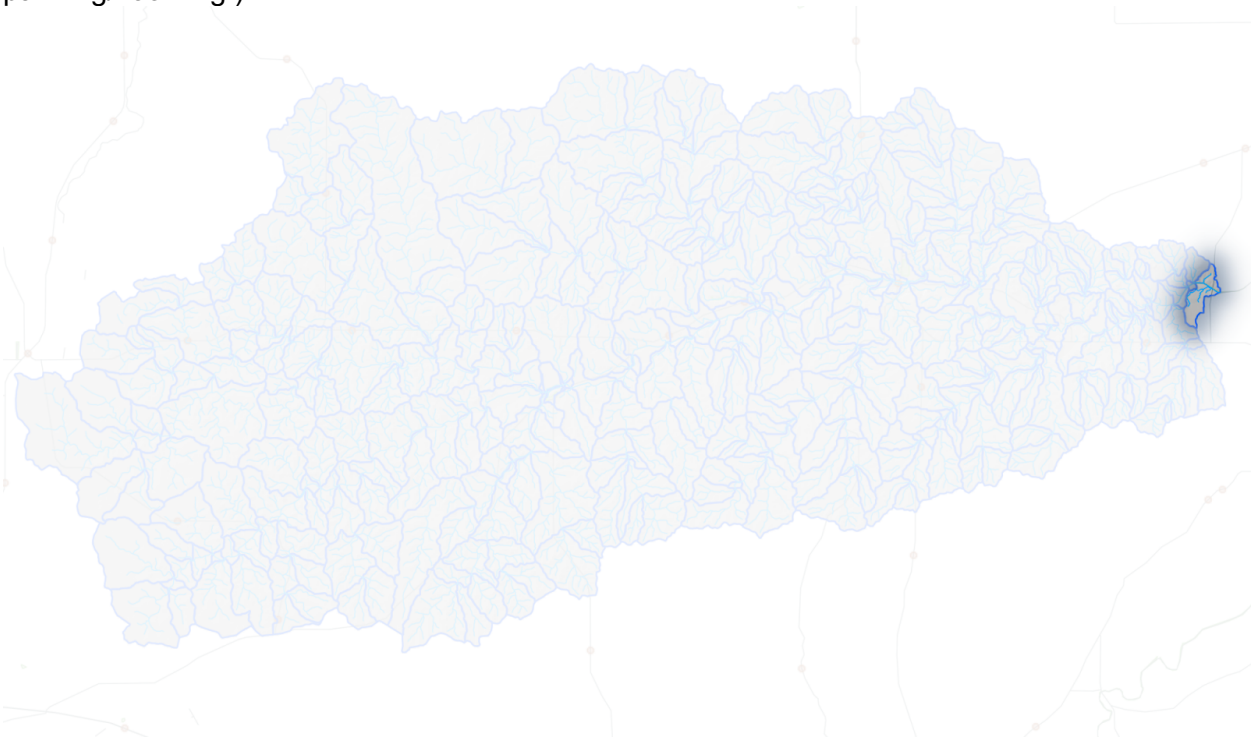
Once a user selects their parcel of land from the display map showing the Upper San Saba, they are provided information regarding the NRCS Ecological Site Descriptions that fall within the selected catchment. In addition, information on hydrology, geology, soils, slope, canopy cover are also provided to assist the landowner with identifying areas within the catchment where additional management considerations, such as slope or canopy cover, are warranted. Information on the location of neighboring parcels within the catchment is also included so that neighbors can partner efforts to improve conditions within their catchment using a list of best management practices and potential sources of funding for implementing these practices.

Catchment ID 43588

The outlet catchment of the study area.



Catchment context map (note that this is for illustration in the Q2 summary only. In the app the end user would have the context because they navigated to that catchment by searching, or panning/zooming.):

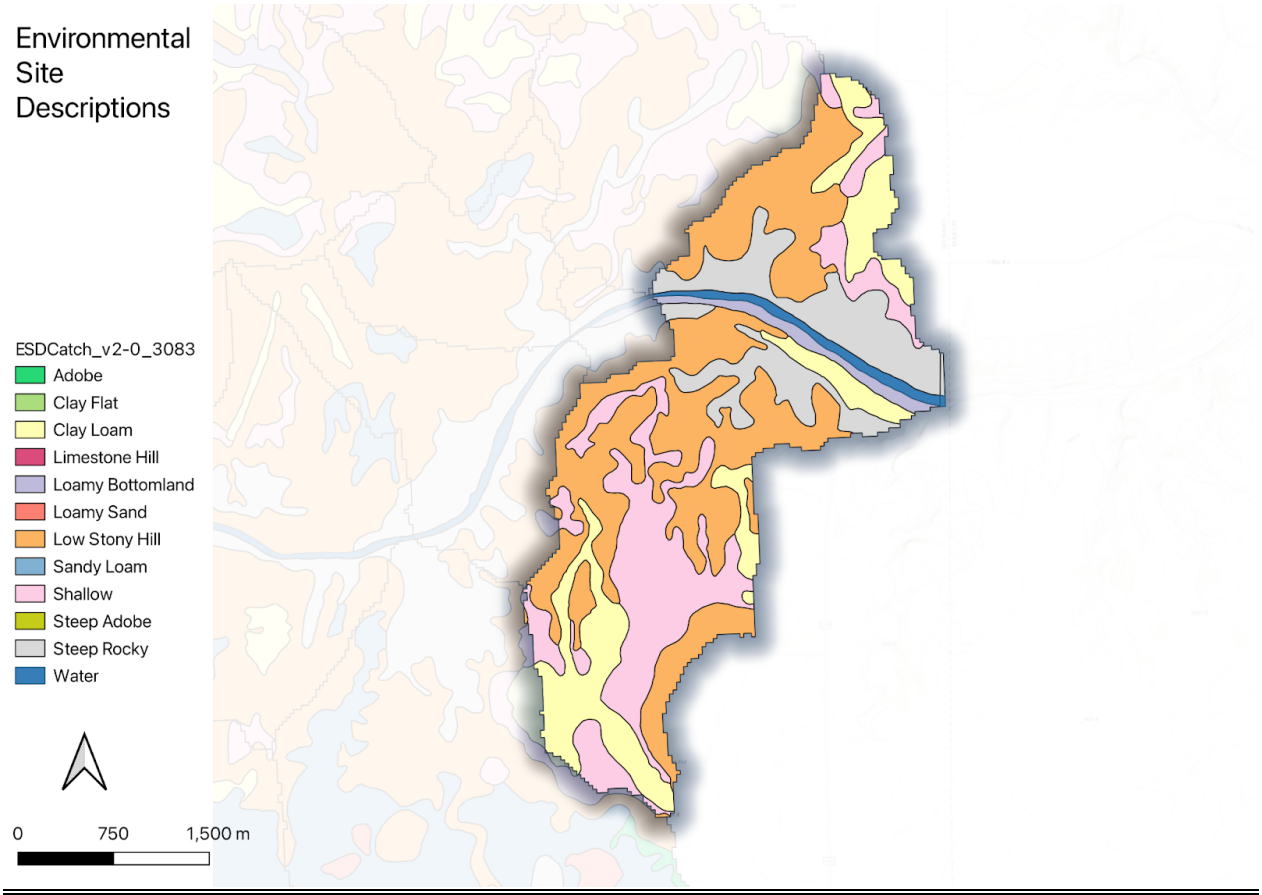


Core Statistics

Statistic	Value
Catchment Size (acres)	2087.4
Average Annual Precipitation (inches)	24.9 - 26.1
911 Service Addresses (total)	1
Number of Wells (total)	6

Environmental Site Descriptions

ESD	Sum of Acres
Clay Loam	380.9
Loamy Bottomland	45.6
Low Stony Hill	835.7
Shallow	473.3
Steep Rocky	312.1
Water	39.9
Grand Total	**2,087.4**



Shallow Ecological Site (R081BY343TX)

The Shallow ecological site is composed of nearly level soils (0-8% slope) underlain by bedrock or caliche. These soil types, Kavett and Mereta, are suitable for cultivation, but due to their shallowness and limited moisture-holding capacity, are primarily used for rangeland.

Mid and Tallgrass Prairie Community (Reference Community)

Shallow: Mid and Tallgrass Prairie Community
(image: Natural Resources Conservation Service)

Before European settlers arrived in the region, mid and tall grasses such as little bluestem and sideoats grama dominated the Shallow ecological site, producing about 90% of the species composition of the community. Canopy cover from woody species, such as live oak and hackberry, covered less than 3% of the surface area and were limited to mottes associated with rock crevices and deeper soils on areas protected from fire. Forbs comprised the remaining vegetation. This historic vegetative distribution is known as the 'reference' community.

The Shallow ecological site is named for its shallow soils, usually only 8-20 inches from the surface layer to bedrock or to a layer of caliche below. In the reference condition, the historic grass cover enhanced the shallow soils, aiding in infiltration of rainfall into the slowly permeable soils and reducing runoff to periods only during extended rains or heavy thunderstorms.

Midgrass/Oak Savannah Community

With overgrazing, a decrease in the frequency and intensity of fires, and no brush management, canopy cover from woody plants quickly increases to 10-25% and the Mid and Tallgrass Prairie transforms into a Midgrass/Oak Savannah. Midgrasses begin to replace

preferable tall grasses and soil litter and mulch is reduced, increasing bare ground and exposing soil to erosion, although erosion may be limited, due to gentle slopes.

Mechanical brush management, along with reduced grazing and prescribed burning are effective methods for controlling the woody plant species. Effective grazing management is the critical tool, as grazing is a driver, or cause of change to the community. Historic grasses, such as little bluestem, are still present but are being out-competed and replaced by more grazing-resistant species such as side-oats grama.

Shallow: Midgrass-Oak Savannah (B1354CE6)

Functional grass cover provides fine fuels and organic matter, necessary for effective burning. In locations where the woody species are less than 5 feet in height, prescribed burning can aid in decreasing these species. Live oaks are adapted to fire and generally remain unharmed with prescribed burns that mimic the historic fire frequency (roughly every 7-12 years).

Oak-Juniper/Shortgrass Community

In the absence of land stewardship, mesquite and/or *Ashe* juniper and other shrubs continue to increase, becoming more dominant, forming thickets, and comprising 25% or greater of the plant canopy. Organic matter and soil structure are reduced, resulting in a decrease in grassland diversity, plant vigor and productivity. Mid-grasses are replaced by short grasses.

Shallow : Oak-Juniper Shortgrass in foreground.

With grassland reduction comes more soil exposure, increasing the opportunities for erosion. Interception rates of precipitation by woody canopy combined with increases in surface evaporation and runoff, can greatly reduce the effectiveness of rainfall, resulting in a drier microclimate.

Lacking sound grazing practices, brush management, and prescribed

burning, the condition of the land will continue to trend towards a woodland community. Good grazing practices alone will not be sufficient reverse the trend; brush management and prescribed burning should also be implemented. As reference-conditions grasses and forbs can still occupy spaces between the woody species, these species may reappear following brush management, taking advantage of the soil organic matter created beneath the tree canopy and the soil moisture once used by encroaching, but now removed, woody species.

Oak/Juniper/Mesquite Woodland Community

By the time the canopy cover of Live oak, *Ashe* juniper, and mesquite reach 35-40%, what once was a prairie has become a woodland. The microclimate continues to become drier (xeric) due to increased interception of precipitation and evapotranspiration by the woody canopy cover. Grasses and forbs comprise 25% or less of the community, and the reference mid and tall grasses are replaced with shortgrasses and low-quality forbs in the tree interspaces. These grasses and forbs are in a weakened condition due to continual shading (especially from juniper), competition from woody plants, and diminished soil health due to exposure to heat. Because there is less vegetation and litter covering the soil, what precipitation does reach the ground, often results in erosion.

Shallow: Oak/Juniper/Mesquite Woodland with greater than 40% canopy cover (img4301)

Landowners should determine where they want to commit their resources to land stewardship. The most practical stewardship approach for lands that have become woodland may be minimal management. Because the reference community grasses are no longer present, the energy and expense required to return this community to some form of grassland is significant, requiring dozing, range planting, grazing deferment, and prescribed burning. Because little vegetation is available to cover the soil following treatment, there is a greater potential for erosion of exposed soils, further hindering the recovery process.

While a woodland community does not represent the original condition and has crossed a functional threshold to support grasslands, the site does provide good habitat cover for wildlife. Soil litter formed beneath the woody canopy will continue to increase, eventually decreasing the potential for erosion.

Converted
Early settlers to the area plowed the Shallow upland soils to convert small, fairly-level tracts to cultivation, growing food, fiber, and hay. Cultivation continues today, with introduced or native annual forage crops in summer and small grains for grazing in winter. Including additional

Shallow: Converted - Inactive cultivation in foreground. Active cultivation in background

legumes and other forbs enhances the productivity of these tracts, especially for wildlife. Some cultivation is supplemented with irrigation from groundwater.

Abandoned
As summer crops in the Edwards Plateau succeed only one in every 4-5 years, some lands originally cleared for cultivation have been abandoned and let 'Go Back' to native pasture. The soil structure and health in these abandoned communities has often been damaged due the development of a 'plow pan', a layer of soil compacted due to plowing. Abandoned areas will usually re-established with brush species from adjacent areas. Without proper reseeding and brush and grazing management, they will become dominated by woody plant species before a grassland community becomes established.

Shallow: Abandoned cultivation becoming dominated by woody plant species (img 4330).

Clay Loam Ecological Site (R081BY326TX)

The Clay Loam Ecological Site is named for its deep clay loams 26-56" thick on slopes 0-3%. These soils, Valera, Nuvalde, Angelo, and Karens have high vegetative production and are used primarily for rangeland, but may be irrigated for vegetables, cotton, corn, and grain sorghum.

Midgrass Prairie Community (Reference Community)

Wildfire in the pre-settlement era in this community was historically very effective due to the level topography, fine-fuel source from grasses, and hot, dry summers. Grasses composed 85-90% of the plant composition, with trees and shrubs comprising less than 5%. Side-oats gramas, little and big bluestem and Indian grass were the primary grasses; live oak and hackberry survived wildfires in scattered mottes.

Most of the precipitation falling on these grasslands was stored in the upper horizons of the soil layer, for ready use by the grasses. Runoff across the flat terrain only occurred following extended or heavy rainfalls; little soil erosion occurred.

Mid and Shortgrass Savannah Community
With Anglo settlement, the periodic wildfires were suppressed and the grasslands overgrazed; ecological changes began. Savannahs replaced midgrass prairies with less vigorous shortgrasses. Woody plants, with deeper roots than the replacement short grasses, began to

Clay Loam: Mid and Shortgrass Savannah (img 4297)

draw water from deeper in the soil. Less competition from grasses and forbs, and less mortality from wildfires, resulted in endemic species such as *Ashe* juniper and mesquite invading the landscape, their canopy sheathing 10-35% of the landscape.

Despite the invasion, there is only a slight decrease in soil cover and organic matter and very little increase in runoff and erosion, due to the level terrain of this community. The transition towards more woody vegetation and less vigorous grasses can be reversed back towards a mid-grass prairie with brush management practices such as prescribed burning and individual plant treatments (*see* Considerations). Grazing management is a critical component of and complement to these land stewardship practices as the preferred mid grasses need an opportunity to recover and fine fuels need to become reestablished to promote effective burning.

Mixed Brush Shortgrass Community
Without land stewardship, mesquite and/or *Ashe* juniper and other shrubs continue to increase in size and density, becoming more dominant and forming thickets. Woody species comprise 40% or more of the plant canopy and brush 20%; grasses comprise 25% of the species composition and forbs 10%.

Under these altered conditions, the water cycle has been significantly altered. The tree and shrub canopy intercepts rainfall and increases evapotranspiration, resulting in more xeric (dry) conditions. Organic matter is reduced, exposing more soil to erosion, and infiltration and the water-holding capacity of the soil is reduced.

Clay Loam: Mixed Brush Shortgrass encroachment (5DD3697B)

At this stage, returning the landscape to a prairie or savannah community cannot be accomplished without extensive and expensive mechanical brush management, range planting, and grazing management. Removing the overstory that is providing some protection to the bare soil beneath, potentially increases the potential for erosion, further hindering the recovery process.

If no stewardship strategies are employed, the Mixed Brush Shortgrass site does provide good habitat cover for wildlife. Soil litter that has formed beneath the woody canopy does increase soil organic matter, decreasing the potential for erosion. Bare ground between the trees, however, has the potential to erode.

Converted
Early settlers to the area plowed upland soils to convert small, fairly-level tracts to cultivation, growing food, fiber, and hay. Cultivation continues today, with introduced or native annual forage crops in summer and small grains for grazing in winter. Some plantings include additional legumes and other forbs to enhance the productivity of these tracts, especially for wildlife. Some cultivation is supplemented with irrigation from groundwater.

Clay Loam: Maintained Converted lands in foreground, Abandoned in background (img 4322)

Abandoned
As summer crops in the Edwards Plateau succeeded only one in every 4-5 years, some lands originally cleared for cultivation have been abandoned, to ‘Go Back’ to native pasture. These areas are usually reestablished with brush species from adjacent areas. Without proper brush and grazing management, they will become dominated by woody plant species before a grass community becomes established.

Low Stony Hill Ecological Site R081BY337TX

The Low Stony Hill Ecological Sites are shallow soils overlying bedrock on undulating hills with 1-15% slope. Rock outcrops are often found on areas with >8% slopes. The primary soil is Tarrant series, the most widespread soil type in the region. Due to the stony and shallow nature of these soils, they sites are entirely used for rangeland.

Midgrass Oak Savannah (Reference Community)

The Midgrass/Oak Savannah Community before the mid-19th century consisted almost entirely of mid and tall grasses such as little bluestem and side oats grama, and big bluestem and Indiangrass where soils were deeper or protected from grazing by rock outcrops and fissures. Woody vegetation, kept in check by competition from grasses and fire, consisted primarily of live oaks and hackberry and covered less than 10% of the land surface.

Low Stony: Midgrass/Oak Savannah Community
(image: Natural Resources Conservation Service)

Small rainfall events proved very effective as they were dispersed by the rock cover and then intercepted by the grassland vegetation and held in reach of the root zone by the underlying bedrock. Rock outcrops and fissures in the bedrock allowed percolation to groundwater. Only during extended rains did much runoff occur.

Low Stony Hill : Midgrass/Oak/Mixed Brush Savannah

Midgrass/Oak/Mixed-brush Savannah Community

With settlement and the resulting overgrazing and suppression of fire, woody species such as oak, *Ashe* juniper, and mesquite, and other brushy species increase in size and density. Higher-quality grasses and forbs begin to transition to less palatable species.

The overall impact of this transition is fairly small, however, perhaps due the shallow bedrock facilitating the maintenance of soil moisture and grassland cover. Overall forage production is not altered, only the plant composition. There is only a slight increase in erosion and loss of organic matter following precipitation events. Evapotranspiration losses change only slightly.

Returning the Midgrass/Oak/Mixed Brush Savannah back to a Midgrass Oak Savannah can be accomplished with brush control such as prescribed burning or removal of woody species. Deferred grazing and on-going grazing management are critical after treatment. On rocky landscapes such as the Low Stony Hill Community, correctly calculating the carrying capacity of the land is a critical calculation (see Considerations).

Oak/Juniper Woodland Community

Without proper treatment, mesquite, juniper, and other shrubs will continue to increase in size and density. Once woody species comprise 30-40% or more of the plant canopy, and grasses account for less than 50% of the forage base, a Woodland Community has developed, the hydrologic cycles has been disrupted, and more significant hydrological responses begin to appear.

The tree and shrub canopy intercepts rainfall and increases evapotranspiration, resulting in more xeric (dry) conditions. Organic matter is reduced, exposing more soil to erosion, and infiltration and the water-holding capacity of the soil is reduced.

Low Stony Hill : Oak Juniper Woodland Community (img4303)

A few of the grasses and forbs prevalent in the reference community are still present, having found protection amongst the rocky outcrops. While this provides some seed source for restoring the landscape to its original state, complete restoration cannot be accomplished without extensive and expensive mechanical brush management, range planting, and grazing management. Without these practices, however, the woodland canopy will continue to thicken.

Closed Canopy Woodland Community

The Closed Canopy Community results when oaks, juniper and/or mesquite exceed 50% of the canopy cover. Only shade tolerant grasses such as Texas winter grass (speargrass) exist in the understory, providing little forage or organic matter. Interception of precipitation by the overstory increases the dryness of the soils and erosion occurs on steeper areas.

Low Stony Hill : Closed Canopy Community (img 4302) NEED TO RETAKE

Restoration of the site requires major brush management and range seeding followed by prescribed grazing management. If the overstory of this community is removed to restore the site, the resulting grass oak/shrub savannah will not be as productive as the original midgrass/oak savannah due to soil losses and reduced water availability. Although there may be remnants of vegetation from the reference community (mid grasses), they are in such a debilitated state that they must be aided with reseeding of native plant species and ongoing grazing and brush management.

Loamy Bottomland R081BY334TX (Riparian)

Loamy Bottomland is an Ecological Site located along the floodplains of intermittent and perennial creeks, and along overflow or flood channels paralleling the San Saba River. Several types of soil occur within the Ecological Site; each having slightly different characteristics and uses, depending on how frequently they are inundated.

The soils of the lowest lying areas, frequently flooded Dev (Ds) and Frio (Fr) soils, are moderately deep and level. However, due to the coarseness of the soil and frequent flooding (historically, twice a year), they are not suitable for cultivation, but can be used for range. As these soils support the riparian zone along the river, their proper management is critical for preserving and enhancing river health.

Further away from the stream and at slightly higher elevations, the upland Frio soils (FcA & FcB) are infrequently flooded (once per 15-30 years) and are some of the best soils in the watershed. They are used extensively for cultivation and irrigation.

Riparian habitats are those areas alongside streams and intermittent draws where vegetation can readily access water; these habitats are in marked contrast to the more-arid uplands. Riparian habitats are critical as they provide numerous benefits including habitat for terrestrial and aquatic wildlife, erosion control, pollution abatement, and water storage.

The thicker and taller vegetation in proximity to the waterways provides habitat and corridors for terrestrial wildlife and provides shade for aquatic species, buffering water temperatures against summer extremes. Organic matter and nutrients washed into rivers from the riparian areas also provides a major source of energy for these aquatic species.

Woody plants, and other organic matter such as fallen limbs and flood debris, slow floodwaters moving across the riparian zone, helping to stabilize and build soils, and decreasing runoff of contaminants from uplands. The root masses of these woody plants also help hold stream banks in place, reducing stream bank erosion and the formation of cutbanks. Floodwaters moving slowly across healthy riparian areas also infiltrate and become stored in the stream bank, later appearing as streamflow during dryer times or recharging the aquifer below.

Mixed-Grass Hardwood Complex Community (Reference Community)

Loamy Bottomland : Mixed Grass Hardwood Complex

During pre-settlement times, the Loamy Bottomland plant community closest to the waterways consisted of a tall grass understory with hardwood woodlands overhead. With the increased moisture availability in these low-lying areas, these sites were more resistant to periodic wildfire, and likely more enticing for migrating buffalo. Less intense wildfires, coupled with periodic heavy grazing disturbance facilitated the establishment of these woody stands. Big bluestem and Indiangrass (tall grass) and side oats grama and little bluestem (mid grass) covered the landscape beneath a scattered-to-thick canopy of pecan, live oak, hackberry, black walnut, and cedar elm. Adjacent to the stream, Switchgrass and Eastern gamma grass and numerous sedges sank their deep roots into the bank, providing additional protection.

Away from the stream, the woody species decreased in density and canopy cover, creating more of a savannah. Average production for the entire community were about 80% grasses, 10% trees, and 10% forbs and shrubs.

Loamy Bottomland : Mid-Grass Hardwood Complex-Need better

Mid-Grass Hardwood Complex Community

Early settlers, unaware of the fragile nature of their riparian lands, often concentrated their livestock along waterways, resulting in degradation of the original plant communities. Mid and tall grasses were replaced by mid and short grasses, reducing the available litter and organic matter covering soil and exposing bare soil to increased erosion, especially during floods. Mesquite and *Ashe* juniper, no longer kept in check by frequent wildfires began to encroach from the uplands into the floodplains. Grasslands were reduced to 60% production, while canopy cover from trees increased to 15-35%.

At this level of encroachment however, the riparian zone is still functioning and helping to maintain the quality and quantity of river flows. Landowners today, can reverse the degradation trend by implementing several management strategies to deter livestock grazing such as off-site watering sources, fencing, and brush berms and avoiding others, especially bulldozing.

Like the early settlers, many landowners today are unaware of the many benefits provided by riparian zones. New residents often immediately mow or clear riparian vegetation to promote a 'park-like' setting. The result is a loss of riparian function and all the associated benefits. Oftentimes, the result is also significant loss of land. The riparian area in the photos below was cleared in January 2018 (left); these lands, void of their natural riparian cover, were scoured away in the October 2018 flood.

Before and after showing October 2018 flood results (right) following bulldozing of riparian area in January 2018.

Following floods, the first temptation is to remove the flood debris. Often, the most effective strategy is to do nothing. Flood debris is an important component for regenerating riparian areas and capturing topsoil. Removing the debris decreases the availability of organic matter to build soil and removes materials that aid in the prevention of erosion. Large woody debris such as trees deposited by floodwaters provide critical protection against erosion and shelter new seedlings from flood flows.

That riparian areas provide good habitat for wildlife is also a bit of a curse. Deer populations are increasing due to removal of their natural predators such as bobcat and mountain lion, but also, due the eradication of the screw worm in the late 1960s. In addition, exotic species such as axis deer, escaped from captivity behind high fences, often utilize riparian areas in great numbers. The increased browsing from these species results in a loss of new growth hardwood species (pecans) and other important species in the riparian zone, raising concerns for the future sustainability of the riparian zones as the older species die off. Constructing exclosures utilizing fencing material or even flood debris can provide protection for these new plants and assist regeneration. Coordinated landowner efforts to remove an overpopulation of these browsing species is also a tasty strategy.

Feral hog populations cause billions of dollars in damage to both land and water. Their wallows and fecal deposition along waterways likely have the biggest impact on water quality in the San

Saba. An effective approach to reducing populations is through coordinated landowner conservation efforts to facilitate the exchange of information, equipment and professional services. More immediate hog-control measures include removing deer feeders from the riparian zone or building low-fences or “exclosures” around them to exclude hogs.

In addition to exotic wildlife, several species of exotic flora also exploit the moist conditions in the riparian zone. *Arundo donax* (giant cane) and elephant ear (*Colocasia esculenta)* along with chinaberry *(Melia azedarach*) are the primary invasive flora in the San Saba. Control of these species is primarily through chemical control by a licensed applicator; Texas Parks and Wildlife’s Healthy Creek Initiative is likely the best place to begin inquiries about controlling these species.

Bottomland Hardwood Community
Once the canopy cover from woody species reaches 40% and the grassland component of the community is reduced to about 25%, returning the land back to its original condition becomes very challenging. Organic matter becomes so reduced that the lands are often scoured by flooding. Restoration requires selective brush management, prescribed burning, prescribed grazing, and expensive native plant and range plantings.

NEED PHOTO
Converted
Early settlers to the area plowed upland soils to convert small, fairly-level tracts to cultivation, growing food, fiber, and hay. Cultivation continues today, with introduced or native annual forage crops in summer and small grains for grazing in winter. Some plantings include additional legumes and other forbs to enhance the productivity of these tracts, especially for wildlife. Some cultivation is supplemented with irrigation from groundwater.

Abandoned
As summer crops in the Edwards Plateau succeeded only one in every 4-5 years, some lands originally cleared for cultivation have been abandoned, to ‘Go Back’ to native pasture. These areas are usually reestablished with brush species from adjacent areas. Without proper brush and grazing management, they will become dominated by woody plant species before a grass community becomes established.

Steep Rocky
R081BY350TX

Need better photo of Steep Rocky-misleading

The Steep Rocky ecological site is composed of shallow soils on upper slopes and hill summits. Slopes range from 20-60% and are about 10 inches deep. As these Tarrant soils are subject to severe erosion, they are only used for rangeland.

Tallgrass Oak/Woodland Community
Traditionally, a mosaic of open grasslands, savannahs and woodlands dominated the Steep Rocky ecological site. Because of the shallow and steep rocky soils, effective precipitation from rainfall is limited to fractured rocks and crevices where enhanced soil moisture can support tall and midgrasses such as little bluestem and side oats grama. Oak and other tree species grow most effectively along north and east facing-slopes in cracks and fissures in the limestone. Due to the lack of fine fuels along these slopes, wildfires were historically less effective than other locations, resulting in historic canopy covers of 15-35%.

Midgrass/Oak/Mixed-brush Community
Overgrazing and a reduction in fires altered the reference Steep Rocky Ecological Site. Woody species such as sumac, acacia and juniper begin increasing in density, increasing the tree and shrub canopy to 40%. The increase in woody species increases competition for grasses and tall grasses give way to more shade-tolerate midgrasses, such as Texas wintergrass.

The trend can be reversed back towards the reference condition with grazing and brush management. Great care should be exercised due to the steep slopes and only hand-cutting or burning of woody species are recommended. Range plantings of native seed can hasten the restoration process.

Oak/Juniper Woodland Community

Steep Rocky - Midgrass/Oak/Mixed Brush (img 3705)

Lacking effective brush management and grazing, the woody canopy will increase to 75%, with junipers comprising about 40-50% of the canopy cover. Tall and midgrasses give way to lesser shade-tolerant species; prickly pear, persimmon, and Algeria occupy non-fractured rocky areas and south-facing slopes.

The site begins to provide only cover and low-quality food for livestock and deer. Only expensive brush management and range plantings, along with grazing management can reverse the trend.

Water

The Water Ecological Site, as defined by NRCS, includes the perennial streams as well as small (5-40 acres), natural or constructed lakes, ponds, or pits that contain water most of the year and are used for livestock water, migratory waterfowl, or other wildlife. The main Water sites are the San Saba River and stock tanks. The vast majority of these areas are located in the eastern half of the Upper San Saba watershed, below Fort McKavett.

The San Saba River between Fort McKavett and the crossing of RR 1311 has no major water quality impairments. The river meets TCEQ standards for primary contract recreation (wading, swimming), aquatic life, and public water supply. Despite having good water quality, there are several opportunities for landowners activities to maintain and improve water quality.

With the exception of Menard residents (which utilize a municipal waste-water treatment facility), rural area residents of the Upper San Saba watershed, rely on on-site sewage facilities, or septic systems, for the disposal of household wastewater. The maintenance of these facilities is the responsibility of the landowner, without which, major problems can arise.

When septic systems fail, wastewater does not receive adequate treatment and can become a source of bacteria, pathogens and nutrients. Inadequate maintenance can be a factor in system maintenance, as can inappropriate design, inappropriate soils, and age. While new systems must be tested when installed, governing bodies do not have adequate resources to do perform follow up inspections. Clay soils may inhibit leaching, resulting in surfacing of wastewater. Plus, systems installed prior to 1989 requirements are not as efficient as new systems and are more prone to failure. Residents with septic systems should learn proper maintenance from (link) and should inspect their systems annually for any sign of failure.

As also mentioned in the section for Loamy Bottomlands, feral hog populations cause billions of dollars in damage to both land and water. Their wallows and fecal deposition along waterways likely have the biggest impact on water quality in the San Saba. The best approach to reducing populations is through coordinated landowner conservation efforts to facilitate the exchange of information, equipment and professional services. More immediate hog-control measures include removing or building exclosures around deer feeders near waterways.

In addition to exotic wildlife, several species of exotic flora also exploit the moist conditions in the riparian zone. *Arundo donax* (giant cane) and elephant ear (*Colocasia esculenta)* along with chinaberry *(Melia azedarach*) are the primary invasive flora in the San Saba. Control of these species is primarily chemical control by a licensed applicator; Texas Parks and Wildlife's Healthy Creek Initiative is likely the best place to begin inquiries about controlling these species.

Some locations on the upper San Saba River are home to several unique mussel species. Mussels are often called the 'Livers of the Rivers' for their natural ability to filter pollutants and sediments to maintain clarity in a water body. Two species, the Texas Fatmucket and Texas Pimpleback are proposed for listing on the Endangered Species List due to decreases in water quality, loss of stream flow, riparian and instream habitat fragmentation and degradation of stream habitats. The Texas Fawnsfoot is proposed for listing as 'Threatened'.

The Clear Creek Gambusia, a small fish found only in Clear Creek in Menard County, was listed as Endangered in 1967.

Important Considerations

Grazing Management-

1) With grazing management, it is important to utilize accurate stocking rates based on effective grazing acreage. Some lands, due to rock outcrops, dense vegetations and slope should not be accounted as available for grazing, thus reducing the available acreage. Additionally, browsing pressure on the lands should also account for the presence of wildlife and exotics. With the eradication of the screwworm fly, suppression of natural predation, and increase in woody vegetation for cover, deer populations have increased in excess of carrying capacity in areas. The increase in exotic populations further encourages over browsing. The effects of increasing drought conditions should also be factored into the equation.
2) Stacked brush can be used to discourage livestock access where terrains are too rocky to erect fence posts.

Brush Control

1) To not promote additional erosion, brush control should generally be limited to slopes of less than 12%.
2) Old growth

Prescribed Burning

Spraying-Considerable care should be taken so as not to contaminate nearby vegetation or waterways.

While shrublands within the Upper San Saba have traditionally been viewed as “degraded” relative to livestock production, it is important to recognize that they are not necessarily degraded from the ecological perspective of primary productivity, biomass accumulation, nutrient cycling, and biodiversity. The productivity of shrublands may be equal to or greater than that of the grassland they replaced. In addition, shrubs help modify soils and microclimate to increase levels of organic matter and nutrients in the upper soils horizons. This nutrient enhancement by shrubs can offset grazing-induced losses of soil nutrients and contribute to enhance grass production when shrub cover is reduced. While shrub communities may have adverse impacts on grasses and grassland fauna, other plants and animals may benefit. Thus, while ecosystem biodiversity certainly changes, it does not necessarily decrease with a shift from grass to woody dominance on these sites.