The San Saba River (0E3E9942)

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 of 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 edge of the Edwards Plateau to expose water in 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. The changes have the potential to decrease the water quality and quantity of the the river.

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

The majority of the information provided for this application comes from the Natural Resources Conversation Service Ecological Site Descriptions. These descriptions are based on…

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 but 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. As a result, lands were overstocked with cattle, sheep and goats, resulting in a reduction in grasses and organic matter. Settlers also reduced the frequency of fires and what fires did occur were less intense due to lack of organic matter. These activities upset the vegetative balance that had existed for centuries 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.

Today, landowners have opportunities to reverse the trend towards woody plant encroachment using techniques such as grazing and brush management and prescribed burning in appropriate areas of each catchment. The Natural Resources Conservation Service (NRCS) has prepared Ecological Site Assessments based on soils to help landowners 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.

<u>Ecological Site Assessments</u>
The Ecological Site Assessments for this catchment include:
- Shallow
- Clay Loam
- Low Stony Hill
- Steep Adobe
- Draw
- Water (mussels)

Shallow Ecological Site

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

Mid and Tallgrass Prairie Community (Reference Community)

Before European settlers arrived to the region, mid and tall grasses such as little and big bluestem and Indiangrass dominated the Shallow ecological site, covering about 90% of the community. Woody species, such as live oak and hackberry covered less than 10% 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.

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

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 in this phase, 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. 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. Better 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).

Shallow: Midgrass-Oak Savannah (B1354CE6)

Oak-Juniper/Shortgrass Community

Failing land stewardship, mesquite and/or juniper and other shrubs continue to increase, becoming more dominant, forming thickets, and comprising 25% or greater of the plant

Shallow-Oak-Juniper Shortgrass in foreground. Oak/Juniper/Mesquite Woodland in background (D5DE0249).

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.

With grassland reduction comes more soil exposure, increasing the opportunities for erosion. Higher interception losses from woody canopy, combined with increases in evaporation and surface runoff reduce the effectiveness of rainfall. The microclimate within the grassland becomes drier.

Without good 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

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

the woody species, these species may reappear following brush management, taking advantage of the soil organic matter created beneath the tree canopy.

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 micro climate within the resulting community becomes 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. These grasses and forbs are in a weakened condition due to continual shading (especially by juniper) and competition from woody plants. Because there is less vegetation and litter covering the soil, what precipitation does reach the ground, often results in erosion.

The best stewardship approach for lands that have become woodland may be minimal management. 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 will be 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, the site does provide good habitat cover for wildlife. Soil litter formed beneath the woody canopy will continue to increase, eventually stabilizing with the climate and beneath and 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 legumes and other forbs will enhance the productivity of these tracts, especially for wildlife. Some cultivation is supplemented with irrigation from groundwater.

Shallow: Converted - Inactive cultivation in foreground. Active cultivation in background (img4313).

Abandoned

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

As summer crops in the Edwards Plateau succeeded only one in every 4-5 years, some lands originally cleared for cultivation have been abandoned and let ‘Go Back’ to native pasture. These areas will 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.

Clay Loam

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

Midgrass Prairie Community

This Midgrass Prairie Community, in the pre-settlement era, was historically very responsive to fire due to its level topography and hot, dry summers. Grasses composed 85-90% of the plant composition, with trees and shrubs less than 5%. Side-oats grams, 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. Midgrass prairies were replaced with savannahs composed of less vigorous shortgrasses. Woody plants have deeper roots than the replacement short grasses and draw water from deeper in the soil. With less competition from grasses and forbs, and less mortality from wildfires, endemic species such as live oak, *Ashe* juniper and mesquite began to invade the landscape, their canopy sheathing 10-35% of the landscape.

Clay Loam: Mid and Shortgrass Savannah (img 4297)

Despite the invasion, there is only a slight decrease in soil cover and organic matter but very little increase in runoff and erosion, due to the fairly level terrain of this community. The transition towards more woody vegetation and less vigorous grasses can be reversed back to a mid grass prairie with brush management practices such as prescribed burning and mechanical or chemical applications to the plant stem or leaf (*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, 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 diminished conditions, 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. Less water is available to return to the aquifer.

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 the overstory is removed, one alternative is to plant crops or pasture to expedite the recruitment of ground cover over the bare soils.

Clay Loam: Mixed Brush Shortgrass encroachment (5DD3697B)

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

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

The Midgrass/Oak Savannah Community before the mid-19th century (reference community) 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. 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)

During reference conditions, small rainfall events proved very effective as they were 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.

Midgrass/Oak/Mixed-brush Savannah Community

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

Low Stony Hill - Midgrass/Oak/Mixed Brush Savannah

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 remains high, and 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 woody plant 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 had developed, 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. Groundwater recharge is reduced.

Returning the landscape to its original state 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.

Low Stony Hill - Oak Juniper Woodland Community (img4303)

Closed Canopy/Toxic Plant Community

The Closed Canopy Community result 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. Transpiration from the overstory increases desertification of the soils and erosion occurs on steeper areas.

Low Stony Hill - Closed Canopy/Toxic Plant 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.

Steep Adobe

The scenic and very fragile Steep Adobe Hill Ecological Sites contain shallow soils less than 20 inches deep on uplands greater than 20% slopes. These sites tend to be adjacent to rivers or larger ephemeral creeks. Slopes around 20% tend to have deeper soils, above average soil moisture, and more grass cover. Slopes ranging from 20-50% tended to be rockier, droughtier, and less productive. The Tarrant-Brackett soils associated with Steep Adobe is not conducive to cultivation.

Steep Adobe in foreground along San Saba River (C45B4210)

Mid and Tallgrass Savannah Community
Prior to the mid 19th century, savannah composed of mid and tall grasses with scattered trees and shrubs covered Steep Adobe Site. Grasses, primarily little bluestem, accounted for approximately 75% of the vegetative cover. Overstory species such as oaks and junipers accounted for 10-15%, while forbs accounted for the remainder.

Due to low natural fertility in the soil and the steep terrain, runoff rates can be high and soil infiltration low. The good vegetative ground cover and organic matter of pre-settlement times helped slow runoff, increase infiltration, and limit erosion.

With the arrival of early settlers, overgrazing caused considerable impact on this community. Due to its proximity to streams, vegetation and soils were particularly impacted by livestock accessing and crowding around water. The practice of utilizing fencing around streams as a conservation tool to limit occupancy did not occur until later times.

Mid and Shortgrass Savannah Community
Changes came quickly to this fragile community. The dominant grasses mid and tall grasses declined and gave way to less desirable mid and shortgrass. Woody species, especially *Ashe* juniper and mesquite double, expanded their canopy cover to about 30%. Soil organic matter declined, infiltration decreased, and runoff increased, resulting in erosion. The resulting loss of topsoil and organic matter make it difficult for the historic grasses to return to some areas, even if stressors are removed.

Steep Adobe - Mid and Shortgrass Savannah (img 3705)

However, the decline of the original plant community can be revered, especially on lower slopes, with relatively small labor and cost. Grazing management techniques, essential to stopping the decline of preferred grasses, can include fencing of riparian areas where necessary and installation of watering facilities away from streams (offsite). Prescribed burning can also be effective, especially on juniper under 4 feet tall, or through mechanical individual plant treatment (chainsaw). Extra caution should be exercised on steep slopes to not further enhance erosion.

Offsite Watering Source (img 3730)

Oak/Juniper/Shrub Complex

The Mid and Shortgrass Savannah community deteriorates rapidly to an Oak/Juniper/Shrub Complex unless stewardship practices are implemented. Woody species can quickly dominate slopes, out-completing even the short and mid grass understory, resulting in further issues associated with organic matter, infiltration and erosion. Up to 80% of the ground can be bare of herbaceous vegetation. Large gullies can result.

Steep Adobe- Oak/Juniper/Shrub complex in foreground. San Saba River in background

With the exception of the lower slopes in this community, the potential for restoring this community back to the reference state within a reasonable timeframe is extremely low. Much of the original soil, original species diversity, and hydrologic function have been lost. Brush management on the terrain is usually prohibitively expensive. Reducing grazing by livestock, however, can assist in the development of desirable wildlife habitat and the recreational opportunities that it provides.

Draw

Draws are a critical Ecological Site located along the floodways of intermittent and perennial creeks. Draws also occur along overflow or flood channels paralleling the San Saba River. As the Dev soils associated with this site are primarily flood deposits, they are moderately deep, but rather stoney. With the coarseness of the soil and frequent flooding, the soils are not suitable for cultivation, but they can be used for range. They can also be used enhance water supply, with proper management.

During pre-settlement times, the plant community in Draws consisted of a mid and tall grass savannah composed of switchgrass, Indiangrass, and side oats grama, along with others. Because of the increased moisture availability in these low-lying areas, these sites were more resistant to periodic wildfire facilitating the establishment of scattered to thick stands of woody species such as live oak, hackberry, little walnut and pecan and cedar elm, forming a riparian habitat.

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 shades for aquatic species, buffering water temperatures against summer extremes. Organic matter and nutrients washed into the water 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.

Early settlers, unaware of the fragile nature of their riverine 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, and woody species such as mesquite and Ashe juniper began to encroach from the uplands into the floodplains.

Like the early settlers, many landowners today are unaware of the many benefits provided by riparian zones. Recently purchased tracts are often immediately mowed or cleared of riparian vegetation to promote a ‘park-like’ setting more familiar to urban residents. The result is a loss of riparian function and all the associated benefits. Oftentimes, the result is also significant loss of land (photos).

There are several management strategies for improving and protecting riparian zones. Often, the most effective strategy is to do nothing. Following high-water events, flood debris important for regenerating riparian areas is often removed to clean-up the area. 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 result in a loss of new growth 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 plant 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. 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.

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.

Hydrology?-quick facts…gain losses
Water Quality?
Septic tanks
Feral hogs-see Draws-or move here from draws
Mussels
Clear Creek Gambusia

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.