Ecological site R036XC013UT
Southwestern Plateau Riparian Complex Intermittent (Valley Type IV - F4/B4C Stream Type)

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General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

MLRA notes

Major Land Resource Area (MLRA): 036X–Southwestern Plateaus, Mesas, and Foothills

This MLRA is in New Mexico (58 percent), Colorado (32 percent), and Utah (10 percent). It makes up about 23,885 square miles (61,895 square kilometers). The major towns in the area are Cortez and Durango, Colorado; Santa Fe and Los Alamos, New Mexico; and Monticello, Utah. The city of Grand Junction in Colorado, and Interstate 70 are just outside the northern tip of this area. Interstate 25 crosses through the middle of the MLRA, and U.S. Highway 550 runs along the MLRA's southwest boundary in New Mexico. Mesa Verde National Park and the Bandelier, Hovenweep, Natural Bridges, Yucca House, and Colorado National Monuments are in the area. Many Indian reservations are in this MLRA. The largest are the Southern Ute, Ute Mountain, and Jicarilla Apache Reservations. Also in the area are the Cochiti, Jemez, Nambe, Navajo, Picuris, Pojoaque, San Felipe, San Ildefonso, San Juan, Sandia, Santa Ana, Santa Clara, Santa Domingo, Taos, Tesuque, and Zia Reservations.

This MLRA is within the Intermontane Plateaus Region. It is mainly in the Canyon Lands and Navajo Sections of the Colorado Plateau Province, partly in the Mexican Highland Section of the Basin and Range Province, and extends marginally into the Southern Rocky Mountains Province. Underlying sedimentary rock controls the landforms seen in most places, but fluvial landforms are in the Rio Grande Rift Basin at the southeastern portion of the MLRA. The elevation is commonly 4,600 to 8,500 feet (1,400 to 2,590 meters) and is generally highest (as high as 9,300 feet or 2,835 meters) in the foothills and high mesas that border the Southern Rocky Mountains. Relief is typically less than 1,500 feet (455 meters). The upper reaches of the Rio Grande and San Juan Rivers and their tributaries are in the part of this MLRA, near the Colorado and New Mexico state lines. The Rio Puerco and Rio Chama Rivers are in the New Mexico part of the MLRA. The Dolores and San Miguel Rivers are in the Colorado part of the MLRA, and a short reach of the Colorado River crosses this MLRA near the Utah and Colorado state lines.

Predominantly horizontal sedimentary beds from the Jurassic, Cretaceous, and Tertiary Periods underlie most of the MLRA. Representative formations are the Morrison Formation, Dakota Sandstone, Mancos Shale, Cliff House Sandstone, and other members of the Mesa Verde Group, including the Animas Formation and the San Jose Formation. The sedimentary rocks have eroded into plateaus, mesas, hills, and canyons. Thick eolian deposits from the Pleistocene Epoch blanket the tops of mesas in some areas. Small areas of Tertiary and Quaternary volcanic rocks, including cinder cones and lava flows, are in the Rio Grande Rift Basin in New Mexico. Broad valleys in the rift basin have accumulations of deep alluvial sediments, and fan remnants are commonplace.

The dominant soil orders in this MLRA are Alfisols, Inceptisols, Mollisols, Entisols, and Aridisols. The soil moisture regime is mainly ustic, but an aridic soil moisture regime that borders on ustic is present in some areas. The soil temperature regime is mesic or frigid. Mineralogy is dominantly mixed or smectitic. In warmer places of the MLRA, shallow Ustorthents (Menefee Series) formed in residuum on shale hills and mesas. Shallow Haplustalfs (Arabrab Series) and Torriorthents (Rizno Series) formed in material weathered from sandstone on mesas, hills, and cuestas. Moderately deep, loamy Haplargids (Gapmesa Series) and very deep, loamy Haplustalfs (Orlie series) formed in slope alluvium derived from sandstone and shale on mesas or fan remnants. Very deep, clayey Haplustepts (Roques series) formed in alluvium derived from shale on valley sides. Very deep, silty Haplustalfs (Cahona and

Wetherill Series) formed in eolian deposits on hills and mesas. In cooler places, very deep, clayey Haplustalfs (Goldbug Series) formed in slope alluvium derived from sandstone and shale on hills and mesas. Shallow Argiustolls (Fivepine Series) formed in slope alluvium and residuum derived from sandstone. Moderately deep Argiustolls (Nortez Series) formed in eolian deposits derived from sandstone on hills and mesas.

LRU notes

MLRA 36X is in the Colorado Plateau, a physiographic province existing throughout eastern Utah, western Colorado, western New Mexico, and northern Arizona. Uplifted plateaus, canyons, and other land features formed by erosion are characteristic of the MLRA. The Colorado Plateau lies south of the Uintah Mountains, north of the Mogollon Rim in the Transition Highlands, west of the Rocky Mountains, and east of the highlands in central Utah. MLRA 36X is in the higher-elevation portion of the Colorado Plateau, which has

broken topography and lacks perennial water sources. This MLRA has a long history of use by prehistoric humans, and archaeological evidence indicates their activities modified the native pinyon-juniper woodlands. Additional alterations to the native conditions of the area occurred at the time of European settlement (Cartledge and Propper, 1993). Historically, this area also included the natural influences of herbivory, fire, and climate. However, the area rarely served as a habitat for large herds of native herbivores or large, frequent fires due to the broken topography. This ecological site is highly variable, and plant community composition varies in response to water fluctuations.

The lower part of MLRA 36X developed under climatic conditions of hot and dry summers, summer rain showers, mild winter temperatures, and little to no snow. This area has climatic fluctuations, ranging from above-average annual precipitation to years of drought, and prolonged droughts are commonplace.

Forbs are the most dynamic vegetative component of the plant communities in the MLRA, and species composition can vary up to fourfold on any given ecological site (Passey et al., 1982). The precipitation and climate of MLRA 36X are conducive to producing pinyon-and-juniper and sagebrush complexes and highly-productive sites at the bottoms of canyons. The dominant species in the Colorado Plateau are Wyoming big sagebrush (Artemisia tridentata var. wyomingensis), mountain big sagebrush (Artemisia tridentata var. vaseyana), and black sagebrush (Artemisia nova), basin big sagebrush (Artemisia tridentata ssp. tridentata), Utah juniper (Juniperus utahensis), oneseed juniper (Juniperus monosperma), and twoneedle pinyon (Pinus edulis). Oneseed juniper can discontinue active growth under limited moisture conditions and resume growth when moisture availability improves. This growth pattern may represent a critical adaptation allowing them to survive on very arid sites. It is possible that drought may kill small trees, but mature oneseed junipers are resilient to drought, especially in comparison to twoneedle pinyon (Johnsen, 1962).

The Land Resource Unit (LRU) has 10 to 16 inches of annual precipitation and a mesic soil temperature regime. The LRU is in the lower part of MLRA 36X and is dominated by monsoons in summer, unlike the upper part of MLRA 36X.

Classification relationships

Vegetation Classification and Mapping Project Report, Natural Bridges National Monument (Coles et al. 2008)
Populus deltoids (ssp. wislezenii, ssp. monilifera)/*Salix exigua* (PCC3 and PCC2)
Populus deltoids (ssp. wislezenii, ssp. monilifera)/Artemisia tridentata (PCC3)
Populus fremontii/Salix (ligulifolia, lutea) (PCC3 and PCC2)
Salix exigua/Mesic graminoids (PCC2 and PCC1)

Ecological site concept

The Southwestern Plateau Riparian Complex Intermittent (Valley Type IV - F4/B4C Stream Type) ecological site covers intermittent riparian complexes in MLRA 36X. This site is intermittent with interspersed ephemeral reaches. Stream flow occurs during spring runoff and summer monsoonal rainfall events. It can be episodic, changing from no flow to high flow rapidly. The episodic nature of water flow in this system is typical of desert streams influenced by monsoonal rain patterns. These riparian complexes have developed within a natural canyon (Valley Type IV) and have very narrow and patchy riparian vegetation corridors. The dominant vegetation is Fremont cottonwood (Populus fremontii, with scattered Populus angustifolia and Populus xhinkleyana), coyote and yellow willow, and mixed grasses and forbs. This complex is dependent on a natural hydrology (i.e. annual and storm induced flooding).

It is characterized by a B4c or F4 stream type that ranges from cobbly to sandy alluvium, with a typical gravelly bed material. Grade control is present as exposed bedrock within the channel. The channel is also constrained by the canyon walls. The parent material is composed of sandstone from White Rim and Cedar Mesa formations. The canyon bottoms have a single active channel with associated flood plains and a series of terraces. There are three native plant community components that are patchy but repeated longitudinally throughout the riparian complex on different fluvial surfaces including the herbaceous community found within the bank zone at or below bankfull, shrub community within the over bank zone between bankfull and flood prone, and mature cottonwood on terraces, above flood prone width (see Hoag et al. 2001 for zones).

Associated sites

R036XY405CO	**Loamy Bottom** The Loamy Bottom site occurs on adjacent stream terraces.

Table 1. Dominant plant species

Tree	(1) *Populus fremontii*
Shrub	(1) *Salix exigua*
Herbaceous	(1) *Juncus arcticus subsp. littoralis*

Physiographic features

This ecological site is located in the Canyon Lands section of the Colorado Plateau province of the Intermontane Plateaus. The ecological site is characterized by narrow canyons and restricted riparian complex development. This site occurs on flood-plains, flood-plain steps and terraces. Run-off is low and is influenced by micro-topography. The valley slope is between 0 and 3 percent.

Fluvial Surface/Landform 1/PCC1: Flood plain (bank zone)
Minimum, Maximum
Water Table Depth (inches): 30, >60
Flooding Frequency: Frequent
Flooding Duration: Brief
Ponding Depth (inches): none
Runoff Class: Very low

Fluvial Surface/Landform 2/PCC2: Flood plain step (overbank zone)
Minimum, Maximum
Water Table Depth (inches): 30, >60
Flooding Frequency: Frequent
Flooding Duration: Brief
Ponding Depth (inches): none
Runoff Class: Very low

Fluvial Surface/Landform 3/PCC3: Low terrace (terrace)
Minimum, Maximum
Water Table Depth (inches): 60
Flooding Frequency: Occasional
Flooding Duration: Very brief
Ponding Depth (inches): None
Runoff Class: Very low

The table below provides a range for all of the fluvial landforms.

Table 2. Representative physiographic features

Landforms	(1) Flood plain (2) Flood-plain step (3) Terrace
Flooding duration	Brief (2 to 7 days) to very brief (4 to 48 hours)
Flooding frequency	Frequent to occasional
Ponding frequency	None
Elevation	5,600–6,200 ft
Slope	0–3%
Water table depth	30–60 in
Aspect	Aspect is not a significant factor

Climatic features

The climate is characterized by warm summers and cool winters. The climate is modified by local topographic conditions, such as canyon shading. Mean annual high temperature is 64 degrees Fahrenheit and mean annual low temperature is 37 degrees Fahrenheit. Much of the rainfall occurs as convective storms in late summer and early fall; about 20 to 30 percent of the total precipitation falls in July and August. Snowpack is generally light and not persistent; about 15 to 20 percent of the total precipitation falls as snow. May and June are typically the driest months. The average annual precipitation is between 11 and 15 inches.

Table 3. Representative climatic features

Frost-free period (average)	163 days
Freeze-free period (average)	190 days
Precipitation total (average)	15 in

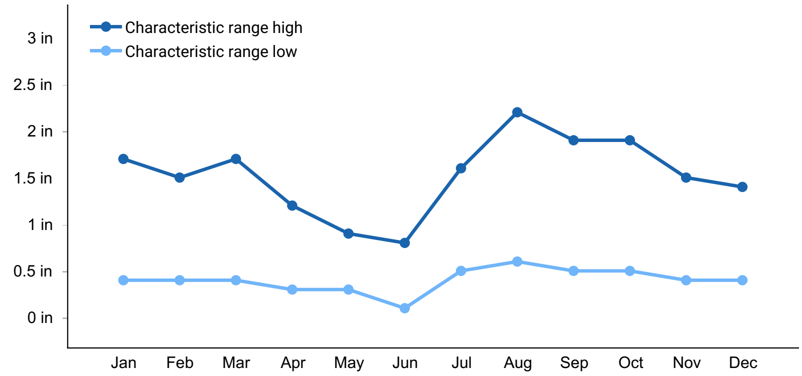


Figure 1. Monthly precipitation range

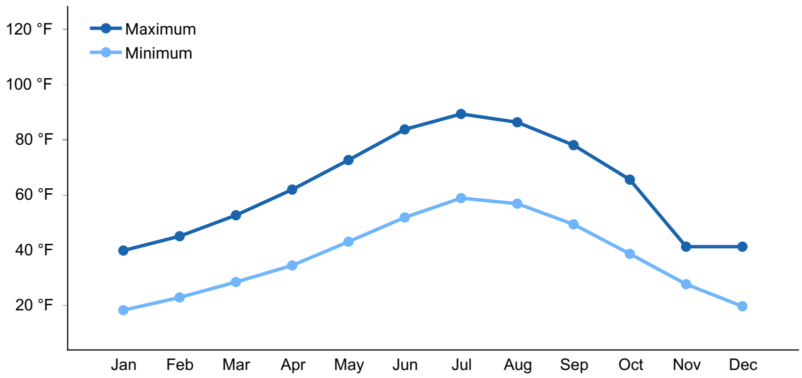


Figure 2. Monthly average minimum and maximum temperature

Influencing water features

This site is an intermittent and ephemeral fluvial system with little groundwater influence. Most water is from runoff from snowmelt in the spring and from summer rain storms, which is typical for the area. Water remains in deep pools and areas where there is bedrock beneath the surface to perch the water table. Water chemistry is neutral and non-saline (fresh).

Valley Type: Valley Type IV consists of canyons and gorges with gentle elevation relief and valley floor gradients. This valley type is generally structurally controlled and incised in highly weathered material. Alluvial sediments occupy the valley floor. Sediment supply is generally moderate to high.

Reference Stream Types: The B4c stream types are systems that are moderately entrenched with a moderate gradient. They are typically riffle dominated with infrequently spaced pools. The channel bed material is dominated by gravels, but the material ranges from silt to cobble sized material. B4c stream types are generally very stable in plan and profile with stable banks. The “c” notation after the stream type indicates that the slope is less than two percent. Also typical of this site are F4 stream types.

The F4 stream type is entrenched and deeply incised. The top of bank elevation for the F stream type is much greater than the bankfull stage, which indicates deep entrenchment. This stream type generally has slopes that are less than two percent, exhibit riffle/pool features and width to depth ratio that are high to very high. Sediment supply can be moderate to high depending on the erodibility of the stream banks. Depositional features are common in this stream type and over time may develop into a floodplain inside of the bankfull channel, leading to a B4c stream type in this particular ecological site.

The stream type may be dependent on the width of the valley within the canyon walls. Where the canyon is narrow, an “F” channel predominates and where the canyon is wider, a “Bc” channel predominates.

Channel Materials: Sand, Gravel and Cobbles, finer material is generally found on stream banks and coarser material is found in the channel bed

Stream Succession Scenario: F4 or B4c G4c F4 B4c (entrenched)

Channel Evolution Stage: I II III II V

Delineative Criteria F4 Channel Type (low, high):
Entrenchment Ratio: 1.0, 1.4
Width/Depth Ratio: 12, 84
Sinuosity: 1.5, 2.0
Slope Range: 0.0001, 0.02
Channel Materials D50 (mm): 0.5, 1.0
Channel Materials D84 (mm): 12, 16

Delineative Criteria B4c Channel Type (low, high):
Entrenchment Ratio: 1.4, 2.17
Width/Depth Ratio: 10.7, 36.7
Sinuosity: 1.2, 1.7
Slope Range: 0.002, 0.02
Channel Materials D50 (mm): 16, 24
Channel Materials D84 (mm): 64, 96

Soil features

This ecological site is characterized by soils formed in alluvium derived from sandstone. The soil is excessively drained to moderately well drained, with rapid permeability in the upper 10 inches of soil. The soil is deep with greater than 60 inches to bedrock. The soil texture at the surface is loamy fine sand on the floodplain steps and extremely cobbly sand on the floodplain and stream banks. Other soil textures found on the site are coarse sand, fine sand, very fine sandy loam and sand. Surface and subsurface coarse fragments are less than 5 percent by cover or volume on the floodplain step and 40 to 65 percent surface fragments and 0 to 50 percent subsurface fragments on the floodplain and stream banks. The available water capacity is 6.0 to 7.1 inches and the pH is 7.9 to

8.4. Soils are non-saline and moderately alkaline. The soil temperature regime is mesic and the soil moisture regime is aridic ustic to ustic aridic.

Soils associated with this site include the Natural Bridges National Monument (UT 638 subset), Levante family soils located on higher terraces, and Levante family, frequently flooded soils (73) located on flood plain-steps.

Fluvial Surface/Landform 1/PCC1: Flood plain(bank zone)
Parent Materials - Kind: Alluvium derived from sandstone
Bedrock - Kind: sandstone
Typical Surface Texture (<2mm): sand
Surface Texture Modifier: Extremely cobbly
Minimum, Maximum
Surface Fragments =10” (% cover): 40, 65
% Coarse Fragments >2mm (% volume in 10–20” layer): 0, 50
Drainage Class: moderately well drained
Permeability Class: rapid
Depth to Bedrock (inches): >60
Electrical Conductivity (mmhos/cm): 0, 2
Sodium Absorption Ratio within 16” Depth: 0
Calcium Carbonate Equivalent within Surface 10”: 2
Soil Reaction within Surface 4 Inches:7.9, 9
Available Water Capacity (inches):6.6

Fluvial Surface/Landform 2/PCC2: Flood plain step (overbank zone)
Parent Materials - Kind: Alluvium derived from sandstone
Bedrock - Kind: sandstone
Typical Surface Texture (<2mm): sand
Surface Texture Modifier: Extremely cobbly
Minimum, Maximum
Surface Fragments =10” (% cover): 40, 65
% Coarse Fragments >2mm (% volume in 10–20” layer): 0, 50
Drainage Class: excessively drained
Permeability Class: rapid
Depth to Bedrock (inches): >60
Electrical Conductivity (mmhos/cm): 0, 2
Sodium Absorption Ratio within 16” Depth: 0
Calcium Carbonate Equivalent within Surface 10”: 2
Soil Reaction within Surface 4 Inches: 7.9, 9
Available Water Capacity (inches): 6.0, 7.1

Fluvial Surface/Landform 3/PCC3: Terrace (low terrace)
Parent Materials - Kind: Alluvium derived from sandstone
Bedrock - Kind: Sandstone
Typical Surface Texture (<2mm): Loamy fine sand
Surface Texture Modifier: Sandy
Minimum, Maximum
Surface Fragments =10” (% cover): 0, 35
% Coarse Fragments >2mm (% volume in 10–20” layer): 0
Drainage Class: Excessively drained
Permeability Class: Rapid
Depth to Bedrock (inches): >60
Depth of Fine Roots (1-2mm): 60
Electrical Conductivity (mmhos/cm):0, 2
Sodium Absorption Ratio within 16” Depth: 0
Calcium Carbonate Equivalent within Surface 10”:5
Soil Reaction within Surface 4 Inches: 7.9, 9.0
Available Water Capacity (inches): 4.7

The tables below provide a range of characteristics from all fluvial landforms.

Table 4. Representative soil features

Parent material	(1) Alluvium–sandstone
Surface texture	(1) Extremely cobbly sand
Drainage class	Moderately well drained to excessively drained
Permeability class	Rapid
Soil depth	60 in
Surface fragment cover <=3"	40–65%
Surface fragment cover >3"	40–65%
Calcium carbonate equivalent (Depth not specified)	5–10%
Electrical conductivity (Depth not specified)	0–2 mmhos/cm
Sodium adsorption ratio (Depth not specified)	0
Soil reaction (1:1 water) (Depth not specified)	7.9–9
Subsurface fragment volume <=3" (Depth not specified)	0–50%
Subsurface fragment volume >3" (Depth not specified)	0–50%

Ecological dynamics

FLUVIAL GEOMPRPHOLOGY, CHANNEL EVOLUTION, AND STREAM TYPE SUCCESSION OF THE SITE: The natural gorges in this MLRA have low gradient F channels that are efficient at moving water and sediments downstream, because of the high flows that can occur after storm events. These channels can be very stable when controlled by bedrock and bank vegetation. There is also a B4c channel that has developed a wider floodplain and low terraces that support cottonwoods. This stream type occurs in channel segments where there is additional width to the valley bottom. In areas where the valley is wider, there is more room for the stream to meander and create a flood plain. The streams within this site are predominantly intermittent with interspersed ephemeral sections. This occurs because of the bedrock control in the canyon bottom. In sections where the bedrock is closer to the surface, the water table is perched, where the bedrock is deeper, the water table drops creating the sections of intermittent and ephemeral flow in this riparian complex. Large woody debris may also alter channel form, allowing sediment to accumulate and build banks changing the channel from an F to a B stream type. This process would occur when mature cottonwoods fall in the channel, or when large wood is deposited on the bank after flooding.

Large floods have been documented in this ecological site. Large magnitude floods are generally the result of heavy rain in the summer or fall. Channel morphology can remain stable with large floods, although vegetation can be scoured as a result. However, vegetation found in this type of flashy system is adapted to this type of disturbance. Coyote willow has very flexible stems that bend with the water and the dominant herbaceous vegetation (Baltic rush and common reed) can grow up through fresh sediment deposits (McBride & Strahan 1984; Anderson 2006).

Historic land management practices may have influenced current channel morphology directly or indirectly through upland degradation, but the effects of the management practices have not been adequately documented to establish a cause and effect relationship within this site. Juniper encroachment may have decreased understory vegetation which would increase runoff and sediment possibly increasing storm flow into the canyon bottoms. Over use by livestock would have a similar effect in the uplands and if overuse occurred in the canyon bottoms, the removal of bank stabilizing vegetation could increase bank failure, accelerating bank erosion and undermining the stable channel.

The state and transition model is based on a customized (derived from documented scenarios) stream succession scenario of F4 ? B4c ? G4c ? F4 ? B4c. This system appears to have a bi-modal channel succession scenario that consists of a reference state and stable analogue state that can have two different channel types (F4 and B4c) depending on the width of the valley bottom and the amount of alluvial fill. These channel types can be observed within the system and intermediate conditions can also occur where one type was changed to another.

ECOLOGICAL DYNAMICS OF THE SITE: General: This riparian complex is a low gradient (0.005-.016%), gravelly, B4c-type stream system with low to moderate sinuosity (about 1.1-1.5) and moderate (>12) width/depth ratio. The site extends throughout MLRA 36 including streams that have the same potential channel morphology, channel succession, bed and bank materials, fluvial surfaces, potential plant community components, and similar response to disturbance.

Plant Communities and Fluvial Surfaces: This system exhibits a complex of narrow floodplains and wider terraces. Some areas also display a poorly defined channel and exhibit the characteristics of an ephemeral system (wash). Vegetation composition is influenced by flood frequency, flow duration and length of inundation. Fluvial surfaces that are closer to the channel are inundated more frequently with floods, thus have less woody vegetation. Fluvial surfaces further from the channel are inundated less frequently and have greater woody vegetation cover. Dominant vegetation in this ecological site is adapted to yearly variations in flow and sediment deposition, cottonwoods and willows particular to this site are adapted to frequent disturbance and are known to be aggressive colonizers of disturbed sites (Richenbacher 1984). Willows and cottonwoods require fresh wet sediment that is devoid of other vegetation to germinate (Braatne et al. 1996). Yearly variations in flow and large floods that scour vegetation and deposit sediment on floodplains are ideal microsites for willow and cottonwood seeds. Cottonwoods and willows produce large amounts of wind and water dispersed seeds that are only viable for a short period of time after the seeds come in contact with moist soil (Braatne et al. 1996). Germination can occur quickly, usually in a 24 hour period (Karrenberg et al. 2002) and they will remain viable for 2 to 3 days (Braatne et al. 1996). Mortality of cottonwood and willow seedlings is very high ranging from 77 to 100% in the first year (Karrenberg et al. 2002). Mortality is often attributed to desiccation of the seedling and seedlings are at a great risk of subsequent summer floods that may scour the recently deposited sediment (Braatne et al. 1996; Karrenberg et al. 2002). Willows and cottonwoods have a number of characteristics that allow them to grow on this highly disturbed fluvial surface. They produce a large number of seeds, the seedlings have a high growth rate, stem fragments can regenerate, and willow root systems are extensive and allow the plant to anchor and bind the soil (Karrenberg et al. 2002).

The stream banks/floodplains are very narrow and are correlated to plant community component 1 and 2 (PCC1 and PCC2). Point bars and the lowest floodplains flood frequently and are stable enough to support obligate and facultative wet perennial vegetation. Plant communities that are found closest to the channel on the stream banks are rushes, common reed and mesic forbs. These rhizomatous plants have the ability to survive frequent high flow and can send stems up through freshly deposited sediment. Willows and mesic forbs often establish on the floodplain-step in this ecological site. The willows are found at this intermediate location because this fluvial surface is still influenced by high water tables and is distanced from the active channel and found just above bankfull so that it does not experience yearly scouring. Coyote willows found in this community have flexible stems and are able to bend with high flow (Karrenberg et al. 2002; McBride & Strahan 1984). Native fish and other aquatic species, including frogs and aquatic insects, are present, utilizing floodplain wetlands for refuge during high flows, and deeper residual pools as drying occurs during the drier months of the year.

Middle and higher terraces are not flooded as often, are more isolated from the water table, and are dominated by PCC3. The mesic species in these communities are relict and probably established when the water table was closer to the soil surface or established after a large flood in a wet year. Higher terraces support Fremont cottonwood generally with upland species in the understory such as basin big sagebrush, rabbitbrush, and Indian rice grass. Young cottonwoods and coyote willow, typically establish after a flood. These young cottonwoods established close to the channel and the likelihood of reaching maturity is low because of the close proximity to the stream channel and susceptibility of the streambank to high flow. Parts of the floodplain and low terraces may appear disconnected from the active channel, but they continue to be hydrologically linked by the water table and flood events (Braatne et al. 1996). Ephemeral sections of this ecological site will have PCC3 as the dominant plant community while PCC1 and 2 are generally absent.

Invasive Species: Tamarisk is the most invasive plant in this ecological site. It can replace the willows in PCC2 and can readily establish. As the channel abandons floodplains and terraces, the groundwater influence decreases which can create a better environment for tamarisk to establish (Horton et al. 2001). Tamarisk is more tolerant of drought and salinity than native species (Horton et al. 2001). The timing of seed dispersal is also different for tamarisk than native shrubs. Tamarisk produces seed from April to October (Horton et al. 2001) and with high summer flows could be at a seed dispersal advantage over cottonwoods and willows, which produce seed from February to March (Braatne et al. 1996). Tamarisk seedlings can establish midsummer on fresh sediment deposits from runoff during summer rain storms, months after cottonwood and willows dispersed seed (Stromberg et al. 2007).

Fire: Fire has not been found to be a major factor contributing to plant community change. The landscape is dissected by deep canyons and the uplands do not support high grass production that would allow a fire to move. Fremont cottonwood is not as tolerant of fire as narrowleaf cottonwood, indicating that the dominant plant community is not adapted to frequent fire. Fremont cottonwood can be top killed even by a moderate fire and the cambium layer has been found to be damaged by a low severity fire, although it can sprout from the bole and roots (Taylor 2000).

State and transition model

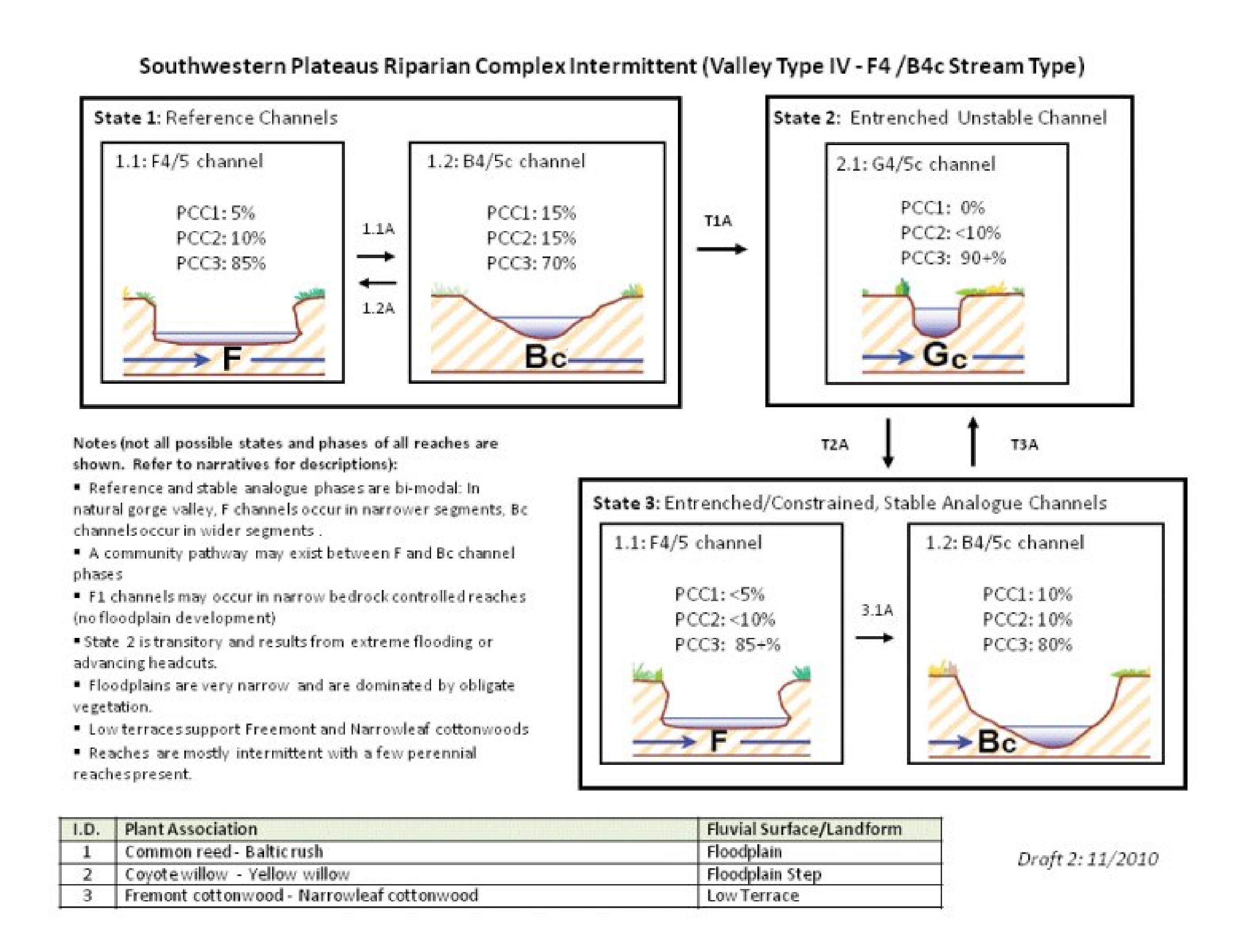


Figure 3. State and Transition Model

State 1
Reference Channels

The Reference Channels State is characterized as a B4c/F4 channel. There are two phases identified in this state, F4 and B4c channel. The F4 channel may evolve into a B4c channel through sediment deposition in the channel. This is believed to occur when there is enough valley fill to create an expanded floodplain and a low terrace. This occurs through a community pathway where no transition is crossed. Both channels are considered stable. The freshly deposited sediment is colonized by plants either through seed or rhizomes. The material on the stream banks is fine material (sand) that is more susceptible to erosion when not held together by roots, especially from rhizomatous plants and shrubs. Movement to any other channel type indicates a threshold has been crossed and the channel will not change back to an F4/B4c channel in phase 1.1 or 1.2 without major inputs of money or energy. The channel can be an F1 channel where the canyon is narrow and there is exposed bedrock. These channels will not change due to the bedrock control. Plant communities exist on specific fluvial surfaces (PCC1 on stream banks/floodplains and PCC2 on floodplain-step and PCC3 on low terraces). These communities may exist over the entire length of the site and vary slightly to moderately in plant community composition. PC1: Common reed/Baltic Rush, Bank Zone/Floodplain, Phases: 1.1; 1.2; 3.1; 3.2 PC2: Coyote willow/Yellow willow, Overbank Zone/Floodplain-step, Phases: 1.1; 1.2; 2.1; 3.1; 3.2 PC3: Fremont cottonwood/Narrowleaf cottonwood, Terrace, Phases: 1.1; 1.2; 2.1; 3.1; 3.2 Plant Community 1 is frequently disturbed by flash flooding. Shrubs and trees are generally not found within this plant community because of the close proximity to the stream channel and scouring floods. Herbaceous plants can establish between flooding events and can often come up though sediment if they are buried during a flood event. Coyote willow is sometimes found within this community because it is able to expand through rhizomes and grow under conditions that it would not be able to germinate (Anderson 2006). Roots of graminoids and coyote willow hold the stream banks during typical flood events, but may be scoured during large floods. This community is generally found around meander bends or on point bars. Plant Community 2 is maintained by flooding and is located in the overbank zone and floodplain step. Willows tend to have flexible branches that are able to bend with the force of water without much damage to the plant (Karrenberg et al. 2002; McBride & Stahan 1984). Coyote willow (*Salix exigua*) is drought resistant and very tolerant of flooding (Anderson 2006) an essential characteristic in the dry environment of south eastern Utah. Willow seeds are non-dormant and quickly lose viability. Seedlings generally establish close enough to a water supply and far enough from the channel to be protected from scouring during floods (Anderson 2006). Once established, vegetative clones can expand perpendicular to the stream channel, developing closer to the water source (Anderson 2006). Branches can resprout if buried by sediment and they may also regenerate vegetatively from broken stems and roots (Anderson 2006). Coyote willow is shade intolerant and is shaded out once cottonwoods grow tall enough to dominate the overstory (Karrenberg et al. 2002). Seedlings of willow and cottonwood require the same germination conditions of bare and moist soil, so they often germinate together. Initially, willows grow faster than cottonwood, but given time cottonwood overtops the willows. Cottonwood is not the dominant overstory in this plant community because it is scoured before it can grow to maturity, in response to being too close to the channel. Young cottonwood was found scattered on this fluvial surface but was not dominant and may not grow to maturity. This community initially develops on floodplain steps and may become established on exposed depositional sand bars. Establishment of this community depends on periodic flooding for maintenance and growth. As sediment and debris become trapped among woody stems, the bar becomes more stable. This community occurs on flood plains with sufficient sediment deposition. Downed wood is sparse. Stands usually occur about one meter above the current channel on point bars and low floodplains. After a large flood event in some parts of this MLRA in 2003, willow stands were severely damaged and all that remained after the event were sparse stands of coyote willow. Before the flood, yellow willow was generally co-dominant and stands were dense (Coles et al. 2008). Fremont cottonwood is the dominant overstory plant in plant community component three. Narrowleaf cottonwood occurs within this community, but is not as prevalent as Fremont cottonwood. These two species are known to hybridize, creating the hybrid Populus xhinckleyana (Eckenwalder 1984). Intermittent flooding maintains this stream terrace. Flooding only reaches this terrace during high flows that generally occur in the summer monsoon season. Cottonwoods have been documented to establish on these higher terraces (Johnson et al. 1976; Stromberg et al. 1997). Spring flooding is required for cottonwood seedling establishment and this does not occur every year (Lytle & Merritt 2004). Given the uniform age class of the cottonwood trees present, such flooding occurs every 50 years. Fremont cottonwood flowers from February to early March allowing the seed to be dispersed late spring (May), optimally on the receding limb of the spring flood stage. Seeds established during this stage of flooding are not typically susceptible to subsequent flooding and the soil is generally moist enough to allow germination (Braatne et al. 1996, Rood et al. 2007). Germination may occur more often, but establishment and survival past seeding stage in to young stage is unlikely to occur every year. Due to the deep water table in PCC3, understory species are not riparian obligates and only those species that are deep rooted, such as cottonwood, can access the water table. Cottonwoods generally only germinate on freshly deposited sediment and will generally not germinate in an area already covered by vegetation (Rood et al 2007). Fluvial disturbance is essential in maintaining cottonwood communities. Fremont cottonwoods generally establish from seed and not asexual reproduction, and because of this they are generally found on channels that are affected by moderate flows (Rood et al 2007). Fire is unlikely to be a driving force in this plant community because of the location in deep canyons and discontinuous vegetation along the channel. Fremont cottonwoods are not regenerated by fire and mature trees can be top-killed by moderate fires (Taylor 2000). Mature Fremont cottonwood stands are generally found on middle to upper terraces (2-3 meters above the existing channel) that do not flood yearly (Coles et al. 2008). Mature cottonwoods live to maturity in the location because the plants have time to establish between large flood events (Irvine 1976). Young narrowleaf cottonwood and the hybrid occur at a lower elevation, generally just outside of PC2. Terraces at this elevation above the stream channel are rarely flooded, except in severe flooding that occurs every 100 years. Floods of this magnitude can reach this terrace and remove understory vegetation. The understory is often dominated by upland species. Stands occurring on lower terraces may have mesic understory, but there are subject to more frequent flooding and scouring events. If flooding has not removed litter, there is generally a high litter cover and a low cover of downed wood. There is little soil development occurring on these terraces because of flooding disturbance. Some stands may be high enough above the current channel, they are not self-perpetuating because the conditions are too dry and the flooding is too infrequent. Plant community composition is listed by group, group one for PC1, group two for PC2 and group three for PC3.

Community 1.1
F4 Channel

Figure 4. F4 channel, note flat channel bottom.

Figure 5. Example of PCC1 (bank zone/floodplain)

Figure 6. Coyote willow in PCC2 within floodprone elevation.

Figure 7. Scattered old Fremont cottonwood in PCC3 located o

Figure 8. F4 channel with high terrace.

This phase represents the channel after a flood has removed deposition and PC1. There are generally three major fluvial surfaces with distinct plant communities (PC1, PC2, and PC3) on each surface. Stream banks/floodplains have herbaceous and shrubby vegetation for stabilizing fine sediment soils on the stream banks and are below the flood prone area. Above the flood prone area are wider, flatter terraces with scattered cottonwood and shrubs with few grasses (PC3).

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	75	250	550
Shrub/Vine	50	200	500
Forb	50	125	350
Total	**175**	**575**	**1400**

Table 6. Ground cover

Tree foliar cover	0-1%
Shrub/vine/liana foliar cover	0-50%
Grass/grasslike foliar cover	10-20%
Forb foliar cover	0-20%
Non-vascular plants	0-1%
Biological crusts	0-34%
Litter	29-98%
Surface fragments >0.25" and <=3"	0-2%
Surface fragments >3"	0-2%
Bedrock	0-2%
Water	0%
Bare ground	2-30%

Table 7. Soil surface cover

Tree basal cover	0-1%
Shrub/vine/liana basal cover	0%
Grass/grasslike basal cover	0%
Forb basal cover	0%
Non-vascular plants	0-1%
Biological crusts	0-34%
Litter	0-14%
Surface fragments >0.25" and <=3"	0-2%
Surface fragments >3"	0-2%
Bedrock	0-2%
Water	0%
Bare ground	64-100%

Table 8. Woody ground cover

Downed wood, fine-small (<0.40" diameter; 1-hour fuels)	0-2% N*

Downed wood, fine-medium (0.40-0.99" diameter; 10-hour fuels)	0-6% N*
Downed wood, fine-large (1.00-2.99" diameter; 100-hour fuels)	0-1% N*
Downed wood, coarse-small (3.00-8.99" diameter; 1,000-hour fuels)	0-1%
Downed wood, coarse-large (>9.00" diameter; 10,000-hour fuels)	0-2%
Tree snags** (hard***)	–
Tree snags** (soft***)	–
Tree snag count** (hard***)	0-1 per acre
Tree snag count** (hard***)	0-1 per acre

*** Decomposition Classes: N - no or little integration with the soil surface; I - partial to nearly full integration with the soil surface.**

**** >10.16cm diameter at 1.3716m above ground and >1.8288m height--if less diameter OR height use applicable down wood type; for pinyon and juniper, use 0.3048m above ground.**

***** Hard - tree is dead with most or all of bark intact; Soft - most of bark has sloughed off.**

Table 9. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	–	–	–	0-5%
>0.5 <= 1	–	–	0-35%	0-20%
>1 <= 2	–	–	–	0-5%
>2 <= 4.5	–	0-25%	0-30%	–
>4.5 <= 13	–	0-40%	–	–
>13 <= 40	5-60%	0-40%	–	–
>40 <= 80	–	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

Community 1.2
B4c Channel

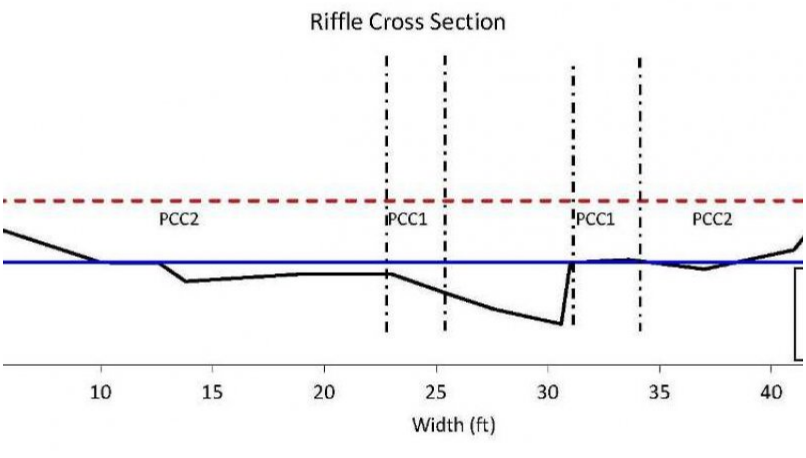


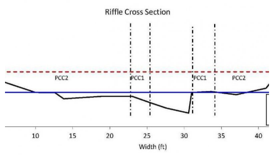
Figure 10. Stream channel cross section with PCC delineated.

Figure 11. B4c intermittent channel.

Figure 12. B4c channel with bedrock control, bankfull elevati

This phase represents a relatively stable combination of stream morphology and potential natural vegetation. This phase provides better in stream habitat for aquatic species because it has more pools than phase 1.1. There are generally three major fluvial surfaces with distinct plant communities (PC1, PC2, and PC3) on each surface. Stream banks/floodplains have herbaceous and shrubby vegetation for stabilizing fine sediment soils on the stream banks and are below the flood prone area and have greater composition than phase 1.1. Above the flood prone area are wider, flatter terraces with scattered cottonwood and shrubs with few grasses (PC3).

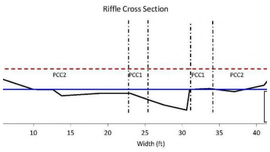
Pathway 1.1A
Community 1.1 to 1.2



F4 Channel **B4c Channel**

Sediment deposition creates microsites for new cohorts of cottonwood and willow. Sediment deposition in stream channel also increases the establishment area for PC1 and PC2. This sediment deposition may be facilitated by large woody debris.

Pathway 1.2A
Community 1.2 to 1.1



B4c Channel **F4 Channel**

Infrequent large flooding caused by large rain storms in summer or rain on snow events in spring.

State 2
Entrenched/Unstable Channel

This state occurs when disturbances (to phases in State 1 or State 3) remove bank stabilizing vegetation which leads to destabilization of banks and bed. G4c channel evolves from the B4c channel by downcutting through the fine bed material. Disturbance could include large floods that scour vegetation below flood prone area. Increased erosion of banks and bed result in vertical instability and especially lateral instability. This site also has sections that are bedrock controlled that will not deepen vertically. In this situation the stream channel will erode laterally. In this state the stream becomes disconnected from the floodplains. Stream bank vegetation (PC1) is removed and some floodplain vegetation is also removed (PC2). This channel morphology may also be the result of a large sediment pulse that is deposited in the channel, that intermittent flow is unable to carry downstream.

Community 2.1
G4 Channel

This channel type may occur in this ecological site when disturbance and high water erode bed and bank material. The G4 channel type does not last long because the fine sediments found in the banks are erodible when not held together by the appropriate vegetation. Widening of the channel due to erodible bank material occurs quickly (State 3 Phase 3.1). This phase has little floodplain remaining (PC2) and has no streambank remaining (PC1). The predominant vegetation remaining is the cottonwood terrace community (PC3). In locations where there is bedrock control of the channel bed, the stream will primarily erode bank material and will create a wider channel that may have multiple wide, shallow channels.

State 3
Stable Analogue Channels

The channels in this state are stable analogues (stable channels that have similar morphology as State 1 channels) that have re-established some floodplain connection during bankfull flows. These channels also have the potential to express all plant communities. The lower channels may have established after several incremental entrenchment and widening events, as evidenced by floodplains and terraces. Stable analogue B4c/F4 channel succession within State 3 is similar to State 1, but at a lower elevation. These stable analogue channel types are at risk of crossing a threshold back to State 2 if sediment and flow do not remain in balance.

Community 3.1
F4 Channel

Figure 13. Entrenched F4 channel.

This phase represents the initial re-establishment of stream connectivity to its floodplain. Narrow floodplains are established where desirable bank stabilizing vegetation can establish. Local water tables may be raised, creating better conditions for terrace vegetation as well. All three plant community components are present in this phase, although PC1 and PC2 are reduced because the fluvial surfaces are narrower than in State 1 Phase 1.1. The potential natural plant communities may occur on their correlated fluvial surfaces (as in State 1 Phase 1.1). In some cases, previous invasion by tamarisk will continue in the willow community (PC2), restricting the extent of native vegetation. This state can become a stable analogue and can persist if flows, energy and sediments are not excessive and disturbances to banks and vegetation are limited. This stable analogue channel type is at risk of crossing a threshold back to State 2 if flow, energy, and sediment are not in balance.

Community 3.2
B4c Channel

This phase represents the re-establishment of stream connectivity to its floodplain. Wider, more efficient floodplains are established with depositional features than PC1 and PC2. Local water tables are raised creating better conditions for terrace vegetation as well. The entire system is constrained by moderate entrenchment so lateral development of floodplains is limited but previous widening (Phase 3.1) provides the room necessary for floodplain establishment. All plant communities are found in this phase.

Pathway 3.1A
Community 3.1 to 3.2

Sediment deposition creates microsites for new cohorts of cottonwood and willow. Sediment deposition in stream channel also increases the establishment area for PC1 and PC2. This sediment deposition may be facilitated by large woody debris.

Transition T1A
State 1 to 2

Disturbance to channel to cause entrenchment (loss of vegetation, unnaturally high or frequent flows)

Transition T2A
State 2 to 3

Establishment of stabilizing vegetation over time since large flood event

Transition T3A
State 3 to 2

Disturbance to channel to cause entrenchment (loss of vegetation, unnaturally high or frequent flows)

Additional community tables

Table 10. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Shrub/Vine					
1	**PCC1**			20–85	
	mountain rush	JUARL	*Juncus arcticus ssp. littoralis*	50–450	5–75
	common reed	PHAU7	*Phragmites australis*	0–300	0–50
	rough Canada goldenrod	SOCAS	*Solidago canadensis var. salebrosa*	15–300	1–20
	western wheatgrass	PASM	*Pascopyrum smithii*	0–50	0–30
	narrowleaf willow	SAEX	*Salix exigua*	15–50	2–25
	Wyoming Indian paintbrush	CALI4	*Castilleja linariifolia*	5–35	1–10
	Grass, perennial	2GP	*Grass, perennial*	10–30	1–15
	Grass, annual	2GA	*Grass, annual*	0–25	0–10
	Forb, annual	2FA	*Forb, annual*	5–25	1–10
	Forb, perennial	2FP	*Forb, perennial*	5–25	1–10
	western white clematis	CLLI2	*Clematis ligusticifolia*	5–20	5–15
	Canada wildrye	ELCA4	*Elymus canadensis*	5–20	1–10
	scratchgrass	MUAS	*Muhlenbergia asperifolia*	5–10	1–5
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–5	0–5
	fowl mannagrass	GLST	*Glyceria striata*	0–5	0–5
	toad rush	JUBU	*Juncus bufonius*	0–5	0–5
	swordleaf rush	JUEN	*Juncus ensifolius*	0–5	0–5
	longstyle rush	JULO	*Juncus longistylis*	0–5	0–5
	rush	JUNCU	*Juncus*	1–5	1–5
	Torrey's rush	JUTO	*Juncus torreyi*	0–5	0–5
	spike bentgrass	AGEX	*Agrostis exarata*	0–5	0–5
	golden sedge	CAAU3	*Carex aurea*	0–5	0–5
	smallwing sedge	CAMI7	*Carex microptera*	0–5	0–5
	clustered field sedge	CAPR5	*Carex praegracilis*	0–5	0–5
	sedge	CAREX	*Carex*	1–5	1–5
	ditch reedgrass	CASC	*Calamagrostis scopulorum*	0–5	0–5
	skunkbush sumac	RHTR	*Rhus trilobata*	0–5	0–5
	Woods' rose	ROWO	*Rosa woodsii*	0–5	0–5
	Shrub, other	2S	*Shrub, other*	1–5	1–5
	Shrub, deciduous, broadleaf	2SDB	*Shrub, deciduous, broadleaf*	1–5	1–5
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	0–5	0–5
	yellow columbine	AQFL	*Aquilegia flavescens*	0–5	0–2
	showy milkweed	ASSP	*Asclepias speciosa*	0–5	0–2
	thistle	CIRSI	*Cirsium*	0–5	1–2
	povertyweed	IVAX	*Iva axillaris*	0–5	0–2
	starry false lily of the	MAST4	*Maianthemum stellatum*	0–5	0–2

	valley				
	Hooker's evening primrose	OEEL	*Oenothera elata*	0–5	0–2
	yellow evening primrose	OEFLF	*Oenothera flava ssp. flava*	0–5	0–2
	longstem evening primrose	OELO	*Oenothera longissima*	0–5	0–2
	evening primrose	OENOT	*Oenothera*	0–5	0–2
	white panicle aster	SYLAH6	*Symphyotrichum lanceolatum ssp. hesperium var. hesperium*	0–5	0–2
	Moss	2MOSS	*Moss*	0–1	0–2
2	**PCC2**			115–255	
3	**PCC3**			45–210	
Grass/Grasslike					
1	**PCC1**			90–682	
	yellow willow	SALU2	*Salix lutea*	50–300	25–75
	common reed	PHAU7	*Phragmites australis*	50–250	10–30
	narrowleaf willow	SAEX	*Salix exigua*	50–150	25–75
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	5–50	2–7
	western white clematis	CLLI2	*Clematis ligusticifolia*	15–25	5–15
	Shrub, other	2S	*Shrub, other*	10–20	5–15
	Grass, perennial	2GP	*Grass, perennial*	5–20	5–10
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	5–20	1–5
	Forb, annual	2FA	*Forb, annual*	5–15	1–10
	Forb, perennial	2FP	*Forb, perennial*	5–15	1–10
	Grass, annual	2GA	*Grass, annual*	5–10	1–5
	greenleaf willow	SALUC	*Salix lucida ssp. caudata*	0–10	0–5
	Woods' rose	ROWO	*Rosa woodsii*	1–10	1–5
	rough Canada goldenrod	SOCAS	*Solidago canadensis var. salebrosa*	1–5	5–15
	smallwing sedge	CAMI7	*Carex microptera*	0–5	0–5
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–5	0–5
	foxtail barley	HOJU	*Hordeum jubatum*	0–5	0–5
	entireleaved thelypody	THIN	*Thelypodium integrifolium*	0–5	0–2
	mountain goldenbanner	THMO6	*Thermopsis montana*	0–5	0–2
	bush pea	LABRZ2	*Lathyrus brachycalyx ssp. zionis*	0–5	0–2
	starry false lily of the valley	MAST4	*Maianthemum stellatum*	0–5	0–2
	smooth spreading four o'clock	MIOX	*Mirabilis oxybaphoides*	0–5	0–2
	Hooker's evening primrose	OEEL	*Oenothera elata*	0–5	0–2
	yellow evening primrose	OEFLF	*Oenothera flava ssp. flava*	0–5	0–2
	Indianhemp	APCA	*Apocynum cannabinum*	0–5	0–2
	painted milkvetch	ASCEC	*Astragalus ceramicus var. ceramicus*	0–5	0–2
	scouringrush horsetail	EQHY	*Equisetum hyemale*	0–5	0–2

	scouringrush horsetail	EQHY	*Equisetum hyemale*	0–5	0–2
	smooth horsetail	EQLA	*Equisetum laevigatum*	0–5	0–2
	bedstraw	GALIU	*Galium*	0–5	0–2
	prairie sunflower	HEPE	*Helianthus petiolaris*	0–5	0–2
	western poison ivy	TORY	*Toxicodendron rydbergii*	0–5	0–2
	redosier dogwood	COSE16	*Cornus sericea*	0–5	0–2
2	**PCC2**			60–295	
3	**PCC3**			35–145	
Forb					
1	**PCC1**			30–450	
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	20–80	5–10
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	15–50	1–15
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	15–50	5–10
	yellow willow	SALU2	*Salix lutea*	10–50	1–5
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	5–40	2–15
	Shrub, other	2S	*Shrub, other*	5–25	5–20
	Grass, perennial	2GP	*Grass, perennial*	10–25	5–10
	Forb, annual	2FA	*Forb, annual*	0–15	0–10
	Forb, perennial	2FP	*Forb, perennial*	5–15	1–10
	mormon tea	EPVI	*Ephedra viridis*	0–15	0–5
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–15	0–2
	tarragon	ARDR4	*Artemisia dracunculus*	1–10	1–15
	copperweed	OXAC4	*Oxytenia acerosa*	1–10	1–5
	Grass, annual	2GA	*Grass, annual*	5–10	1–5
	Woods' rose	ROWO	*Rosa woodsii*	0–10	0–2
	Wyoming Indian paintbrush	CALI4	*Castilleja linariifolia*	5–10	1–2
	painted milkvetch	ASCEC	*Astragalus ceramicus var. ceramicus*	0–5	0–2
	longleaf brickellbush	BRLO	*Brickellia longifolia*	0–5	0–2
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	0–5	0–2
	Bridge penstemon	PERO10	*Penstemon rostriflorus*	0–5	0–2
	ragwort	SENEC	*Senecio*	0–5	0–2
	manyflowered aster	SYERP2	*Symphyotrichum ericoides var. pansum*	0–5	0–2
	entireleaved thelypody	THIN	*Thelypodium integrifolium*	0–5	0–2
	mountain goldenbanner	THMO6	*Thermopsis montana*	0–5	0–2
	meadow deathcamas	ZIVE	*Zigadenus venenosus*	0–5	0–2
	scarlet gilia	IPAG	*Ipomopsis aggregata*	0–5	0–2
	Rusby's goldenbush	ISRU2	*Isocoma rusbyi*	0–5	0–2
	bush pea	LABRZ2	*Lathyrus brachycalyx ssp. zionis*	0–5	0–2
	narrowleaf four o'clock	MILI3	*Mirabilis linearis*	0–5	0–2
	Hooker's evening primrose	OEEL	*Oenothera elata*	0–5	0–2
	Cainville thistle	CICA10	*Cirsium calcareum*	0–5	0–2
	Rydberg's thistle	CIRY	*Cirsium rydbergii*	0–5	0–2
	buckwheat	ERIOG	*Eriogonum*	0–5	0–2

	buckwheat	ERIOG	*Eriogonum*	0–5	0–2
	bedstraw	GALIU	*Galium*	0–5	0–2
	western poison ivy	TORY	*Toxicodendron rydbergii*	0–5	0–2
	willow baccharis	BASA	*Baccharis salicina*	0–5	0–2
	big bluestem	ANGE	*Andropogon gerardii*	0–5	0–2
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–5	0–2
	needle and thread	HECO26	*Hesperostipa comata*	0–5	0–2
	foxtail barley	HOJU	*Hordeum jubatum*	0–5	0–2
	alkali sacaton	SPAI	*Sporobolus airoides*	0–5	0–2
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–5	0–2
	sixweeks fescue	VUOCO	*Vulpia octoflora var. octoflora*	0–5	0–2
	prairie sunflower	HEPEF	*Helianthus petiolaris ssp. fallax*	0–2	0–2
	Rocky Mountain beeplant	CLSE	*Cleome serrulata*	0–2	0–2
	Canadian horseweed	COCAG	*Conyza canadensis var. glabrata*	0–2	0–2
	Fremont's goosefoot	CHFRF	*Chenopodium fremontii var. fremontii*	0–2	0–2
	narrowleaf goosefoot	CHLE4	*Chenopodium leptophyllum*	0–2	0–2
	flatspine bur ragweed	AMAC2	*Ambrosia acanthicarpa*	0–2	0–2
2	**PCC2**			15–150	
3	**PCC3**			20–210	
Moss					
1	**PCC1**			0–1	

Table 11. Community 1.1 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)	Diameter (In)	Basal Area (Square Ft/Acre)
Tree							
Fremont cottonwood	POFR2	*Populus fremontii*	Native	8–40	5–50	15–18	–
boxelder	ACNE2	*Acer negundo*	Native	8–35	0–5	–	–
narrowleaf cottonwood	POAN3	*Populus angustifolia*	Native	5–25	1–5	–	–
	POHI8	*Populus ×hinckleyana*	Native	1–15	1–5	–	–
peachleaf willow	SAAM2	*Salix amygdaloides*	Native	–	0–5	–	–

Animal community

Wildlife:
This ecological site provides good habitat for all types of wildlife, including birds, large mammals, small mammals, fish, salamanders, reptiles, and both terrestrial and aquatic insects, because of the surface and groundwater present. Native fish species area adapted to these intermittent streams, surviving in residual pools until continuous flow resume after seasonal storms and snowmelt. Vegetation along intermittent streams can provide structure for cover, nesting and breeding habitat, and a corridor for movement for wildlife that may not be available in the surrounding uplands (Levick et al. 2008).

The plant communities help moderate soil and air temperatures and reinforce stream banks. Cottonwood specifically can provide habitat for avian and insect fauna as well as bats. Birds can nest in the crown, or create nests in the cavities and in the dead trunks and limbs (Taylor 2000). This site also provides some thermal cover and forage opportunities for mule deer and elk. Birds, bats, lizards, snakes and rodents are very common. Birds from several families are typically present, from hawks to sparrows. Several species of rodents forage and occupy this site, including desert cottontail, black tailed jack rabbit, Colorado chipmunk, white-tailed antelope squirrel, Apache pocket mouse, and several species of Peromyscus. Coyotes and kit foxes will also forage in the area. Bats (Myotis, Pipisturellus, and others) can be observed in this ecological site.

The species listed below were seen over a three-day period June 2010 in White Canyon in Natural Bridges National Monument, Kane Gulch, Arch Canyon, and Mule Canyon. These species were seen mid-morning to late-afternoon. This is not an all inclusive list; other species may exist at this site.

Species List (complied by Wendell Gilgert, Wildlife Biologist, WNTSC):

Birds
American Goldfinch, Brown Creeper, Juniper Titmouse, Say’s Phoebe, Western Tanager, American Robin, Bushtit, Lazuli Bunting, Sharp-shinned Hawk, Western Wood Pewee, Black-chinned Hummingbird, Canyon Wren, Lesser Goldfinch, Spotted Towhee, White-throated Swift, Black Phoebe, Common Raven, Mountain Chickadee, Turkey Vulture, Black-throated Gray Warbler, Downey Woodpecker, Mourning Dove, Violet-Green Swallow, Blue-gray Gnatcatcher, Gambel’s Quail, Peregrine Falcon, Yellow-breasted Chat, Blue Grosbeak, Gray Flycatcher, Pinyon Jay, Yellow Warbler, Broad-tailed Hummingbird, House Finch, Plumbeous Vireo, and Western Kingbird

Mammals
Hopi Chipmunk, Red Squirrel and Mule Deer

Reptiles
Eastern Fence Lizard, Sagebrush Lizard, Plateau Stripped Whiptail, Western Whiptail, Tiger Whiptail, and Ornate Tree Lizard

Amphibians
Canyon tree frog (native) and Tiger salamander (native)

Fish
Flannelmouth sucker (native), Mountain sucker (native), and speckled dace (native)

Insects:
Megaloptera (hellgrammites), Hymenoptera (various bees, ants, wasps) , Native Bees (Ground nesters, Bumbles (3)), Dipterans, Odonata (Dragonflies), Lepidoptera (Swallowtails, Admirals), and Coleoptera (water beetles and terrestrial beetles)

Spiders

Grazing:
This site provides good to excellent grazing conditions for livestock and wildlife during spring, summer and fall when in good ecological condition. This site also may provide water sources to livestock for some of the year. Care should be taken to maintain native perennial grasses and shrubs because they are difficult to reestablish, especially willow and cottonwood seedlings that can be susceptible to livestock grazing (Taylor 2000). Reseeding and restoration are possible, but the major limiting factor is precipitation at critical plant growing periods. All plants within the riparian site need water table access to successfully establish as seedlings.

Hydrological functions

Intermittent streams in this ecological site flow when it receives water from a groundwater source or from seasonal runoff during heavy rain events. Intermittent and ephemeral streams in the arid southwestern United States typically have flashy hydrology (Moody et al. 2003). This flashy hydrology can make identifying bankfull flows difficult because these streams rarely reach process-form equilibrium (Levick et al. 2008). The flow in some situations may change too quickly for recognizable stream features to develop (Levick et al. 2008). While there are no USGS stream gages within the ecological site, regional curves for bankfull flow have been developed for this region (see Moody et al. 2003).

Recreational uses

Natural Bridges National Monument supports three hiking trails that meander through the bottom of the canyons. It draws thousands of visitors a year to see the bridges formed by ancient rivers, now the intermittent streams in the monument. There is also evidence of canyon dwelling cultures (ancestral Puebloans) and ruins that attract visitors to the monument and down into the canyons.

The Bureau of Land Management manages much of the other areas that are within this ecological site. Some canyon bottoms are accessible to off-road vehicles on the established trails while other canyon bottoms allow only non-motorized forms of travel. Canyon bottoms in this MLRA are primarily visited in the spring and fall.

Inventory data references

The ecological data collection for this site coincided with progressive soil surveys in the New Mexico and Arizona Plateaus and Mesas and in MLRA 36 in New Mexico.

Type locality

Location 1: San Juan County, UT	
UTM zone	N
UTM northing	4163489
UTM easting	587425
Latitude	37° 36′ 51″
Longitude	-111° 59′ 26″
General legal description	White Canyon in Natural Bridges National Monument, upstream of Sipapu Bridge.

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Approval

Kirt Walstad, 9/07/2023

Acknowledgments

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--Site Development and Testing Plan--:

Additional field data collection is necessary to validate and further refine the information in this provisional ecological site description. These efforts will include field activities using low-, medium-, and high-intensity sampling, soil correlations, and data analysis.

Additional information and data are necessary to refine the Plant Production and Annual Production Tables. The full extent of MLRA 36X also needs further investigation.

Field testing of the information contained in this Ecological Site is necessary. Once the site becomes approved, the technical team, quality control specialist, quality assurance specialist, and peers will review the work.

Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	
Contact for lead author	
Date	04/19/2024
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

2. **Presence of water flow patterns:**

3. **Number and height of erosional pedestals or terracettes:**

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

5. **Number of gullies and erosion associated with gullies:**

6. **Extent of wind scoured, blowouts and/or depositional areas:**

7. **Amount of litter movement (describe size and distance expected to travel):**

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

    Sub-dominant:

    Other:

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

14. **Average percent litter cover (%) and depth (in):**

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

17. **Perennial plant reproductive capability:**