

**Cebolla Canyon Closed Basin Watershed
Cibola County, New Mexico
Wetland Action Plan
October 2014**



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Credits

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ACRONYMS:

ACEC	Area of Critical Environmental Concern
ARRA	American Recovery and Reinvestment Act
AUMs	Animal Unit Months
AWF	Albuquerque Wildlife Federation
BLM	Bureau of Land Management
CAC	Citizens' Advisory Committee
CG	Cottonwood Gulch
DOI	Department of Interior
EMNCA	El Malpais National Conservation Area
EPA	Environmental Protection Agency
HGM	Hydrogeomorphic
NAWCA	North American Wetlands Conservation Act
NEEF	National Environment Education Foundation
NFWF	National Fish and Wildlife Foundation
NHNM	Natural Heritage New Mexico
NMDGF	New Mexico Department of Game and Fish
NMED	New Mexico Environment Department
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NWI	National Wetlands Inventory
NWTF	National Wild Turkey Federation
OSM	Office of Surface Mining
QAPP	Quality Assurance Project Plan

RERI	New Mexico's River Ecosystem Restoration Initiative
RPA	Rio Puerco Alliance
RPFO	Rio Puerco Field Office
RPMC	Rio Puerco Management Committee
SCA	Student Conservation Association
SCC	Southwest Conservation Corps
SUH	Southwest Urban Hydrology
SWQB	Surface Water Quality Bureau
TMDL	Total Maximum Daily Load
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFS	U. S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VISTA	Volunteers in Service to America
WAP	Wetland Action Plan
WRCC	Western Region Climate Center
WSA	Wilderness Study Area

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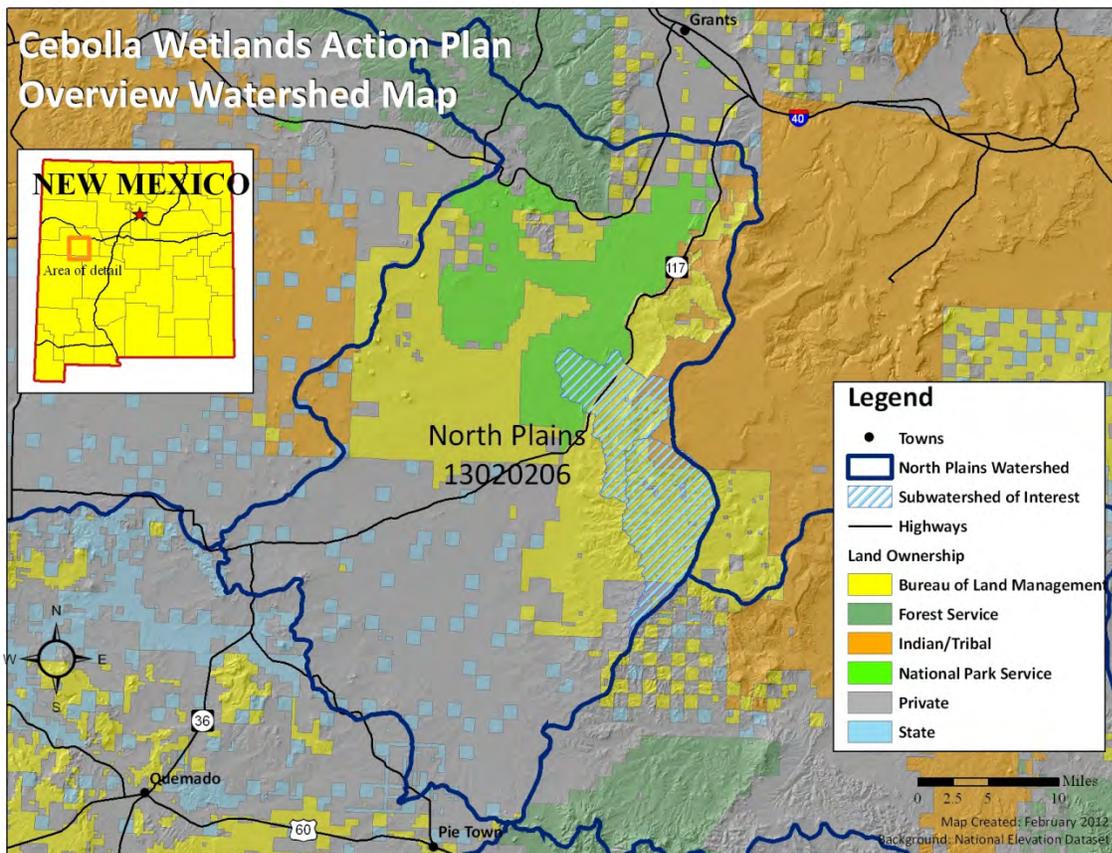
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1. INTRODUCTION

New Mexico wetlands support a great variety of species and are crucial for their survival. In semi-arid regions, wetlands provide habitat, water, food for wildlife and livestock, and contribute to sustaining biodiversity. Due to the limited availability of water, species often compete for this resource with agricultural expansion. In the past, species' habitats have been greatly reduced when wetlands were modified or lost. The Cebolla Canyon Wetland, in west-central New Mexico, is an example of this; early stream diversion and human interventions have led to the reduction and near disappearance of the wetland's natural hydrologic system.

Since 1994, different agencies and organizations have initiated and completed several restoration projects to rehabilitate the Cebolla Canyon wetland. Today, large portions of the wetland have been restored, but the need for further management measures in protecting and restoring the wetland persists.



2. CEBOLLA WETLAND

The Cebolla Canyon watershed has beautiful contrasting landscapes from the breathtakingly lush valley views that surreally melt into the sandstone canyon walls lined with

piñon, juniper, and ponderosa trees to the rugged black lava flows of the El Malpais (“The Badlands”) National Monument. In addition to its beauty, Cebolla Canyon is the location of an extremely important wetland significant to wildlife and water-dependent plant communities in an arid setting. The sedimentary formations punctuated by lava flows have developed wetland springs and playas. The perennial springs formed a wetland habitat that has now dried out considerably due to human intervention.

The headwaters of Cebolla Creek lie near Cebollita Peak in the east and to the south. The Cebolla Creek and its tributaries are predominantly intermittent and only flow as a result of storm events. Lower in the Cebolla Creek Canyon and within the floodplain lies an important ground-water dependent wetland ecosystem supported by Cebolla Springs and Cebollita Springs. Where these springs surface, their flow down the valley would hydrate the entire floodplain creating a marsh. These types of wetlands are considered to be slope wetlands using the Hydrogeomorphic classification system (Brinson 2003). However, the floodplain also contains the Cebolla Creek. Wetlands immediately downstream of Cebolla Springs slope wetlands are considered to be predominantly riverine as the supporting hydrology becomes again dominated by precipitation-driven flow events.

Manipulations of the Cebolla Creek watershed and particularly the stream channel and floodplain have greatly altered the flow and hydrology of the stream, which has displaced the creek from its natural drainage. Following these alterations, head cutting has occurred that severely dried out adjacent wetland areas.

Since 1994 restoration efforts by a number of organizations including but not limited to the Bureau of Land Management (BLM), the Albuquerque Wildlife Federation (AWF), the New Mexico Environment Department Surface Water Quality Bureau Wetlands Program (SWQB Wetlands Program), and the Rio Puerco Alliance (RPA) have resulted in an expansion of the wetland area. The most recent report regarding wetland restoration prepared for the Rio Puerco Alliance in 2013 (Vrooman, 2013) that between 2010 and 2013, 3.8 acres were added to the Cebolla Creek in Reaches 0-5 totaling 20.5 acres of wetland.

3. PURPOSE OF THE WETLAND ACTION PLAN

This area has been a magnet for wildlife and humans for centuries. However, due to numerous historical activities, such as hydromodification, irrigation diversions, livestock grazing, and road building, there are currently major impairments to stream hydrology, attendant floodplain and spring-fed wetlands. Because of the scarcity of perennial water in the area (the next closest source is approximately 40 miles distant), the spring-dependent wetlands and the associated stream and floodplain have been the focus of intense restoration efforts. Initial wetland restoration was undertaken by government agencies and non-governmental organizations. These efforts have resulted in an impressive recovery of wetland areas and showcase results of passive and active ecological restoration techniques. Although encouraging

signs of ecosystem recovery exist, there remains a need for further rehabilitation and monitoring of the Cebolla Canyon wetland.

The purpose of this document is to describe how wetlands and riparian resources are being and going to be restored and protected in the North Plains Watershed. This Wetlands Action Plan also documents lessons learned, findings, and community feedback gathered during the planning for wetlands. The most practical purpose for this document has been that anyone can refer to it about priorities, funding resources, and important next steps. It is also a reference document for developing future proposals for wetland restoration initiatives.

This Wetland Action Plan (WAP) hopes to provide information about areas that are still in need of mitigation and thus channel future action to those areas.

4. WETLAND ACTION PLAN

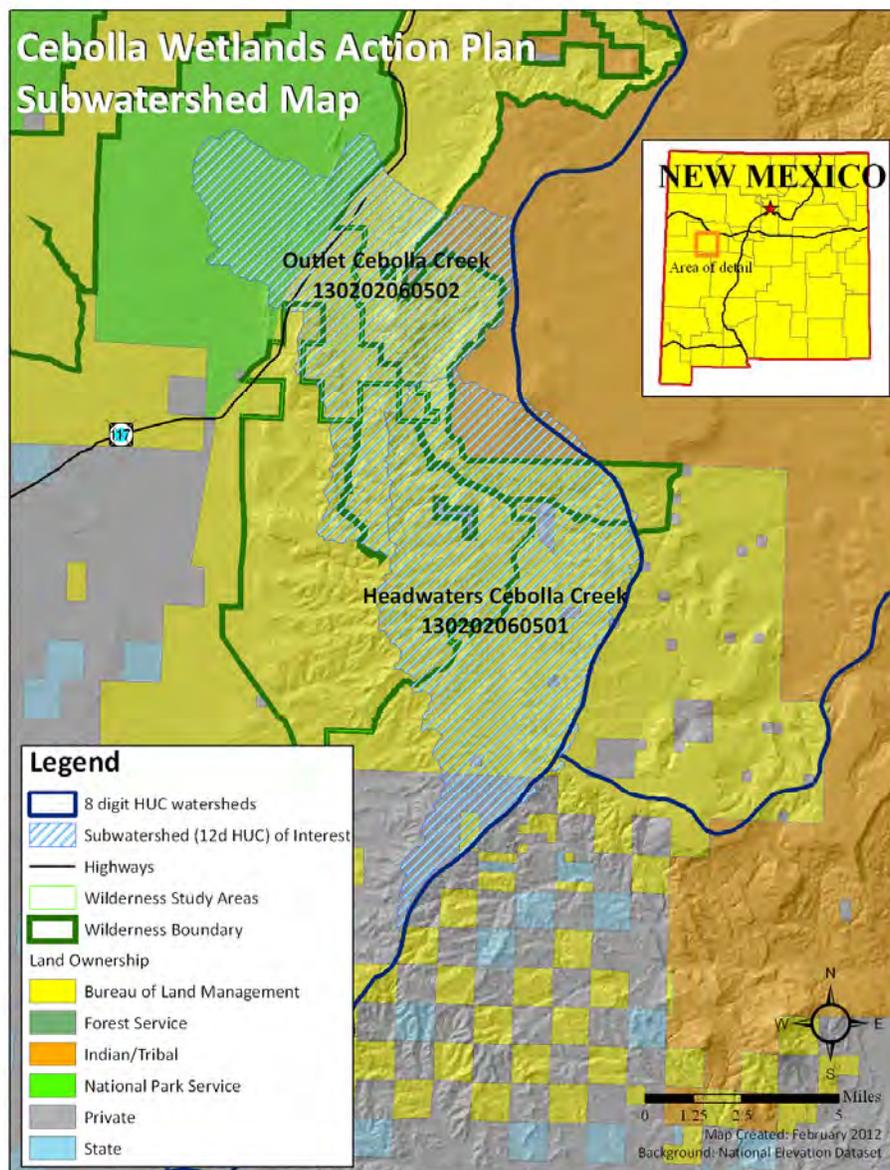
As part of a New Mexico Environment Department Surface Water Quality Bureau Wetlands Program restoration project entitled *Restoring and Protecting Wetlands in Cebolla Canyon Closed Basin*, a WAP for the Cebolla Canyon watershed was required. A WAP is a planning document designed specifically to address wetlands within the boundaries of a specific watershed. A WAP provides guidance for protection and restoration of wetlands, as well as emphasizes water quality benefits and ecological integrity, preservation of wildlife corridors, habitat conservation of threatened and endangered species, migratory birds, and other species of concern.

This plan is written for community partnerships, state and local institutions, and conservation groups who are involved in the preservation, conservation, and restoration of wetlands and riparian areas within a watershed. The WAP includes descriptive landscape background information and information for three major planning components: resource analysis, resource management, and a local involvement strategy. These planning components help ensure that watershed planning and any other local planning activities adequately address wetland management issues. Since certain data and information are currently unavailable, part of the goal of this plan is to fill these information gaps and help direct future action. The development and refinement of the watershed WAP will be an ongoing process.

5. WETLAND BACKGROUND

5.1 LOCATION

The Cebolla Canyon Wetland is located 72 miles west of Albuquerque, New Mexico in Cibola County within the North Plains Closed Basin watershed (HUC 13020206) (see Map 1, page 11). The portion of Cebolla Canyon this WAP addresses is the Headwaters Cebolla Creek sub-watershed (HUC 130202060501), which covers approximately 356,333 acres and the Outlet Cebolla Creek sub-watershed (HUC 130202060502) with an area of 22,125 acres (see Map 2, below).



5.2 HISTORICAL BACKGROUND

Due to the location of Cebolla Canyon's boundaries within the El Malpais National Conservation Area, it is difficult to obtain the history of this small isolated area while not discussing the broader El Malpais area. Prior to Spanish settlement and the eventual homesteaders, there is little documentation citing Cebolla Canyon specifically. Although the lack of data is a hindrance to direct referential comprehension of the pre-Anglo era, it does not necessarily prohibit the discussion of archeological findings within and in the near vicinity to provide a reasonable idea of the area's history and development.

5.2.1 Ancestral Puebloan

Chaco Canyon, New Mexico, is one of the most important Ancestral Puebloan (also known as the Anazasi) sites in the western United States. It is located about 85 miles northwest of Cebolla Canyon. There is evidence of habitation in the Chaco Canyon area prior to 900 B.C. but it did not become a major cultural center until sometime between 300-400 A.D., when inhabitants began to use an advanced irrigation farming system (Stuart, 2000). The Ancestral Puebloan town of Pueblo Bonito, in Chaco Canyon, housed around 1,150 persons, 800 rooms and 37 kivas. Threatening Rock, one of the most dominant structures in the pueblo, was home for more than 1,000 persons and lasted over 1,000 years.

Even though the occupants of the area were part of an advanced culture, Chaco Canyon's inhabitants did not know about the wheel. In building their infrastructure, they had to "...load big timbers and slabs of sandstone from the mountains more than 50 miles away" (Ayer, 1993). Their simple technology and considerable distance between resources made for a logical general expansion of Chaco Canyon that influenced more remote locations, as Ayer (1993) reports: "Not all Anasazi moved into communities, some families lived in single unit homes in cliffs quite far from the main population centers." The distance traveled to find and harvest resources and the movement of families indicates long distances of communication and settlement stemming out from Chaco Canyon. According to David E. Stuart (2000), the peoples of Chaco Canyon had a multitude of "sister" pueblos in their more than "...40,000 square miles of roadways, granaries and distinct trading villages in the basin lands of North America." Remnants of some of those Pueblos have been found on Cebollita Mesa, a very short distance from Cebolla Canyon (Stuart, 2000)

Cebollita Mesa overlooks the wetland areas of Cebolla Canyon as well as the location of four important sites, identified by archeologists, as remains from the Pueblo II period (A.D. 950-1100). The most significant of these archeological sites from the Cebollita Mesa was a structure that had nearly 300 rooms. According to Bureau of Land Management (BLM) archeologist, Gretchen Obenaus, "isolated surveys have found an extensive number of Paleo Indian sites within Cebolla Canyon and even more in the area of Cebollita Mesa."

As the Pueblo peoples moved out from the cultural centers, they brought with them their extensive farming knowledge; they harvested corn, squash, beans, cotton—their daily lives revolved around these crops. Pueblos with available water sources irrigated from the rivers, while the Pueblos with limited water resources used dryland farming techniques that relied on multiple fields over a range of environments to compensate for the sporadic rainfall of the region (Owen, 2004). Since Cebolla Canyon has a constant water source at the springs and is part of a major drainage, it is no wonder that a multitude of ancient agricultural sites have been identified. In an interview, Gretchen Obenaus noted, “We know they used the area extensively for agriculture. From the mouth of Cebolla Canyon there are lots of prehistoric fields up and down the area. We see prehistoric sites on the high ground above Cebolla Canyon as well. We know where there was water and flat land. It was being used for agriculture.”

As more serious farmers, the early Puebloans began “...to improve the growing conditions of particular fields by terracing, irrigation, and gridding” (Ortiz, 1979). Even though land shaping advancements were made, they continued to use crude tools such as digging sticks that were “...hardened wood shafts used to make holes in the earth for planting seeds of corn, beans, and squash in gardens” (BLM Colorado, 2012). Nevertheless, they farmed intensely on both large and small patches of land and were quite efficient in producing large amounts of food.

Historians and archeologists are not exactly sure why, but around A.D. 1300 the Ancestral Puebloans in this area begin to disappear. In an interview with Eleanor Ayer, Ayer claimed that “...a great drought struck Chaco Canyon around 1130 A.D. and lasted around 50 years.” As the drought persisted, people began moving into canyons. Ayer stated, “the Anasazi at Kayenta in Arizona moved into the canyons hoping to have enough water to water their crops and continue farming.” However, as the drought continued to intensify, it was found that there was insufficient moisture, which forced the Puebloans to abandon the canyon by 1300 A.D.

Before the desertion of Cebolla by the Ancestral Puebloans, it is quite easy to imagine Cebolla with its lush valley bottom as a series of irrigated farm systems. Land was molded and shaped to sow seeds, harvested and processed by the community with crude tools. Because of the springs and large basin, the farming trend continued. Wet fertile land in a dry desert climate is rare, and to think that the industrialized Anglo man was the only one to have molded and worked this land is just not so.

5.2.2 Zuni /Acoma Pueblos

The cultural demise of the Ancestral Puebloan Peoples in this area gave way to two defining pueblos: the Zuni and the Acoma. During 1300-1500 of the Pueblo IV Period, Zuni Pueblo and other prehistoric towns were founded as the population in the area consolidated in the Zuni River Valley. By the middle of Pueblo IV Period, Zuni had seven settlements called Cibola. Each village contained 200 people or more (Ayer, 1993).



*Lobo Canyon
Petroglyph*

East of Zuni, geographically adjacent to Cebolla Canyon, on top of Mesa Encantada, was the pueblo Acoma, also known as Sky City. Not unlike their predecessors, the Zuni and Acoma were agriculturalists and cotton growers. There was significant trading between the two Pueblos; the trail between Zuni and Acoma is still a popular hiking destination today.

Although the locations of the Acoma and Zuni Pueblos are near Cebolla, there are no indications of Pueblo IV (A.D. 1400-1600) settlements within Cebolla Canyon (Gretchen Obenaus). A study in 1951 used, "...a critical examination...to provide exact information and systematic collection and analysis of data" (Ruppé, 1990) for Acoma land claims against the United States Government, does indicate an extremely strong Acoma presence in Cebolla Canyon and Cebollita Mesa just nine miles to the north. Nels C. Nelson's field drawings from 1952 indicate that the "...ruins in Cebolla Canyon are identical with those of Cebollita and Veteados Canyons" (Ruppé, 1990). The 1952 survey of Cebollita Mesa and Veteados Canyon found 228 housing sites with 2,615 rooms (Ruppé, 1990). Sadly, the funding ran short for this expedition and findings regarding Cebolla Canyon were not documented. Nelson's photos of the area indicate that, "there may have been a larger occupation in Cebolla Canyon than in the other canyon areas," and that the range in "...cultural periods with growing certainty extends from San Jose to Pueblo IV," connecting it "...to the modern Pueblo of Acoma" (Ruppé, 1990).

The walls and buildings of this era are no longer present since "...homesteaders used them as sources of building stone and removed all traces of them. Skill of the ancient masons was such that free-standing walls no more than 46 cm thick were capable of maintaining a height of about 2.5 m until the 1920's when they were knocked down for their blocks" (Ruppé, 1990). At any rate, the life and land as the Native Americans of the Southwest knew it, was about to change forever with "La Entrada" of the Spanish in 1539. With the entrance of the Spaniards comes a whole new written and documented perception of the land surrounding Cebolla Canyon.

5.2.3 Spanish/Navajo

In 1539 Fray Marcos de Niza went north to Arizona and New Mexico in search of the fabled “Seven Cities of Cibola.” Niza was selected to escort the Spanish conquistadors and given the special authoritative powers by the Pope with “...full authority. . .in matters relating to the conversion of the Indians” (Hallenbeck, 1989). On his journey to the north, a Moor named Estéban accompanied Marcos. As they searched desperately for signs of riches and gold throughout the poor agricultural societies of the southwest, Estéban heard a rumor of riches from native peoples. Estéban went against Marcos and disobeyed orders by making contact with the Zuni. He showed little respect for the Zuni peoples and their authority, and it is said that they killed him, chopped his body up and sent it to each of the villages for future invaders to see (Ayer, 1993).

Although he never made it to Cibola for fear of his life, Fray Marcos de Niza wrote an untruthful report claiming the area to have tremendous riches. Believing the account, another group, headed by Francisco Vásquez de Coronado left Mexico a year later in search of the Seven Cities of Cibola. What he found were “...poor farmers who had no knowledge of gold or its value.” Following Marcos’s directions, Coronado’s army passed through the Zuni Pueblo and went to Acoma, which was seen and documented for the first time in 1540. The village described as “Acuco” was situated where it currently is today on the “Peñol,” a large rocky mountain (Ayer, 1993).

The Acoma stronghold called “Sky City” is located a short distance away from Cebolla Canyon on Mesa Encantada. A later Spanish expedition to the area in 1582 by Antonio de Espejo, an explorer, begins to detail the region and its land use. He states:

“We found a Pueblo called Acoma where there appeared to be more than 6,000 souls...they had cisterns of water at the top with many provisions. Here they gave us mantas of cotton, deer, buffalo hides and many provisions consisting of maize and turkeys. These people have their fields about two leagues from this site on a medium sized river whose water they intercept for irrigating purposes as they water their fields with many partitions of the water near the river in a marsh. We also found Castillan roses and Castillan onions that grow in this country without cultivation...the mountain people (Querechos) around the settlements come to their aid. They carry on trade with the peoples of the settlements taking to them salt, game such as deer rabbits and hares and trade for cotton other things” (Minge, 1976).

Espejo left Acoma heading westward (Sedgwick, 1927). He states in his diary “We marched four leagues up a river which originates in some badlands. We found many irrigated maize fields with canals and dams as if the Spanish had built them” (Minge, 1976).

Analyzing this documentation there are three things of unique and pertinent interest to the near areas of Cebolla Canyon. The first thing that is of interest is the reference to the “Castillan onion” which in Spanish is the word Cebolla. The areas around the Acoma village today take on the respectful names of: Cebollita Mesa (little onion), Cebollita Canyon and Cebolla Canyon. The second interest is that upon leaving the village, they travel west about four leagues and come to badlands. This distance would be around 14.6 miles, which is almost the exact distance from the Acoma Village on the Zuni-Acoma trail to the marshy areas of the Cebollita Canyon—near the terminus of Cebolla Creek in the North Plains of the Closed Basin on NM117 in the current day El Malpais National Conservation Area.

This information is also extremely relevant for an understanding of what the area surrounding Cebolla Canyon looked like in 1582. Although we do not have a direct historic reference to Cebolla Canyon, we may come to appreciate that the areas around the Acoma village towards the Malpais badlands along the Acoma-Zuni trail were full of intensively irrigated farmlands with infrastructure similar to European civilizations. Ruppé’s claim that Cebolla Canyon was more populated than Cebollita Canyon during this time period suggests a similar landscape in Cebolla Canyon.

As more Spaniards moved into New Mexican Territory, they brought with them domesticated livestock. At the same time a more nomadic and aggressive Navajo tribe began to move into the territory. In 1636, when Friar Benavides wrote a description of the early Navajos, they were already farming and at least partially sedentary. They learned the rudiments of raising crops from their Pueblo neighbors (Vogt 1961). However, sheep and goats acquired through raiding and trading were already making their appearance. The Navajos raided Spanish settlements for sheep, horses and fresh produce. They were raiding the Spanish as early as 1608 (Worcester, 1947).

During the 1700s, the Navajos raided Spanish settlements and the Spaniards responded with military action. This action forced the Navajo south into the Cebollita Mesa (Schroeder, 1965) (Reeve, 1960). Spanish settlers began to move into the mountains as well. Throughout this time period, the human population and the sheep population continued to increase. “In general, most families owned herds although their numbers remained small” (Bailey, 1986). But in the 1800s, economic subsistence began to shift from farming and hunting to herding while the introduction of the railroad to the Malpais area would only further increase herding and livestock in the area.

5.2.4 Basque, Cattle Ranching and Timber Industries

In 1881, a railroad station was built in Grants, New Mexico, less than 30 miles away from Cebolla Canyon. With the railroad came a steady increase in population with economic opportunities for export.

“With the advent of the railroad, ranchers had a means of transporting their livestock to market. Moreover, the railroad encouraged the ranchers to expand their herds. New Mexico’s sheep census skyrocketed following the subjugation of the Indians and the coming of the railroad. No longer did Navajo devastate the surrounding flocks. Settlers expanded their herds without fear of livestock loss. In 1870, the New Mexico sheep count numbered 619,000 animals statewide. Ten years later the sheep population exploded to 3.9 million” (Magnum, 1990).

The Malpais became grounds for mass sheep production. Spanish shepherders bought or acquired a vast portion of the Malpais lands up to the Acoma Reservation. Basque herders from France and Spain moved in to tend to the flocks of “...typically ten to twelve thousand” requiring a “...grazing land equivalent to three townships or an area 18 miles long and 18 miles wide” (Magnum, 1990). The flocks would bounce up and down the Malpais range moving locations three to four times a day, eventually arriving in Grants for shearing and slaughtering. As the number of sheep began to increase so did the cattle though not nearly to the same capacity. In the statewide census of 1880, there were only 347,936 cattle compared to 3.9 million sheep. But the Malpais area was a very important grazing ground and the surrounding population began to recognize the cattle industry as profitable. The Acoma Nation started their own cattle business; in 1884, the Acoma Land and Cattle Company merged with the Cebolla Cattle Company to control “41,592 acres east of the Malpais” (Magnum, 1990). The massive numbers of cattle would continue to increase and with the profitability came a greater number of inhabitants to the region.

With a railroad and new inhabitants came the need for more industry and jobs in the area, making the timber industry an obvious candidate to increase economic activity. The Southern Pacific began its expansion near Grants in 1880, making the Zuni Mountains and Cebolla Mesa a prime location for timber harvesting. Joe Lally in his 2012 report on sawmill culture (Lally J. , 2012), stated that the “...forested areas in and around Cebolla Canyon supplied much of the timber used to satisfy the increased demand for lumber and crossties,” which were numbering upwards of “110 million crossties per year at the turn of the century.” It is suspected that for this very reason various sawmill production facilities were constructed in Cebolla Canyon. Large-scale timber operations in the Cebolla Canyon area were not restricted to corporations. According to Lally, “...it was very common for teams of individuals” during the late 1800s and early 1900s “...to go themselves and cut small to medium diameter trees to use for sales and for building purposes.” With the timber and livestock usage clearly taking hold in Cebolla Canyon, came the advent of more used and accessible roads allowing eager modern homesteaders the opportunity to build and colonize within the walls of the Canyon.



Ruin of a homesteader's cabin in Cebolla Canyon.

5.2.5 Homesteaders

Due to dramatic changes in the post-World War I and dustbowl eras, people decided to move west and leave their farms. Instead of going to California, many families decided to try the high desert of New Mexico. The Savage family from Texas was one example that decided to homestead Cebolla Canyon sometime in the early 1930s (Towner, 2010) (Magnum, 1990). They built various public and private cabins, a schoolhouse, corrals, barns, dugouts, and outhouses, totaling around 20 structures. The Savages attempted to make a living farming beans, corn, and cane in the valleys but found it very difficult. According to the records, the Savages possessed limited amounts of livestock: 10 head of cattle and 6 horses (Towner, 2009). The absolute decimation of the southwest lands was due to overgrazing from the 1860s to 1930s that resulted in a federally enforced livestock reduction in the 1930s. The Taylor Grazing Act directly affected all the herds and flocks in the Malpais area, including those on Navajo and Acoma land.

In his harvest testimonial chart, Towner describes the agricultural situation in Cebolla Canyon at this time as nearly impossible. The Savages' seeded area during their four growing seasons (1935-39) averaged 13 acres of corn, 10 acres of beans and 7 acres of cane. From those areas they harvested minimal returns and had no crop yield due to a severe drought in 1939. To access their fields, and their nearly 250 acres of grazing lands, they built a series of roads. To

irrigate the crops, the Savages dug irrigation and drainage ditches. Shortly after the abandonment of the area, a mere 10-20 years later, a series of headcuts began to form.

Towner notes this degradation claiming that one of the roads created by the Savages formed an “Arroyo Road” which he states “...could not have existed prior to the occupation of the site” in Cebolla Canyon. “The rainwater,” Towner continues, “...flooded the ruts in the road and downcut,” which is a process that takes place extremely quickly. Towner’s report is limited to the archeological finds of the Savage ranch because it fails to take into consideration the many roads existing due to timber production in other parts of Cebolla Canyon. Nor does it take into account the massive amount of cutting that was taking place in the canyon walls at the time.

During the 1940s to 1950s, Cebolla Canyon underwent a severe transformation from its original state. It continued its use as grazing lands for livestock, yet was uninhabited. Instead of living in a single, permanent camp by their fields, families began using separate summer and winter camps, where forage and water were available for their livestock (Bailey, 1986).

In addition, the hills were harshly thinned for railroad production and unchecked roads zigzagged their way through the territory. During weather events, a less vegetated sloped area has a much higher erosion rate and less infiltration than one that is vegetated. The amount of sediment traveling from the hills off the roads and valleys was likely substantial.

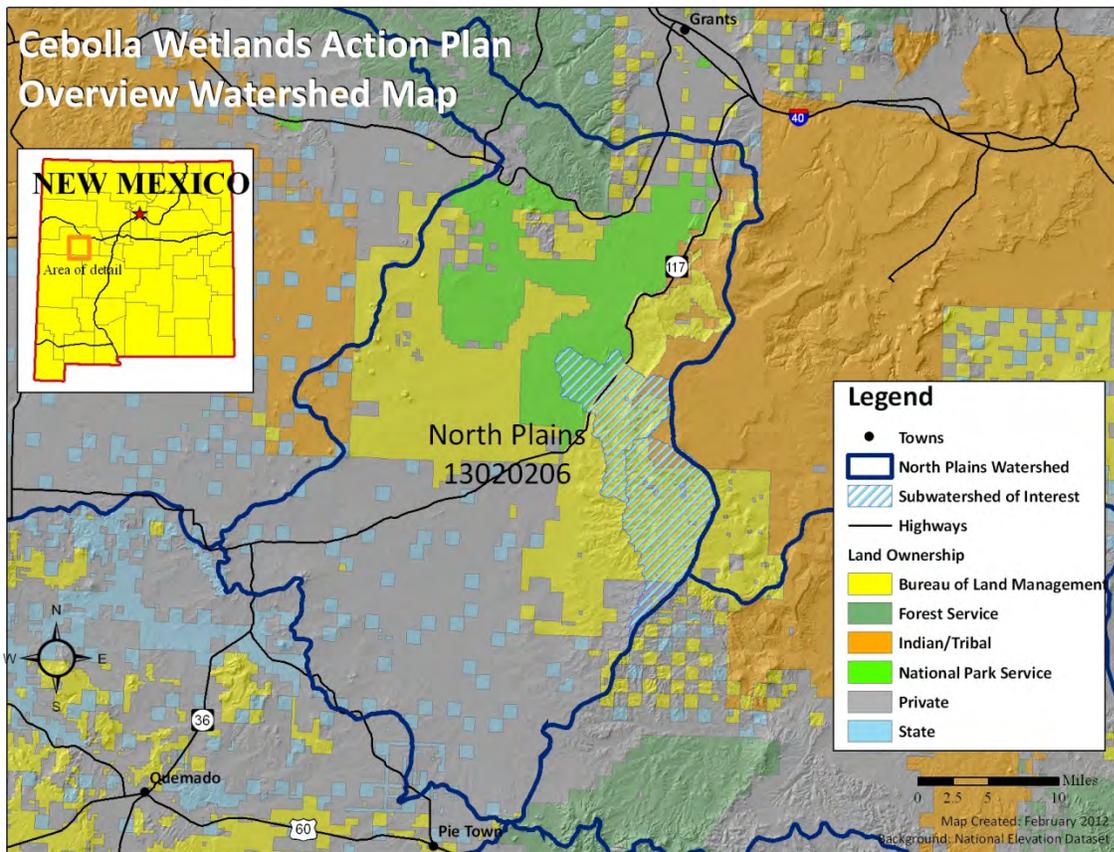
There is no doubt that Cebolla Canyon has been changed and molded over time, but the last 60 years have produced a rapid degradation that resulted in what exists today.

5.3 BLM/NCA/WILDERNESS ESTABLISHMENT

In 1976 the BLM became a multi-faceted agency with the Federal Land Policy and Management Act (1976), which “allowed a variety of uses on their [BLM] land while simultaneously trying to preserve the natural resources in them.” This act gave the BLM the power to inventory land for potential wilderness status. Around this time the Malpais had been given the designation of an outstanding natural area and because of this legal standing the BLM began studying its lands for possible wilderness areas, one of those areas being Cebolla Canyon. Steve Fisher, BLM El Malpais project coordinator, said, “As the early 80s came around after studying the areas we drafted the first environmental impact statement.” At the same time the town of Grants was experiencing a collapse in the uranium mining industry and many people were being laid off. The town was trying to survive economically. U.S. Representative Bill Richardson was the congressional delegate for the area and in 1986 began attempting to push a bill through in order to make the area a national monument and create jobs. Richardson’s political opposition, U.S. Senator Pete Domenici, blocked the bill and brought out William Penn Mott who had recently been appointed the 12th National Park Service (NPS) director in 1985 by Ronald Regan “to look at the land.”

According to Steve Fischer, “Richardson and Domenici came to a compromise that focused on the splitting the lava flow area, making some parts U.S. Forest Service Land and

some a National Monument. At the time there were only three other Conservation Wilderness Areas,” and with Ronald Regan’s signature on the bill in 1988 forming El Malpais National Monument, and Cebolla Wilderness Area (61,600 acres) became the fourth wilderness area in the United States. To complete the canyon’s transformation into more pristine and intact wilderness area, the BLM made some land trades with individuals and families who owned land in Cebolla Canyon and were using the area for ranching purposes. Bruce King, the longest serving New Mexican Governor, and his brothers owned a large portion of Cebolla Canyon, which included Cebolla Springs. In 1994, the BLM traded the Kings for some valuable land surrounding Santa Fe in a land swap effectively bringing Cebolla Canyon under their jurisdiction. Mr. Fisher commented on what Cebolla Springs looked like prior to the land swap: “There was no riparian area in all of Cebolla Canyon. No riparian vegetation, no upland grasses in canyon bottom no sedges, no rushes. The Kings who owned Cebolla Springs had diversions into two ditches, which still remain today. In fact, the so-called Cebolla Creek is not in its true location--it’s an irrigation ditch. When I first started to go to the area in 1977, what was supposed to be Cebolla Spring was not impressive at all and was almost nonexistent. Today, it is real riparian area, and has been radically altered (Steve Fisher, personal communication 2013).”



5.4 DEFINITIONS

5.4.1 Wetland Definition/Classification

The U.S. Fish and Wildlife Service (USFWS) defines wetlands as, “transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is covered by shallow waters” (Tiner, NA) and must have one or more of these three attributes:

- At least periodically, the land must support predominantly hydrophytes (wetland plants).
- The substrate is predominantly un-drained hydric soil.
- Rocky, gravelly, or sandy areas that are saturated with or covered by shallow water at some time during the growing season (Cowardin, 1979).

The EPA on the other hand defines a wetland as:

“Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas” (EPA, 2013).

The State of New Mexico defines “**Wetlands**” as those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions (NMAC 20.6.4). In more general terms, a wetland is the aquatic ecosystem at the interface, or transitional zone, between upland, dry ecosystems and deeper water aquatic ecosystems, such as rivers or lakes. Wetlands are also found in isolated locations away from other bodies of surface water. For assessment and management purposes, the NMED Surface Water Quality Bureau Wetlands Program uses the following definition:

Wetlands. Wetlands are aquatic systems with physical, chemical and biological attributes that are transitional between terrestrial (or upland) and deeper water aquatic systems. In wetland ecosystems the water table is usually at or near the surface, or the land is covered by shallow water. Wetlands have one or more of the following attributes: (1) at least periodically, the land supports hydrophytes (plants dependent on saturated soils or a water medium); (2) the substrate is predominantly hydric soil or contains hydric soil indicators and/or redoxymorphic features that indicate saturation periodically; and (3) the substrate is non-soil such as bedrock or boulders, and is saturated with water or covered by shallow water at some time during the growing season. Because of the climatic variability of New Mexico which sometimes includes long periods of drought that dry up even the most persistent water sources, wetlands are not expected to be saturated each year.

The upland limit of a wetland is where soil and vegetation is not influenced by shallow water or a water table near the surface, displays predominantly mesophytic or xerophytic plant

cover that cannot tolerate saturated soil conditions, soil that is non-hydric and land that is not saturated some time during the growing season. The lower boundary between wetlands and deeper water habitat associated with riverine and lacustrine systems lies at 2 meters (6.6 feet) below low water, or the maximum depth at which emergent plants normally grow.

Because ecosystem services and functions of wetlands are tied to the continuum and mosaic of the entire ecosystem, the hyporheic zone (local water table) is also part of a wetland. Linkages include exchange of water and materials along vertical surface/subsurface (hyporheic) water exchanges.

Riparian Areas. Riparian areas are intrinsically connected to and interdependent on the water sources and hydrologic regimes that also support wetlands. Riparian areas include entire floodplains able to support vegetation dependent on runoff and overbank flow, scour, sedimentation, infiltration and shallow groundwater. They include areas considered as somewhat drier portions of a wetland ecosystem and are characterized by phreatophytic and mesophytic vegetation and habitats also associated with flowing or stationary bodies of water. They are dependent on existence of perennial, intermittent or ephemeral surface water and/or hyporheic zones. Riparian areas occupy the same areas of the landscape as wetlands, may contribute to the same functions within the landscape, and are interdependent, and, therefore, are considered together as part of a wetlands ecosystem and constituting a wetlands assessment.

Buffers. Buffers are non-disturbance or minimally disturbed areas surrounding a wetland/ riparian area where natural vegetation is maintained to protect wetlands and riparian areas from the impacts of stormwater floods, a variety of pollutants, and solid waste from adjacent terrain (Kusler et al. 2003). Buffers provide the functions and services associated with contiguous natural habitat adjacent to wetlands and riparian areas. Land cover elements which are considered acceptable buffer include natural uplands (forests, grasslands, shrublands), swales, nature or wildland parks, unmaintained old fields, and rangeland in good condition. These buffer elements are expected not to disrupt ecosystem connectivity, provide habitat connectivity, and provide protective services such as preventing erosion, reducing pollutant contamination and preventing encroachment of undesirable landscape elements and activities that affect wetland resources. Wetland assessments include assessment of the condition and extent of buffer areas (NMED, 2013).

The EPA recognizes both the Cowardin Classification System and the Hydrogeomorphic (HGM) Wetlands Classification System. The Cowardin system is used by the U.S. Fish and Wildlife Service (USFWS) for the National Wetlands Inventory (NWI). In this system, "...wetlands are classified by landscape position, vegetation cover and hydrologic regime. The Cowardin System includes five major wetland types: marine, tidal, lacustrine, palustrine and riverine" (Cowardin, 1979).

Developed by the U.S. Army Corps of Engineers (USACE), HGM Classification of Wetlands is considered a wetland functional assessment approach (USDA/NRCS, 2008) where "...wetlands are classified by their geomorphic setting, dominant water source (e.g.,

precipitation, groundwater or surface water) and hydrodynamics.” HGM includes five major wetland classes: “...riverine, slope, depressional, flat and fringe” (EPA, 2013).

5.4.2 Cebolla Classification Using the Cowardin System

Cebolla Canyon wetlands are considered a palustrine wetland type. Palustrine is defined by the Cowardin Classification System as:

All non-tidal wetlands vegetated by trees, shrubs, persistent emergents, emergent mosses, or lichens, and all such tidal wetlands where ocean-derived salinities are below 0.5 percent. This category also includes wetlands lacking such hydrophytic vegetation but with all of the following characteristics:

- Area less than 20 acres
- Lacking an active wave-formed or bedrock boundary
- Water depth in the deepest part of the basin is less than 2 meters (6.6 ft.)
- Ocean derived salinities less than 0.5 ppt.

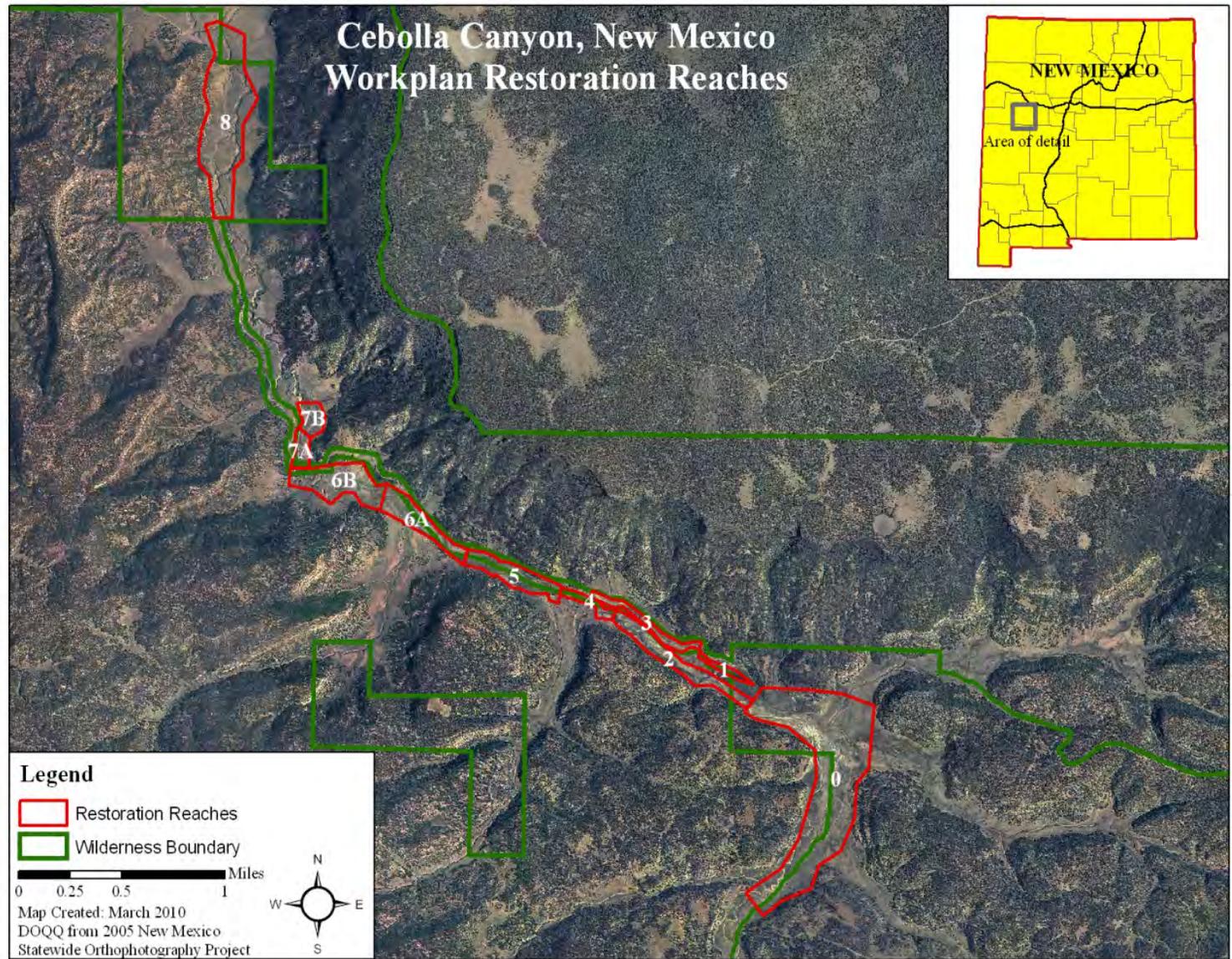
The palustrine class groups the vegetated wetlands commonly known as “...marsh, swamp, bog, fen, and prairie, which are found throughout the United States. It also includes the small, shallow, permanent or intermittent water bodies often called ponds.” Palustrine wetlands are found “...shoreward of lakes, river channels, or estuaries; on river floodplains; in isolated catchments; or on slopes. They may also occur as islands in lakes or rivers” (USGS, 2013).

Unfortunately, the NWI for the Cebolla Canyon wetlands has not been digitized, but a PDF of the 1:100K 1984 30 x 50 minute series paper map “Acoma Pueblo” is available at www.fws.gov/ifw2es/nwi/Raster.html. Some of the Cebolla Canyon Watershed wetlands and their classification codes using the Cowardin System are shown on this map.

5.4.3 Cebolla Wetlands Classification Using HGM

Part of Cebolla Canyon, from approximately Lobo Canyon to an area approximately 10 miles downstream, was divided into reaches for restoration work. The reaches were delineated from 0-8 (see map below). These reaches were in the valley, where homesteaders in the 1930s diverted water from the Creek and springs for agriculture. They were felt to be critical areas that needed the most restoration. Wetlands and riparian ecosystems in other areas, for example some tributaries to Cebolla Creek, are not currently part of this discussion, although the potential for restoration will be addressed as part of the Cebolla Canyon watershed future actions.

The wetlands in Reaches 2 through 8 are considered riverine. Wetlands immediately downstream of Cebolla Springs (Reaches 1 to 2) are considered to be slope wetlands. Below is a description of the characteristics of these wetlands.

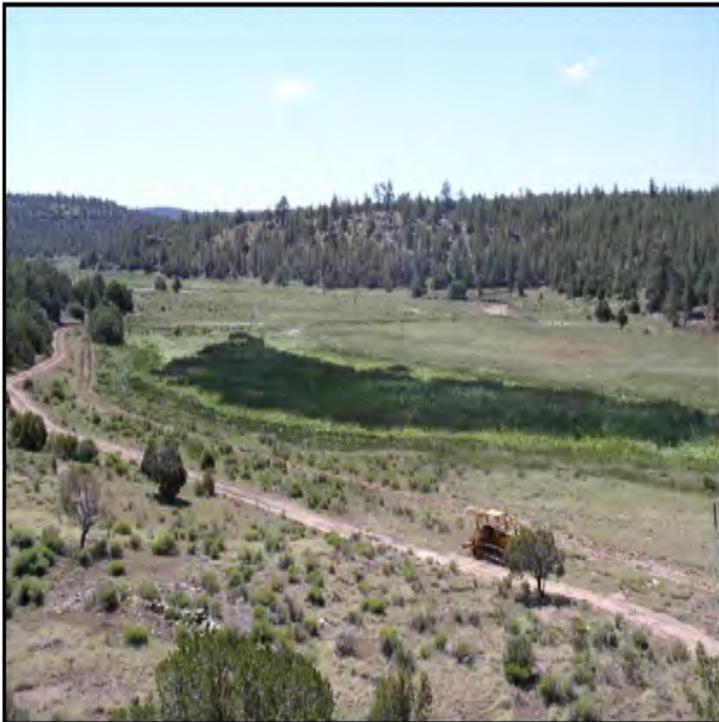


5.4.3.1 Riverine Wetlands

Riverine wetlands occur in flood plains and riparian corridors in association with stream channels. Dominant water sources are often overbank flow from the channel or subsurface hydraulic connections between the stream channel and wetlands. However, sources may be interflow and return flow from adjacent uplands, occasional overland flow from adjacent uplands, tributary inflow, and precipitation. At their headwaters, riverine wetlands often are replaced by slope or depression wetlands where the channel morphology may disappear. They may intergrade with poorly drained flats or uplands. Perennial flow in the channel is not a requirement (USDA/NRCS, 2008).

5.4.3.2 Slope Wetlands

Slope wetlands are normally found where there is a discharge of ground water to the land surface. They normally occur on sloping land; elevation gradients may range from steep hillsides to slight slopes. Principal water sources are usually ground water return flow and interflow from surrounding uplands, as well as precipitation. Hydrodynamics are dominated by downslope unidirectional water flow. Slope wetlands can occur in flat landscapes if ground water discharge is a dominant source to the wetland surface. Slope wetlands lose water primarily by saturation of subsurface and surface flows and by evapotranspiration. Slope wetlands may develop channels, but the channels serve only to convey water away from the Slope wetland. Fens, a low and marshy or frequently flooded area of land, are a common example (USDA/NRCS, 2008).



Wetland area at Cebolla Spring in 2008, restored by AWF. (See pages; photo courtesy of Gene Tatum.)

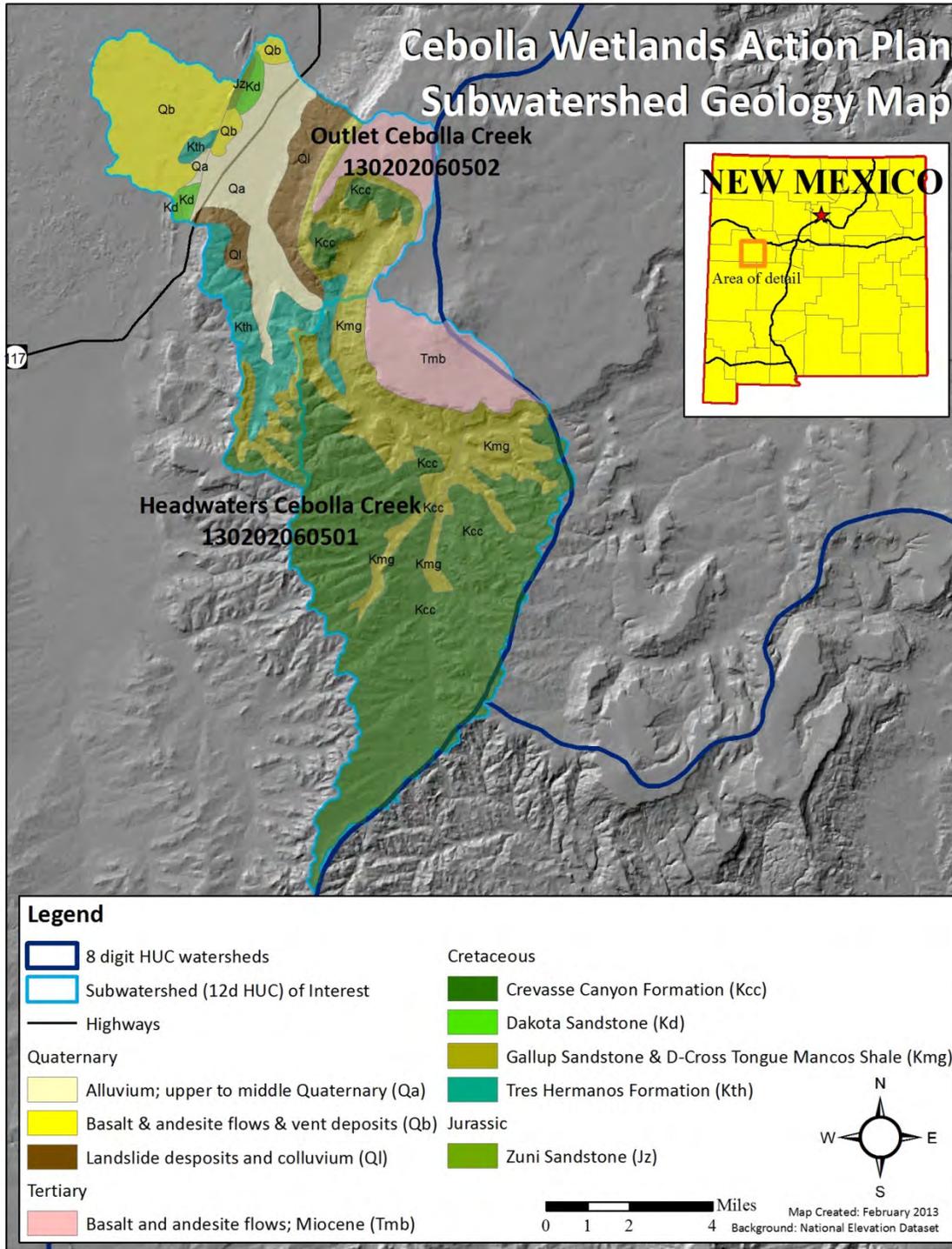
6. RESOURCE ANALYSIS

The resource analysis helps to understand the ecology of the land by providing physiographic information. Beyond ecological characteristics, it is also important to understand the socioeconomic status of the human occupants around the area in order to holistically monitor and define the social relationship of the occupants and the land. Natural resources have more than mere aesthetics for human recreation, and their cataloguing and recognition are primary components for their conservation.

6.1 GEOLOGY AND GEOGRAPHY

The North Plains closed basin is extremely rich in geologic history as it is located at the intersection of Colorado Plateau sedimentary formations and a volcanic region, which has shown relatively recent activity around 4,000 years ago.

Being that Cebolla Canyon is just southeast of the lava flows it possesses quite different geological structure that is defined without question by its sandstone (*Holocene and Pleistocene*). A geologic survey done by Charles H. Maxwell in 1986 indicates that the mesa tops to the south are predominantly a Crevasse Canyon Formation (*Upper Cretaceous*). This is about a 330-ft thick sequence of light yellowish-gray to white sandstone and siltstone, carbonaceous shale, and coal beds. The northern mesas on Cebollita Peak are basalt flows (*Pliocene*). This is typically seen on Cap Mesas and is generally aphanitic and vesicular olivine basalt. These areas are normally covered with soil, alluvium and pine trees. It is about 65-100 feet thick. There is a strong presence along the southern walls of Gallup Sandstone (*Upper Cretaceous*), which has an upper sandstone layer and a silty shale unit at the base. It is light brown and is fine to medium grained. The valley bottoms are the remnants or alluvial runoffs of the Holocene and Pleistocene formations, and are composed largely of silt and fine-grained sand with a few coarse pebbles.



The greater El Malpais region on the other hand is largely covered by lava flows that are relatively young, created by lava that poured from vents in the plain, which erupted periodically. The eruptions began approximately 200,000 years ago with the last eruption was documented as 3,000 years ago. Cerro Encierro, Cerro Bandera and Cerro Rendija are the oldest of the volcanoes that erupted; Bandera and McCartys Crater caused the most recent eruption. Four

types of volcanoes are found within El Malpais: basalt cones, cinder cones, shield volcanoes, and composite volcanoes (Robinson, 1994).

6.1.1 Basalt Lava Cones

Basalt lava cones are the smallest occurring volcanoes in El Malpais. Basalt lava cones are known for shooting lava out at high velocities as well as spreading quickly. Large craters are a typical outcome, measuring as long as two miles across and several hundred feet deep, with steep slopes (Robinson, 1994).

6.1.2 Cinder Cones

Cinder cones are larger than basalt cone volcanoes. Cinder cones have released most of the lava flows in El Malpais. Cinder cones are created from foamy cinders that have accumulated around a vent. One of the oldest volcanoes, Cerro Bandera, is a cinder cone volcano. Since cinder cone volcanoes consist of cinder (*scoria*), and cinder has a very vesicular character, most of their lava is released at the base or site of the volcano cone (Robinson, 1994).

6.1.3 Shield Cones

Shield cone volcanoes earned their name after their shape, as they have a warrior like shield in their profile. When erupting, lava flows into all directions, forming a summit vent and creating a “broad and gently sloping cone” (USGS, 2005). Shield cone volcanoes are built over time, from the accumulation of numerous eruptions, where the lava is spread over great distances, cooling as a “thin, gently dipping sheet” (USGS, 2005). The Cerro Rendija, Cero Hoy, McCartys Crater and a fourth unnamed volcano are all shield cone volcanoes that are located in El Malpais.

6.1.4 Composite

Composite or strato-volcanoes are the largest of their kind. Composite volcanoes are generally tall, symmetrically shaped, and are composed of layers of lava flow, volcanic ash, and cinders. In the vicinity of Malpais we find two composite volcanoes: Mt. Taylor and St. Helens (Robinson, 1994).

6.1.5 Lava Flows Formations

The lava flows that have manifested in El Malpais bear different features. Blocky flows are created by “chunks of hardened lava carried along and then piled up” (Robinson, 1994). Squeeze-ups are formed when the outer crust is fractured and filled with molten material. Kipuka, which translates to “Island of fertile ground” in Hawaiian, are islands of land that are enclosed in lava. The biggest Kipuka in El Malpais is called Hole-in-the-wall and found in the western portion of El Malpais (BLM, 2013). Sinkholes are collapsed depressions where the solidified surface caved in. Lava tubes formed when molten rock flowed underneath a solidified

crust, creating a tunnel. The longest tube in El Malpais measures sixteen miles, which is also the longest known tunnel in North America.

Various significant lava flows have been identified through El Malpais. The McCartys flow is one of the youngest flows, with its creation dating back around three thousand years, and is also one of the largest lava flows produced in El Malpais. The Bandera flow was poured from the Bandera crater and is the second youngest lava flow found in the vicinity of El Malpais. The Hoya de Cibola flow is a shield volcano including a close by crater on the west edge of El Malpais. The El Calderon crater is the oldest known source of lava flows that moved east and north, but much of its original lava flow is covered by soils and younger lava flows. The so-called Twin Craters, composed of the Twin Craters, Lost Women, and Lava Crater, is a collection of neighboring cinder cone volcanoes that produced lava flows that overlapped each other and “because of their similarities they are classed as one flow unit” (Robinson, 1994).

6.1.6 Lava Rock Formation and Composition

After the lava flows solidified, various rock formations formed. Gases escaped or were trapped in the rock, creating bubbles that consolidated. Minerals were trapped in the rock and formed crystals. The black and dark red color of the basalt arises from minerals that contain iron and magnesium.

6.1.7 Sandstone Ridge and Mesas

State Road 117 in the northwest of Cebolla Canyon, is framed by sandstone ridges and mesas. Two hundred ninety to two hundred and forty million years ago, during the Permian time, the sea had reached this area and left marine limestone and gypsum formations in “alternating layers with red muds and sands” (Robinson, 1994) behind. These remnants of the sea eventually formed the Abo Formations consisting of dark red shale and sandstone and the Yeso Formation composed of light red sandstone and light grey limestone and shale, as well as the Glorieta Formation with cream-colored sandstone and the San Andreas Formation composed of light grey limestone.

In the period that followed, from one hundred and forty to two hundred and forty million years ago, the area was above sea level and changed according to the climate from desert to forest. Hot winds brought sand and rivers deposited silts. The Chile Formation was composed of dark red shale; sandstone and conglomerate as well as the Zuni Formation feed off the materials that the winds and rivers left.

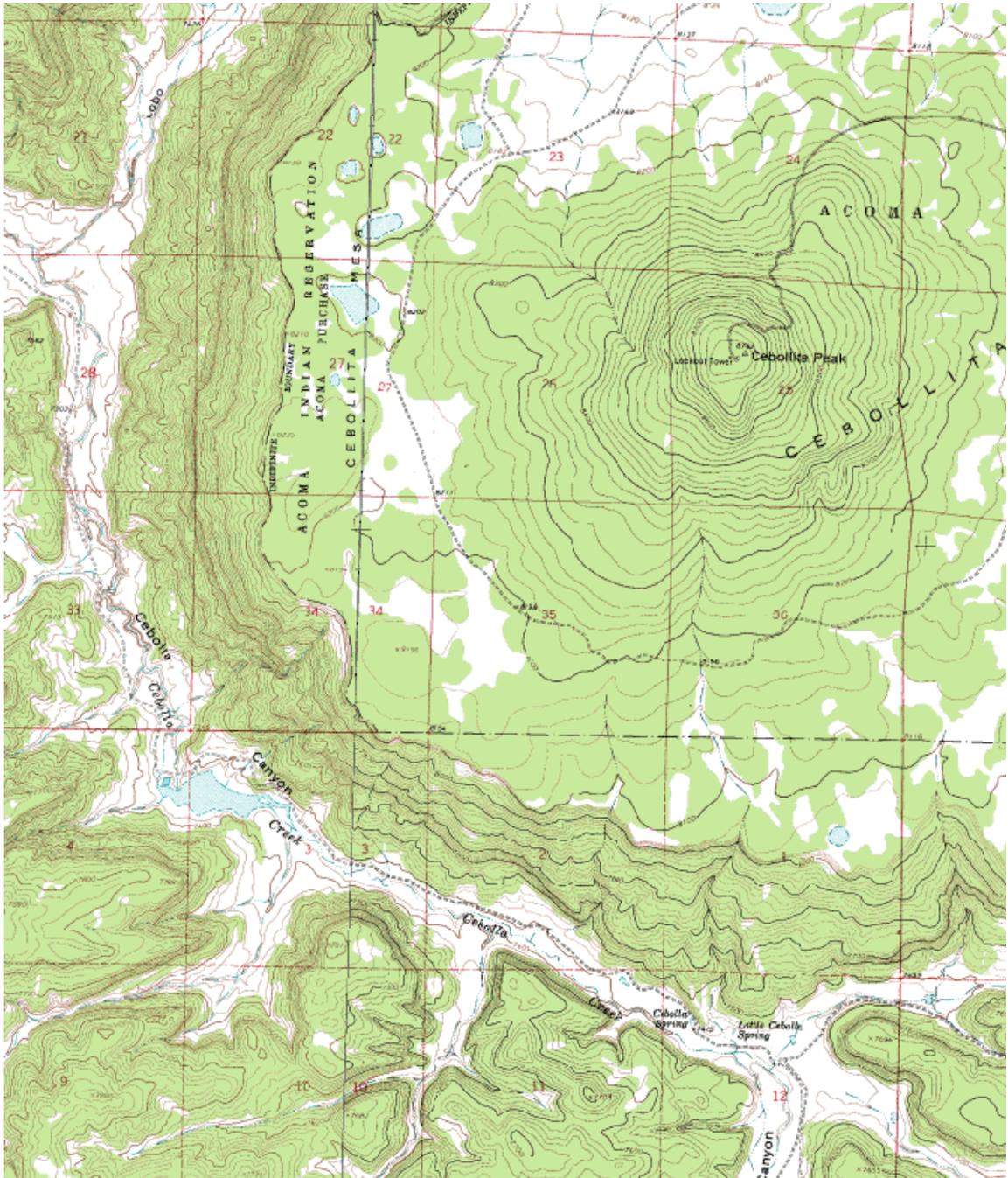
During the late Cretaceous period, one hundred and thirty-eight to sixty-three million years ago, the sea moved “back and forth across the Zuni Mountains” (Robinson, 1994). The water deposited dark shale and buff-colored sandstones that contained a multitude of fossils. The areas bordering the sea became coal deposits. Around seventy million years ago, the water retreated one last time, the Zuni Mountains were pushed up, and erosion started to expose Precambrian granite and the different layers of deposition.

6.2 TOPOGRAPHY

The highest elevation within the Cebolla Canyon Watershed is at the edge of the canyon near Cebollita Peak at just above 8,762 feet, and the lowest elevation is at just below 7,200 feet near Lobo Canyon. The major drainage is Cebolla Canyon, which has named tributaries of Sand Canyon and Lobo Canyon. The area is characterized by mesas, rock outcrops, canyons, and valley bottoms.



Reach 0 View downstream of Cebolla natural channel in the center with Side Valley Right #2 and 3.



Portion of Acoma 7 1/2 minute quadrangle map showing typical topography around Cebollita Peak and the major springs within Cebolla Canyon.

6.3 SOILS

6.3.1 Soil Properties

The soils of Cebolla Canyon are restricted to the geologic parent material (i.e., sandstone, siltstone, and shale) in conjunction with environmental factors such as topography, organisms, and climate. Therefore, in this environment the soils are going to be silty, sandy well-drained soils that have low molecular bondage making them highly erodible. In some areas, clay particles accumulate in the valley bottom, which restrict rapid infiltration, and perch water on the surface.

6.3.1.1 Rock Outcrop-Versilla-Mion Complex

According to the Natural Resources Conservation Service (NRCS), the largest component of soil units in the Lower Cebolla Watershed is a Rock Outcrop-Versilla-Mion complex (*515 on the soil map*), where Rock Outcrop occupies 47 percent and Mion and Vessilla 20 percent each. This complex is found in areas with a slope range between 3 to 55 percent and at an elevation of 5,800 to 7,500 feet with an annual mean precipitation of 12 to 16 inches a year.

The Rock outcrop has very low to moderately high abilities to transmit water, which consequently encourages runoff. The Versilla series on the other hand consists of shallow, well-drained, permeable soils with a 20 percent clay content and rapid runoff characteristics. This series is formed from eolian and alluvial material that weathered from sandstone. It is found predominantly “on narrow ridges, hills, breaks and mesas of bedrock controlled landscapes” (USDA/NRCS, 2009). This soil is intermittently moist from July to October and November to March and dries during the months of May and June.

The Mion soil series is formed from fine textured material weathered from shale, claystone, or sandstone found in hills and upland areas. This shallow soil is well drained and only slowly permeable. Suitable uses for the Mion soils are range and wildlife habitat and these soils are vegetated by sideoats grama, blue grama, little bluestem, needle-and-thread, fringed sage, yucca, oak, piñon, and juniper.

6.3.1.2 Hickman-Catman

The Hickman-Catman (*25 on the soil map*) complex composes 10 percent of the lower Cebolla Watershed and consists of 45 percent Hickman and similar soils as well as 40 percent Catman. It is found in areas of zero to six percent slope at an elevation of 6,500 to 7,500 feet with an annual range of mean precipitation of 12 to 16 inches.

The Hickman series consists of 18 to 35 percent clay. It is “very deep, well drained, moderately slowly permeable soils that formed in alluvium derived from valley fill materials on flood plains and valley floors” (USDA/NRCS, 2009). This soil stays moist for large parts of the year November through April, and is intermittently moist from July through October, with the driest months being May to June. Suitable uses for Hickman series are predominantly livestock

grazing and they are vegetated by alkali sacaton, giant sacaton, blue grama, and western wheatgrass.

Catman series are well drained and very slowly permeable and formed from alluvium that was acquired from sandstone and shale. Catman soils are found in floodplains, upland drainage-ways and playas. It receives around 14 inches of precipitation annually and occupies an area of zero to six percent slope. Catman soils stay intermittently moist July through September and December through March with its driest month being April through June. Catman series soils are suitable for livestock grazing and are vegetated predominantly by western wheatgrass, vine-mesquite, alkali sacaton, and four-wing saltbush. (USDA/NRCS, 2009)

6.3.1.3 Nogal-Galestina

Nogal-Galestina (550 on the soil map) sandy loams compose 7.6 percent of the lower Cebolla Watershed. It is found in areas with a one to ten percent slope and at an elevation of 6,800 to 7,500 feet and receives between 14 and 16 inches of precipitation annually.

Nogal soils are found in areas with one to ten percent slope at an elevation of 6,000 to 7,500 feet. It consists of moderately deep and well-drained soils composed of material that formed through the weathering of gypsiferous shale. It is found on hills with slopes ranging from one to 50 percent and it receives mean annual precipitation of around 16 inches. These soils stay moist during the first 30 to 40 consecutive days following the winter solstice. Suitable uses for Nogal soils are livestock grazing and wildlife habitat and they are vegetated by piñon, alligator and one-seed juniper, wavy-leaf oak, sideoats grama, and western wheatgrass.

The Galestina series are soils that are deep, well drained and slowly permeable that formed in alluvium. Slopes are between one and eight percent receiving around 15 inches of precipitation annually and are found on hills and mesas with an elevation of 6,800 to 7,300 feet. The soils are moist during 30 to 40 consecutive days following the winter solstice. The Galestina soil series is vegetated predominantly with western wheatgrass, blue grama, sideoats grama, and scattered piñon and one-seed juniper and are suitable for livestock grazing. (USDA/NRCS, 2009)

6.3.1.4 Catman-Silkie Association

The Catman-Silkie Association (525 on the soil map) soils are found in areas with a one to ten percent slope at an elevation of 6,500 to 7,500 feet and receive 12 to 16 inches of rain annually.

Catman series soils are well drained and very slowly permeable. They were formed from alluvium that was acquired from sandstone and shale. Catman soils are found in floodplains, upland drainage ways, and playas. It receives around 14 inches of precipitation annually and occupies an area of zero to six percent slope. Catman soils stay intermittently moist July through September and December through March with its driest months being April through June. Catman series soils are suitable for livestock grazing and vegetated predominantly by western wheatgrass, vine-mesquite, alkali sacaton, and four-wing saltbush.

The Silkie series is characterized by deep, well-drained, very slowly permeable soils that are formed in alluvium from sandstone and shale. This series is found in areas with a slope of three to ten percent at an elevation ranging from 6,600 to 7,500 feet, receiving an average of 15 inches of precipitation annually. Its soils are moist 30 to 40 consecutive days after the winter solstice and are found on valley side slopes (USDA/NRCS, 2009).

6.3.1.5 Valnor-Techado Association

The Valnor-Techado Association (*591 on the soil map*) is found at a slope of two to twenty-five percent at an elevation of 7,200 to 8,900 feet with a mean annual precipitation of around 16 to 22 inches.

The Valnor series consist of moderately deep and well-drained soils that formed in slope alluvium, which derived from interbedded shale and sandstone on high plateaus, hills and ridges. The soils are found on hills, ridges, plateaus and mesas with a slope range of two to twenty-five percent at an elevation of 7,100 to 8,200 feet with a mean annual precipitation of around 17 inches. The soils are intermittently moist from July through September and December through April. The soils are suitable for grazing and wood production and are vegetated with blue grama, western wheatgrass, piñon, Rocky Mountain juniper, and ponderosa pine.

The Techado soil series is characterized by shallow, well-drained and slowly permeable soils that formed in slope alluvium and colluvium over residuum derived from shale and sandstone. These soils are found on summits of mesas, dipslopes of cuestras, hills, ridges and mountains on slopes that range between two to sixty percent at an elevation of 6,600 to 8,900 feet with a mean annual precipitation of 18 inches. The soils are intermittently moist from May through October and are driest in May and June. Techado soils are suitable for grazing and wood production and are vegetated with piñon, ponderosa pine, Rocky Mountain juniper and oakbrush (USDA/NRCS, 2009).

6.3.1.6 Paguete Cobbly Clay Loam

The Paguete cobbly clay loam (*291 on the soil map*) are moderately deep, well drained, slowly permeable soils that formed in alluvium derived from basalt on mesas and plateaus. The soils are found in areas with one to five percent slopes, at an elevation of 7,000 to 8,000 feet with a mean annual precipitation of 15 inches. The soils stay moist intermittently 30 to 40 consecutive days after the winter solstice (USDA/NRCS, 2009).

6.3.1.7 Pinitos-Ribera Sandy Loam

The Pinitos-Ribera sandy loam soils (*555 on the soil map*) are found at slopes ranging from one to ten percent at an elevation of 6,800 to 7,500 feet and receive mean annual precipitation of 14 to 16 inches.

The Pinitos soil series is characterized by very deep, well drained, moderately permeable soils that developed in eolian and alluvial material derived from sandstone and shale on hills, fan terraces, cuestras and mesas. The slope ranges from one to 15 percent at an elevation of 6,700 to

7,800 feet with an annual mean of 14 to 16 inches of rainfall. Pinitos soils are found on hills, mesas, cuerdas and fan terraces. The soils are moist 30 to 40 consecutive after winter solstice. They are suitable for rangeland uses and are vegetated by blue grama, piñon and juniper.

The Ribera series is characterized by moderately deep sandstone bedrock soils that are well drained and formed in mixed material deposited by wind and water. They are found on upland fans and in valley fill side slopes with slopes ranging from one to nine percent at an elevation of 6,000 to 7,800 feet and receiving mean annual precipitation of 16 to 18 inches. Ribera soils are predominantly suitable for rangeland and are vegetated by blue grama, sand dropseed, snakeweed, cholla, piñon, and juniper.

6.3.1.8 Trag-Techado-Rock Outcrop Complex

The Trag-Techado-Rock Outcrop complex is found in areas with a three to 55 percent slope at an elevation of 7,200 to 8,900 feet and receives a mean of 16 to 22 inches rain annually.

The Trag soil series is characterized by very deep, well-drained soils that formed from weathered granite and schist material found on mountains, slopes and fans. It's found in areas with a 1 to 40 percent slope at an elevation of 6,800 to 8,900 feet and receives 15 to 22 inches of rain annually. Trag soils are suitable for rangeland and are vegetated with mainly blue grama, big and little bluestem, junegrass, some forbs and shrubs, and widely spaced ponderosa pine.

The Techado soil series is characterized by shallow, well-drained and slowly permeable soils that formed in slope alluvium and colluvium over residuum derived from shale and sandstone. These soils are found on summits of mesas, dipslopes of cuerdas, hills, ridges and mountains on slopes that range between two to sixty percent at an elevation of 6,600 to 8,900 feet with a mean annual precipitation of 18 inches. The soils are intermittently moist from May through October and are driest in May and June. Techado soils are suitable for grazing and wood production and are vegetated with piñon, ponderosa pine, Rocky Mountain juniper, and oakbrush.

The Rock Outcrop obtains properties with very low to moderately high abilities to transmit water and consequently encourages runoff. The Vessilla series on the other hand consists of shallow, well-drained, permeable soils with 20 percent clay content and rapid runoff characteristics. This series is formed from eolian and alluvial material that weathered from sandstone. It is found predominantly "on narrow ridges, hills, breaks and mesas of bedrock controlled landscapes" (USDA/NRCS, 2009). This soil is intermittently moist from July to October and November to March and dries during the months of May and June.

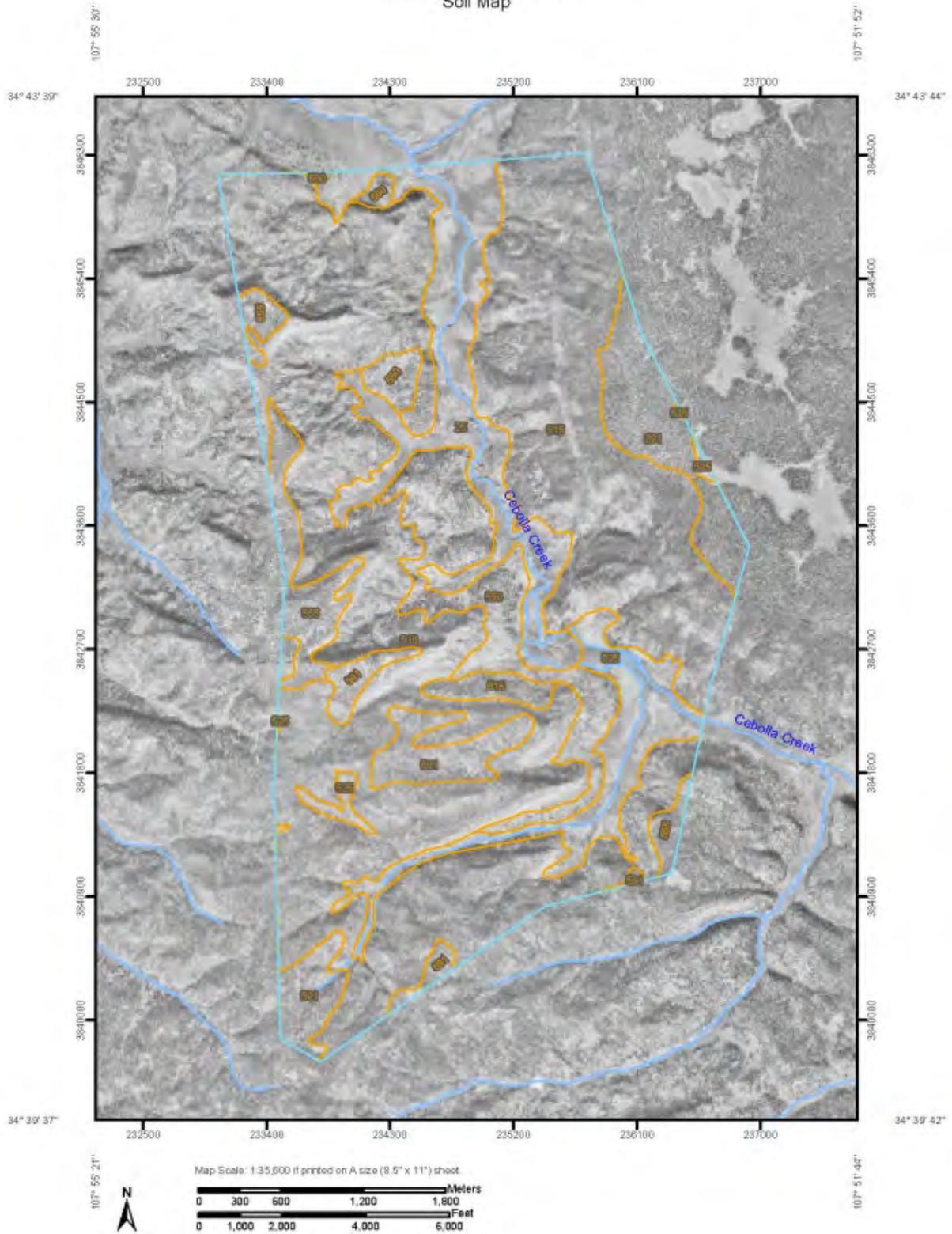
Other soils composing the upper Cebolla Watershed are present at less than one percent and are not described here (USDA/NRCS, 2009).

i. Soil Resource Table

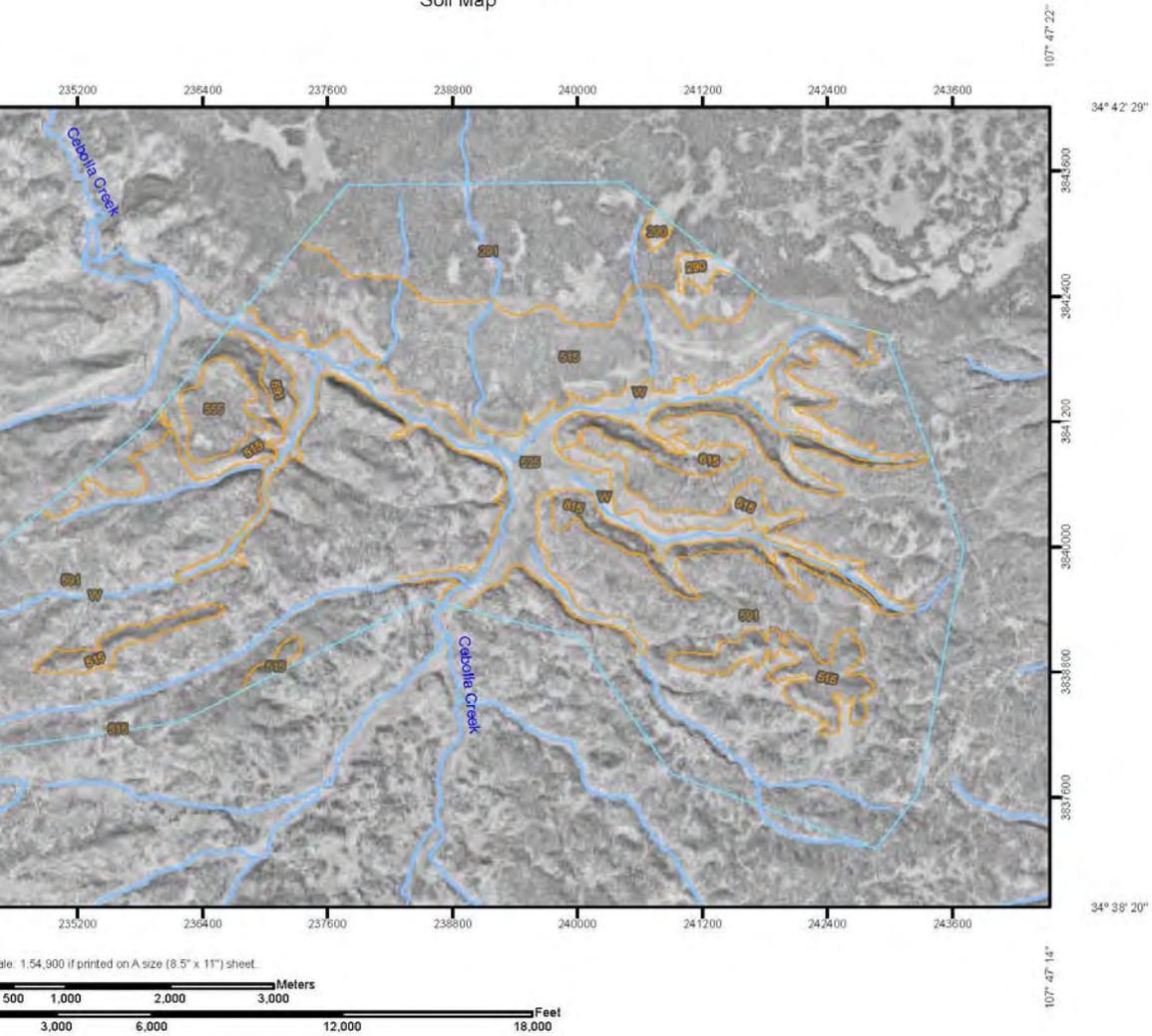
Lower Cebolla Watershed				
Map Unit Symbol	Map Unit Name	Acres AOI	Slope	Percent of AOI
25	Hickman-Catman complex,	432.8	1 to 6 percent	10.0%
291	Paguete cobbly clay loam	177.4	1 to 5 percent	4.1%
515	Rock Outcrop-Versilla-Mion complex	2,714.2	3 to 55 percent	62.5%
525	Catman Silkie association	245.1	1 to 10 percent	5.6%
535	Millpaw loam	5.9	0 to 5 percent	0.1%
550	Nogal-Galestina sandy loams	330	1 to 10 percent	7.6%
555	555 Pinitos-Ribera sandy loam	163.3	1 to 10 percent	3.8%
560	Flugle-Teco association	14.2	1 to 8 percent	0.3%
591	Valnor-Techado association	220.3	2 to 25 percent	5.1%
615	Trag-Techado-Rock Outcrop complex	40.2	3 to 55 percent	0.9%
Middle Cebolla Watershed				
Map Unit Symbol	Map Unit Name	Acres AOI	Slope	Percent of AOI
290	Paguete-Hackroy complex	45.0	1 to 5 percent	0.5%
291	Paguete cobbly clay loam	957.1	1 to 5 percent	10.3%
515	Rock Outcrop-Versilla-Mion complex	1,884.4	3 to 55 percent	20.3%
525	Catman Silkie association	774.0	1 to 10 percent	8.3%
555	555 Pinitos-Ribera sandy loam	126.6	1 to 10 percent	1.4%
591	Valnor-Techado association	5,133.0	2 to 25 percent	55.3%
615	Trag-Techado-Rock Outcrop complex	360.8	3 to 55 percent	3.9%
Upper Cebolla Watershed				
Map Unit Symbol	Map Unit Name	Acres AOI	Slope	Percent of AOI
515	Rock outcrop-Versilla-Mion complex	2,050.0	3 to 55 percent	20.8%
525	Catman Silkie association	931.5	1 to 10 percent	9.5%
550	Nogal-Galestina sandy loams	205.3	1 to 10 percent	2.1%
591	Valnor-Techado association	6,655.4	2 to 25 percent	67.6%
W	Water	NA	7.0	0.2%

(USDA/NRCS, 2009)

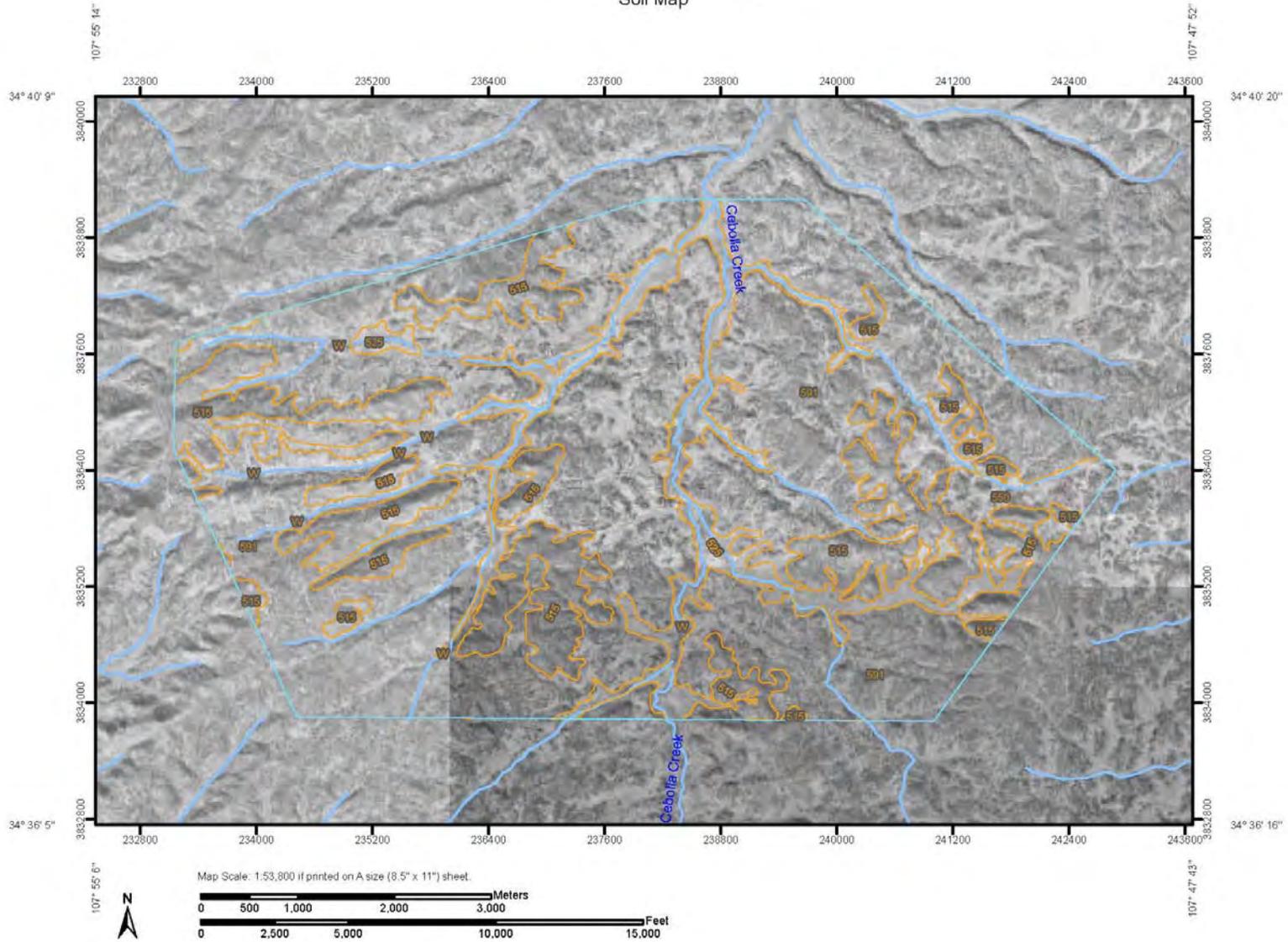
Custom Soil Resource Report
Soil Map



Custom Soil Resource Report
Soil Map



Custom Soil Resource Report
Soil Map



6.3.2 Hydraulic Soils

Hydraulic soil type allows us to understand the runoff potential for the soil. That is to say that this is the amount of water that the soil is able to absorb before it reaches capacity. The soils in the United States are given a letter rating from A-D.

Group A: Soils are deep, well drained and have a high infiltration rate.

Group B: Soils are moderately deep somewhat well drained and have moderate infiltration rate.

Group C: Soils have slow infiltration rate when thoroughly wet. They have a layer that impedes the downward movement of water or soils of moderately fine texture.

Group D: Soils having a very slow infiltration rate or have a high runoff potential. This group consists mainly of clays layers near the surface. (USDA/NRCS, 2009)

The following table illustrates the runoff potential for the main soil types in Cebolla Canyon.

ii. Hydraulic Soil Rating:

Soil Type	Rating
Rock Outcrop-Versilla-Mion (515)	D
Catman-Silkie (525)	D
Valnor-Techado (591)	C
Trag-Techado-Rock Outcrop (615)	D

These ratings confirm the soils infiltration abilities to be very poor. With low infiltration rates comes high amounts of surface water movement and erosion potential, as well as perched water once the floodwater disperses downstream, creating wetland formation opportunities.

6.3.3 Available Water Capacity

Available water capacity (AWC) refers to the quantity of water that the soil is capable of storing for use by plants. “The capacity for water storage is given in centimeters of water per centimeter of soil for each soil layer.” The soil’s ability to retain water and make it available for plants is crucial for vegetative growth in times of extreme weather conditions such as droughts (USDA/NRCS, 2009).

The following table illustrates the runoff potential for the main soil types in Cebolla Canyon.

iii. *Available Water Capacity:*

Soil Type	Rating
Rock Outcrop-Versilla-Mion (515)	N/A
Catman-Silkie (525)	0.15
Valnor-Techado (591)	0.16
Trag-Techado-Rock Outcrop (615)	0.16

6.3.4 The Water Erosion Factor

The water erosion factor is used to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates, which are numerical on a scale of 0.02-0.69, are based on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity. The higher the numerical value, the more vulnerable the soil is to sheet and rill erosion (USDA/NRCS, 2009).

iv. *Sheet and Rill Erosion Potential:*

Soil Type	Rating
Rock outcrop-Vessilla-Mion (515)	N/A
Catman-Silkie (525)	0.32
Valnor-Techado (591)	0.32
Trag-Techado-Rock Outcrop (615)	0.15

These ratings show that all the soils in the survey are vulnerable to rill and sheet erosions when saturated during weather events. This erosion is visible today with the frequent occurrence of headcuts and gullies.

6.3.5 Wind Erodibility Index

Wind Erodibility Index gives a numerical value to the exposure of the soil to wind erosion. The number estimates the amount of erosion that will take place per acre per year due to wind erosion. This number is related to bare soil, without vegetation, and is influenced primarily by aggregate size and surface features such as rocks and other debris (USDA/NRCS, 2009).

v. *Wind Erodibility:*

Soil Type (tons) per acre per year	Rating
Rock Outcrop-Versilla-Mion (515)	N/A
Catman-Silkie (525)	86
Valnor-Techado (591)	48
Trag-Techado-Rock Outcrop (615)	56

6.3.6 Organic Matter

Organic matter is the plant and animal deposits in the soil represented at the different stages of decomposition. Organic matter is fundamental in the production of new soil humus, which is a highly chemically and biologically active portion of the soil. It is measured by weight of the soil material that is less than two millimeters in diameter. But the rating given below is a richness percentage. The higher the number, the richer is the soil in organic matter (USDA/NRCS, 2009).

vi. *Organic Matter Rating:*

Soil Type (tons) per acre per year	Rating
Rock Outcrop-Versilla-Mion (515)	N/A
Catman-Silkie (525)	0.31
Valnor-Techado (591)	0.57
Trag-Techado-Rock Outcrop (615)	0.57

These numbers demonstrate a mid to lower range of organic material present in the soils. These numbers also give a good indication to the decomposition rate of the present vegetation in the soils.

6.3.7 Clay

Clay consists of mineral soil particles that are less than 0.002 millimeter in diameter. The amount of clay influences the shrink-swell and plasticity of the soil. “The amount and kind of clay affect the fertility and physical condition of the soil and the ability of the soil to adsorb cations and to retain moisture” (USDA/NRCS, 2009).

vii. *Soil Clay Content:*

Soil Type Percentage Clay	Rating
Rock Outcrop-Versilla-Mion (515)	N/A
Catman-Silkie (525)	60.1
Valnor-Techado (591)	38.4
Trag-Techado-Rock Outcrop (615)	25.3

6.3.8 Sand

Sand consists of mineral soil particles that are 0.05 millimeter to 2 millimeters in diameter. “The estimated sand content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter” (USDA/NRCS, 2009). The amount of sand is extremely important for soil functionality and hydrology.

viii. *Percent Sand:*

Soil Type	Percent Sand in Soil
Rock Outcrop-Versilla-Mion (515)	N/A
Catman-Silkie (525)	15.0
Valnor-Techado (591)	30.6
Trag-Techado-Rock Outcrop (615)	54.1

6.3.9 Silt

Silt in the soil consists of mineral soil particles that are 0.002 to 0.05 millimeter in diameter. Silt levels determine soil hydrology, erosion rates, and soil physicality. The rating below is based on percentage of silt present in the survey.

ix. *Silt Content:*

Soil Type	Percent
Rock Outcrop-Versilla-Mion (515)	N/A
Catman-Silkie (525)	24.8
Valnor-Techado (591)	31.0
Trag-Techado-Rock Outcrop (615)	20.6

6.3.10 Hydric Soils

The occurrences of hydric (i.e, wetland) soils were compiled for the North Plains watershed from the soil data from the NRCS (NRCS/USDA, 2012) (<http://soildatamart.nrcs.usda.gov/>). The “Cibola Area, New Mexico, Parts of Cibola, McKinley, and Valencia Counties” (survey# NM682) and “Catron County, New Mexico, Northern Part” (survey# NM648) surveys were used to cover the analysis area. The “Hydric Soils” pre-formatted report identified “soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (Federal Register, 1994). These soils, under



natural conditions, are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophytic vegetation.” This analysis resulted in 10 hydric soil types being identified within the North Plains closed basin survey area. These soils are found in floodplains, drainageways, swales, and all soils fall under the hydric criterion of “soils that are frequently flooded for long or very long duration during the growing

season.” Surprisingly, more playas were not identified with this analysis, but this could be due to the large scale of the soil types versus the small scale of the individual playas. The larger analysis can assist in wetland delineation, wetland mapping, planning projects, and targeting future wetland restoration projects.

x. Hydric Soil found within the North Plains Closed Basin:

Soil Type	Number	Slope
Hickman-Catman complex Cibola	25	1 to 6
Warm Springs loam Cibola	30	0 to 2
Catman clay loam Cibola	70	1 to 3
Catman sandy clay loam Cibola	73	1 to 3
Saladon clay loam Cibola	300	0 to 5
Catman-Silkie association Cibola	525	1 to 10
Pietown-Hickman complex Catron	422	0 to 5
Catman-Hickman complex Catron	425	1 to 5
Catman silty clay Catron	494	0 to 2

6.4 ECOLOGY

6.4.1 Ecotypes

6.4.1.1 Wetland and Plant Communities (Natural Heritage New Mexico Program Information)

Natural Heritage New Mexico (NHNM) performs research on the conservation and sustainable management of New Mexico’s biodiversity. They have compiled an inventory of the State’s wetland vegetation communities. This inventory is a “hierarchical vegetation classification which provides detailed information about individual wetland plant community types including: marshes, streamside riparian areas, playas, wet meadows, lakeshores, and peatlands” (Muldavin, 2000).

Applying the NHNM wetland vegetative data to Cebolla gives a better understanding of existing conditions, community types, transitional states, composition, and structure. The following table displays the New Mexico wetlands vegetation classification for the communities presently occurring at Cebolla.

xi. Wetland Vegetation

New Mexico Wetlands Vegetation Classification	National Vegetation Classification Cross walk and Scientific Name
Lowland persistent emergent wetland: Semi-permanently flooded	V.A. 5n1 Semi-permanently flooded temperate or subpolar grassland

Broadleaf Cattail Alliance	<i>Typha latifolia</i> Herbaceous Alliance
Baltic Rush Alliance	<i>Juncus balticus</i> Flooded Herbaceous Alliance
Needle-leaved Scrub Shrub Wetland	
Lowland Exotic Needle-leaved Deciduous Scrub Shrub Wetland	
Temporarily Flooded Salt Cedar Alliance	<i>Tamarix spp.</i>

6.4.1.2 Baltic Rush Alliance (semi-permanently flooded)

Baltic Rush (*Juncus balticus*) is found in flooded temperate or subpolar grasslands between 5,675-7,850 feet. The soils are hydric and rich in organic material and are “young Typic or Mollic Fluvaquents with silty coarse-loamy textures” (Muldavin, 2000).

Other vegetative species typically present are:

- Shortawn foxtail (*Alopecurus aequalis*)
- Porcupine sedge (*Carex hystericina*)
- Nebraska sedge (*Carex nebrascensis*)
- Clustered field sedge (*Carex prae-gracilis*)
- Common Spikerush (*Eleocharis palustris*)
- Alkali muhly (*Muhlenbergia asperifolia*)
- Other *Juncus* species

These communities are found in low alluvial bars, islands, moderate gradient streams or rivers, back channels, pond edges, and spring-fed wet meadows.

6.4.1.3 Needle-leaved Scrub Shrub Wetland

The needle-leaved scrub shrub wetland, or Salt Cedar Alliance, is distributed throughout the Western United States and Great Plains. As the name suggests the Alliance consists of salt cedar. Salt cedar is found in every basin in New Mexico and is considered to be an invasive exotic plant. The community of salt cedar trees represented in Cebolla Canyon is small (75±25). There are future plans for its removal as it may compromise the intended wetland community by outcompeting native wetland species.

The salt cedar community is found at elevations of 3,825-6,000 feet. The community occurs often in basins, narrow canyons, on alluvial flats, around playas and in poor as well as rich soil types. A dominant species with shrub canopies forming 40-60 percent cover also has an understory that is “grassy and strongly dominated by luxuriant alkali sacaton and bottomland bunchgrass” (Muldavian, 2000).

Other present species are often:

- Sandbur (*Cenchrus carolintanus*)
- Bristlegrass (*Setaria leucoptia*)
- Spike dropseed (*Sporobolus contractus*).
- Forbs vary and the same variety is not often continuous.

6.4.2 Existing Vegetation

The existing wetland vegetation species list will expand over time but for now the following table gives a preliminary list from vegetation monitoring efforts.

xii. Vegetation Species List

Species List	
Scientific Name	Common Name
<i>Achillea millefolium</i>	yarrow
<i>Achnatherum hymenoides</i>	Indian ricegrass
<i>Achnatherum robustum</i>	sleepygrass
<i>Artemisa dracuncululus</i>	tarragon
<i>Artemisia frigida</i>	sagewort
<i>Atriplex canescens</i>	flowering saltbrush
<i>Bouteloua barbata</i>	6-week grama
<i>Bouteloua gracilis</i>	blue gramma
<i>Bromus tectorum</i>	cheatgrass
<i>Carex praegraclis</i>	field sedge
<i>Chrysothamnus nauseosus</i>	rabbitbrush
<i>Cleome serrulate</i>	beeplant
<i>Conyza canadensis</i>	horseweed
<i>Desciraonia pinnate</i>	Western tansy-mustard
<i>Eleocharis palustris</i>	spikerush
<i>Eleocharis quinqueflora</i>	few-flowered spikerush
<i>Elymus smithii</i>	Western-wheatgrass
<i>Epilobium ciliatum</i>	epilobium
<i>Erigeron divergens</i>	margarita
<i>Euphorbia sp.</i>	euphorbia species (spurge)
<i>Euphorbia spathilate</i>	warty spurge
<i>Festuca arundinacea</i>	tall fescue
<i>Grindelia squarosa</i>	gumweed
<i>Gutierrezia sarothrae</i>	snakeweed
<i>Hackelia hirsute</i>	stickseed

<i>Hordeum jubatum</i>	foxtail barley
<i>Juncus balticus</i>	baltic rush
<i>Juncus torrey</i>	torre's rush
<i>Kochia scoparia</i>	kochia
<i>Lycopus asper</i>	bugleweed
<i>Lycurus phieoides</i>	wolf tall
<i>Melilotus officinalis</i>	yellow sweet clover
<i>Muhlenbergia asperifolia</i>	scratchgrass
<i>Muhlenbergia Montana</i>	mountain muhly
<i>Muhlenbergia repens</i>	creeping muhly
<i>Opuntia sp.</i>	prickly pear
<i>Plantago patagonica</i>	wooly plantain
<i>Poa pratensis</i>	Kentucky bluegrass
<i>Polygonum punctatum</i>	smartweed
<i>Portulaca oleracea</i>	purslane
<i>Prunella vulgaris</i>	self-heal mint
<i>Ranunculus scellaratus</i>	cursed butter-cup
<i>Ratibida tagetes</i>	Mexican hat
<i>Rumex crispus</i>	dock
<i>Salsola kali</i>	Russian thistle
<i>Schoenoplectus tabernaemontani</i>	bulrush
<i>Soiribilis aeroides</i>	alkali scaton
<i>Sporobolus contractus</i>	spike dropseed
<i>Tamarix ssp.</i>	Salt cedar Tamarix
<i>Taraxacum officinale</i>	dandelion
<i>Thelesperma subnudum</i>	cota
<i>Thermopsis montana</i>	goldenpea
<i>Tragopogon dubius</i>	salsify
<i>Typha latifolia</i>	cattail
<i>Vicia americana</i>	American vetch
<i>Vulpia octoflora</i>	fescue

7.3.3 Ecoregions

An ecoregion is a defined area that is larger than an ecosystem but smaller than a bioregion and ecozone. They contain characteristic, geographically distinct assemblages of natural communities and species. Ecoregions denote areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources; they are designed to serve as a spatial framework for the research, assessment, management, and monitoring of ecosystems and ecosystem components (Bryce, 1999). In the following section we will identify the Cebolla

Canyon Ecoregions using a New Mexico EPA ecoregional map and then elaborate on the ecoregion types.

Cebolla Canyon contains three Ecoregions types: 22j Semiarid Tablelands, 23c Montane Conifer Forest, and 23e Conifer Woodlands and Savannas.

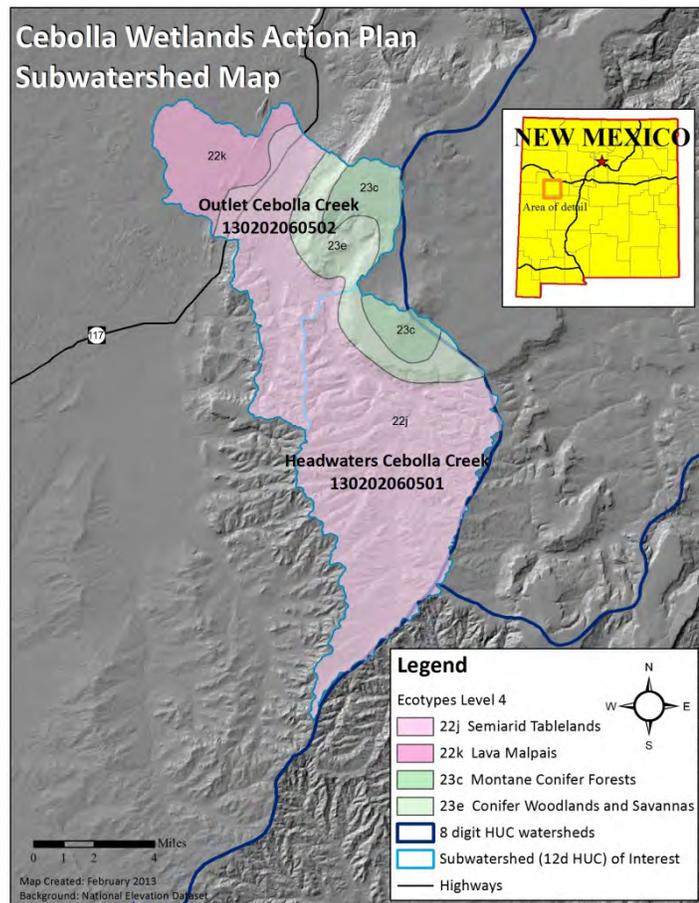
6.3.3.1 Semiarid Tablelands

This ecoregion consists of mesas, plateaus, valleys, and canyons formed mostly from flat to gently dipping sedimentary rocks, along with some areas of Tertiary and Quaternary volcanic fields. The region contains areas of high relief as well as some relief plains. Bedrock exposures are common. Grass, shrubs, and woodland cover the tablelands. It lacks the denser pine forests of the higher and more mountainous Ecoregion 23. Scattered junipers occur on shallow, stony soils, and are dense in some areas. Piñon-juniper woodland is also common in some areas. Saltbush species, alkali sacaton, sand dropseed, and mixed grama grasses occur (Omernik & al, 2009).

6.3.3.2 Montane Conifer Forests

The montane conifer forest is found west of the Rio Grande at elevations from about 7,000 to 9,500 feet. Ponderosa pine and Gambel oak are common, along with mountain mahogany and serviceberry. Some Douglas fir, southwestern white pine, and white fir occur in a few areas. Blue spruce may occasionally be found in cool, moist canyons. In the far south, other oaks appear, such as silverleaf oak, netleaf oak, Arizona white oak, and Emory oak. The summer rains are especially important for herbaceous plants. The region is geologically diverse with volcanic, sedimentary, and some intrusive and crystalline rocks. Livestock grazing, logging, and recreation are the primary land uses. Wildfire is an important feature influencing the forested ecosystems in this region (Omernik & al, 2009).

6.3.3.3 Conifer Woodlands and Savannas



This ecoregion is an area of mostly piñon-juniper woodlands, with some ponderosa pine at higher elevations. It often intermingles with grasslands and shrublands. The region is generally cooler, with more uniform winter and summer seasonal moisture compared to Ecoregion 23b. It lacks the milder winters, wetter summers, chaparral, Madrean oaks, and other species of Ecoregion 23b Madrean Lower Montane Woodlands (Omernik & al, 2009).

6.4.4 Threatened and Endangered Species

6.4.4.1 Federally Listed Threatened, Endangered and Candidate Species

There are five federally listed threatened, endangered and candidate species that are likely to occur in Cibola County, according to the USFWS; however only two are found within or near the planning area. Following is a list of threatened, endangered and candidate species that are potentially found in Cibola County:

- The yellow-billed cuckoo (*Coccyzus americanus*), a candidate, which occasionally occurs in the riparian areas of Cebolla Canyon.
- The Zuni bluehead sucker (*Catostomus discobolus yarrow*), a candidate as well, found amongst others in low-velocity pools and pool-runs.
- The endangered southwestern willow flycatcher (*Empidonax traillii extimus*), found in scrubby, brushy areas, swamps and open woodland.
- The endangered black-footed ferret (*Mustela nigripes*), found in grasslands, as well as steppe and shrub steppe. However, this species might have already been extirpated in New Mexico.
- The threatened Mexican spotted owl (*Strix occidentalis lucida*), found in mixed-conifer forests.

As mentioned above, only two of these species have been sited in Cebolla Canyon: the yellow-billed cuckoo and the Southwestern willow flycatcher.

6.4.4.2 New Mexico State Threatened, Endangered and Sensitive Animal Species

Additionally, New Mexico has listed five species that are threatened or sensitive faunal species, which potentially occur in or close to Cebolla Canyon. Listed below are those that are likely to occur in the planning area.

- The threatened bald eagle (*Haliaeetus leucocephalus alascanus*), that rarely migrates into the planning area, but is not known to reside or breed here.
- The threatened gray vireo (*Vireo vicinior*), found in semi-arid thorn scrubs, oak-juniper woodlands as well as piñon-juniper, dry chaparral, mesquite, and riparian willow habitats. This species is occasionally found in the piñon-juniper woodlands in Cebolla Canyon during the summer months.

- The little brown occult bat (*Myotis lucifugus occultus*) with a sensitive status, is found in caves and hollow trees, but is not a permanent resident in New Mexico.
- The threatened spotted bat (*Euderma maculatum*) is found in ponderosa pine, piñon-juniper woodlands as well as canyon bottoms and open pastures.
- The red fox (*Vulpes vulpes fulva*) with a sensitive status, is found in open and semi-open habitats, but avoids dense forests.

6.4.4.3 Federal Animal Species of Concern

There are two federal species of concern that are likely to appear in or close to Cebolla Canyon. The Townsend's big-eared bat (*Corynorhinus townsendii*) is known to appear in areas with caves or mines but will also occupy hollow trees for roosting. It has recently been seen in Reach 8 of the restoration area. The northern goshawk also occasionally resides in the planning area. It is found in mature coniferous stands and will forage in open habitats.

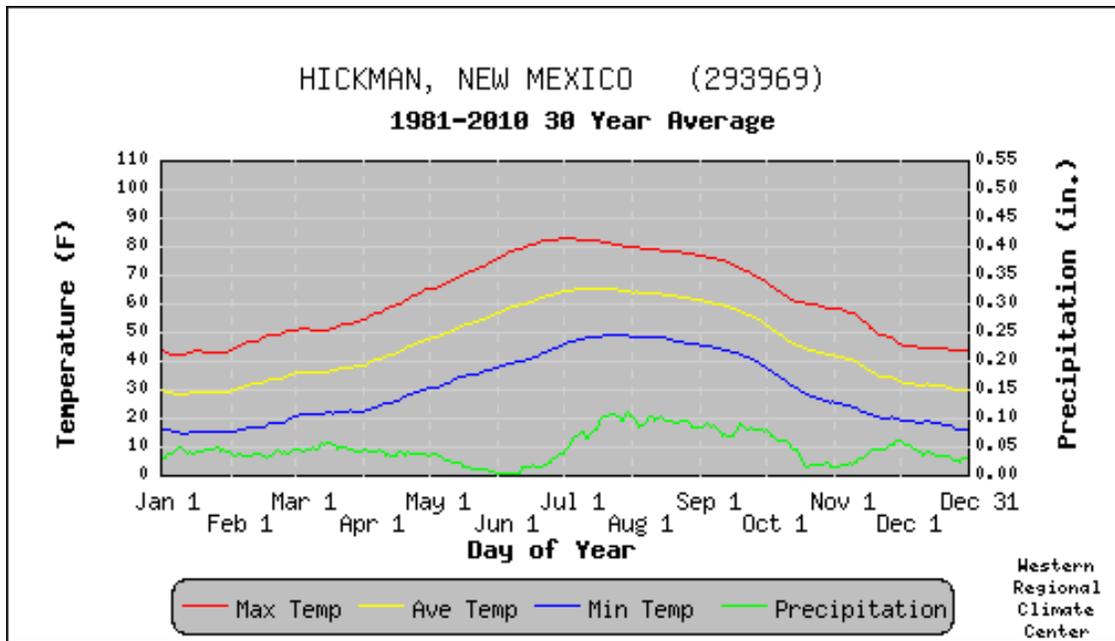
6.4.4.4 Threatened and Endangered Species and Species of Concern – Flora

Two threatened plant species as well as two species of concern are likely to occur in or near Cebolla Canyon. Listed below are the species that are potentially present.

- The threatened Pecos sunflower (*Helianthus paradoxus*) is found in soils that are permanently saturated because it requires a permanent water source for survival. However, Cebolla and Cebollita springs are not known to support this species.
- The threatened Zuni fleabane (*Erigeron rhizomatus*) is known to occur at higher elevations in Cibola County south of Cebolla Canyon.
- The Acoma fleabane (*Erigeron acomanus*) is a federal species of concern found on shaded, sandy slopes.
- The cinder phacelia (*Phacelia serrate*) is also a federal species of concern that occurs on volcanic scoria slopes, which are not found in Cebolla Canyon, but are found in close proximity within El Malpais.

6.5 CLIMATE

Cebolla Canyon is located in semi-arid west-central New Mexico. According to the Western Regional Climate Center (WRCC, 2014) the area receives approximately 12 inches annually, with most of its precipitation falling between July and September. Temperatures vary from average highs in the sixties to average lows in the twenties. Extreme temperatures can reach down to below zero as well as above to above 90° Fahrenheit.



6.6 HYDROLOGY

The Cebolla stream is predominantly intermittent and only flows as a result of storm events. After such events, the water will percolate into “the groundwater systems within the following weeks” (NPS, 2012). Because of underlying eolian deposits, erosion is a constant concern within the area.

Most of the Cebolla Canyon Wetlands are classified as palustrine wetland types that we defined earlier in section 5.3.2 ‘Cebolla Classification using the Cowardin System.’ The wetlands in Reaches 2 through 8 are considered Riverine. Wetlands immediately downstream of Cebolla Springs (Reaches 1 to 2) are considered to be slope wetlands.

As mentioned previously, manipulations of the Cebolla Creek stream channel had greatly altered the flow and hydrology, which displaced the stream from its natural drainage. Following these alterations, head cutting occurred that dried out adjacent wetland areas.

Since 1994 restoration efforts by a number of organizations including but not limited to the BLM, the AWF, the SWQB Wetlands Program, and the RPA have resulted in an expansion of the wetland area. The most recent report regarding wetland restoration prepared for the Rio Puerco Alliance in 2013 (Vrooman, 2013) showed that between 2010 and 2013, 3.8 acres were added to the Cebolla Creek Reaches 0-5 totaling 20.5 acres of wetland. This can be attributed to the restoration techniques. “Simple actions such as plugging a gully with sandbags started a chain reaction that filled a 200 foot gully and created a 10 acre wetland that continues to expand today” (Vrooman, 2013). Additionally, there were 29.4 acres, which according to Vrooman, were areas that have “wetland hydrology but did not have wetland vegetation.”

Hydrologic information on Cebolla Canyon (USGS hydraulic unit codes [HUC] 130202060501 and 130202060502) and North Plains (HUC 13020206) is limited, with no current or historical U.S. Geological Survey gages in the watershed. Hydrology monitoring systems were put into place during the 2011 restoration project to measure precipitation and groundwater levels. A geomorphological study of Cebolla Creek channel was conducted by Steve Vrooman of Keystone Restoration Ecology prior to the 2011 restoration work. The following section will examine the data in Reaches 0 and 7.

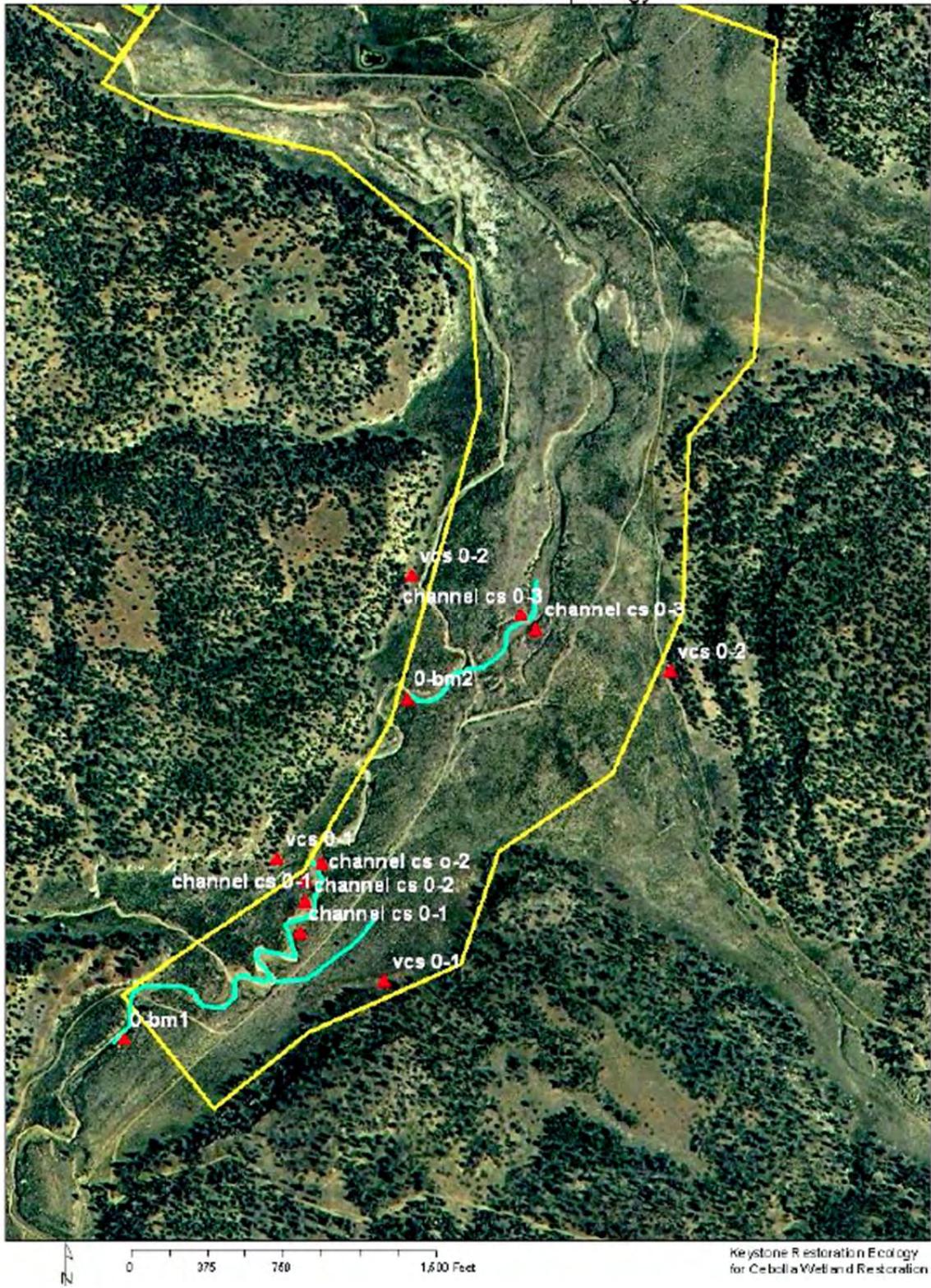
Vrooman used the Rosgen channel classification system to characterize and identify the channel types in Cebolla Creek. The necessary information needed to determine geomorphic setting, hydraulic tendencies, and channel type is:

- Cross sectional area
- Bankfull width
- Width to depth ratio
- Entrenchment ratio
- Slope
- Manning's N
- Stream flow
- Q (cfs)

The channel processes and assessments are “crucial to understand the regime flow patterns and to stratify empirical hydraulic and sediment relations of the condition to minimize variance” (Rosgen, 2007).

Cebolla Creek Reference Reach. A reference reach is “a portion of a river segment that represents a stable channel within a particular valley morphology. The morphological data collected is used for extrapolation to disturbed or unstable reaches in similar valley types for the purposes of restoration, stream enhancement, stabilization, and stream naturalization schemes” (Rosgen, 1998). Vrooman identified the cross-sectional area 0-1, in the Southeast quadrant of Reach 0, as the bankfull (frequent occurring peak flow) reference reach.

Cebolla Wetland Restoration Geomorphology Reach 0



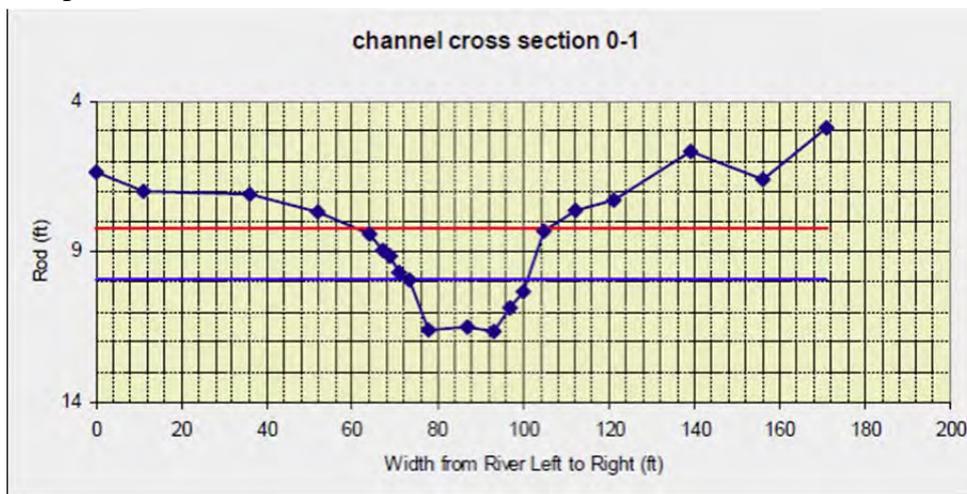
Cross Section 0-1 Data	
Cross section area	36 square feet
Bankfull width	26.5
Width to depth ratio	20.1
Flood prone width	41 ft.
Entrenchment ratio	1.5
Stream flow	Ephemeral
Bed Material	Silt/Sand
Slope	0.05
Channel type	Bc

At this cross section, the Bc channel type is an indication that the channel has two Rosgen stream classifications characteristics. The capital B is an indication of the dominant characteristics. According to Rosgen a type B channel is generally characterized as “moderately entrenched with moderate gradient, riffle dominated channel with infrequently spaced pools” with landform and soil features of “moderate relief, colloidal deposition. Moderate entrenchment and width/depth ratio. Narrow gently sloping valleys and predominate rapids with scour pools” (Rosgen, 1994,1996). The B channel type classification characteristics are the following:

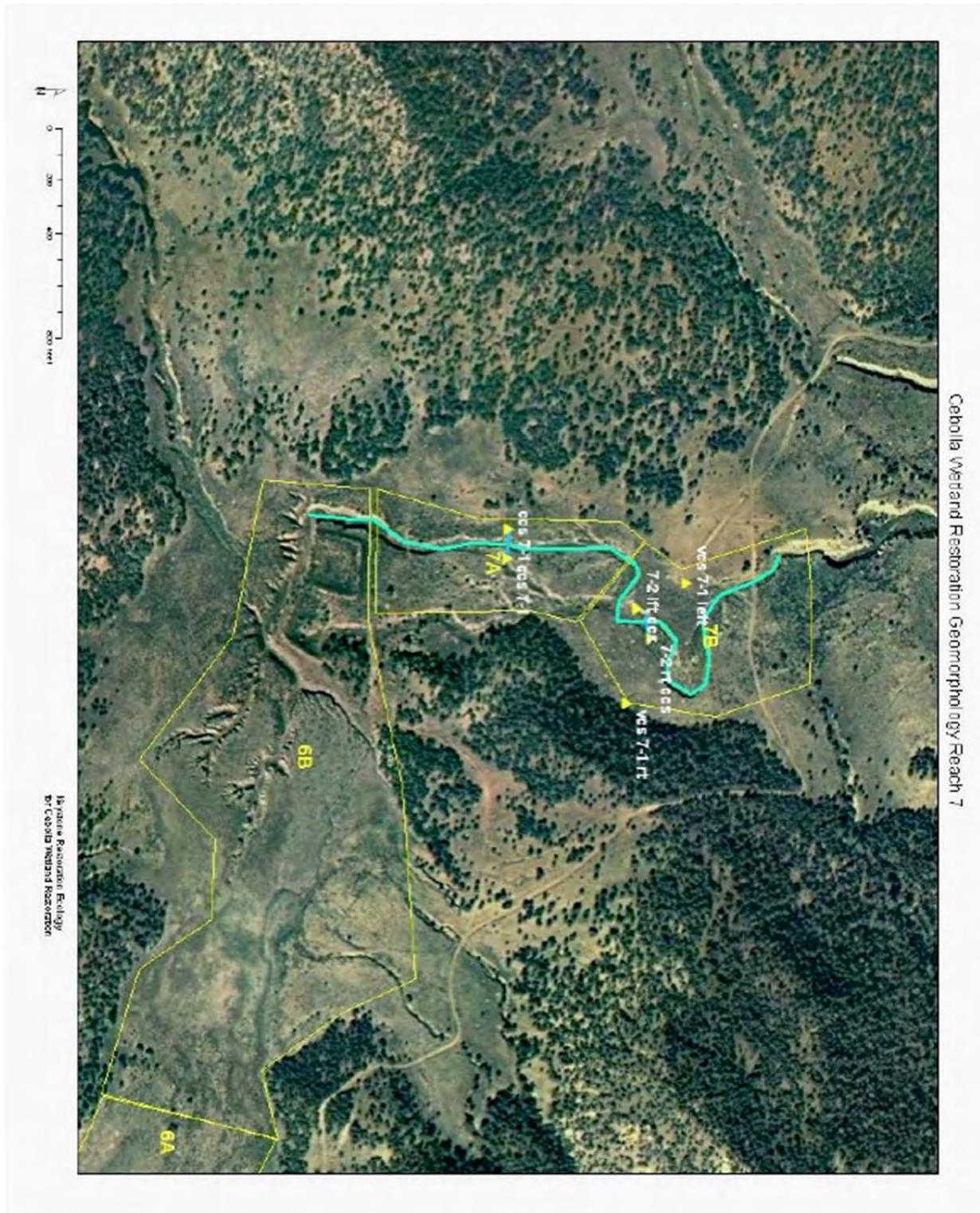
- Entrenchment ratio 1.4 to 2.2
- W/D ratio >12
- Sinuosity >1.2
- Slope 0.02 to 0.039

The lowercase c gives an indication of a more accurate landform and soil features as well as slope. Rosgen states that a type c channel has “broad valleys with terraces, in association with flood plains and alluvial soils. Slightly entrenched with well-defined meandering channels and riffle/pool bed morphology” (Rosgen, 1994, 1996). The C channel type classification characteristics are the following:

- Entrenchment ratio <2.2
- W/D ratio >12
- Sinuosity >1.2
- Slope <0.02



Vrooman identified Reach 7 as an area where flood debris was located and could be a good indicator of levels for a 50-year flood.



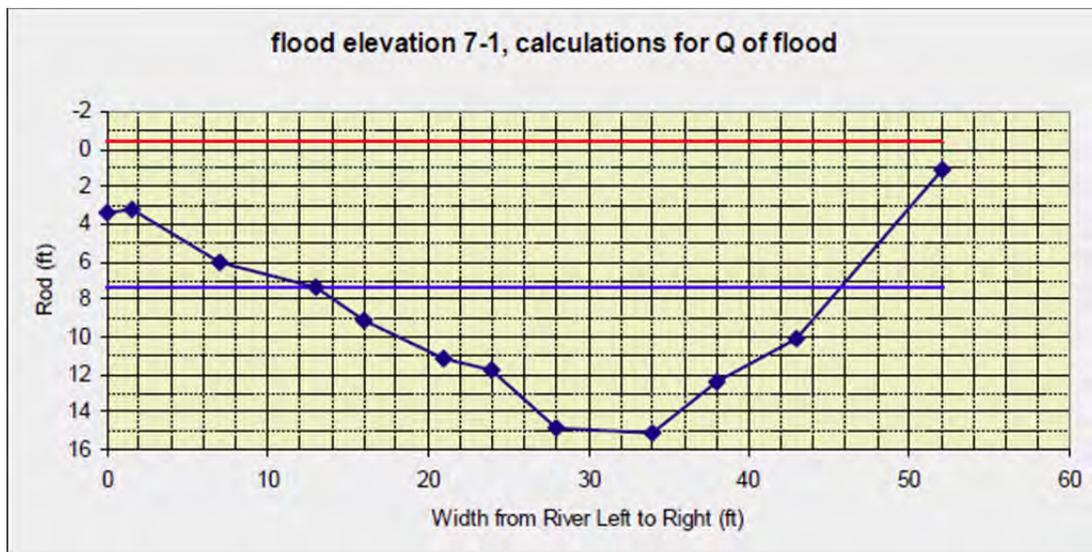
Cross section 7-1 data

Cross section area	33.7 square feet
Bankfull width	16 ft.
W/D ratio	8.1
Flood prone width	30 ft.
Entrenchment ratio	1.9:1
Slope	0.04
Stream flow	Ephemeral
Bed Material	Silt/Sand
Q (cfs)	1075
Manning N	.038 (estimated)
Channel type	G

A Rosgen type G channel is generally described as an “entrenched gully with step/pools and low width to depth ratio on moderate gradients.” Its landscape and soil features have “gullied morphology with moderate slopes and low width to depth ratio. Narrow valleys or deeply incised in alluvial or colluvial, materials. It is unstable with grade control problems and high bank erosion rates” (Rosgen, 1994, 1996).

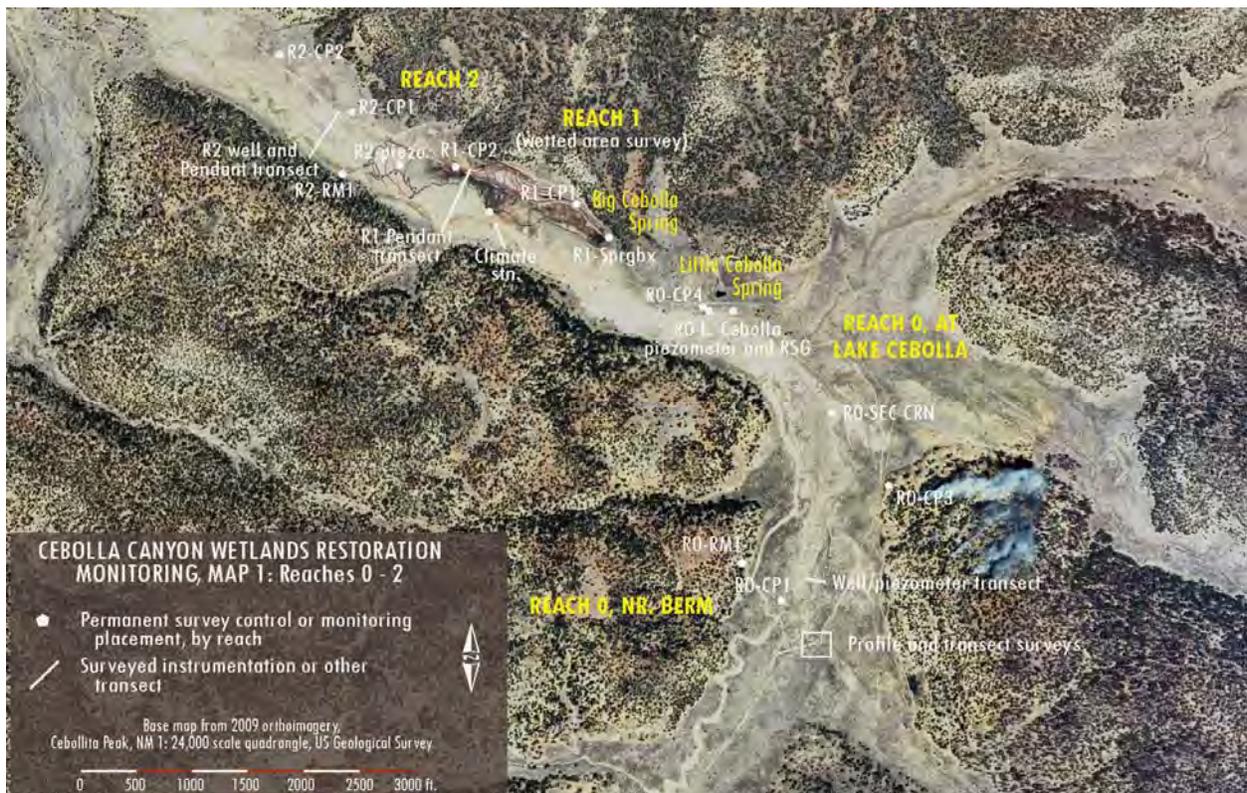
The G channel type classification characteristics are the following:

- Entrenchment <1.4
- Width/depth ratio <12
- Sinuosity >1.2
- Slope <0.039

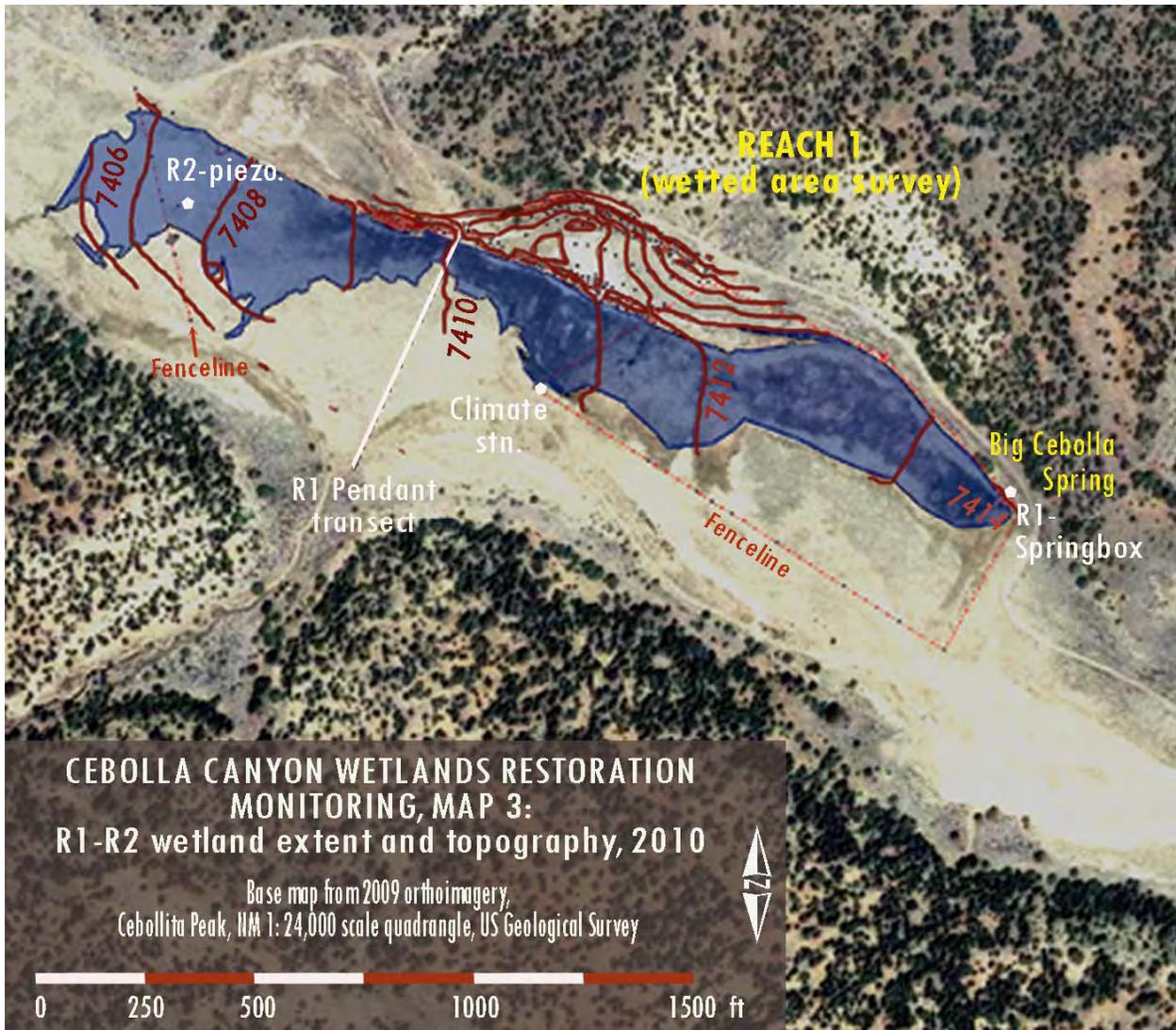


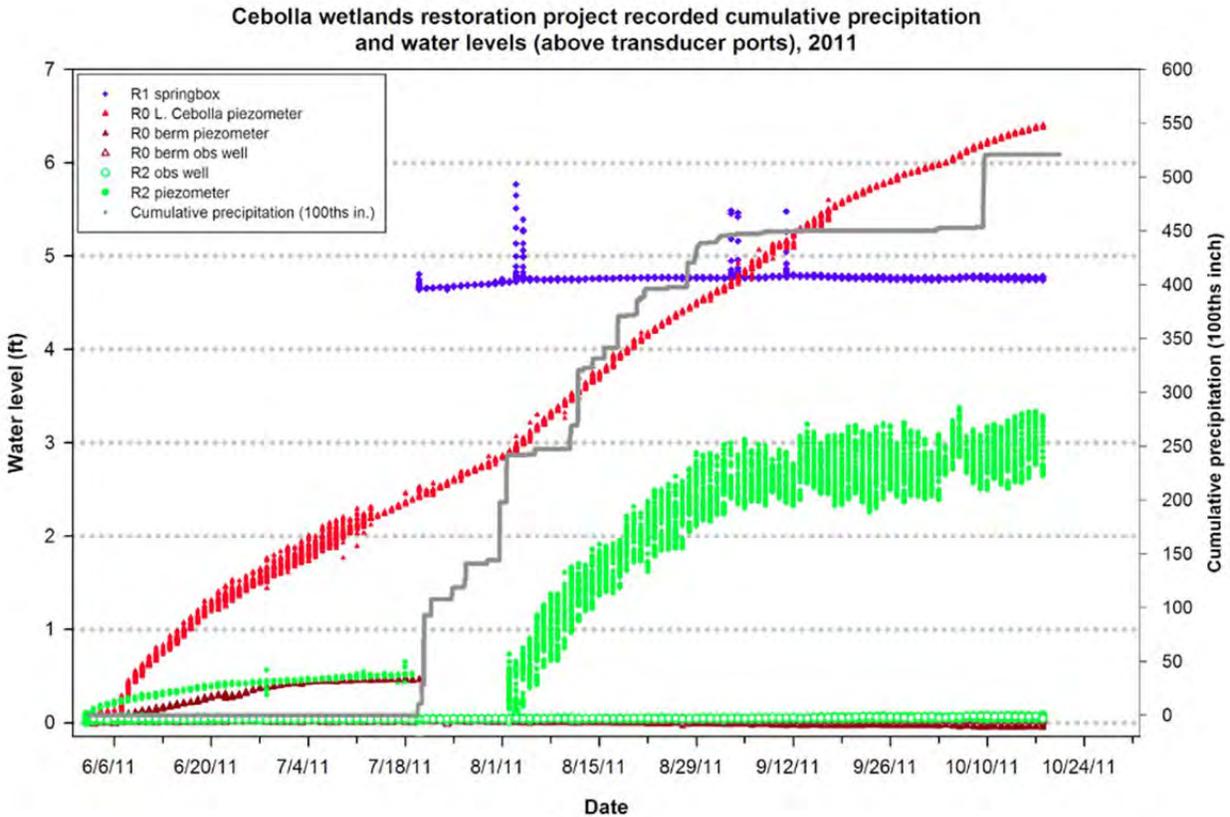
Estimating the bankfull stage allows for the classification of stream types, “establishes dimensionless ratios of key morphological variables” (Rosgen, 2008) and helps to identify potentially impaired streams with stable stream data. Knowing bankfull stage allows for a variety of predictions such as velocity and discharge and active bed characteristics.

A ground monitoring system was put into place to monitor the wetland restoration effort in Cebolla Canyon, “to determine the effectiveness of restoration work on expanding the remnant wetland zones into larger areas they are believed to have historically occupied” (Soles, 2011). The majority of monitoring devices were put into place in July 2011 and the rest in October of 2011. The monitoring equipment collected ground and surface water levels and temperature at stations in reaches 0, 1 and 2 at strategic locations where restoration efforts were going to take place. The findings showed a slow increasing level of sustained moisture especially in the Cebolla Springs area (see images below). According to Soles, “there has been an overall increase in the wetted area due to land management and restoration practices, and the wetted surface area



is anticipated to increase farther, particularly down-valley, as a consequence of future restoration work” (Soles, 2011). Further data showed an increase of water depth below Cebolla Springs as well. The graph below shows Cebolla Spring’s water depth increasing subsequently giving more moisture to the area below.





The gray line indicates moisture received during the study period. The red line indicates Cebolla Spring's moisture levels increase along the gray line. The solid green circle below is the data collection from the monitoring station below the springs. The rest of the monitoring stations seem to increase slowly or show similar levels of moisture.

Because of the limited hydrologic data available, more data collection for the entire valley would provide a better picture of the current hydrology and its departure from reference conditions. Additional restoration could then be targeted to additional critical sites within the watershed.

6.7 LAND USE

6.7.1 Land Ownership and Land Use

Cebolla Canyon is located within the El Malpais National Conservation Area and the Cebolla Wilderness Study Area (WSA) as well as the Canyon's WSA. The greatest portion of Cebolla Canyon is BLM land with 1,759,434.23 acres, a smaller portion of Cebolla Canyon is in private hands (447,519.97), 128,343.93 acres are Indian tribal, and only 4.61 acres are State owned. All of the planning area is BLM Public Lands (see Map on page 11).

xiii. Land Ownership

Ownership	Acres	%
BLM	1759,434.23	75.5%
Indian reservation	128,343.93	5.49%
Private	447,519.97	19%
State	4.61	>0.01%

The planning area is also located within the Techado Mesa Allotment, #00209 (portions of reach 0) and the El Malpais Allotment, #00203 according to the BLM (BLM, 2011). Annually 4,654 Animal Unit Months (AUMs) are authorized on the Techado Mesa Allotment and 23,484 AUMs on the El Malpais Allotment. The two ranches that hold these grazing permits within Cebolla Canyon are the York Ranch and F&F Ranch. The York Ranch is owned by a company operating out of Chicago and is the same company building the Wild Horse subdivision located to the south of Cebolla Canyon.

Cebolla Canyon is also used for recreational activities: hiking, hunting, camping, wildlife viewing, equestrian travel, cultural study, and picnicking as well as back country driving and mountain biking.

Cebolla Canyon is quite famous for its hunting and draws people from all over the United States. Cebolla Canyon falls under the New Mexico Game and Fish Department Game Management Unit 13. Between 2010 and 2011 Deer and Elk seasons, 2,953 licenses were issued for Unit 13. For the hunters, the roads in Cebolla Canyon near the wilderness areas make it a popular access area in the spring and fall.

The Cebolla Canyon road provides this access to Cebolla Canyon, and has been the object of restoration and protection efforts because it is a significant source for erosion. Parts of the road are only passable by high clearance 4WD vehicles. Most of the wetland lies adjacent to this road, within only 500 feet.

6.7.2 Wilderness Area

Cebolla Canyon is located within and adjacent to the Cebolla Wilderness that spans an area of 62,000 acres. This Wilderness area was established by Congress through P.L. 100-225 as part of El Malpais National Conservation Area (EMNCA)

6.8 WILDLIFE HABITAT

The Cebolla Canyon Wetland provides an important wildlife habitat and “has become a hotspot for biodiversity” (BLM, 2011). The recent wetland and riparian improvements have expanded this habitat. In semiarid regions, such as Cebolla Canyon, riparian areas are essential in “maintaining the overall ecosystem health, despite their comparative small size” (BLM, 2000). Recent management techniques have created more habitat for species that use the riparian area as forage, sources of water and cover. There are four different species of game animals seen in Cebolla Canyon: elk, mule deer, black bear, and wild turkey. In addition, four mammalian carnivores were found using the wetland: the mountain lion, coyote, gray fox, and the spotted/striped skunk. There are also a variety of other mammalian species including rodents and lagomorphs. There are birds, such as: American kestrel, Cooper’s/Swainson’s hawks, Northern Goshawk, mountain/western bluebirds, gray flycatcher, mountain plover, hummingbirds, warblers, sparrows, phoebes, tanagers, jays, kingbirds, pewees, turkey vultures, vireos, various species of owl, and other species of resident and migratory birds that occur in and around Cebolla Canyon (BLM, 2000). In recent years, Cebolla Canyon has started to attract a number of water birds, including mallards, rails, and herons. The Canyon provides habitat to a variety of reptiles such as garter snakes, bullsnakes, rattlesnakes, and other species of snakes and lizards. Cebolla Canyon is also home to a variety of bat species including the Townsend’s big-eared bat or *Corynorhinus townsendii*, as well as the red bat or *Lasiurus blossevillii*, both of which are currently federal species of concern (M. & Perry, 2010). A salamander was recently spotted near the wetlands of Cebolla Canyon.



Big-eared bat or Corynorhinus townsendii



Salamander found near Cebolla Canyon wetlands 2013.

7. REFERENCE POINTS AND OTHER AREAS OF INTEREST

Identifying potential reference areas is an important component of restoration, among other things. These areas are seen as the best representations of ecosystem productivity and functionality. The reference reach is a river segment that represents a stable channel within a particular valley morphology. The reference reach is used to develop natural channel design criteria based upon measured morphological relations associated with the bankfull stage for a specific stable stream type. Specific data on stream channel dimension, pattern, and profile are collected and presented by dimensionless ratios by stream type. The morphological data collected are used for extrapolation to disturbed, or unstable reaches in similar valley types for the purposes of restoration, stream enhancement, stabilization, and stream naturalization schemes. Bankfull discharge and dimensions from streamgage stations for a particular hydro-physiographic region are correlated with drainage area to develop regional curves for extrapolation to non-gaged reaches. (*The Reference Reach - A Blueprint for Natural Channel Design, Dave Rosgen*)

The best reference area in Cebolla Canyon is located in Reach 5 because it is the least impacted area within the canyon.

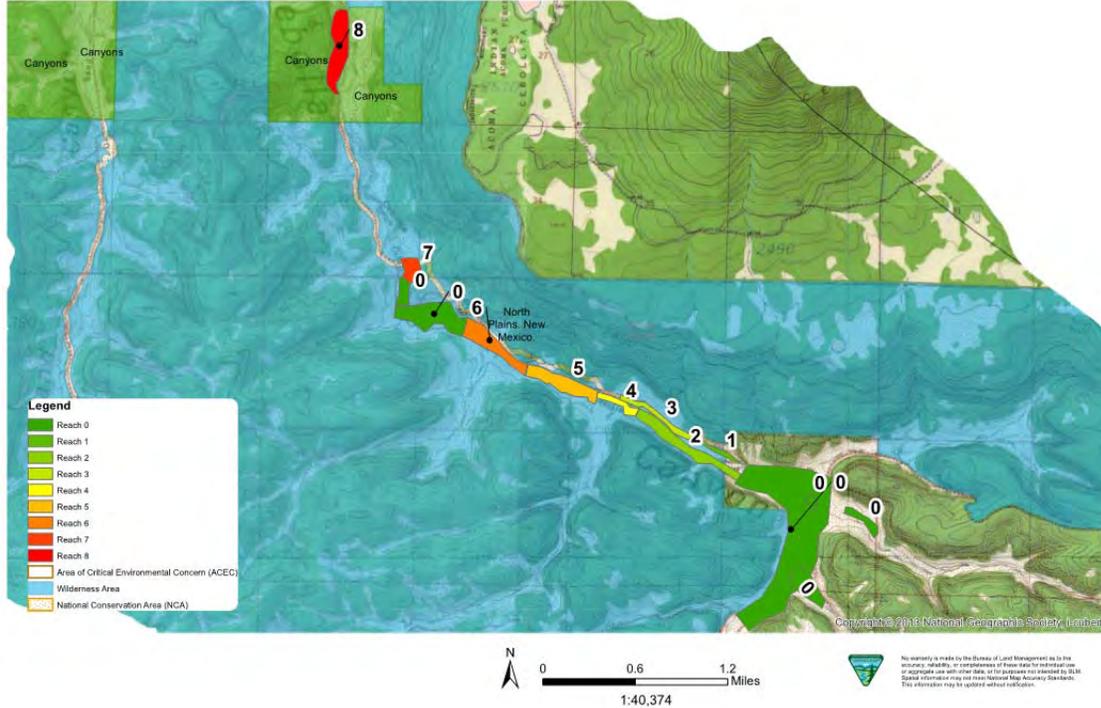


Reach 5.

There are various wetlands of interest in and around Cebolla Canyon. These wetlands have been identified by a number of professional contributors to this paper and are cited as interesting possibilities for reference, conservation and restoration efforts.

- North Pasture
- Cienegita Springs located on the Acoma reservation
- Various valley bottoms in the upper Cebolla Creek Watershed
- Cebollita Springs

Cebolla Spring Reaches



This map is showing the different Reaches of Cebolla Canyon that have been delineated.

8. WETLAND DELINEATION, CURRENT CONDITIONS

8.1 WETLAND DELINEATION

Wetland delineation is the process of surveying wetlands and their properties to determine their boundaries. A wetland delineation was performed in 2009 at Cebolla Creek by Steve Vrooman (Keystone Restoration Ecology) and Matt Schultz (NMED) in accordance with the USACE Wetland Delineation Manual (1987) and the Regional Supplement for the Arid West Region (2008). The wetland delineation was performed on the Reaches 0 to 8. These Reaches do not cover the entire valley, so additional wetland delineation needs to be performed to examine the entire area.

This study was meant to determine the boundaries of the wetlands at the time and enable the tracking of future wetland expansions. The mapping was performed using a GPS (sub-meter Trimble). In 2013 another delineation survey was performed to determine how the wetland boundaries had changed.

xiv. 2013 Wetland Delineation

Location	Delineated wetland in acres 2010	Delineated wetland in acres 2013	Wetland hydrology in 2013
Lake Cebolla (Reach 0)	2.9	2.9	
Reaches 1-2	13.33	16.9	
Reaches 4-5	0.37	0.7	
Total acres	16.6 acres	20.5 acres	29.4 acres

8.2 GENERAL WETLAND CONDITIONS

The current wetland condition is improving around the Cebolla Springs wetland areas due to passive and active restoration techniques. According to the final report on the restoration of Cebolla Canyon completed in 2013 (see Appendix), remarkable improvements have been noted. The following is a summary of the findings of the report.

8.2.1 Added Wetland

Over the timeframe of the grant-funded projects, the delineated wetland areas around Cebolla Canyon increased by about 4 acres. Additionally, the wetland extended downstream into Reaches 4 and 5 for around 1,000 feet and areas with wetland hydrology expanded to 29.4 acres. The Cebolla Creek channel has also “almost been eliminated for 1500 feet, between Reach 0 and 2. This creates the potential for wetlands in this area” (Vrooman, 2013). The potential for more expansion is huge, especially around Lake Cebolla. This area was formerly a sheet-flow valley and has filled rapidly from below, near the Big Cebolla Spring. It is possible that a geomorphic threshold has been crossed, and more aggradation will continue to fill the channel and spread water across the valley.

8.2.2 Plant communities

Most of the vegetation transects showed poor results. Only Reach 1 increased its wetland plant communities. All other Reaches: Reach 0, Reach 2, Reach 4, and Reaches 5-6, experienced poor to middling results.

The especially dry winter and spring of 2013 could have influenced the poor outcome of the vegetation cover in Cebolla Canyon. Additionally, damaging storm events in September of 2013 produced flooding in Cebolla Canyon and “may have some role in the reduction in cover for many species especially forbs such as Rocky Mountain beeplant (*Cleome serrulata*), which can be dominant on freshly deposited sandy soils, but needs springtime moisture to germinate. The vast fields that were seen in Reaches 0 and 2 in 2010, 2011 and 2012 were missing in 2013, either spring or fall” (Vrooman, 2013).

8.2.3 Grazing

The report noted that grazing pressure appeared to be strong in 2013 and left its mark on the wetland. Around 50 cattle grazed Reaches 5 and 6 as well as in Reach 0, 2 and 4. Grazing intensity was noticed, “in the cover of Baltic Rush, which had never before (from 2010 to 2012) been grazed ‘to the nub’. While other, more palatable plant species had been grazed down, Baltic Rush had remained ungrazed until 2013” (Vrooman, 2013).

9. THREATS AND IMPAIRMENTS

Threats and impairments to the Cebolla wetlands come in many forms, of which the majority are human caused. This section will explore some of these threats and their consequences.

9.1 DRAINING OF WETLANDS

The technique for draining wetlands is in itself a diversion of waters away from its pooling wet areas. Draining was historically done through trenching and the laying of clay pipes. Although in Cebolla this technique is not known to have been used, other water diversions have lead to wetlands being drained and reduced, as they have taken the water out of the valley bottoms where wetlands were located.

9.2 HISTORICAL HYDROMODIFICATIONS

Hydromodification is the altering of the natural flow of water through a landscape. The natural hydrological flow patterns are essential drivers of ecosystem services in any given landscape. Modifications of hydraulic flow effectively alter and degrade habitat, water quality, and essential ecosystem functions. Some hydromodifications come from (but are not limited to), “land resources development for agriculture, energy, mining, forestry, transportation, residential housing; and water resources development for irrigation” (Mohamoud, 2009).

As we have seen in the above sections, Cebolla has a consistent history of hydromodifications. From early irrigation techniques of Native Americans to tree felling for railroad ties and agricultural manipulations, the hydraulic functions of Cebolla Canyon have been manipulated in one way or another.

9.3 WATER IMPOUNDMENTS/DIVERSIONS

Water impoundments and diversions can be found throughout the canyon. Water impoundments are manmade structures. They are pools or pits created to capture water primarily

used for livestock. Diversions are any manmade structure or earthmoving that diverts the water from its natural flow.

It is hard to say how many water impoundments there are throughout Cebolla Canyon, but within the planning area there are at least six that are highly visible. Five of these impoundments are ponds for livestock. Their physical traits vary but they are generally square or circular, relatively deep (over ten feet) and quite large. Although water pools in these installations,

Cebolla Spring stock pond.



the trade off for their ecological services in comparison to wetlands is minimal. They capture and cut natural flow regimes and are high traffic, low vegetative sites due to livestock use.

Smaller diversions have been used frequently, especially in Cebolla Springs. Diversions were used to route water out of and away from the channel making more

space in the valley bottom for farming crops. More impoundments/diversions can be seen in the form of dams in Reach 0 as well as above the project site in a multitude of locations.

9.4 ROADS

Roads play an important role in hydromodifications. They alter water movement across the landscape, “which can concentrate and accelerate flow and cause soil erosion and sediment deposits, gully formation and divert surface and subsurface flows causing areas



Gully in Cebolla Canyon

to lose productivity ” (Zeedyk, 2006). Unpaved and rural roads play an especially large role in hydromodifications; they are often times not maintained and evolve organically with usage and weather events.

Cebolla Canyon’s road comes off of State Highway 117 and runs along Cebolla Creek crossing it various times. The road is considered to be a low standard road which is “a single lane constructed of native materials un-surfaced without permanent drainage structures” (Zeedyk, 2006). It is hard to determine the exact square footage of Cebolla Canyon’s road because of its changing dimensions. But an approximate estimate yields in the planning area (Reach 0-7) that the road has a length of 34, 565 ft. and is about 10 feet wide. This gives us around 345,650 square feet or 7.9 acres of road.

Beyond drainage and subsequent erosion from the existing road, Cebolla Creek and some of its tributaries run in old road locations. That is to say, old wagon and work roads have become the creek and tributaries. This can be seen in Reaches 4-5 near some of the Savage Ranch ruins. The water is running down an old road site and is causing rapidly expanding gullies.



In 2009 the American Recovery and Reinvestment Act (ARRA) helped the BLM to fund a project to relocate a 1.8 mile section of the Cebolla Canyon road. The road had altered the hydrology in the valley by trapping the water in the roadbed. After the relocation water could spread again over the valley bottom and help expand the wetland. The road had been moved out of the valley in Reach 0, and is now no longer channeling water. Additionally Rangeland Hands improved about 4-5 miles of the rest of the road. The 2013 Monitoring Report confirmed that “the construction of a rolling dip road drain in the valley, as well as the BLM road work ...

ensured that floodwaters from this valley are spreading across the largest area possible and are flowing in center of the valley” (Vrooman, 2013).

9.5 CONCENTRATION OF FLOWS/CHANNEL INCISIONS

Concentrated flow implies a sufficient amount of energy to move materials and erode. Such erosion takes the forms of rills, ephemeral gullies, gullies, channels, streams, and rivers. Incised channels are a direct cause of concentrated (not dispersed) flows. Incisions are caused by the dropping of the channel bed levels when long-term erosion exceeds sedimentation. “In a typical incising channel, the streambed degrades until the critical bank height is exceeded and the bank fails, increasing channel width and sediment load” (Fischenich, 2000). Channel modification, usually straightening, is probably the most common cause of incision. After a channel becomes incised, the water loses its ability to reach the flood plain and spread during storm events, and will become increasingly concentrated in the channel. Water continues to run through the confined channel system quicker and at higher flow volumes accelerating the incision process.

Flow concentration and incisions are not limited to the creek and river channels but can be found anywhere forming gullies where water drainage occurs in land that is not protected by vegetation. Gullies are an issue all over Cebolla Canyon as well as in almost all the project areas in the canyon. In lower sections of the creek, the incisions are over 50 feet deep. Increased grass and vegetative cover throughout the watershed would help disperse and absorb overland flow helping to prevent gully formation and concentrated flow.

10. EXISTING RESOURCE MANAGEMENT PLANS

10.1 RESOURCE MANAGEMENT PLAN, BLM

Although Cebolla Canyon is a designated Wilderness, its management plan is lumped together with El Malpais National Conservation Area. Because of its uniqueness El Malpais has received a special designation as an Area of Critical Environmental Concern (ACEC) and has special management prescriptions to protect certain “significant values, Congressional designations...living emphasis to significant resources or activities” (BLM, 2012). This special designation prompted a specific “stand-alone plan” to consolidate all decisions and Management guidance to the Rio Puerco Field Office (RPFO). The following section is an overview of some key points in the resource management plan (www.blm.gov/nm/st/en/fo/Rio_Puerco_Field_Office/rpfo_planning/rpfo_draft_rmp.html).

The resource management plan of the AFO takes into consideration:

- Interpretation and public education plan
- Public facilities plan
- Natural and cultural resources management plans
- Wildlife management plan
- Recreation
- Monitoring/Studying
- Fire Management
- Law Enforcement

There are also four standard management goals established by the BLM for designated wilderness. These standard management practices are integrated into the resource management plans in order to maintain the pristine uniqueness of the wilderness area. The practices are:

- Provide for the long-term protection and preservation of the area's wilderness, manage the area's natural condition.
- Manage the area so visitors can use and enjoy it but only in a way that leaves it unimpaired for the future.
- Manage the area using the minimum tools, equipment, and structures needed to successfully, safely, and economically accomplish tasks while least degrading wilderness values, temporarily or permanently.
- Manage the nonconforming but accepted uses allowed by the Wilderness Act that prevent unnecessary or undue degradation of the area's wilderness character. (BLM)

10.2 CEBOLLA CANYON WETLAND INTEGRATED MANAGEMENT PRACTICES, BLM

The following is a breakdown of important key points for Cebolla's integrated Management practices by section.

1. *Interpretation and Public Education*

Develop media guides and maintain interpretive wayside exhibits. Education and materials for the support, understanding and protection of Wilderness areas. Area geology, Wilderness safety, and Leave No Trace ethics.

2. *Public Facilities Plan*

Trail improvements for recreation users and resource protection. Existing recreational facilities on the wilderness perimeters will remain in place. Upgrade of Visitor facilities at trailheads and entry points. Additional on-site information to educate the public. Placement of signs to identify the boundaries, wilderness name and regulations governing use. Maintain roads to reduce erosion and improve access opportunities.

3. *Natural and Cultural Management Plans*

Preventing unauthorized vehicle intrusions through patrolling. Manage the Dittert Site, the Lobo Canyon Petroglyphs, and outstanding homestead-era sites. Compliance with the National Historic Preservation Act. Offsite information to concentrate visitations to certain prehistoric sites. Traditional American Indian cultural practices will be allowed to continue.

4. *Wildlife Management Plan*

Wildlife habitat management will be guided by the BLM's Wilderness Management Policy. Hunting and trapping will be permitted under applicable State and Federal laws. Livestock grazing will take place in permitted areas.

5. *Recreation*

Motorized vehicle access inside designated wilderness will be limited to authorized users. Access will be allowed only to non-Federal inholdings and livestock grazing operations. Allottees may use motorized vehicles on authorized routes to access windmills for annual maintenance, fences every five years, and dirt tanks every ten years.

6. *Identified Ecoregions and Management*

a. *Forests and Woodlands*

Manage ponderosa pine stands for increased reproduction, health, and rehabilitation of degraded sites. Maintain healthy piñon-juniper stands. Provide and establish for natural communities of trees. This program is meant to build and be combined with other ecoregion programs.

b. *Rangeland*

The goal is to maintain healthy multifunctional rangelands and ensure that livestock grazing management on each allotment contributes natural vegetative objectives.

c. *Riparian and Wetland Habitat*

The goal of this program is to manage the riparian and wetland habitats in the Plan Area for their protection and enhancement. BLM policy is to achieve a healthy and productive ecological condition for all public riparian areas. Riparian-wetland management goals and objectives fall into four general management strategies: maintenance of existing riparian conditions; improvement of degraded riparian conditions; recovery of lost riparian areas; and development of new riparian area.

**10.3 RESTORATION AND MANAGEMENT PRACTICES PRIORITIZATION,
BLM**

The following is the prioritization or management objective of the ecosystems and habitats.

1. *Riparian Areas*

All properly functioning springs and associated riparian/wetland habitats on BLM-administered lands will be maintained at that level. Those that are “Nonfunctional” or “Functional-At Risk” will be managed to be improved. The AFO will maintain or improve these features either by using livestock exclosures, or through grazing management practices to maintain and/or improve them to properly functioning condition. Plantings of native species and removal of invasive species will take place where appropriate and when necessary.

2. *Removal or Repair of Fencing that Impedes Movement of wildlife*

All fences that prohibit movement of wildlife will be redesigned.

3. *Prairie Dog Colony Enhancement*

Work to eliminate illegal shootings within the Prairie Dog Colony Enhancement Area in North Pasture area. Move the Cebolla Canyon Road from its junction with NM 117 to approximately three miles south. Work with the NMDG&F to eliminate plague from the prairie dog colony in order to reestablish the black-footed ferret.

4. *Prescribed Burns*

Reforestation and habitat improvement through prescribed burns will take place.

11. WETLANDS ASSESSMENT

The current wetland condition is improving around the Cebolla Springs wetland area due to passive and active restoration techniques. The historic irrigation diversions dried out wetlands and caused headcutting in and along the main channel and the tributaries, cutting off water supply to historic wetland areas. These areas have been targeted and major improvements can be seen.

11.1 PROPER FUNCTIONING WETLAND CONDITION

The proper functioning condition of wetlands is best defined through the interaction and quality of the vegetation, soil structure, and hydrology. A properly functioning wetland according to the BLM and other governmental departments must support adequate vegetation in order to dissipate stream energy during storm events, reduce erosion, improve water quality, filter sediment, capture bedload, and aid floodplain development. It must improve water retention and ground water recharge; develop rootmass to stabilize banks; and develop diverse ponding in order to create habitat and greater biodiversity (Prichard, 1998).

11.2 NONFUNCTIONAL WETLAND CONDITION

A nonfunctional wetland is a wetland area that clearly is not providing adequate vegetation, not reducing erosion, not improving water quality, and lacking certain physical attributes such as a floodplain. If one of these characteristics occurs within a wetland, it indicates non-functionality and can be determined through a set of 17 qualitative questions.

11.3 CEBOLLA CANYON WETLAND FUNCTIONS

Parts of the Cebolla Canyon Wetlands will under the current conditions likely not meet proper functioning standards and are considered nonfunctional or functional at risk. However through recent restoration and protection measures substantial areas in the wetland have been restored and will meet proper functioning wetland standards.

11.4 WETLANDS FUNCTIONS AND VALUES

Functions:

Each wetland type provides a unique suite of physical and biological functions. Therefore, the value of each wetland is different and can be estimated by its importance or the worth “of one or more of its functions to society” (Novitzki, 2009). Humans are just now beginning to understand all the benefits of wetlands. Some of these wetland functions are:

- Habitat for fish and wildlife, including critical habitat for endangered species
- Enhanced water quality and filtration
- Ground water recharge
- Flood control
- Shoreline buffering and erosion control

Values:

The EPA calls wetlands the “biological supermarket” and states that they are one of the most productive ecosystems in the world. Wetland values are relative to their location, climate, and society. Each wetland provides a multitude of services but one or more services is eventually defined by the society that surrounds it. For example, states Richard P. Novitzki, “timber production may be improved by draining a wetland site, whereas waterfowl production may be improved by impounding more water...Furthermore, society may have to choose among wetland functions that benefit individuals or small groups, that are of value to most of society, or that are important to the maintenance of the wetland itself.” In the end, society is the determining factor as to what services and functions are considered relevant and important to humans.

11.5 CEBOLLA CANYON ECOSYSTEM SERVICES

The ecosystem services of Cebolla Canyon wetlands are defined as conservatory as the area is a closed basin and is partially within a Wilderness area. The ecosystem services are primarily intended to provide essential habitat and resources for diverse plant and animal species, aquifer recharge, reduce erosion and improve water quality. These overarching services have, of course, underlying economic services that will be provided to human beings. Some of these are:

- Higher quality habitat for hunting and tourism
- Higher feed quality/growth for cattle
- Less erosion
- Improved water storage

12. PAST AND EXISTING MANAGEMENT MEASURES

There have been a series of projects in Cebolla Canyon with restorative objectives. From land swaps to small-scale plantings the objective to improve the quality of the ecosystem has clearly been kept in mind. The following explores some of these projects' plans, reasoning and goals.

12.1 BLM PRIVATE LAND EXCHANGE

As we have already learned in a previous section, the BLM wanted to expand and combine Cebolla Canyon's total area through land purchasing and exchanging private lands. During the creation of the El Malpais National Conservation Area congressional limitations to the bill required the BLM to: "acquire only those minimum lands in the NCA needed to achieve management purposes and should use cost-effective alternatives to purchase when available." Land protection planning is guided primarily by the policy statement (1982) guiding use of Land and Water Conservation Funds.

Due to this, in 1987, some 93,000 acres of 351,000 (26%) of the land in the NCA remained in private landholdings. Some of these private lands blocked access to the wilderness area and some "key natural and cultural resources in the NCA like Cebolla Springs" and "scenic quality areas of important integrity" (Mutz, 2005) were privately owned. In 1994, an important land exchange took place with the King Brothers who agreed to exchange an ecologically important piece of land in Cebolla Canyon for real-estate plots outside of Santa Fe, New Mexico.

There has recently been talk of adding about "4,000 acres of the Brazo non-wilderness areas to the Cebolla Wilderness Area" (Mutz, 2005).

12.2 FENCING OF CEBOLLA SPRINGS

At the time of the exchange, Cebolla Springs and the surrounding areas were highly degraded. According to Bill Zeedyk, former Albuquerque Wildlife Federation (AWF) chairman/restoration specialist and other witnesses there was a deep gully approximately eight feet deep that ran through the spring's area. The BLM fenced the springs sometime in the 1990s and then in 2000 asked AWF to help maintain the fence. AWF dug and placed a new cross-valley fence and then constructed a new fence downstream in 2003.

The fence was put in place mainly to keep livestock out of the springs area and allow for



vegetative growth. Although the occasional cow entered, the passive restoration technique was a success and wetland vegetation recuperated at a rapid pace. The incredible improvement showcased the importance and professional knowledge of AWF members allowing them to have access to more projects in the canyon.

12.3 AWF HISTORY IN THE AREA

Around the same time as the fencing project, AWF (an all-volunteer non-profit organization, focused on New Mexico's



wildlife and habitat resources. See nmwildlife.org for more information.) placed *Picket baffles* AWF constructed in Reach 8 in 2010.

sandbags or burrito dams around the springs to maintain and spread the water out on the valley right. The water began to create more vegetation, which began to fill in the eight-foot gully. As the gully filled with subsequent floods, the water coming down spread out across the valley augmenting perennial flow from the springs. The wetlands area around the springs before AWF's restoration actions was no more than one acre, whereas today it is over 20 acres and has moved downstream outside of the fenced area.



AWF working at the project site in April 2012.

Seeing the progress made, AWF began to re-vegetate selected areas with plantings of willow (*Salix*), cottonwood (*Populus*), and Baltic Rush (*Juncus balticus*). Downstream in Reach 8 AWF started an induced meandering project in a deep gully in an attempt to raise the bed of the stream and eventually allow for floodplain access.

12.4 HABITAT STAMP PROGRAM INVOLVEMENT

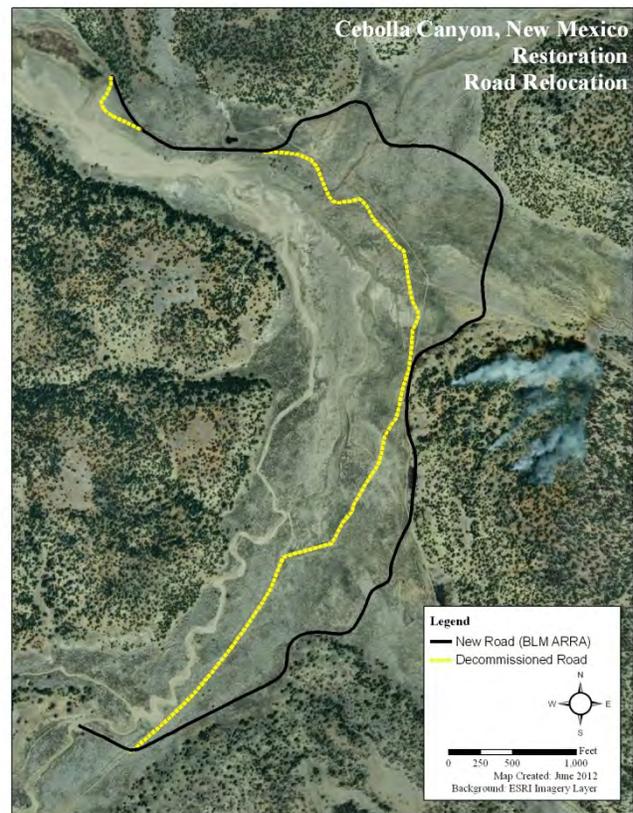
The Habitat Stamp Program cooperators protect ecologically diverse wildlife and fish habitats on U. S. Forest Service (USFS) and BLM managed lands. Licensed hunters, anglers, and trappers on public lands are required to purchase a stamp from the NMDGF. This money then goes to “proactive” habitat restoration/improvement projects. A Citizens' Advisory Committee (CAC) reviews potential projects, which they pass on to the State Game Commission.

Once accepted, the project is done by a competent organization accompanied by volunteers and professionals. AWF has participated alongside the BLM on numerous occasions with funding from the Habitat Stamp Program in Cebolla on improvement projects of wetlands, waterways, and riparian areas.

12.5 ARRA BLM ROAD PROJECT

The American Recovery and Reinvestment Act (ARRA) of 2009 helped to fund a project on the upper portion of the Cebolla Canyon Road. The project’s goal was to relocate Cebolla Canyon Road away from Cebolla Springs and ephemeral playa lakes.

A one-mile portion of road through Reach 0 was moved valley right up against the foothill of the canyon instead of having it run through the valley bottom. The road was re-cut, tilled and a layer of small diameter cobble was placed on top for infiltration purposes.



12.5.1 Analysis of 2011 Cebolla Creek Restoration Project

Map of relocated Cebolla Canyon Road away from Cebolla Springs.

The Cebolla Creek Wetland Restoration Project was funded by two grants. One grant was obtained by SWQB Wetlands Program through EPA 104(b)(3) of the Clean Water Act called: “Restoring and Protecting Wetlands in Cebolla Canyon Closed Basin” CD #966857-01-0C (FY2008) and the second grant was obtained by RPA through the State of New Mexico’s River Ecosystem Restoration Initiative (RERI) and is called “Restoring Cebolla Canyon,” PSC #09-667-5000-0015. The grants were employed to fund restoration efforts in different reaches of the total project area. While the RERI grant funding ended at the end of June of 2012, the SWQB Wetlands Program funding was extended through June 30, 2014.

A wetland delineation was performed in 2013 to estimate whether the restoration efforts had restored wetlands within Cebolla Canyon. The final report found that around 4 acres of wetland were added and the wetland had extended downstream. Additionally, 29.4 acres of wetland hydrology was detected in areas that did not have these characteristics before. Future monitoring is needed to show the continued spread and growth of the Cebolla canyon wetland areas.

13.RECOMMENDATIONS & PRIORITIZATION, RESTORATION/ PROTECTION MEASURES

In previous projects, different restoration measures have proven to be successful in Cebolla Canyon. Therefore, similar measures should be employed in future restoration projects. The restoration techniques include: installation of erosion control, grade control and headcut control structures as well as induced meandering measures as developed by Bill Zeedyk. Fencing protects project areas from livestock grazing while native vegetation is re-established. Infrastructure, such as roads can promote erosion and therefore need to be managed or modified to reduce runoff into the stream. Riparian and wetland plantings will encourage infiltration as well as provide important habitat for native species. Noxious weed control will allow native species to find habitat and support erosion control.



13.1 RECOMMENDATIONS AND PRIORITIZATION ACCORDING TO THE CEBOLLA WETLAND FINAL REPORT (2013)

According to the most recent monitoring report on the Cebolla Canyon Wetland in 2013, the wetland has expanded more than 4 acres and further wetland expansion is expected especially around Lake Cebolla. The former sheet-flow valley around Lake Cebolla has filled and “it is possible that a geomorphic threshold has been crossed, and more aggradation will continue to fill the channel and spread water across the valley, however, only time will tell” (Vrooman, 2013). The following sections are findings and recommendations made by the monitoring:

13.1.1 Rabbitbrush as Indicator for Change

An experiment with rabbitbrush concluded that the number of plants would decrease when soil saturation increases, and sites that have seen a decrease of rabbitbrush can turn into wetlands. Therefore, this rabbitbrush mortality is an indication for change and wetland expansion (Vrooman, 2013) and sites with rabbitbrush mortality should see greater attention, protection, and continued restoration.

13.1.2 The Role of Plants

Grass-like plants play an important role in stabilizing soils and are crucial in the expansion of the wetland. The cold season species Baltic rush, common spikerush, Kentucky bluegrass, and chairmaker’s bulrush capture freshly deposited soils and hold them in place.

These plants have the ability to grow even through thick layers of sediment and these functions are contributing to the expansion of the Cebolla wetland.

13.1.3 Grazing

Year long heavy grazing can have devastating effects on the wetland because the plant species mentioned above are being removed, which destabilizes the soils and encourages erosion. Therefore, the report suggests three management practices that can aid to protect wetland vegetation.

13.1.3.1 Grazing Plan

A grazing plan is needed to exclude cattle from important areas in Reach 0, 2, and 4 during springtime to allow the cold season species to establish, as well as less grazing in late summer and fall to allow these species to go to seed.

13.1.3.2 Repair Fencing

The fence around Cebolla Spring has been damaged by floods during summer storm events in 2013 or cut down by the public or buried by sediments. This fence is at the core of the restoration efforts, to protect native vegetation that then would provide seeds and root stock to the downstream reaches. Therefore, repairing the fence can aid all parts of the wetland.

13.1.3.3 Trigger Points

Small enclosures of areas where sediment and water can be stored should be a focus for future management measures. These enclosures allow vegetation to grow, which in turn will help in stabilizing the soil and filling eroded stream channels. Two of these enclosures have been damaged during the summer flood events, but are scheduled for repair by the BLM in January.

The following are sites to install new enclosures as recommended by the Cebolla Creek Wetland Restoration Monitoring Report:

1. Mini-enclosure around Filter dam and berm breach in Reach 0. This will create wetland area due to the storage of water and sediment. Healthy, un-grazed vegetation will accelerate this process.
2. Mini-enclosure at top of Lake Cebolla, needs repair.
3. Mini-enclosure at bottom of Lake Cebolla, needs repair.
4. Mini-enclosure at large one-rock dam between Reaches 2 and 4, this trigger point will fill the valley upstream if allowed to fill in with sediments.
5. Mini- enclosure at boundary of Reaches 4 and 5 will grow wetland vegetation and capture more sediment.

13.2 LITTLE CEBOLLA SPRING – STOCK POND CONVERSION

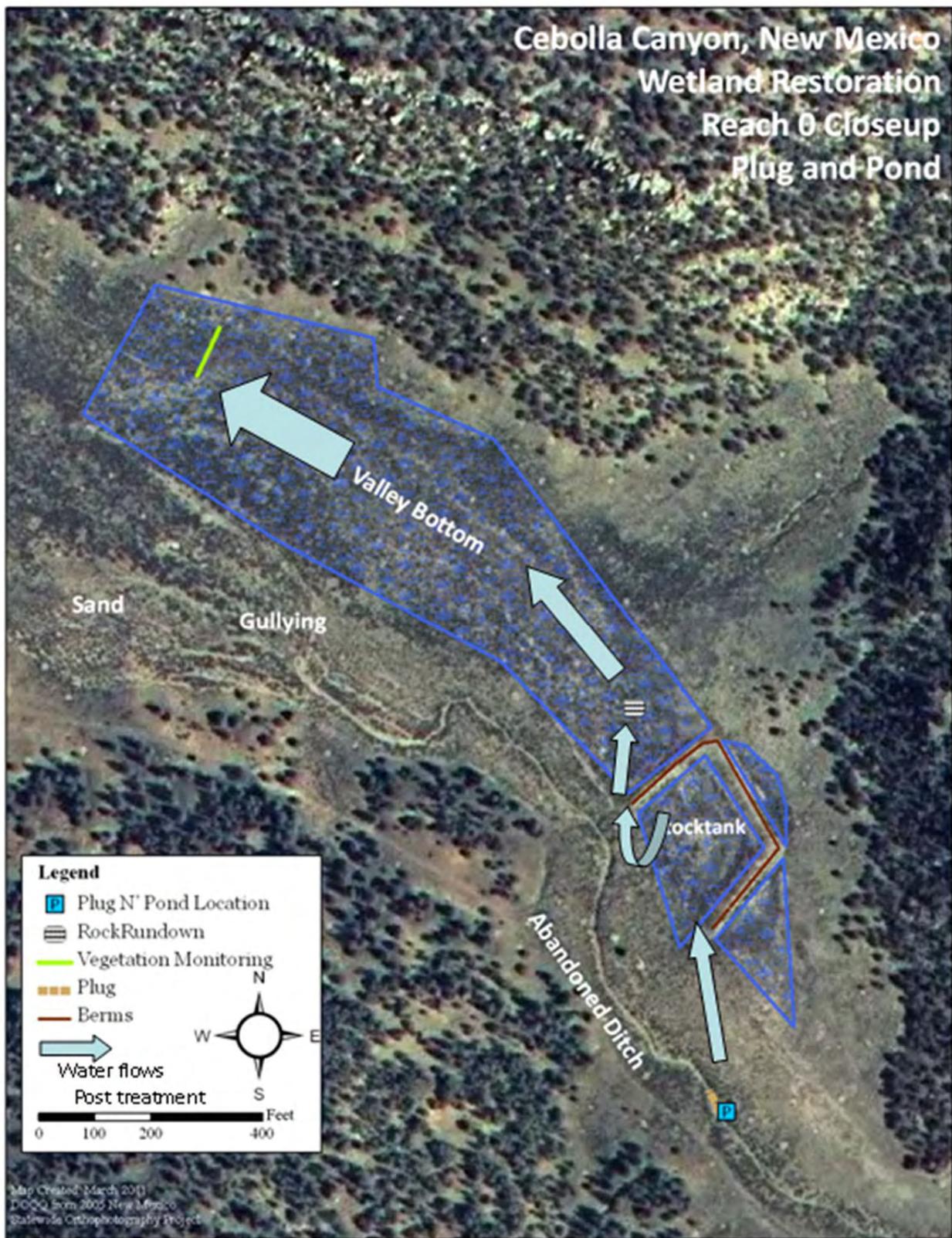


Little Cebolla Spring is a spring fed stock pond located in a small pasture and is actively used by livestock for water. There is some hydric vegetation present such as rushes and sedges. The dam, holding the pond, is low and wide and the pond is around 3 to 5 inches deep when filled. There is no obvious spillway or head-cutting.

This site has a great potential for a conversion from water impoundment with the sole purpose of watering stock to wetland pond with

substantial provision of wildlife habitat. Expanding the pond and creating protected habitat would also improve the overall water quality and benefit the livestock as well as wildlife species.

To expand the pond an excavator could help move the soil and compacting of the soil would help increase the water storage. Added and reconfigured fencing would protect the pond and manage the livestock access creating valuable wetland habitat.



13.3 FUTURE PLUG AND PONDS

Plug and ponds are constructed from native soils and wetland sod to plug the channel. The chart above shows the plug and pond used in Reach 0. An abandoned ditch in Reach 0 was diverting water away from the valley bottom and spilling the water out into sand without any wetland potential. We used the plug and pond technique to restore water flow to the natural valley bottom with hydric soils and wetland potential.

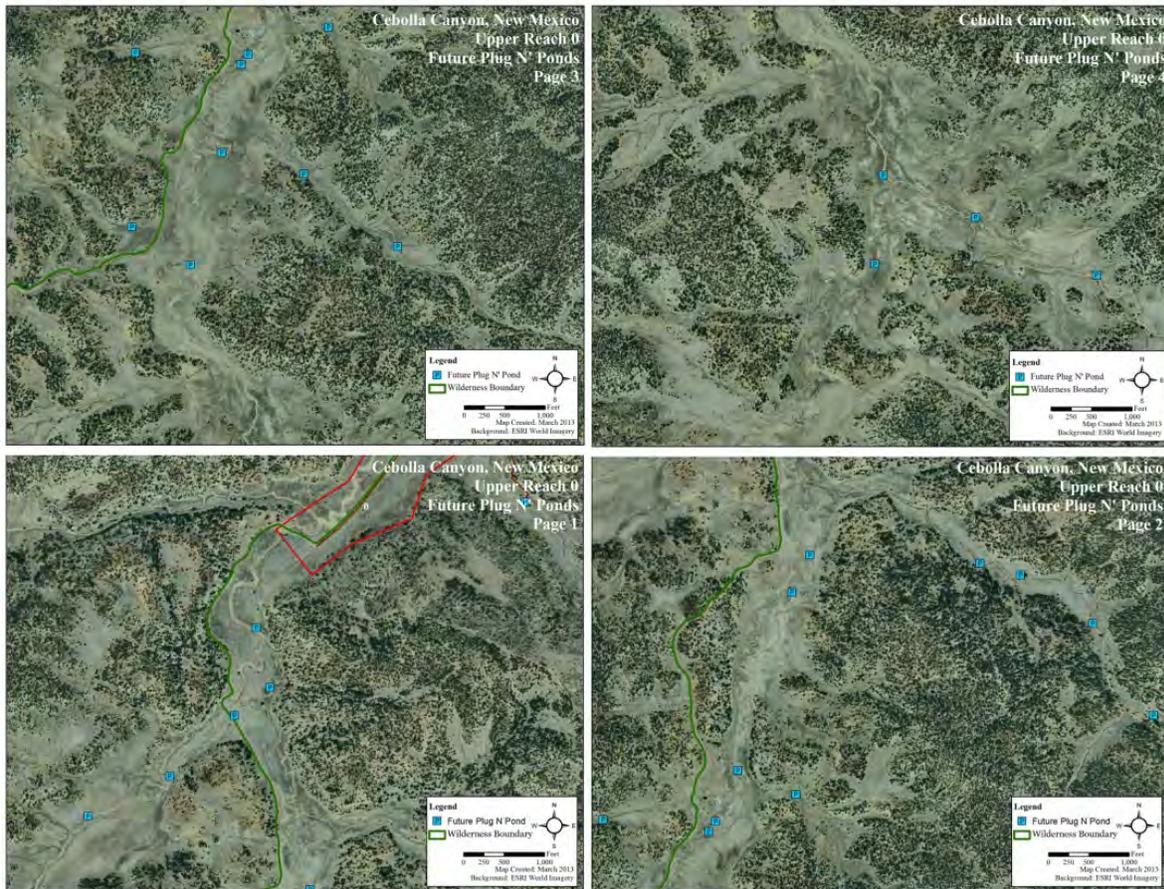


*[Top left] Before plug and pond construction.
[Top right] Water is once again accessing the stock tank benefitting the permittee.
[Left] Water is returned to the Valley Bottom, increasing wetland potential.*

Plug and pond structures spread water over the floodplain and to create a temporary pond. These techniques have proven to restore wetlands effectively by enabling the stream to replenish the floodplain, reducing the energy of the water flow and re-watering nearby meadows. Implementation of this technique generally results in a higher water table, encourages the growth of riparian vegetation, and provides cooler water for fish and wildlife.

Bill Zeedyk and Steve Vrooman have identified sites that would benefit from plug and pond restoration structures. Below are maps of the Cebolla Canyon Wetlands with proposed locations for plug and pond structures. These locations were identified before the floods in 2013. Therefore a new assessment of those sites might be necessary to determine whether the need still persists and or whether there are new sites in need of a this type of treatment.

Proposed sites for new plug and pond structures.



13.4 REPAIRING OF RESTORATION STRUCTURES AND ADAPTIVE MANAGEMENT

Floods in fall 2013 have moved large amounts of water and sediment through Cebolla Canyon and have damaged restoration structures. These will need to be repaired. Sedimentation has also changed the valley bottom morphology and possibly created the need for new restoration structures. Therefore a new assessment of the wetland should be undertaken to identify where restoration structures are necessary.

13.5 WETLAND DELINEATION

Wetland delineation is the process of surveying wetlands and their properties to determine their boundaries. So far the delineation efforts were focused on Reach 0 to 8 and have not spanned the entire wetland. In order to determine the overall boundaries of the wetland a new delineation process should be performed capturing the entire wetland. In addition, delineations should be conducted on a regular basis (every two or three years) to determine long-term improvements to the wetlands from restoration measures, or losses from climate or man-made effects.

13.6 SPECIES REINTRODUCTION

The Cebolla Canyon Steering Committee discussed the need to re-introduce some missing species to the area to restore the ecosystem. Among the species discussed were:

- Muskrat, which could help diversify marsh habitat.
- Montane vole, which has not been seen in the area.
- Mexican vole. There is a good chance of its occurrence the area.
- Meadow Jumping Mouse. There is no historic evidence it was in the area.
- Leopard Frog.
- Western Chorus Frog.
- Canyon Tree Frog.
- Fish species.
- Tawny bellied cotton rat. These are a vole surrogate, according to Jim, and he has seen them in the Grants area.

The opportunity to use the functioning restored ecosystems in Cebolla Canyon to allow these fragile species to survive there is being researched and considered. Wetlands are now expanding because of current work there, and it will be determined by a host of wildlife and other experts if the system is ready for this next step.

The Committee discussed how we might re-introduce species.

- Survey/literature search – what might already be there, what might have occurred historically, and what is the role of the species in the ecosystem?
- Locate suitable release sites so the species will have a reasonable chance of survival.
- Determine the manner of release (soft release, provide shelter, etc.).
- Where will they come from? Transplant stock, how will they be caught?
- Timing – when do we release which?
- Veterinary study to determine if the candidates for release are disease free.
- For NEPA, the possibility of something going wrong will need to be considered and how it would be mitigated.

- Permits and permit requirements. Will they be needed? Some species might be protected.

According to BLM , these efforts must conform to the Resource Management Plan (RMP) for the El Malpais and the Land Use Plan (LUP) that is part of the RMP. Right now, the only species that was analyzed for translocation/augmentation in the plan was the Prairie Dog. For other establishments, the BLM will need to have a thorough analysis in the LUP. Therefore, a Plan Amendment to incorporate new species may be required.

To initiate the process of re-introduction of a species, whether or not the species are already there must be determined. If the species is found, a strong justification to augment the existing population would be necessary. If they are definitely no longer in the area, a determination for the necessity and feasibility of re-introducing the species would be needed. This would involve NEPA and Section 7 consultation. Information would include species habitat range, whether the Cebolla Canyon habitat is suitable, the populations' genetics. and the minimum viable population.

During the Cebolla Canyon Steering Committee meeting in 2010 regarding the re-introduction of species, the following comments were made:

Dale asked if we could get a jumpstart on the inventory. Andrea said that there shouldn't be any hindrance in starting surveys for the species on this list. This is a phased process; it will likely take a lot of time. Also there will be budgetary hurdles to leap. Therefore, starting promptly, even if it takes awhile, is a very important first step.

Tom wondered what effects the re-introduction would have on trapping or hunting which are all legal activities on the project site.

Love Road Sanctuary wants to purchase the York Ranch and bring horses out to Cebolla. We will need a lot of support to convince them that it's not a good idea.

Barbara asked if surveys have to be done by DFG/BLM employees. Ed said that whoever did them, they had to have credentials and collection permits. Funding or paying BLM or federal employees might be an issue.

Bill suggested that we look at the most likely species first (i.e., pick 3). Tom said that the BLM would support that. Andrea said she would check on the NEPA requirements. Barbara will send the Fuhrman University small mammal survey to Jim Stuart.

13.7 ADDITIONAL PROTECTION AND RESTORATION MEASURES

The table below lists additional protection and restoration measures that would benefit the Cebolla Canyon Wetlands.

xv. Restoration Measures

Objective/Action	Time Frame	Partner
New Grazing Plan	Urgent	BLM
Repair of Riparian Fences, Exclosures	Urgent and ongoing	BLM, RPA, AWF
New Riparian Pasture	Urgent	BLM
Stock Pond Conversion	1-2 years	RPA, BLM, Bat Conservation International
Plug and Ponds (19+)	1-2 years	RPA
Trigger Point Exclosures	Urgent	RPA, AWF, BLM
More Road Repair	1 year	BLM
Species Re-introduction	1 year	BLM, RPA, USFWS
Reconnaissance to Determine Restoration Work Needed in Other Reaches	Urgent	RPA, AWF

xvi. Monitoring

Objective/Action	Time Frame	Partner
Continue to assess wetland ecosystem conditions and functions of the Cebolla Canyon Wetlands	ongoing	Watershed groups and NGO partners
Generate web based up-to-date map and information database of the condition of the wetland.	ongoing	SWQB, USFWS, universities and NGO partners
Establish a program to update stakeholders on the conditions, improvements and challenges that the wetland is facing in terms of changing climate patterns and land use.	ongoing	SWQB, USFWS, universities and NGO partners

xvii. Outreach

Objective/Action	Time Frame	Partner
Continue to develop outreach strategies to inform and educate different stakeholder groups about relevant wetland ecosystem services as benefits of wetland restoration and protection.	ongoing	SWQB, NGO and government agencies
Continue to target school and youth groups in Grants and Acoma to support and be actively engaged in wetland restoration and protection efforts	ongoing	SWQB, NGO and schools
Continue to engage new groups, such as Sierra Club and National Wild Turkey Federation, in restoration work	ongoing	RPA, BLM, AWF, NMED, NMDFG, EMNCA, RPMC

Develop an Adopt-a-Wetland program to raise awareness and money for restoration and protection projects	ongoing	SWQB, NGO and schools
Continue Steering Committee Meetings	Urgent	RPA, BLM, AWF, NMED, NMDFG, EMNCA, RPMC
Continue Cebolla Summer Wetlands Academy	Urgent	RPA, BLM
Display at the Ranger Station	Urgent	RPA, BLM

14. OUTREACH AND LOCAL INVOLVEMENT STRATEGY

14.1 STEERING COMMITTEE

A steering committee was established shortly after the Cebolla Canyon restoration project began, composed of stakeholders, contractors, and cooperators representing the NMED, BLM, RPA, AWF, NMDGF, El Malpais National Conservation Area (EMNCA), and the Rio Puerco Management Committee (RPMC). There were eight Steering Committee Meetings held. The group is willing to continue meeting for future projects.

14.2 CORE OF VOLUNTEERS

14.2.1 Current Groups involved

AWF has been involved in Cebolla Canyon since 2000. They have been conducting at least two work weekends a year for the past five years under the various projects RPA has received funding for. They have made a commitment to continue this work into the future.

National Wild Turkey Federation (NWTF) has been holding at least one work weekend a year for the past two years. They too, have made a commitment to continue with this work. The Pueblo of Acoma Youth & Community Corps is a program of the Southwest Conservation Corps' (SCC) Ancestral Lands office that has done both volunteer and paid work in the area for us.

14.2.2 Future Groups to Engage

A number of other groups will be asked to contribute to the restoration of Cebolla Canyon watershed. These currently include the Sierra Club, and to continue work with Acoma SCC. Hunting is popular in the area, as numerous hunting groups set up camps in the canyon, and through the Game and Fish Department hunting groups should be engaged. More stakeholders can also be engaged through the efforts of the Rio Puerco Management Committee and their 35+ organizations that are represented.

14.3 INFORMATIONAL PROGRAMS AND ACTIVITIES

14.3.1 BLM Ranger Station on NM117

As part of the outreach associated with RERI and SWQB Wetlands Program funding, a display at the BLM Ranger Station was created showing the work done and discussing the Summer Academy. A future display will be discussed that will include monitoring results, adaptive management and future restoration needs.



14.3.2 Interpretive Display at the Multiagency Visitor Center

An interpretive display for the Multiagency Visitor Center located in Grants is also being planned. The display is to reach area children to introduce them to wetlands and the need for their restoration.

14.3.3 Wetlands Academy

On July 21st and 22nd of 2013, the Summer Academy/Cebolla Outdoors Classroom took place in Cebolla Canyon and Thoreau, NM. The event involved a two-day workshop, including an overnight at the Cottonwood Gulch (CG) basecamp. RPA and partners recruited 7 students from the community of Grants – the target population we were trying to reach – and 19 students from one of the CG summer programs.

The participants ranged from 7th to 10th grade and had a wonderful time learning about land and water management in the high riparian habitat of Cebolla Canyon, building 12 one-rock dams under the guidance of Southwest Urban Hydrology (SUH) owner Aaron Kauffman. The day dawned bright and sunny for an early morning pickup in Grants, and thankfully as the Grants

participants joined the Trekkers from Cottonwood Gulch, a cool cloud cover favored the group, allowing for a comfortable day of outdoor activities.

The group then moved on to the beautiful, shady Cottonwood Gulch base camp in Thoreau, NM. Trekkers and Grants youth got to dine together and enjoy fun group activities around camp, and OSM/VISTA Emily Wolf and BLM Ranger Jen Cutillo joined the next day! Emily and Jen led the group in exploration of the Cottonwood riparian area, including a riparian scavenger hunt and a group rainmaking activity.

This program was the second-annual Cebolla Summer Classroom – the first was arranged by former RPA OSM/VISTA Nikolis Gualco, and took place July 1st and 2nd, 2012. The classroom brought out Keystone Restoration owner Steve Vrooman, who took the group out to tour the canyon. He highlighted all of the different restoration techniques used and showed us some really effective examples. After the tour, the group visited a nearby Student Conservation Association (SCA) project site to see an ongoing example of rock-work-based restoration. SCA presented a rock structure they were currently building. This program went a long way to foster important partnerships between the Grants Ranger Station at El Malpais, Los Alamos Middle School in Grants, Cottonwood Gulch Foundation, and various RPA restoration contractors such as Steve Vrooman and Aaron Kauffman. Not only did the group get to aid in the empowering process of restoration and see the effects of erosion control at work, they got to explore the outdoors and spend time with other peers from very different parts of the world!

The programs were funded under an RPA contract with the SWQB Wetlands Program, which has been providing funds to restore Cebolla Canyon for four years, and has seen amazing results. Already the treated reaches in Cebolla Canyon are showing marked signs of improvement, and are serving as important tools for any visitors to the site, who can see successful restoration in action!

Funding is being sought to continue this program, but thus far requests have not been successful.

15. FUNDING SOURCES

Cebolla Canyon is not eligible for Clean Water Act 319 (non-point source) funding, as it is not listed on the 303d list. - We have tried to get further restoration funding from:

- the National Fish and Wildlife Foundation;
- the North American Wetlands Conservation Act program (NAWCA);
- the Frost Foundation; and
- the National Environment Education Foundation (NEEF).

Thus far, this area has been overlooked for further funding. The New Mexico Legislature is funding a River Stewardship Initiative in 2014. That may give us another opportunity for restoration funding. We received a \$25,000 grant from the New Mexico Community Foundation

in 2012 which provided valuable work by the Acoma SCC in restoring Cebolla canyon wetlands. They will be contacted again. Other foundations will be contacted as well.

16.MONITORING

Monitoring of ongoing wetland restoration efforts will help identify impacts specific to the restoration and protection measures being used on the wetland. The monitoring of the wetland will show how successful different measures and techniques are and will help in determining whether measures have to be adjusted or redesigned. In addition, data that is produced through the monitoring process can be used in reports and for educational purposes and will influence future wetland restoration and protection actions.

Several monitoring reports have already been produced and are listed below. The wetlands are expected to be monitored continuously if funding is available, to evaluate the short and long-term effects that restoration and protection measures have. Specifically, monitoring will determine wetland expansion through changes in wetland vegetation, geomorphology, and groundwater as well as in soils. Additionally, photomonitoring will help visually display how the wetland is expanding and vegetation cover is changing.

Specific monitoring techniques that have been applied and are recommended to be used are:

- Wetlands delineation
- Site photography (photo points)
- Vegetation transects
- Installation of piezometers to determine whether the hyporheic zone and wetland areas expand as intended.
- Development of a Quality Assurance Project Plan (QAPP)
- Training of monitoring volunteers

16.1 PAST MONITORING EFFORTS

There have been project specific monitoring efforts in Cebolla Canyon. Below is a list of the reports on these efforts:

- Restoring Cebolla Canyon Monitoring Report
Keystone Restoration Ecology, December, 2013
Prepared for the Rio Puerco Alliance and the New Mexico Environment
- Restoring and Protecting Wetlands in Cebolla Canyon Closed Basin
Monitoring Report
Keystone Restoration Ecology, January, 2011