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ARCH CANYON CONDITION ASSESSMENT

AND MANAGEMENT RECOMMENDATIONS

Report for the

Southern Utah Wilderness Association

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Charles Schelz has worked for the past ten years as a biologist/botanist/ecologist within Southeast Utah. Over the past 19 years he has designed and/or participated in long-term ecological monitoring throughout the Colorado Plateau and the western United States. He has worked in several parks of the National Park Service, the Nature Conservancy, private consulting firms, the U.S. Forest Service, and as a private contractor. He has worked on numerous vegetation and wildlife monitoring projects, management plans, and environmental assessments and impact analyses on the Colorado Plateau, in Oregon, and California. His education includes Masters and Bachelor’s Degrees in Biology and Ecology, and three years of Civil Engineering. The United States Government web-based bibliography service “NatureBib” lists over 60 reports and species lists he has written in the past 19 years.

EXECUTIVE SUMMARY

This is a qualitative report describing the ecological condition of Arch Canyon, a tributary of Comb Wash, in San Juan County, Utah. Present and potential impacts of existing land management practices are addressed as they influence the condition of the Canyon, and recommendations are given for future management. The lower 8.5 miles of Arch Canyon is managed by the Bureau of Land Management (BLM), while upper Arch Canyon is managed by the United States Forest Service (USFS).

Specifically, the objectives are to:

1. Define and identify reaches and classify the stream type of the BLM-managed section of Arch Canyon.
2. Assess the existing condition of the BLM-managed section of Arch Canyon using Proper Functioning Condition assessment techniques for riparian areas developed by the BLM.
3. Identify the primary ecological impacts in Arch Canyon.
4. Identify Sensitive, Threatened or Endangered species incidentally observed during the Condition Assessment in Arch Canyon.
5. Provide recommendations to the BLM for the future management of Arch Canyon.

For this project, I used a visual riparian assessment method developed by the U. S. Department of Agriculture for the Natural Resources Conservation Service (NRCS) (USDA 2004). Their methodology was developed to provide a description and scoring template for hydrologic, soil and vegetative elements observed at the site. It provides a quantitative dimension to the Proper Functioning Condition assessment process by assigning values to each element assessed, which are then totaled, and a determination for the condition of the riparian area can be calculated.

Most of the length of Arch Canyon investigated was found to be in a **"Functioning At Risk" condition, with a downward trend**. The primary impacts appear to be past livestock grazing, and the existing 4-wheel drive route that traverses the floodplain and continually crosses the stream bed as many as 60 times in approximately 8.5 miles. Findings also include the presence of the flannelmouth sucker (*Catostomus latipinnis*), a BLM "Sensitive Species" in the state of Utah. The occurrence in Arch Canyon of this species is of concern because threats to its habitat include the impacts of roads in stream channels.

Although the Condition Assessment of Arch Canyon reveals ecological dysfunction, there is still time and opportunity to reverse this trend and return the riparian zone to a more ecologically balanced system by implementing appropriate management actions. Riparian areas in a "Functional At Risk, with a downward trend" condition are prime candidates for planning recovery strategies. They are often the highest management

priority because while a decline in resource values is apparent, these areas often retain much of the resiliency associated with Proper Functioning Condition and have a high potential for recovery. Arch Canyon showed strong resiliency through its rapid recovery from grazing impacts. Thus, there is opportunity to reverse downward trends successfully through rapid decisive changes in management.

The presence of the existing 4-wheel drive route in the Canyon bottom is the primary cause of the ongoing negative impacts to the system. Off road 4-wheel drive vehicles have been using this route increasingly over the past 15 years. It is probable that simply closing the 4-wheel drive route would result in a quick ecological recovery and a return to natural stream and riparian dynamics. Closing the 4-wheel drive route and restoring it would make Arch Canyon a premier example of managing an ecological functioning riparian/wetland canyon system in southeastern Utah, and provide a unique environment for campers, hikers, hunters, naturalists, researchers, outdoor enthusiasts, and conservationists to enjoy. It would also become a more effective connected and functioning wildlife habitat corridor, used by a wide assortment of wildlife species for its rare and valuable source of food, water, and shelter.

The following are recommendations for future management of Arch Canyon:

1) Close the 4-wheel drive route and prohibit vehicles and bicycles in Arch Canyon. Maintain a hiking trail that conforms to engineering standards and practices designed to protect riparian and upland systems.

2) Restore sections of Arch Canyon where vehicles have created areas that are susceptible to erosion. These areas are primarily where the 4-wheel drive route crosses the stream channel. This route crosses the stream at approximately 60 locations in 8.5 miles.

3) Develop a plan to actively control the exotic plant species in Arch Canyon and the surrounding area. Specifically, control tamarisk.

4) Fund research studies of the fish of Arch Canyon and in particular the flannelmouth sucker and the bluehead sucker. Research should focus on their movement patterns, habitat needs, and how long the flannelmouth suckers have been isolated from other populations. Comparative genetic studies are recommended.

5) Institute additional measures to protect fish populations in Arch Canyon and to enhance their habitat.

6) In concert with interested private and public organizations, the BLM should take the lead in the coordinated development of an Arch Canyon Management Plan.

7) The effects of the 4-wheel drive route on aquatic macroinvertebrates, frogs, toads, and salamanders is unknown. Their habitat in Arch Canyon is probably being negatively impacted. It is recommended that general surveys be conducted for these species and a research study on the effects of the 4-wheel drive route on their population health be initiated.

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1. INTRODUCTION

Upper Arch Canyon, San Juan County, Utah

This is a qualitative report describing the ecological condition of Arch Canyon, a tributary of Comb Wash, in San Juan County, Utah. Present and potential impacts of existing land management practices are addressed as they influence the condition of the Canyon. Arch Canyon is managed by the Bureau of Land Management (BLM), a federal agency that is charged with the management of a large portion of public lands throughout the western United States.

1.1 Importance of Riparian Areas in the Desert Southwest

Riparian areas are the most biotically diverse and important habitat type in southwestern United States (US) deserts. They provide food, shelter and water for a wide assortment of biota, representing every trophic level. This results in very high biological diversity relative to other desert habitats. The Utah Division of Wildlife Resources (1997) estimates that although riparian areas in this region constitute only 1-2% of the landscape, they support 75-80% of the wildlife. It is well established in the ecological literature that riparian habitats are far more productive in terms of floral and fauna biomass, and biotic diversity, than adjacent uplands (Knopf et al. 1988, Gillis 1991, Bristow 1968, Carothers 1977, Anderson et al. 1977, Johnson et al. 1977, Johnson et al. 1985, Johnson and Carothers 1982, Johnson and Jones 1977, Johnson and McCormick 1978, Stauffer and Best 1980, Thomas et al. 1979, Warner and Hendrix 1984). It is also well established that the presence of a riparian system adjacent to desert upland habitats enhances species diversity and overall productivity of the upland. Riparian areas provide habitat for Sensitve, and Threatened and Endangered species. They protect soil as well as water quality and quantity. They function as major wildlife corridors for seasonal movements and migration. And finally, they are important in promoting the development of productive vegetative communities within the surrounding desert matrix.

It has been documented that riparian habitats in the US, and in particular in the southwestern US, have been significantly reduced from their original abundance. Swift and Barclay (1980) estimate that “at least 70% of the original area of riparian ecosystems has been cleared by human activities” in the US. Although pre-development data on riparian habitat abundance are lacking in this region, it has been estimated that only 10% of the original native cottonwood-willow (*Populus fremontii - Salix* spp.) habitat type remains (Johnson and Carothers 1982). Noss et al. (1995) ranked riparian areas in Arizona and New Mexico as endangered, with 85%-98% declines due to destruction, conversion to other uses, or significant degradation in structure, function, or composition since settlement by Europeans.

Many of the ecological values, such as water retention and increased primary production, that make riparian areas rare and valuable, particularly in a semiarid landscape, also make them sensitive to disturbance and major destructive changes. Riparian ecosystems throughout the Southwest have been severely degraded as a result of human activities and limited management goals and efforts. Developing operational strategies and management guidelines to repair and protect riparian ecosystems represents a challenging but necessary opportunity for land management organizations. This is especially true in sensitive desert riparian ecosystems where traditional, single-use management (e.g., grazing, forest harvest, mining, and the recent exponential increase in the use of off road 4-wheel drive vehicles) have not and will probably not result in the desired outcome: a sustainable, functioning riparian ecosystem.

1.2 Area Description and Importance

Arch Canyon is an extensive riparian/wetland canyon located southwest of Blanding, Utah. It drains parts of the southern Abajo Mountains into Comb Wash, which then flows into the San Juan River. The San Juan River is a major tributary of the Colorado River. Arch Canyon is located approximately 15 miles southwest of Blanding (**Figure 1**). Access is via Utah State Route 95 west from Utah State Highway 191 just south of Blanding. Arch Canyon is the second drainage from the west, north of where UTah State Route 95 crosses Comb Wash. From Utah State Route 95 there is a dirt 4-wheel drive route that travels north on the west side of Comb Wash about two miles to the outlet of Arch Canyon.

The stream in Arch Canyon appears to be perennial; however, during dry periods it may be intermittent with perennial pools. Most of the hundreds of eroded drainages of this area are typically dry, sandy, or rocky washes, where water flows only briefly after heavy rainfall. Arch Canyon is unique, however, because it has perennial water and is a direct hydrological and ecological link to the nearby Abajo Mountains. As a result, classic desert riparian vegetation composed of cottonwood and willows and a host of other typical riparian/wetland plants are present in large quantities. In addition, the stream channel itself contains sections with well-developed mesic vegetation, periphytes (algea), and aquatic macroinvertebrate (insects, crustacians, etc.) communities. Typical native species encountered within the riparian zone in Arch Canyon include: Cottonwood trees

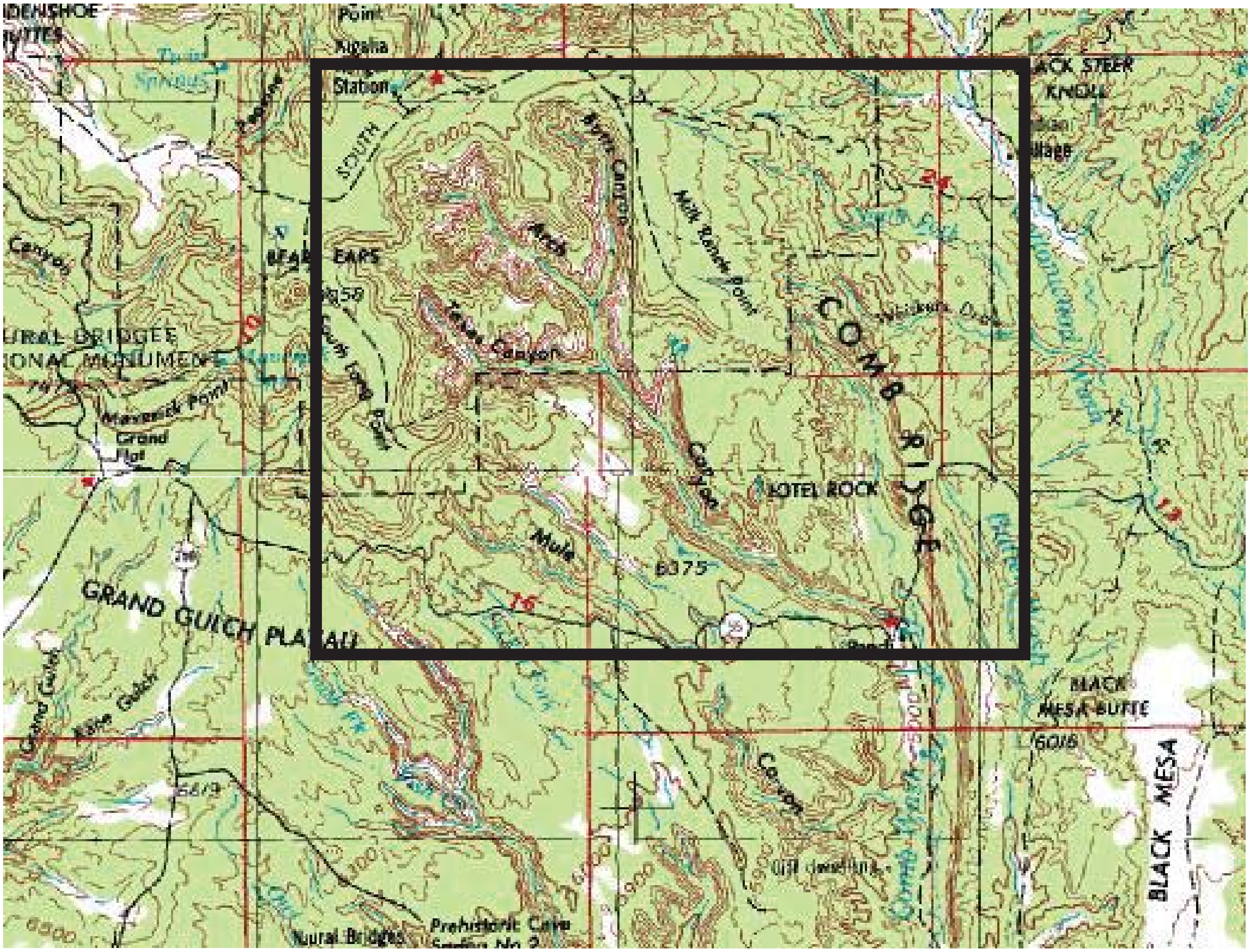

FIGURE 1. Location of Arch Canyon (within square), San Juan County, Utah.

(*Populus fremontii*), Willows (*Salix exigua*), Arctic Rush (*Juncus arcticus*), saltgrass (*Distichlis spicata*), Utah serviceberry (*Amelanchier utahensis*), Rabbitbrush (*Chrysothamnus* spp.), reedgrass (*Phalaris arundinacea*), Goldenaster (*Heterotheca villosa*), Sagebrush (*Artemisia tridentata*) pinion pine (*Pinus edulis*), Utah juniper (*Juniperus osteosperma*) snakeweed (*Gutierrezia sarothrae*) indian ricegrass (*Hesperostipa hymenoides*), etc. Exotic species include tamarisk (*Tamarix ramosissima*), cheatgrass (*Bromus tectorum*), Russian thistle (*Salsola iberica*) etc.

Other biological evidence of the uniqueness and importance of this canyon system is the presence of at least two species of fish, the speckled dace (*Rhinichthys osculus*) and the flannelmouth sucker (*Catostomus latipinnis*). The speckled dace is a common minnow of these types of canyon systems, but the flannelmouth sucker is a BLM "Sensitive Species" in Utah. The presence of fish highlights this canyon as unique to the area because large fish the size of flannelmouth suckers in canyons of this small size are extremely rare in the Four Corners region, particularly in situations such as this where there is no continuous water connection to a larger river.

The nearest large river system is the San Juan River, which is separated from the mouth of Arch Canyon by approximately 25 miles of the mostly dry alluvium of Comb Wash.

It is possible that the flannelmouth sucker is a “relict” population that has been separated from the species’ larger gene pool for millions of years. However, it is also possible that these fish were transplanted to the area in recent times. Interviewing local people and the Utah Division of Wildlife Resources (UDWR) may shed some light on this question.

The lower 8.5 miles of Arch Canyon is managed by the BLM, and the upper section by the US Forest Service USFS). The existing 4-wheel drive route in Arch Canyon is entirely on BLM-managed land and ends at the Forest Service boundary where there is a fence and signs prohibiting the use of motorized vehicles.

1.3 Objectives of this Report

This report is a qualitative Condition Assessment of Arch Canyon, based on two visits to the area. The overall purpose is to describe the present riparian condition and impacts in Arch Canyon, with recommendations for future management. Specifically, the objectives are to

1. Define reaches and classify the stream type of the BLM-managed section of Arch Canyon.

2. Assess the existing condition of the BLM-managed section of Arch Canyon using Proper Functioning Condition assessment techniques for riparian areas.

3. Identify the primary impacts on the ecology and health of Arch Canyon.

4. Identify Sensitive, Threatened or Endangered species incidentally observed during the Condition Assessment in Arch Canyon.

5. Provide recommendations to the BLM for the future management of Arch Canyon.

2. RIPARIAN CONDITION CATEGORIES

2.1 Proper Functioning Condition

According to the BLM Riparian Area Management guidelines (USDI 1995), the capability and potential of riparian-wetland areas are depicted as the interaction of three components:

1) vegetation
2) landform/ soils
3) hydrology

Fish and wildlife are sometimes regarded as a fourth element because some wildlife species are more than just "users", they may alter a riparian-wetland area's capability and potential (i.e., beaver) and as such can be considered a special modifier under the hydrology component.

According to this definition, riparian-wetland areas are healthy and functioning properly when adequate vegetation, landform, or large woody debris is present to dissipate energy associated with high water flows or wave action. Healthy riparian-wetland areas perform several critical ecological functions such as:

-Purifying water by removing sediments;
-Reducing the risk of flood damage;
-Increasing available water by holding it in streambanks and aquifers;
-Maintaining instream flows;
-Stabilizing stream banks;
-Increasing ground-water supplies;
-Supporting a diversity of wildlife and plant species;
-Maintaining habitats for healthy fish populations.

2.2 Assessment Categories

The BLM uses the following four categories to assess and describe the health of riparian areas (USDI 1998):

1) Proper Functioning Condition (PFC) - Riparian-wetland areas are functioning properly when adequate vegetation, landform, or large woody debris is present to dissipate stream energy associated with high waterflows, thereby reducing erosion and improving water quality; filter sediment, capture bedload, and aid floodplain development; improve flood-water retention and ground-water recharge; develop root masses that stabilize streambanks against cutting action; develop diverse ponding and channel characteristics to provide the habitat and the water depth, duration, and temperature necessary for fish production, waterfowl breeding, and other uses; and support greater biodiversity.

2) Functional—At Risk - Riparian-wetland areas that are in functional condition but an existing soil, water, or vegetation attribute makes them susceptible to degradation. The riparian area may contain some or even most of the elements of “Proper Functioning Condition”, but attributes of at least one of its vital processes gives it a high probability of degradation during relatively high flow events.

“Trend” must be determined, if possible, when a rating of “Functional - At Risk” is determined (USDI 1998). This is usually rated as “downward” or “upward”. A downward trend indicates there is some process being affected by a condition that contributes to degradation and away from Proper Functioning Condition. If there is a downward trend, there is usually an opportunity for management to correct the problem and reverse the trend. An upward trend indicates the system is healing itself from some previous degrading condition but needs time to complete the process to achieve a Proper Functioning Condition.

3) Nonfunctional - Riparian-wetland areas that clearly are not providing adequate vegetation, landform, or large woody debris to dissipate stream energy associated with high flows and thus are not reducing erosion, improving water quality, etc., as listed above. The absence of certain physical attributes such as a floodplain where one should be are indicators of nonfunctioning conditions.

4) Unknown - Riparian-wetland areas that BLM lacks sufficient information on to make any form of determination.

3. BUREAU OF LAND MANAGEMENT RIPARIAN MANAGEMENT REGULATIONS

3.1 General BLM Guidelines

Given the value of riparian habitat, the BLM has developed general guidelines for their protection and proper functioning condition. In 1991, the BLM released the “Riparian-Wetland Initiative for the 1990’s”, which sets a series of goals and strategies to meet healthy conditions on the 23.7 million acres of riparian-wetlands they manage. The Initiative summarizes the state of the agency’s efforts at managing these vital ribbons of green that are so valuable for fish, wildlife, livestock, water quality, recreation, and biodiversity. Four national goals are set forth in the plan:

1. Restore and maintain riparian-wetlands so that 75 percent are in proper functioning condition by 1997.
2. Protect riparian-wetland areas and associated uplands through proper land management and avoid or mitigate negative impacts.
3. Ensure an aggressive riparian-wetland education program, including providing training and research.
4. Improve partnerships and cooperative restoration and management efforts in implementing the Initiative.

The Riparian-Wetland Initiative plan states that the BLM will implement an inventory of riparian-wetland conditions, prepare plans, implement projects to protect and enhance the resources, and monitor accomplishments. The Initiative provides a framework for field actions through BLM’s state, district, and area offices. Each state is developing necessary strategies to implement the Initiative consistent with existing regulations, policy, and funding.

3.2 Specific BLM Standards and Guidelines

The BLM has published specific guidelines concerning the protection and proper management of riparian areas and rangeland. The regulations in 43 Code of Federal Regulations 4180.2 provide fallback Standards and Guidelines that are to be implemented until such time as region-specific Standards and Guidelines (S&Gs) have been approved by the Secretary of the Interior. At this point in time, no region-specific S&Gs have been developed for Utah. The fallback S&Gs for Utah BLM lands are listed below.

3.2.1 BLM Fallback Standards:

Soils: Upland soils exhibit infiltration and permeability rates that are appropriate to soil type, climate and land form.

Riparian / Wetland: Riparian-wetland areas are in properly functioning condition.

Stream Function: Stream channel morphology (including but not limited to gradient, width/depth ratio, channel roughness and sinuosity) and functions are appropriate for the climate and land form.

Native Species: Healthy, productive and diverse populations of native species exist and are maintained.

3.2.2 BLM Fallback Guidelines:

Guideline 1: Management practices maintain or promote adequate amounts of ground cover to support infiltration, maintain soil moisture, and stabilize soils.

Guideline 2: Management practices maintain or promote soil conditions that support permeability rates that are appropriate to climate and soils.

Guideline 3: Management practices maintain or promote sufficient residual vegetation to maintain, improve, or restore riparian-wetland functions of energy dissipation, sediment capture, groundwater recharge and stream bank stability.

Guideline 4: Management practices maintain or promote stream channel morphology (e.g., gradient, width/depth ratio, channel roughness and sinuosity) and functions that are appropriate to climate and landform.

Guideline 5: Management practices maintain or promote the appropriate kinds and amounts of soil organisms, plants and animals to support the hydrologic cycle, nutrient cycle, and energy flow.

Guideline 6: Management practices maintain or promote the physical and biological conditions necessary to sustain native populations and communities.

Guideline 7: Desired species are being allowed to complete seed dissemination in one out of every three years (Management actions will promote the opportunity for seedling establishment when climatic conditions and space allow).

Guideline 8: Conservation of Federal Threatened or Endangered, Proposed, Category 1 and 2 candidate, and other special status species is promoted by restoration and maintenance of their habitats.

Guideline 9: Native species are emphasized in the support of ecological function.

Guideline 10: Non-native plant species are used only in those situations in which native species are not readily available in sufficient quantities or are incapable of maintaining or achieving properly functioning conditions and biological health.

Guideline 11: Periods of rest from disturbance or livestock use during times of critical plant growth or regrowth are provided when needed to achieve healthy, properly functioning conditions (The timing and duration of use periods shall be determined by the authorized officer).

Guideline 12: Continuous, season-long livestock use is allowed to occur only when it has been demonstrated to be consistent with achieving healthy, properly functioning ecosystems.

Guideline 13: Facilities are located away from riparian-wetland areas wherever they conflict with achieving or maintaining riparian-wetland function.

Guideline 14: The development of springs and seeps or other projects affecting water and associated resources shall be designed to protect the ecological functions and processes of those sites.

4. METHODS

I visited Arch Canyon on April 8 and 28, 2006. I walked the 4-wheel drive route from the Canyon outlet in Comb Wash to the US Forest Service boundary and back, approximately 17 miles. I took many photos, counted the stream crossings, measured 4-wheel drive route width, noted riparian conditions, and searched for wildlife sign. I spent approximately 16 hours in the Canyon.

Arch Canyon can be divided into 3 reaches:

1) The “upper” reach, from the US Forest Service boundary downstream for about a mile and a half, has a moderately steep slope (3-4^{o}) and the channel is more confined, with a rougher surface of cobbles and boulders.
2) The “middle” reach makes up a majority of the area I investigated and contains a more open and sinuous channel with a more gentle slope (1-2^{o}) than the upper reach.
3) The “lower” reach encompasses the section of the stream at the outlet and approximately one half mile upstream. Here the slope has decreased to just about 0^{o} due to the sediment buildup from the stream emptying into Comb Wash. This section has been healing from past grazing for some time and the vegetation has developed very well in places. The stream, however, has lost its sinuosity, probably due to historic channel manipulation

The focus of this analysis is primarily the “middle” reach. This section encompasses approximately 85% of the area investigated and is the reach most susceptible to damage from human influences.

For this project I used a visual riparian assessment method developed by the US Department of Agriculture for the Natural Resources Conservation Service (NRCS) (USDA 2004). NRCS developed this method using three publications: 1) US Department of the Interior, Bureau of Land Management, TR 1737-9 Process for Assessing Proper Functioning Condition, 2) US Department of Agriculture, Natural Resources Conservation Service, Stream Visual Assessment Protocol, Fourth Draft, and 3) University of Montana, School of Forestry, Riparian and Wetland Research Program, Assessing Riparian Health, RWRP’s Short Form (USDA 2004). The methodology was developed to provide a description and scoring template for hydrologic, soil and vegetative elements observed at the site. It is an attempt to introduce a quantitative dimension to the Proper Functioning Condition assessment process by assigning values to each element assessed. These values are then totaled and a determination for the condition of the riparian area can be calculated. The score sheet varies from the BLM definition for Proper Functioning Condition in that instead of being a subjective rating system, numerical values are assigned - giving the assessor a defensible management tool. The final result of the score sheet will allow the field staff to assess whether or not the riparian area is functioning, in what capacity, and will also direct the assessor to specific areas of concern. Results of the Condition Assessment of Arch Canyon are included in **Appendix A.**

The author has completed training in Proper Functioning Condition (PFC) offered by the BLM. I have also spent many hours in the field performing PFC analyses of riparian areas throughout southeast Utah. In particular, I have spent three days in the field with Wayne Elmore, Don Prichard, and Janice Staats of the National

Riparian Service Team, evaluating Salt Creek in the Needles District of Canyonlands National Park. Salt Creek is a nearby canyon riparian system very similar to Arch Canyon. I have worked for the past ten years as a biologist/botanist/ecologist within Southeast Utah, and have designed and/or participated in long-term monitoring throughout the Colorado Plateau and the western United States for the past 19 years.

5. RIPARIAN CONDITION IN ARCH CANYON

In the 8.5 mile section of Arch Canyon I investigated, I found a system that was primarily in a **"Functional At Risk" condition, with a downward trend,** and a number of sections in a **"Nonfunctional" condition.** This pertains to all three reaches I examined.

The following sections describe the type of stream in Arch Canyon, and detail the condition of each element considered in assessing the overall condition of the riparian area in the Canyon.

5.1 Arch Canyon Stream Classification and Succession Status

Based on Rosgen's (1998) system of stream classification, Arch Canyon is a C1 to C5 stream type with some sections containing an E5 channel type. The "C type" is a slightly entrenched, meandering, riffle-pool, bedrock- (C1), to cobble- (C3), to sand- (C5) dominated channel with a well-developed floodplain. The section of Arch Canyon studied has a gentle gradient of less than 2%. It displays a high width/depth ratio (>12), and has a sinuosity of at least 1.2. See Rosgen (1998) for a thorough explanation of these terms and numbers.

Figure 2 is an example of the succession of ecological states of a riparian area and stream channel in a riparian system like Arch Canyon. The channel characteristics in **Figure 2 (A-F)** illustrate varying conditions of this type channel. State A is a naturally undisturbed channel. States B-D are progressively degraded, usually due to some external disturbance. State D is the worst possible ecological condition. States E and F are recovery conditions from State D.

State A and/or F are what we look for along the length of a riparian area when making a decision on whether the stream is in a functioning ecological condition or not. States C and D indicate serious ecological problems are occurring.

State A represents a high degree of bank stability, floodplain, and plant community development, and would be classified as Proper Functioning Condition.

State B would be Proper Functioning Condition but at Risk.

State C and **D** would be classified as a Nonfunctioning Condition.

State E is Proper Functioning Condition but at Risk.

State F is Proper Functioning Condition even though the riparian area may not have achieved the greatest ecological extent exhibited in State A. (USDI 1995).

Conditions vary throughout Arch Canyon, but generally speaking most of the canyon is in state E, a fragile ecological state that is at risk of impairment if deteriorating conditions are exacerbated by an extreme flood event. Other states observed were D and F, these included sections where the proper ecological funtion was impaired by recent flood events that may have been magnified by human induced physical changes.

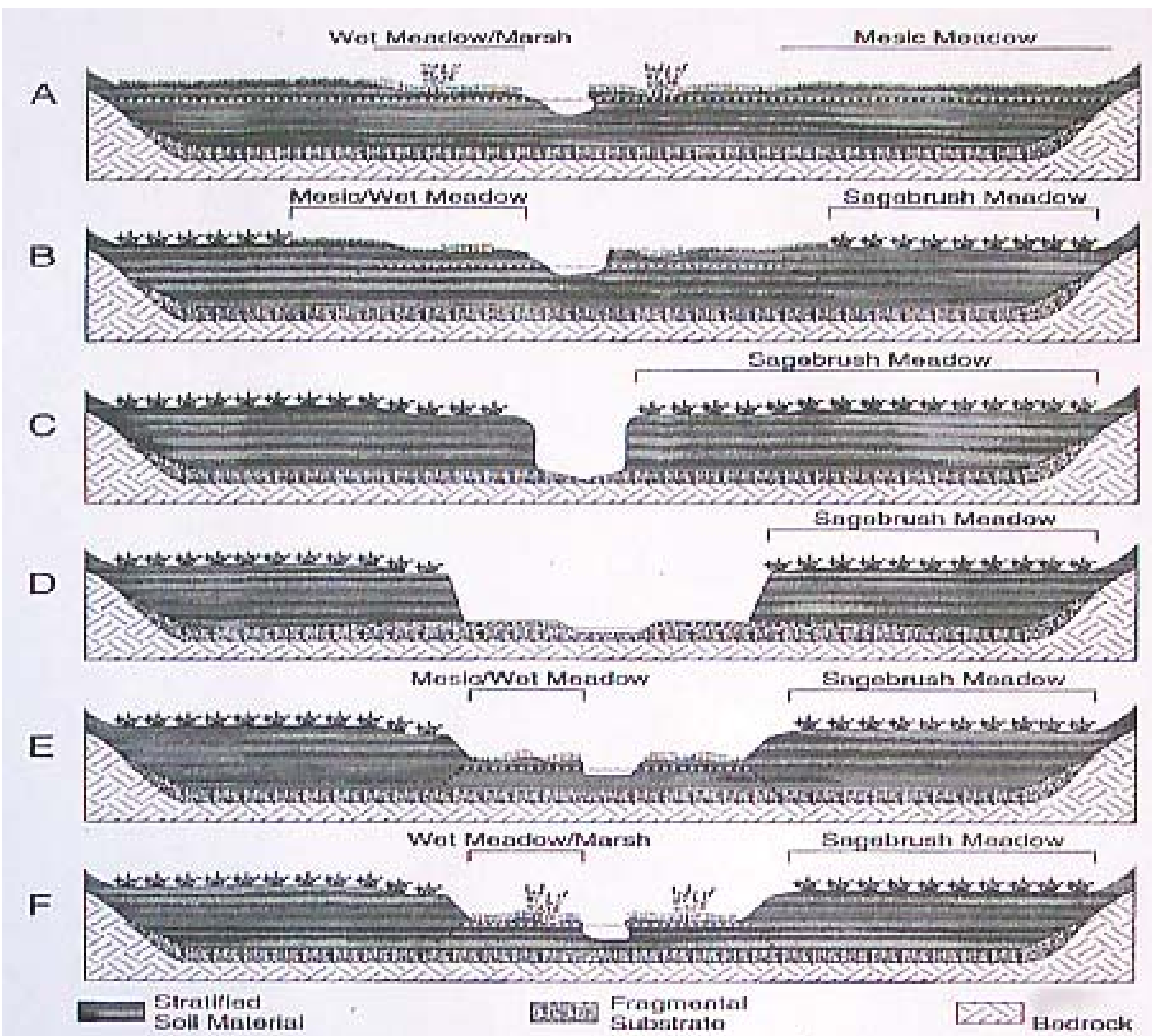

FIGURE 2. Succession of states for alluvial canyon bottom type stream such as Arch Canyon (USDI 1995). State A is Proper Functioning Condition.

5.2 Hydrologic Conditions

5.2.1 Hydrologic Alterations

"Flooding is important to maintaining the structure of the channel and maintaining the physical habitat for animals and plants. Flooding moves sediments, scouring fine sediments and moving gravels and boulders to create pools and riffles. The river channel and floodplain exist in dynamic equilibrium having evolved in the present climatic regime and geomorphic setting. The relationship of water and sediment are the basis for the dynamic equilibrium that maintains the form and function of the river channel. The energy of the river (water volume discharge and slope) should be in balance with the bedload (volume and particle size of the sediment). Any change in flow regime alters this balance. Decreases in flood flows decrease the river's ability to transport sediment and can result in excess sediment deposition, channel widening and shallowing, and ultimately, in braiding of the channel. Conversely, an increase in flood flows or the confinement of the river away from its floodplain increases the energy available to transport sediment and can result in bank and channel erosion" (USDA 2004). Wolman and Leopold (1957) suggest that there should be an annual flood that reaches the floodplain every year or so. Bankfull discharge should have an average recurrence interval of 1.5 years (Leopold 1994). Gebhart et al. (1989) call this area of inundation the active floodplain to distinguish floodplain activity from floodplain inactivity.

In Arch Canyon, no artificial water diversions were noted. The floodplain appears to flood infrequently, every three to five years. Thus, much of the floodplain is in an inactive state for more than a couple of years. Many sections of the channel contained little sediment, indicating increased flow velocity and a lack of the system's ability to build sediment. Some historic channel incision was noted and is probably due to past intensive grazing. Other sections contained an oversized channel width. These conditions imply that there is a lack of hydraulic continuity between the stream and the floodplain, which results in a floodplain that is not being adequately recharged to perform vital ecological functions. These functions include: adequate water table level, maintaining instream flows, support of a diversity of plant life and wildlife, and fish habitat maintenance.

5.2.2 Channel Condition

"Streams naturally meander through a valley bottom or topographic low area. Often, land usages in the area result in changes in a meandering pattern and the flow of a stream. These changes in turn may affect the way a stream naturally does its work, such as the transport of sediment, development and maintenance of habitat for fish, aquatic insects and aquatic plants, and the transfer of oxygen into the water. Some of the modifications may not be noticeable because they are located upstream and may not be accessible or visible. Some modifications to stream channels have more impact on stream health than others. " (USDA 2004). For example, when a stream losses its meandering nature and the channel straightens, the scouring energy of a flod increases which contributes to the loss of sediment, soil, and vegetation, and the destruction of the streambank.

The channel condition in Arch Canyon varies throughout the area investigated. There is consistent evidence of past degradation, present channelization, and, in particular, channel straightening and widening caused by lateral cutting and the loss of vegetation. There are areas where the stream flow has connected with the 4-wheel drive route and straightened. This resulted in bank failure and lateral cutting, destroying riparian vegetation and the stream bank. This condition is evident at numerous sections in Arch Canyon. It is indicative of a stream channel that has lost its stability and energy absorbing capacity to slow and spread the water out onto the floodplain, an extremely valuable ecological function. See **Figure 3** below for a typical example of this.

FIGURE 3. Downstream view where high water widened the channel and eliminated the riparian vegetation, streambank, and floodplain between the stream on the right and the 4-wheel drive route on the left. Arch Canyon, San Juan County, Utah.

5.2.3 Bank Stability

"This element is the existence of or the potential for detachment of soil from the upper and lower stream banks and its movement into the stream. Steep banks are more susceptible to erosion or collapse. Complete vegetative cover helps stabilize the banks; roots from trees, shrubs and even deep rooted grasses are important in providing support to the bank" (USDA 2004).

Bank stability is moderate to poor in 30-40% of the middle reach because of the many unvegetated and unstable and detached areas associated with 4-wheel drive route crossings. At a number of crossings the streambank is in excellent condition upstream but deteriorates immediately downstream due to flooding damage and erosion of unvegetated sections. **Figures 4** and **6** show upstream and downstream views at a 4-wheel drive route crossing. The upstream channel is vegetated and in good condition, but the downstream view shows severe loss of vegetation, streambank, and soil. **Figure 5** shows one of as many as 60 crossings where vegetation is destroyed on the stream bank, making the area more susceptible to erosion.

FIGURE 4. Upstream view at place where 4-wheel drive route crosses the channel. Channel upstream of route is in Functional condition. See Figure 6 for downstream view. Arch Canyon, San Juan County, Utah.

FIGURE 5. Pool formed by the 4-wheel drive route crossing the creek in Arch Canyon, San Juan County, Utah. Deep pools initiate wider route scars and additional crossings and destabilize banks. Flannelmouth suckers were found just upstream.

FIGURE 6. Downstream view of Figure 4 where 4-wheel drive route crosses the channel. Channel is in Non-Functional condition due to loss of bank, soil and vegetation. Arch Canyon, San Juan County, Utah.

FIGURE 7. Upstream view at section where the 4-wheel drive route eliminated vegetation on the stream bank and caused the bank to degrade significantly. The 4-wheel drive route crossing has subsequently been moved downstream where bank erosion is beginning to re-occur. Arch Canyon, San Juan County, Utah.

5.2.4 Active or Stable Beaver Dams

"Beaver dams reduce water velocity and the stream's power to erode. This leads to sediment deposition, elevated water tables, and increased herbaceous and woody vegetation. Beaver dams decrease or retard rapid spring runoff through water storage and improve water quality. Beaver are a desirable species for improved fish habitat and brood rearing areas for waterfowl" (USDA 2004).

No beaver activity or sign, past or present, was observed in the stretch of Arch Canyon between the outlet and the US Forest Service boundary.

5.3 Soil - Erosion and Deposition Factors

5.3.1 Soil Characteristics / Rooting Medium

The two important functions of soil in a riparian area are to act as a sponge for retaining water and water table recharge, and to act as a medium upon which vegetation can establish. The soil in Arch Canyon is composed primarily of sand, with some silt and some clay. The water-holding capacity of this type of soil is limited but extremely important if any riparian vegetation is to develop. The more soil there is, the longer moisture is retained and becomes available to the surrounding floodplain. In a sandy soil type, it takes time to develop dense root masses from riparian vegetation such as rushes, sedges, and willows, because before the root masses are mature they are highly susceptible to the erosive forces of high velocity flows. **Figure 8** below shows an area in Arch Canyon where there is sufficient soil but the plants are easily destroyed whenever there is a flood because of increased flow velocity and consequent lateral cutting.

In Arch Canyon, although conditions vary with every flood event, it is estimated that 60% of the "middle" reach has sufficient soil to hold water and act as a rooting medium. In the other 40%, due to frequent high velocity flows and lateral cutting, vegetation establishment and maturation in the floodplain has been impeded.

FIGURE 8. Area where lateral cutting of the bank between the 4-wheel drive route and the channel occurred. This process inhibits vegetation establishment and maturation. Arch Canyon, San Juan County, Utah.

5.3.2 Exposed or Bare Ground

"Exposed soil surfaces are those surfaces not protected from erosive forces by plants, litter or duff, downed woody materials or rock material larger than 2.5 inches. Exposed soil can be caused by soil conditions, human caused activities, livestock, wildlife, or dense canopy cover. Exposed soil is an important factor in evaluating the health of riparian sites for several reasons: 1) exposed soil is vulnerable to erosion; 2) it may contribute to streambank deterioration; 3) it reflects reduced vegetation cover available for sediment entrapment; and 4) exposed soil provides sites for potential invasion by noxious weeds and other undesirable species. Generally, if the causes are human related or are accelerated by human land uses, this more strongly suggests a deteriorating situation" (USDA 2004).

It is estimated that at least 20% of the "middle" reach riparian area has exposed soil surface due to lateral cutting of the streambanks and the consequent loss of vegetation. See **Figure 9** below for one of many examples of exposed soil throughout the "middle" reach of Arch Canyon.

FIGURE 9. Upstream view at section where vegetation on the stream bank has been eliminated, causing the bank to degrade significantly. Arch Canyon, San Juan County, Utah.

5.3.3 Topographic Variance or Surface Expression on Floodplain

"Once water leaves the stream channel and begins overland flow, the factors which determine whether sediment will be trapped include, 1) the overbank topography, 2) the amount and types of herbaceous and woody vegetation, 3) the amount of dead and down woody vegetation, and 4) any bedrock outcrops or boulders present. The greater the amount of surface variability and additional roughness factors will lead to an increased ability for sediment to be filtered and trapped from the overland flow. Trapped sediment helps to enrich the soil and add nutrients to the ecosystem. Topographic variance also allows for energy dissipation of the flood waters. This prevents scouring and erosion from damaging the overbank areas" (USDA 2004).

In Arch Canyon there are sections of floodplain with dense vegetation and rocks that can mitigate the energy of high flows. Woody debris is not abundant however, and there are many areas where vegetation has been destroyed and the soils compacted. In many sections of the "middle" reach of Arch Canyon, the floodplain is traversed by the 4-wheel drive route and thus is extremely susceptible to increased flow velocity and washouts (see **Figure 10** below). Fortunately, a number of the exposed areas contain cobbles and boulders. These add roughness to the surface and assist in trapping some sediment. In areas already denuded of vegetation however, they do not appear to provide sufficient sediment trapping and protection from scouring to assist plants in re-establishing, developing to maturity and establishing extensive root systems.

Many sections of Arch Canyon have a high channel width/depth ratio, as well as 4-wheel drive route-initiated secondary channels that prevent access of overflow to the floodplain. These artificial secondary channels widen the channel by encouraging lateral or sideways cutting with the subsequent loss of vegetation and soil. This action decreases flow resistance and increases flow velocity. It thus impedes the settlement of soil and development of a functioning floodplain.

FIGURE 10. View of area where vegetation in the floodplain has been eliminated and caused the bank to degrade significantly. Arch Canyon, San Juan County, Utah.

5.3.4 Streambed Rock Armoring

"The composition of streambank materials influences streambank susceptibility to erosion from water flow, trampling and other disturbances. In general, larger rocks provide better protection against disturbance than smaller rocks. Streambanks composed primarily of fine sands, silts and clays are more susceptible to degradation and require adequate vegetative protection to compensate for their smaller particle size" (USDA 2004).

Figures 5, **6**, and **8** show excellent examples of streambed rock armoring in Arch Canyon. Without this important riparian element, the channel in Arch Canyon would be in much worse shape. Too much rock armoring, especially along the banks, has a disadvantage in that it inhibits vegetation establishment, extensive root development, and point bar development. Although there are exceptions, most sections of Arch Canyon contain cobbles over 2.5 inches in diameter in at least 40% of the streambank. The most notable exception is where the 4-wheel drive route crosses the stream. At these crossings, rocks are broken up and displaced, creating an almost entirely smooth sandy streambed and bank (see **Figure 11**) at and downstream of the crossing. These sandy areas enlarge and soon spread downstream as more and more flood events with increased energy scour the pools. Over time the pools deepen by scouring during floods, creating deep open sandy areas that vehicles avoid by driving around them, thus spreading the damage to an ever wider area.

FIGURE 11. Typical 4-wheel drive route crossing where streambank rock armoring has been displaced and a pool is beginning to form. Arch Canyon, San Juan County, Utah

5.3.5 Point Bar Revegetation

"Point bar revegetation is a visual indicator of a stream channel which is maintaining a balanced channel width. Lateral movement of a stream is a natural function and over time will increase the width of the floodplain. During lateral movement, streams remove bank material from the outside bend and deposit material on the point bar formed on the inside bend of the meander. As vegetation is established on the point bar, new roots help to stabilize the bar and the emergent vegetation acts as a sediment filter and a velocity drag on flood waters. Preferred woody species such as cottonwood and willow need moist, bare, mineral soil in order to have successful seed establishment" (USDA 2004).

There are many sections in Arch Canyon where the scouring and flow velocity has increased to the extent that sediment does not have a chance to settle and the formation of point bars is inhibited. This widens the channel and prevents a proper functioning condition from developing, especially the extremely valuable functions of increased vegetation development, sedimentation, and sinuosity. Degraded banks are either scoured to bedrock or left with a jumble of large cobbles and boulders (See **Figure 12** below). This rock armoring protects the channel from excessive erosion, but it usually is not enough to encourage the development of a soil base and vegetation. Point bars with a developed vegetation component do occur in sections of Arch Canyon, but there are many areas where point bar development is inhibited, and the channel is widening and tending away from balance.

FIGURE 12. Area where the formation of point-bars has been inhibited due to increased flow velocity. Arch Canyon, San Juan County, Utah.

5.4 Vegetation Factors

5.4.1 Diverse Age Class Distribution of Trees

"One of the clearest indicators of the ecological stability of riparian tree habitat and subsequent health is the presence of trees of all age classes (seedling, sapling, pole, mature, decadent, and dead) of the species. The presence of all age classes gives promise of the self-perpetuating stability inherent to all potential natural communities" (USDA 2004).

In Arch Canyon, the range of age classes of cottonwood trees includes seedlings, saplings, poles, and old mature trees, with a conspicuous sparsity of young mature trees. It appears that regeneration of the cottonwoods was greatly inhibited by intensive past livestock grazing. Grazing was eliminated from Arch Canyon in the mid-1990's, with resulting regeneration over the younger age classes in the past 15 years. However, there is a gap in the young mature stage that will take years to correct. **Figure 13** shows a typical area where young mature and mature trees are missing. The trend is positive but there are indications that conditions still exist that inhibit tree development in the stream channel. Due to the apparent increased velocity of the flow during floods, there is much lateral cutting and loss of sediment. This increased energy can destroy established trees and retard development of the younger age classes in the floodplain. Overall however, more than 10% of the canopy cover is represented by seedlings and saplings, indicating a healthy condition.

FIGURE 13. Cottonwood regeneration in Arch Canyon, San Juan County, Utah.

5.4.2 Shrub Regeneration

"Another clear indicator of a riparian habitat's health is the presence of shrubs representing all age classes. The presence of all age classes of shrubs ensures the self-perpetuating stability inherent to all potential natural communities" (USDA 2004).

In Arch Canyon, the total canopy cover of the shrub layer, including seedlings and saplings, is in good to excellent condition in sections of the stream channel not adjacent to or crossed by the 4-wheel drive route. Shrubs, through their extensive root and above ground growth, can naturally arm themselves against large flows and greatly influence local sedimentation and flow velocity rates by increasing sedimentation and decreasing velocity. However, in many areas where erosion has destroyed the natural streambanks, there is very little shrub regeneration because the seedlings are not protected from high velocity flows. In these areas, floods consistently scour the floodplain (see **Figure 14** below).

FIGURE 14. Area where high flows and lateral cutting of vegetation and soil scour the stream channel and floodplain, reducing shrub establishment and persistence. Arch Canyon, San Juan County, Utah.

5.4.3 Total Ground Cover of Grasses and Forbs

"Vegetative groundcover is instrumental in the ability of the system to trap sediments and to reduce the velocity of water moving over the floodplain or along the streambanks during flooding or overbank flow events. The vegetative canopy cover mitigates raindrop impact, other erosive forces, and the rate of evaporation" (USDA 2004). "The best protection against excessive erosion is the preservation of adequate vegetation cover to dissipate the erosive forces acting upon the channel banks during periods of high streamflows" (USDI 1998).

Figure 15 shows a common condition in Arch Canyon. The proximity of the 4-wheel drive route to the channel results in lateral cutting and the clearing of grasses and forbs. Throughout the study area, I estimate that 55% to 65% of the channel is covered by plant cover. This is lower than expected, resulting in denuded areas susceptible to erosion. Areas in functional condition should have at least 80-90% of the surface covered by vegetation.

FIGURE 15. Area where there is a loss of vegetation due to lateral cutting and soil erosion between the 4-wheel drive route and the channel. Area just behind the small juniper tree near the center of the photo has been almost completely denuded of vegetation due to the flow jumping onto the 4-wheel drive route in Arch Canyon, San Juan County, Utah.

5.4.4 Percent of the Streambank with a Deep Binding Root Mass

"The vegetation along streams stabilizes the soil with a deep, binding root mass and filters sediments from overland flow. All tree and shrub species, and some sod forming grasses, are considered to have deep, binding root masses. Among riparian wetland herbaceous species, the first rule is that annual plants lack deep, binding root masses. Perennial species offer a wide range of root mass qualities. Some rhizomatous species such as the deep rooted sedges (*Carex* spp.) are excellent streambank stabilizers. In all situations, a greater density of woody species or vigorously rhizomatous herbaceous species indicates greater streambank stability" (USDA 2004).

There are many sections of Arch Canyon that contain vegetation with deep binding root masses, but there are also many sections where the vegetation and/or soil has been so disturbed that these conditions do not exist. The fact that there are sections with well established vegetation indicates that this condition should be more prevalent throughout the system. If the stream channel is protected from excessive erosion and lateral cutting, the establishment of these types of plants in damaged areas would occur in time. I estimate that 55% to 65% of the stream bank in Arch Canyon contains deep binding root masses, however, all indications are that this system could support more than 85% cover of this vegetation type. In **Figure 16** there is a good cover of deep binding root mass vegetation in the lower right hand corner. This should also be the case on the bank just behind the person in the photo, but due to lateral cutting and soil scouring, the vegetation has been swept away.

FIGURE 16. Area where high flows and lateral cutting of vegetation and soil scour the stream channel and floodplain, eliminating many plants with deep binding roots. Arch Canyon, San Juan County, Utah.

5.4.5 Total Area Occupied by Undesirable Herbaceous Plants

"Disturbance-induced herbaceous plants (either native or introduced) may indicate a trend away from the preferred native plant communities, or a reduction in a site's ability to function as a healthy riparian wetland ecosystem. Most of these weedy, herbaceous species provide less soil holding and sediment trapping capability and less desirable forage and wildlife values than native, later successional species" (USDA 2004).

Undesirable herbaceous plants appear to occur only at low levels in Arch Canyon. The most likely vectors are past grazing and motor vehicles. Motor vehicles are the primary vector for the introduction of undesirable herbaceous plants (Elton 1958, Gelbard 1999, Mooney et al 1986, Schmidt 1989, Tyser and Worley 1992). It is estimated that 5-10% of the area is covered by undesirable herbaceous species. Exotic species in Arch Canyon include Tamarisk (*Tamarix ramosissima*), as well as the following undesirable herbaceous plants: Russian thistle (*Salsola iberica*), cheatgrass (*Bromus tectorum*), and sweetclover (*Melilotus* spp.).

Flannelmouth Sucker. Photo by Mike Ottenbacher of Utah Division of Wildlife Resources.

6. SPECIAL STATUS SPECIES

The focus of this Condition Assessment is on the components of Proper Functioning Condition, specifically vegetation, landform/soils, and hydrology. Therefore, no surveys were conducted for specific biota. This section addresses a Special Status Species found incidental to the Condition Assessment. This species is an important factor in the management of the riparian area.

The flannelmouth sucker, along with the more common speckled dace, were both observed in many pools for most of the length of the Canyon from the outlet to the US Forest Service boundary. While the speckled dace occurs in many isolated drainages of western North America, fish the size of the flannelmouth sucker in other small canyons of southeast Utah are usually found only near the canyon's outlet where there is a direct water connection to a larger river and where they find refuge during high spring flows. This condition does not exist at the outlet of Arch Canyon where it drains into Comb Wash. Comb Wash is a canyon with deep alluvium where the water quickly disappears underground, and surface water is practically non-existent for many miles most of the year. The existence of the flannelmouth sucker thus makes Arch Canyon somewhat unique amongst canyons in southeast Utah.

Most of the following information comes from a technical Conservation Assessment by David Rees et al (2005).

6.1 Natural History of the Flannelmouth Sucker

The flannelmouth sucker is native to the Colorado River system of the western United States and northern Mexico. In Utah, the species occurs in the main-stem Colorado River, as well as in many of the Colorado River's large tributaries. Flannelmouth suckers are usually absent from impoundments. Flannelmouth suckers are benthic (bottom dwelling) fish that primarily eat algae, although invertebrates and many types of plant

FIGURE 17. Typical pool in Arch Canyon where the flannelmouth sucker was found. Note the preference for pools with an overhanging bank and thick vegetation. Arch Canyon, San Juan County, Utah.

FIGURE 18. Flannelmouth sucker can be seen just above the shadow in the center of the photograph. Arch Canyon, San Juan County, Utah.

matter are also consumed. The species spawns in streams over gravelly areas during the spring and early summer. Flannelmouth suckers prefer large rivers, where they are often found in deep pools of slow-flowing, low gradient reaches. In Arch Canyon, they prefer deep pools with overhanging banks and thick vegetation. See **Figures 17 and 18** for typical habitat in Arch Canyon. This habitat is not ideal because of the loss of the overhanging streambank and vegetation on one side of the channel.

6.2 Threats to the Flannelmouth Sucker

The native fish community that evolved in the warm-water reaches of the Upper Colorado River basin has been greatly reduced as a result of human activities during the last 100 years. Flannelmouth sucker populations have suffered reductions in abundance and distribution from the same mechanisms that have caused the near extinction of other endemic fish species in this drainage. These mechanisms can be separated into two general categories: 1) habitat degradation through loss, modification, and/or fragmentation, and 2) interactions with predatory or competing non-native species (Tyus and Saunders 2000). Both of these threats imperil the long-term persistence of the flannelmouth sucker. Each may work independently or in conjunction with the other to create an environment where populations may be reduced or eliminated. The relative importance of each threat and the specific cause-effect relationship usually depend on location. In Arch Canyon, non-native fish species do not appear to be present.

Habitat degradation comes primarily from human-induced activities that divert water, destroy overhanging vegetation, widen stream channels, and change the flow regime in both tributary and main stem streams. Effects of habitat degradation may not be limited to localized areas but may cascade through the watershed. Therefore, activities or events occurring upstream on National Forest System lands may have detrimental impacts on populations of flannelmouth suckers existing in rivers many kilometers downstream.

Specifically, **habitat loss** occurs when streams are dewatered, when dams block upstream migration for seasonal use, or when currently occupied areas are inundated by reservoirs. **Habitat modification** occurs when the natural stream flow regime is changed or when stream channels are modified by channelization, scouring, or sedimentation from land use practices such as grazing or driving motor vehicles in the stream channel (Rees et al. 2005). Land use practices that can impact stream channels include construction of roads through highly erodible soils, improper timber harvest practices, and overgrazing in riparian areas. All of these lead to increased sediment load in the system and the subsequent change in stream channel geometry (widening or incision). These modifications result in changes in width:depth ratios, pool:riffle ratios, pool depth, and other aspects of natural stream functioning that affect the quality of habitat occupied by flannelmouth suckers. Modification of habitat also occurs as a result of changes in temperature and flow regime, as well as alterations to water chemistry related to pollution. Severely reduced streamflows may lead to increased water temperatures and reduced dissolved oxygen levels, especially in smaller tributaries. Although specific tolerances to water quality parameters (i.e., temperature, dissolved oxygen, toxicants) are undefined for this species, it is likely that as water quality is reduced, flannelmouth sucker fitness also declines. For example, during periods of elevated summer water temperatures and decreased baseflows, flannelmouth suckers were observed in stressed conditions with evidence of adult mortality at higher levels than during times of normal summer temperatures and baseflows (Rees et al. 2005). **Habitat fragmentation** can result from dewatering of sections of river with populations occurring both upstream and downstream of the dewatered section, or reservoir or diversion construction that separates the exchange of individuals from separate populations throughout a river reach. The populations that become fragmented in some areas remain viable and reproduce and successfully recruit and maintain population levels at the same density or number as they were before the fragmentation occurred. This usually occurs in larger mainstem river sections. In smaller rivers and tributaries to a mainstem drainage, such as Arch Canyon, habitat fragmentation can eventually lead to habitat loss and extirpation of some of the populations.

6.3 Status of the Flannelmouth Sucker

Flannelmouth sucker populations have declined in abundance and distribution throughout their historic range (Bezzerides and Bestgen 2002, Weitzel 2002). The flannelmouth sucker is not listed by Federal statute as Threatened or Endangered, but it has been given special status with other agencies. The flannelmouth sucker currently has a Natural Heritage Program rank of G3G4 (globally vulnerable but apparently secure) and a state rank of S3 (vulnerable) in Utah, Colorado and Wyoming. In all of these states, the Bureau of Land Management (BLM) considers the flannelmouth sucker a “Sensitive Species”. The Colorado Division of Wildlife (CDOW) considers the flannelmouth sucker a “Species of Concern”, and Wyoming Fish and Game Department (WGFD) has assigned this species a state rank of NSS1, suggesting that its presence is extremely isolated and habitats are declining or vulnerable. In Arizona, the flannelmouth sucker has a state rank of S2 (rare). Utah considers the flannelmouth sucker a “Species of Concern” due to declining populations. New Mexico gives this species no special status.

7. DISCUSSION

Over the years, scientists and federal agencies have documented and established the importance of riparian areas to the surrounding landscape, especially in desert ecosystems. Once the relationship between riparian habitats and local and regional species diversity and abundance was formally recognized by various government agencies and academic symposia in the 1970's and 1980's, most land management agencies dedicated significant energy and resources to protecting and restoring all types of riparian habitat where they remained intact. This Condition Assessment of Arch Canyon is in line with such efforts to preserve rare riparian areas in the desert Southwest. The following discussion focuses on probable causes, interrelated effects, and long-term consequences of impacts that were identified in Arch Canyon.

Most of the length of Arch Canyon investigated was found to be in a **"Functioning At Risk" condition, with a downward trend**. Many sections were at risk of becoming non-functional and were on a downward trend primarily because of the 4-wheel drive route that traverses the floodplain and continually crosses the stream bed as many as 60 times. Because livestock grazing is no longer present in the Canyon, its impacts - such as vegetation loss and stream bank destruction- have become less of a factor as the riparian area recovers. The presence of the existing 4-wheel drive route in the Canyon, however, remains an important impediment to its reaching a Proper Functioning Condition, and the primary reason that there is a downward trend.

7.1 Roads and 4-Wheel Drive Routes

The ecological effects of roads and 4-wheel drive routes have been studied extensively (Andrews 1990, Brown 1994, Dittmer and Johnson 1975, Forman and Hersperger 1996, Forman and Alexander 1998, Gelbard 1999, Harris and Gallagher 1989, Harris and Scheck 1991, Iverson et al. 1981, Langton 1989, Miller et al. 1996, Montgomery 1994, Oxley et al. 1974, Schmidt 1989). Negative ecological effects include:

1) increased soil erosion and compaction;
2) increased water velocity;
3) plant community destruction;
4) loss of terrestial and aquatic insect communities;
5) soil, water, and air pollution;
6) sound pollution;
7) exotic plant invasion;
8) loss of fish and wildlife habitat;
9) reduction of fish and wildlife populations.

Many of these effects are top priority resource issues identified by the Bureau of Land Management and other federal and state land management agencies.

Multiple negative effects of roads in riparian areas are related by a cascading sequence of cause and effect. An overview of this cascade begins with the impact of vehicle tires on a stream bank. Vegetation is crushed and eliminated, which allows more soil to be washed downstream and the velocity of high water flows to increase.

This scouring effect can uproot and further destroy vegetation downstream, as well as diminish the naturally meandering and morphologically diverse nature of the channel. The adjacent floodplain is affected in two primary ways by 4-wheel drive routes. Loss of vegetation along the stream bank prevents high water flows from slowing down and backing up onto the floodplain to allow for groundwater and nutrient recharge. Alternatively, high water flows can jump onto the incised, compacted soil path of a 4-wheel drive route. The 4-wheel drive route then becomes a “storm water discharge conduit”, causing scouring, lateral cutting between the 4-wheel drive route and the original stream channel, straightening of the channel where the 4-wheel drive route cuts off a natural meander, increased water velocity, and reducing the amount of potential floodplain infiltration and recharge. With diminished sediment in the stream channel and the resulting lower water table and decreased ground water recharge in the floodplain, in-stream flow is lowered during low flow periods – negatively affecting the number and extent of aquatic habitats. Ultimately, the final loser in this cascade of events is native biodiversity.

The specific ways in which road impacts ecologically affect each component of Proper Functioning Condition and other resources in Arch Canyon are discussed in more detail in the following sections.

7.2 Vegetation

Vegetation in a proper functioning riparian area consists of mesic and native herb, shrub, and tree species spanning all age classes and being particularly well-established along the banks of the stream channel. Except for a dearth of young mature cottonwood trees attributable to past grazing, the impacts I observed to the vegetation in Arch Canyon focused primarily in areas at or downstream of the 4-wheel drive route crossings. At these locations, it was common to see denuded and washed out stream banks, sparsity of regenerating shrubs (in contrast to the higher levels of shrub regeneration away from the 4-wheel drive route), less than ideal total ground cover of native grasses and forbs, lower than expected deep binding root masses along the streambank, and the occasional presence of undesirable exotic plants. **Figure 19** shows one area of many in Arch Canyon where these negative conditions exist. This kind of damage is extremely difficult to stop once the initial damage takes place. With every new high flow event, the damage widens and continues downstream because bank and vegetation damage, especially to the shrubs, grasses, forbs, and exposed soils, creates ideal openings for undercutting and uprooting established vegetation downstream of the scar. **Figure 20** is a prime example of a thickly vegetated channel in Arch Canyon that is in Proper Functioning Condition. Vegetation such as this is extremely effective in slowing a flood surge and spreading out the flood waters onto the floodplain.

The lack of vegetation rooted in the soil next to a stream channel negatively affects several ecological functions of a healthy riparian area, including: the filtering of sediment, capturing of bedload, slowing down high water flows to decrease scouring (erosion), as well as the promotion of over bank flooding to recharge both water and nutrients in the floodplain. In addition, loss of vegetation inhibits the ability of the overall riparian corridor to support greater biodiversity. These ecological functions will continue to be impeded by the existence of the 4-wheel drive route.

FIGURE 19. View of channel just downstream of a 4-wheel drive route crossing. Note lack of vegetation, the wide channel, and loss of stream bank. Arch Canyon, San Juan County, Utah.

FIGURE 20. View of channel in Proper Functioning Condition. Arch Canyon, San Juan County, Utah.

7.3 Landform / Soils

The soils in a properly functioning riparian area are sufficiently deep to hold water and act as a rooting medium, are relatively unexposed, are present on the bottom of the stream channel, and build up on the inside of stream meanders in the form of point bars. The exposed soil visible in Arch Canyon at 4-wheel drive route crossings and on the 4-wheel drive route bed allow an intensifying cycle of erosion to occur downstream of the initial scar, with all the attendant negative effects of erosion on water quantity, establishment of native vegetation, and channel morphology. If a flood is large enough, the flow will be diverted onto the 4-wheel drive route, which will make the vegetation and soil between the 4-wheel drive route and the stream bed highly susceptible to lateral cutting impacts, furthering erosion. **Figures 11-14** illustrate typical areas where the 4-wheel drive route has a direct effect on the loss of vegetation and exposure of bare ground. The conditions in these photos point to future erosion problems.

There are many sections in Arch Canyon where flow velocity has increased, due to the cascade of 4-wheel drive route effects, to the extent that sediment does not have a chance to settle and the formation of point bars is inhibited. This often results in banks that are either scoured to bedrock or left with a jumble of large cobbles and boulders. This rock armoring performs valuable functions that protect the channel from excessive erosion, but it does not encourage the development of point bars and vegetation.

7.4 Hydrology

Hydrologic conditions in a properly functioning riparian area consist of a meandering channel with diverse ponding and channel characteristics, and banks that are vegetated and stable. Hydrological impacts were obvious in areas where the 4-wheel drive route ran parallel to and where it crossed the stream. Although stream channel meanders and point bar formation were visible in the Canyon, there were also areas where the 4-wheel drive route has caused a straightening of the channel and increased erosion effects. Channel straightening occurred from lateral cutting when high flows jumped up onto the 4-wheel drive route and scoured banks from increased flow velocity. The loss of the naturally meandering channel has serious negative effects on the transport of sediment, development and maintenance of habitat for fish, aquatic insects and aquatic plants, and the transfer of oxygen into the water. These are all major components of healthy fish habitat, the loss of which is a great danger to the continued survival of the flannelmouth sucker in Arch Canyon. Any loss of the channel's sinuosity also lessens the water retention function of the floodplain and thus seriously impacts the ability of the water table to stabilize and sustain a healthy riparian system.

One of the critical ecological functions of a healthy riparian area is to stabilize stream banks. Motor vehicles going up and down a stream bank often swerve and cause additional damage with multiple passes, widening the bank scar. **Figure 21** on the following page shows areas where multiple routes have formed, destabilizing the streambank, degrading fish habitat, and making the area susceptible to future flood damage. There are numerous stream crossings in Arch Canyon where multiple routes have been used to climb up the streambank.

FIGURE 21. Area where multiple 4-wheel drive routes have formed; this destabilizes the streambank and makes it highly susceptible to future damage. Arch Canyon, San Juan County, Utah.

Oftentimes, stream channel erosion is initiated at a crossing due to the displacement of coarse streambed materials in the channel by the passing of vehicles. This will start the formation of a deep pool at the crossing without vegetation or rocks to armor it against high velocity flows. Once a deep sandy pool is formed drivers will avoid it by driving around it, thus creating a larger bank scar, or creating another 4-wheel drive route up the bank altogether. The total failure of numerous sections of stream bank in Arch Canyon is testament to the presence of hydrological dysfunction in the Canyon.

7.5 Exotic Species

When the stream channel loses its wet meadow vegetation and widens, and the channel becomes straighter and incised because of a persistent disturbance, such as a 4-wheel drive route, the nature and ecological functioning of the riparian landscape changes. Acting as a storm water conduit, the channel experiences less shifting of the kind that historically created mosaics of riparian vegetation, especially cottonwood and willow habitat (Crawford et al. 1993). Decreased flooding over the streambank inhibits the development of floodplain habitat for establishment of cottonwood seedlings, which are dependent on recently inundated sediments to become established. Less over bank flooding also results in a decline in the diversity of native species because when the frequency or intensity of a natural floodplain disturbance is decreased, competitively superior non-native exotic plants may invade the floodplain (Hobbs and Huenneke 1992).

Exotic species invasion is a top priority resource management issue for the federal land management agencies.

Changes in plant species composition, relative abundance of species, and plant density cause the overall plant community structure to change. Roads and motor vehicles are the primary vectors for the introduction of invasive weeds (Gelbard 1999), and the establishment of weeds is only successful if there has been some disturbance to the system. Having the 4-wheel drive route in Arch Canyon not only introduces seeds of exotic and noxious weeds to the canyon, but it also creates the conditions for successful germination and survival by the destructive actions described above. At this point, the weeds in Arch Canyon can be easily controlled, but if degradation continues to occur, control will be much more difficult.

Exotic species interfere with natural processes and the perpetuation of natural features, native species or natural habitats, and they can disrupt the genetic integrity of native species. They can change the accurate presentation of a cultural landscape and damage cultural resources. They can pose a public health threat as advised by the U.S. Public Health Service, and they can create a hazard to public safety.

7.6 Water Quality

Although no water quality parameters were measured, information about probable trends and potential impacts can be presented by extension from nearby analogous studies. Schelz (2001) collected water samples in Salt Creek, a similar canyon just north of Arch Canyon. In a comparison of 3 water quality sites in Salt Creek, the site with a 4-wheel drive route had relatively higher levels of Turbidity, Temperature, and Total Suspended Solids (TSS) compared with those lacking a 4-wheel drive route. These elevated levels in the 4-wheel drive routeed site also exceeded state standards. The BLM as been monitoring water quality in various streams in the SE Utah area. In streams where a 4-wheel drive route is present, the agency also found elevated levels of Turbidity, Temperature, and Total Suspended Solids (USDI 2005).

An additional parameter measured by the BLM in SE Utah streams was the presence of Total Petroleum Hydrocarbons (TPH). They detected levels at all sites where vehicles drove through water (USDI 2005). Not all sites were sampled for TPH, but the results clearly suggest that TPH are likely to be present wherever vehicles traverse water. Considering this information, the BLM should be concerned about the cumulative impact of TPH. TPH in water cause chronic and deleterious effects on aquatic organisms, especially algae, plants, and aquatic macroinvertebrates. These organisms are the primary constituents in the natural food chain of desert riparian areas, and they are particularly important to fish. Any leak of TPH into natural waters will adversely affect the food base of fish and other animals of the riparian area, including amphibians, reptiles, and birds. Fish and amphibians can be impacted directly through uptake by the gills, ingestion of oil or oiled prey, effects on eggs and larval survival, loss of algae, or changes in the ecosystem. Oil has the potential to impact spawning success, as eggs and larvae of many fish species are highly sensitive to oil toxins (USDI 2004).

Preventing leakage of TPH from vehicles is nearly impossible. There are few 4-wheel drive vehicles that do not leak some amount of TPH. Also, once TPH leaks into the water, it is virtually impossible to clean it up without specialized equipment. Unlike other water quality parameters affected by vehicles, TPH does not disappear within a few hours, but is persistent within the system and accumulates with each additional dose from other vehicles.

7.7 Fish

The presence of a disjunct population of flannelmouth suckers in Arch Canyon distinguishes this canyon as unique in the area, and as such this canyon should be afforded special status and increased protection against human-induced impacts. It is likely that the effects of Total Petroleum Hydrocarbons (TPH) on water quality has direct and indirect negative effects on the flannelmouth suckers in Arch Canyon. See the water quality section (Section 7.6) above for a discussion of these toxic effects on the fish directly, as well as indirectly on its foodbase and habitat.

The most serious impact to the flannelmouth sucker is probably the loss of suitable habitat due to the destruction of the streambanks and vegetation by motor vehicles and the accelerated erosion processes caused by the presence of a 4-wheel drive route that crosses the stream at least 60 times. The ecological condition and functioning of the hydrology of Arch Canyon has a major impact on the maintanence and development of fish habitat. Section 7.4 describes the deteriorating condition of the hydrology of Arch Canyon and discusses its impacts on dfish habitat.

As discussed earlier, flannelmouth suckers are endemic native fish with a declining population trend in Utah. It is a Utah “Species of Concern” and a BLM “Sensitive Species”. The conservation status of this specis of fish, and the documented detrimental effects of vehicles and roads on fish habitat and populations in small streams should be a significant management concern.

A Utah Division of Wildlife Resources survey (Walker 2003) also found Bluehead suckers (*Catostomus discobolus*) in Arch Canyon. These are also a sensitive species and should be treated the same as flannelmouth suckers in regards to protection and research.

7.8 Aquatic Macroinvertebrates

Aquatic macroinvertebrates are integral components in the food chain of riparian areas throughout the world. They supply food to nearly every faunal group in these extremely important wildlife habitats. They are an important food source for anadromous and resident fish, as well as amphibians, birds, bats, and other mammals. They also are important herbivores, detritivores, as well as predators of other invertebrates and, therefore, play a critical role in the cycling of energy and nutrients through stream ecosystems (Vaughan 2002). As mentioned previously, riparian areas provide habitat and sustenance to an inordinate proportion of wildlife in desert ecosystems.

Aquatic macroinvertebrates are extremely sensitive to water quality and habitat degradation. Schelz (2001) studied macroinvertebrates in pools in Salt Creek, a nearby similar riparian system. I found on that study decreases in species richness in sections of Salt Creek where vehicles drove through the channel. Haskell (1998) found that macroinvertebrate terrestrial fauna was significantly less abundant and less diverse close to roads in his study. Leaf-litter depth was also reduced close to roads. Haskell suggested that the effects of roads on faunal abundance and leaf-litter depth may persist up to 100 m from the road, whereas the effect on faunal richness persists to 15 m. Streams that had steep declines in macroinvertebrate abundance and richness tended to be wide and to have open canopies. These conditions are present in Arch Canyon, primarily due to the presence of the 4-wheel drive route.

In Arch Canyon, a variety of aquatic macroinvertebrate species was observed throughout the Canyon. Although aquatic macroinvertebrates were not sampled for this Assessment, it is likely that the habitat degradation documented in this report has had detrimental impacts on species richness of the aquatic macroinvertebrates in Arch Canyon. It is also likely that the immediate and cumulative effects of the leaking of THP from vehicles also has a detrimental effect on aquatic macroinvertebrate populations (see water quality section above).

7.9 Present and Future Condition

7.9.1 Present Condition

Many sections of the riparian areas of Arch Canyon that contain the 4-wheel drive route are at risk of becoming non-functional in their present state of increased erosion and scouring. These at-risk sections lack productive habitat for fish, amphibians, aquatic organisms, and wildlife. They no longer dampen flood peaks or assist in recharging subsurface aquifers. There is evidence of a lowered water table in areas where once-productive wet meadows are now occupied by sagebrush, cheatgrass and other typical upland plants. Considering these conditions, the riparian areas of Arch Canyon appear to be in a less ecologically productive state than their natural potential. Of course, flood damage and erosion occur naturally in areas like Arch Canyon. Erosion is an integral part of the landscape of this region. However, there is a significant increase in the actual and potential extent and destructive energy of floods because of the presence of the road in and around the stream channel.

7.9.2 Future Condition with Road

The existing road in Arch Canyon can directly impact much of the ecologically important mesic wet-meadow habitat within this predominantly xeric land mosaic. Consequently, if the road remains, the downward trend will continue and the system will eventually degrade further. Sections of the channel that now handle spring runoff and summer floods easily will become unstable and erode. Where channel erosion proceeds unabated, extensive gullies are likely to form as monuments to a lack of awareness of how riparian areas function and maintain themselves.

7.9.3 Future Condition without Road

What would a recovered and healthy desert riparian area such as Arch Canyon look like? The damage to proper functioning riparian areas is sometimes not recognized because many people in the Western United States have never seen a “healthy” riparian area. Degradation was widespread before any of us were born. The whole picture may not be obvious, even to old-timers, because many changes occurred before the turn of the 20th century (Elmore and Beschta 1987). Attempts to identify what pre-settlement stream systems and riparian areas were like are not always successful. Old photos and journals of early fur trappers and ranchers, however, do provide glimpses of how riparian areas may have looked originally. Gregory (1938) interviewed Piute Indians who related that valleys such as Beef Basin, just north of Arch Canyon, were once level and grass covered, with very few arroyos prior to the coming of Europeans and their livestock. The picture is indeed different today, and points to the severity of the ecological changes throughout the West that have occurred. The potential future condition of Arch Canyon, after elimination of human-induced impacts, could take on a robust appearance not seen in over a century.

8. RECOMMENDATIONS

Although the Assessment of Arch Canyon places it as “Functional At Risk, with a downward trend”, there is still time and opportunity to reverse this trend and return the riparian zone to a more ecologically balanced system. Riparian areas in a “Functional At Risk, with a downward trend” condition are prime candidates for planning recovery strategies. They are often the highest management priority because while a decline in resource values is apparent, these areas often retain much of the resiliency associated with Proper Functioning Condition and have a high potential for recovery. Arch Canyon showed strong resiliency through its rapid recovery from grazing impacts. Thus, there is opportunity to reverse a downward trend successfully through rapid decisive changes in management.

The 4-wheel drive route that crosses the stream channel at least 60 times is the primary cause of remaining impacts to the system. The 4-wheel drive route in Arch Canyon has only recently been constructed - in the early 1990’s. It is probable that simply closing the 4-wheel drive route would result in a quick ecological recovery and a return to natural stream and riparian dynamics. Closing the 4-wheel drive route and restoring and reclaiming the tracks would make Arch Canyon a premiere example of a functioning riparian/wetland canyon system in southeastern Utah, and provide a unique environment for campers, hikers, hunters, naturalists, researchers, outdoor enthusiasts, and conservationists to enjoy. It would also become a more effectively connected and functioning wildlife habitat corridor, used by a wide assortment of species for its rare and valuable source of food and shelter.

The following are recommendations for future management of Arch Canyon:

1) Close the 4-wheel drive route and keep motor vehicles and bicycles out of Arch Canyon. Maintain a hiking trail that conforms to engineering standards and practices designed to protect riparian and upland systems. This recommendation specifically addresses BLM riparian management guidelines #1-6:

    Guideline 1: Management practices maintain or promote adequate amounts of ground cover to support infiltration, maintain soil moisture, and stabilize soils.

    Guideline 2: Management practices maintain or promote soil conditions that support permeability rates that are appropriate to climate and soils.

    Guideline 3: Management practices maintain or promote sufficient residual vegetation to maintain, improve, or restore riparian-wetland functions of energy dissipation, sediment capture, groundwater recharge and stream bank stability.

    Guideline 4: Management practices maintain or promote stream channel morphology (e.g., gradient, width/depth ratio, channel roughness and sinuosity) and functions that are appropriate to climate and landform.

    Guideline 5: Management practices maintain or promote the appropriate kinds and amounts of soil organisms, plants and animals to support the hydrologic cycle, nutrient cycle, and energy flow.

    Guideline 6: Management practices maintain or promote the physical and biological conditions necessary to sustain native populations and communities.

2) Restore sections of Arch Canyon where vehicles have created areas that are susceptible to erosion. These areas are primarily where the 4-wheel drive route crosses the stream channel. The 4-wheel drive route crosses the stream at approximately 60 locations.

   This recommendation addresses the BLM fallback standards listed in the regulation section of this report. Specifically, BLM's Management Standards require that the BLM shall manage riparian-wetland areas so that they are in properly functioning condition, and stream channel morphology (including but not limited to gradient, width/depth ratio, channel roughness and sinuosity) and functions are appropriate for the climate and land form.

3) Develop a plan to actively control the exotic plant species in Arch Canyon and the surrounding area. Specifically, control tamarisk. This recommendation addresses BLM riparian management guideline #9: Native species are emphasized in the support of ecological function.

4) Fund research studies of the fish of Arch Canyon and in particular the flannelmouth sucker and the bluehead sucker. Research should focus on their movement patterns, habitat needs, and how long the flannelmouth suckers have been isolated from other populations. Comparative genetic studies are recommended.

5) Institute additional measures to protect the fish populations, and in particular the flannelmouth sucker, in Arch Canyon and to enhance their habitat. The general lack of information for the flannelmouth sucker suggests that management should begin with a detailed survey of each drainage on BLM land that could potentially hold populations of flannelmouth sucker. This effort should be coordinated with relevant agencies (i.e., state Game and Fish Departments, US Forest Service, US Fish and Wildlife Service) to obtain information concerning stream reaches that are off BLM system land, yet may be influenced by BLM management activities. The BLM could use this information on habitats and populations to coordinate management activities on BLM lands throughout the region. Given the known threats to this species, conservation measures should concentrate on maintaining aquatic habitat diversity and natural temperature and flow regimes in stream reaches with existing and adjacent flannelmouth sucker populations (Rees et al. 2005).

   This recommendation specifically addresses BLM guideline #8: Conservation of Federal Threatened or Endangered, Proposed, Category 1 and 2 candidate, and other special status species is promoted by restoration and maintenance of their habitats.

6) In concert with interested private and public organizations, the BLM should take the lead in the coordinated development of an Arch Canyon Management Plan. This plan should be a detailed account of proper ecosystem management for the protection of this unique desert riparian area.

   The Riparian-Wetland Initiative plan states that the BLM will implement an inventory of riparian-wetland conditions, prepare plans, implement projects to protect and enhance the resources, and monitor accomplishments. It is recommended that the BLM use this plan as a guide to the management of riparian areas in southeast Utah, and especially to the unique riparian area of Arch Canyon.

7) The effects of the 4-wheel drive route on aquatic macroinvertebrates, frogs, toads, and salamanders is unknown. Their habitat in Arch Canyon is probably being negatively impacted. It is recommended that general surveys be conducted for these species and a research study on the effects of the 4-wheel drive route on their population health be initiated.

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APPENDIX A

RIPARIAN ASSESSMENT

STANDARD SCORE SHEET

Date: 04 | 08 | 2006

County: San Juan **Geographic Coordinates or UTM's:** ____________

Land Ownership Status: (X Federal) (__State) (__Private)check the appropriate status

Name of Land Owner: USDI Bureau of Land Management

Identify the Tract or Field Where the Scoring Occurred: Middle Reach

Name of the Stream or River: Arch Canyon

Names of Field Scoring Members: Charles Schelz

Attach Map of Site and Identify the Different Reaches: See Attached Report

Available Points	Points Scored	HYDROLOGIC
10	7	Hydrologic Alteration
10	7	Channel Condition
10	5	Bank Stability
5	2	Riparian Zone Width
5	N/A	Active or Stable Beaver Dams

Available Points	Points Scored	SOILS - EROSION AND DEPOSITION FACTORS
10	3	Soil Characteristics / Rooting Medium
10	5	Exposed or Bare Ground
10	5	Topographic Variance or Surface Expression on Floodplain
5	3	Streambank Rock Armoring
5	2	Point Bar Revegetation

Available Points	Points Scored	VEGETATION FACTORS
10	10	Diverse Age Class Distribution of Trees
10	7	Shrub Regeneration
10	3	Total Ground Cover of Grasses and Forbs
10	4	Percent of the Streambank with a Deep, Binding Root Mass
10	7	Total Area Occupied by Undesirable Herbaceous Species

Total Available Points	Total Points Scored	Percentage Scored
125	70	56%

REMARKS:

A total score of 56% identifies the overall condition of the middle reach of Arch Canyon as **Functional – At Risk**. This score is on the lower end of the overall range for this rating, which is 40-70%. Since the condition is "Functional – at Risk" a trend must be determined, if possible. It is my opinion that this system is in a "**downward trend**" because of the existence and placement of the 4-wheel drive route in the riparian area. to be the primary driver of degradation of the riparian area.

SUMMARY DETERMINATION

FUNCTIONAL RATING:

A riparian assessment examines various elements to determine the condition of the riparian area. Various characteristics have been rated to establish whether the site has a minimal capacity to function in a natural state. The ratings established through the scoring process should provide direction for the land owner or land manager in the identification of individual elements of concern. By using a percentage of the total points scored, we have tried to eliminate any negative bias, which may arise from an element which may not be appropriate for a site. An example would be "Active or Stable Beaver Dams", which may not be an appropriate category for some sites. In this case, the 5 points would be deducted from the total available points, and would therefore not affect the final percentage scored.

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To determine the percentage scored, divide the total points scored by the total available points and multiply by 100. This value, expressed in percent will provide the rating to be used in the assessment tool.

For a riparian area to be considered for possible effective treatment, a percentage of 40% and above must be reached. Some riparian areas are damaged to the point where effective treatment is not practical. Funds would be better spent on areas where positive benefits can be more readily achieved. When riparian areas are found in entrenched systems, especially in the southwest, the rating party should consider the effect of the steep gully walls as part of the riparian area. These unstable walls may contribute large amounts of sediment and areas lacking vegetation.

Place a check mark in the appropriate box for the assessed riparian area. Your assessment is based on the assessment percentage. 70% and above is considered as a functioning riparian area, 40-70% is functioning at some capacity, while <40% is non-functional.

Proper Functioning Riparian Area	**(70-100%)**	___
Functional --At Risk	**(40-70%)**	_X_
Nonfunctional	**(0-40%**	___

Are Factors Contributing to Unacceptable Conditions Outside of the Land Owners Control?

Yes ___ No _X_

If Yes, What are Those Factors?

__Flow regulations __Mining Activities __Upstream channel conditions
__Channelization __ Road Encroachment __Oil field water discharge
__Augmented flows __Other (specify) ______________________________