Appendix C: Riparian Specialist Reports

CAMPAIGN / BAR V BAR ALLOTMENT
STREAM CHANNELS AND RIPARIAN AREAS
EXISTING AND DESIRED CONDITIONS

Janet Grove and Lynn Mason
August 12, 2008

INTRODUCTION

Physical Setting

The Campaign and Bar V Bar Allotments are situated on the north slope of the Superstition Mountains on the Tonto Basin Ranger District. These allotments are managed together as one allotment which extends from Pinto Peak (elevation 5991 feet) to Roosevelt Reservoir (2200 feet). The Campaign Allotment lies within two 5th hydrologic unit code watersheds. The Campaign Allotment and the south half of the Bar V Bar Allotment lie within the Pinto Creek 5th code watershed. None of Pinto Creek is included within the allotment, although the eastern allotment boundary follows Pinto Creek for about one mile. Tributaries to Pinto Creek within the allotment include Campaign Creek and its tributaries Tule Canyon and Two Bar Canyon, Wildcat Creek and Spring Creek.

The north (lower elevation) half of the Bar V Bar Allotment lies within the Upper Salt River-Theodore Roosevelt Lake 5th code watershed. Tributaries that drain into the lake include Schoolhouse Wash and several unnamed ephemeral washes.

Historic Conditions

Based on the long history of grazing in the Tonto Basin area, and associated changes in both upland and riparian vegetation, it seems likely that prior to the 1870's, there were more miles of perennial stream reaches and acres of riparian vegetation than currently exist (Croxen 1926, Haskett 1935, Hendrickson and Minkley 1984, Heffernan 2008). Less than 6.0 miles of this drainage network currently support cottonwood or mixed broadleaf deciduous forest as mapped by the National Wetland Inventory (NWI) (USDI maps based on 1980 aerial photography). Based on our analysis, most of the 6.0 miles of these streams are capable of supporting riparian areas. There are also remnants of "historic riparian areas". These are defined by the Riparian Area Survey and Evaluation System (RACES) as aquatic ecosystems that no longer have the capability of supporting the development of riparian areas dominated by riparian obligate plants. Scattered old sycamore trees in Campaign Creek below the box and above the Cross P Ranch, in lower Tule and Two Bar Canyons and Spring Creek

represent formerly functional riparian areas and stream channels. These non-functional areas occur most commonly in two situations: in downcut channels where sycamores and other riparian trees occupy high terraces which are disconnected from the channel and in aggraded channels that have accumulated so much sediment that they have buried the bases of riparian trees and the surface waters needed for regeneration of new trees. These and downstream reaches completely lacking any remnants of obligate riparian vegetation are typically unstable. Every high flow event results in dramatic channel shifts, with cutbanks eroding and high sediment loads being moved and re-deposited.

EXISTING CONDITIONS

There are approximately 36 miles of named streams on the USGS 1:24,000 topographic quadrangles within the Campaign/Bar V Bar Allotment. These streams include Campaign Creek, Tule Canyon, Two Bar Canyon, Wildcat Creek, Spring Creek and Schoolhouse Wash. There appear to be at least as many miles of unnamed streams delineated as blue lines on the USGS topographic quadrangles. These unnamed streams are the ephemeral and intermittent tributaries to the named streams and Roosevelt Lake. These channels are primarily headwaters, channels dominated by upland vegetation, or ephemeral washes. They provide important functions relating to water quantity, water quality, the flood regime, hydrological connectivity, riparian vegetation and wildlife habitat (Levick et al. 2007) within the watershed. However, without historical descriptions or reference stream channels to provide a comparative framework, there is little opportunity for assessing the condition of this network, stream channels or reaches within channels

Key Reaches

For the purposes of this environmental analysis, existing and desired conditions are limited to stream channels and riparian areas that have the potential to improve within a relatively short time period (10 years). This includes about 5.5 miles of stream channel identified by the National Wetland Inventory as perennial or having 30% cover of cottonwood or mixed broadleaf forest (Table A1). Key reaches and designated monitoring areas have been or will be identified for each of these streams and pastures listed in Table 1. Key reaches, similar to upland key areas (Interagency Technical Team 1996), are stream channels/ springs/ riparian areas that are representative, responsive to changes in management, accessible to livestock, and contain key species. Key reaches are synonymous with designated monitoring areas (DMA's) defined by Burton, Cowley and Smith (2007) as the location where monitoring occurs.

Table 1. List of pastures and streams with key reaches.

Pasture	Streams
Granite	Campaign Creek

Reevis	Campaign Creek
Holding	Spring Creek
Tule	Tule Canyon
Two Bar	Two Bar Canyon

Campaign Creek

Campaign Creek originates below Pinto Peak and flows northeast approximately 19 miles to its confluence with Pinto Creek. Campaign Creek flows 17 miles through the Campaign/Bar V Bar Allotment in eight pastures, and two private inholdings. Recovery of the Campaign Creek riparian area was one of seven objectives identified in the 1992 Allotment Management Plan. Most of the riparian vegetation along Campaign Creek occurs in the Reevis and Granite Pastures, and the private property between these two pastures.

Reevis Pasture. The Reevis Pasture includes about 4.0 miles of Campaign Creek. The National Wetland Inventory delineates about 2.5 miles of intermittent stream channel with riparian vegetation and 0.5 mile of perennial stream (Table A1). All of the field data collected in the Reevis Pasture (Appendix A) is from this 0.5 mile reach of Campaign Creek, located below the junction of Trails # 117 and 256 and the private property.

This reach is delineated by the National Wetlands Inventory maps as a spring-fed, perennial stream. The channel lies in a valley bottom that is generally less than 100 feet wide. It is a "B" type stream having a 2-4% gradient with a narrow floodplain. This 0.5 mile reach includes sections dominated by sand and gravel sediment sizes and sections of the channel with larger boulder and bedrock substrates. Assessments of channel condition between 1997 and 2008 (Table A3) at specific locations vary from stable near the trail junction to impaired with an upward trend (Table A3) just above the private property.

Riparian vegetation data collected along Campaign Creek in the Reevis Pasture in 1992 is described in a letter to the Tonto Basin District Ranger (Martin 1992). There was 53% collective canopy cover of sycamore, Fremont cottonwood, walnut, Goodding's and red willow, and a density of 49 trees/acre. Sycamore had the highest density, canopy cover, and basal area. Riparian shrubs included from 1-5% canopy cover of net-leaf hackberry, seep willow, California buckthorn and Arizona grape. Herbaceous cover was 25% consisting mostly of Bermuda grass and horsetail.

In 1992, impacts to riparian resources from livestock grazing were described as moderately adverse. Browsing intensity of riparian tree seedlings measured in 2000 and 2002 is reported as moderate to high (49 to 92%). Herbaceous vegetation was not monitored because there are no protocols available for monitoring use of horsetail. Notes from 2000 state that horsetail was grazed on average to a one-inch stubble height. The trail was heavily impacted. During the summer of 2002, cattle were

removed from the allotment and did not use the Reevis Pasture until December 2007. Post-season monitoring after this use period observed little to no use of riparian vegetation along Campaign Creek between the trail junction and the private property. Nor were there any impacts along the trail. According to Brandon Burgett, ranch manager, cattle were moved into the pasture on the trail in small bunches of about 20 animals.

According to the water points layer in the Forest's Geographic Information System (GIS), this pasture contains 12 springs, no stock tanks and no wells (Table A4). All of the water in this pasture is located in springs and streams, including Campaign Creek. There is no information on the condition or management of any of the springs or Campaign Creek above the trail junction. According to the ranch manager, Bull Canyon Spring is developed with a trough but the current status of the remaining springs is unknown. They may have been developed at one time but he reports that the developments might have been removed for wilderness values several years ago.

Reevis Mountain School private property. In 1981, Reevis Mountain School was established on the former Upper Horrell ranch. Cattle were excluded. Lew Myers (retired Tonto National Forest riparian ecologist) inventoried this one-quarter mile reach in 1989 and compared it with the Reevis and Granite Pasture reaches above and below the private land. (Martin 1992). He described all these stream reaches as similar. He classified the private property reach as a sand and gravel dominated "B" channel, with just over 2% gradient in a moderately narrow (100 to 300 feet) valley bottom. A permanent stream channel cross section established in 2004 on the private property was classified as a "C3" channel. A key difference between "B" and "C" type channels is the width of the floodplain. The difference in channel type between 1992 and 2004 may simply reflect site differences since the location of the 1992 "B" type cross section is unknown. Or it could indicate that the floodplain is widening as the stream channel is narrowing and deepening.

Myers measured a riparian overstory tree canopy cover of 71% and a density of 78 trees/acre. Species included Arizona sycamore, Fremont cottonwood, Arizona walnut, and Goodding and red willow. The stand was dominated by young age classes. This reach had the highest herbaceous canopy cover, varying between 67% in 1989 and 30% in early 1991 following a flood.

Granite Pasture. A two mile segment of Campaign Creek flows from north to south through the Granite Pasture. It is delineated by the National Wetland Inventory as perennial immediately below the Reevis Mountain Ranch, but intermittent for most of its length. Based on field observations, most of Campaign Creek in this pasture is perennial or interrupted perennial.

There are two distinct reaches of Campaign Creek in the Granite Pasture: the upper reach located from below the Reevis Mountain School to "the Box" and the lower reach located in "the Box". Both of these reaches are approximately a mile long. Both will be included within a fenced riparian pasture.

The upper reach has been used as a key area since it was first inventoried and monitored in 1992 by Lew Myers. The channel is moderately confined in a valley bottom that is generally less than 100 feet wide. Immediately below the private property, Campaign Creek is a “B” type stream with 2-4% gradient and a narrow floodplain. It is similar to Campaign Creek above the Reevis Mountain School (in the Reevis Pasture), in that it includes both sand and gravel sediment dominated sections, and cobble and boulder dominated sections. Further downstream, a surveyed reach was classified as an “F4” type stream (see Appendix B for stream type descriptions) in unstable condition. This short reach is shallow and wide, with little to no floodplain and a gravel dominated channel. Its poorly defined streambank features are dominated by silt. There is a large bedload of sand and gravel that moves downstream in pulses after precipitation events. This reach of Campaign Creek is adversely impacted by three road crossings that contribute sediment to the channel.

This section of Campaign Creek also lies in an area that has been subject to accelerated erosion. This section of Campaign Creek lies nearly perpendicular to the Two Bar Ridge South fault, a northwest-southeast trending fault which marks the western edge of the Tonto Basin. This basin-bounding fault is located at the base of the Two Bar Ridge and represents a near vertical fault contact between Precambrian granitic rocks and diabase, and Tertiary basin-fill deposits. The area has been subject to accelerated erosion of sediments from the surrounding elevated areas and episodic deposition within the basin through processes of debris flow and fluvial sedimentation (Harbour 2008).

Based on comparison of riparian vegetation provided by Lew Myers (Martin 1992), this entire reach of Campaign Creek, from the private land to above “the Box”, had the lowest cover and density of riparian vegetation of the three Campaign Creek reaches. There was 28% collective canopy cover of sycamore, Fremont cottonwood, walnut, Goodding and red willow, and a density of 29 trees/acre. Sycamore had the highest density and canopy cover, but cottonwood the highest basal area, suggesting that the cottonwood is dominated by very large trees. Seep willow, an unpalatable obligate riparian shrub, had 16% canopy. Other more palatable species had less than 5% cover. Herbaceous cover was 14% consisting mostly of Bermuda grass and horsetail.

In 1992, impacts to riparian resources by livestock grazing were described as severely adverse. In the eleven years between and including 1998 and 2008, the Granite Pasture was grazed seven years, three times during the winter, once during the summer and three times between March and May/June. Monitoring occurred in 2000, 2002 and 2004. Utilization of tree leaders in 2000 and 2002, both during the summer, was measured at 0% and 98%. Horsetail is the dominant understory plant. Although it is considered unpalatable in other regions of the United States, it often remains green year round, and is commonly grazed to less than one inch stubble height. There are no protocols for measuring use of this plant. It is not considered an herbaceous species and cannot be monitored using herbaceous species protocols.

Yet it plays a critical role in sediment stabilization as the dominant emergent plant in this pasture. The role that emergent species play in stabilizing sediments and developing stream channel features is described in Heffernan (2008).

The lower one mile reach of Campaign Creek is located in "the Box", a narrow, steep-walled canyon. The upper end of "the Box" has a series of pour-offs and waterfalls, a steep (2-4%) gradient, very narrow valley, and is inaccessible to livestock. The lower end of "the Box" is wider (< 100 feet) with a gentle (0-2%) gradient, some floodplain development and a smaller than cobble sediment dominated channel. At the lower end of "the Box" the canyon walls restrict to less than 10 feet, discouraging upstream use by livestock. Herbaceous plant diversity is high and young age classes of obligate riparian trees are present.

According to the water points layer in the Forest's Geographic Information System (GIS), this pasture contains seven springs, no stock tanks and no wells (Table A4). All of the water in this pasture is located in springs and streams, including Campaign Creek. According to the ranch manager, two springs are developed, Blackberry Spring and trough and Cane Spring trough and pipeline. There is also corral and trough supplying Two Bar, Neck and Granite Pastures. It is not known which, if any, of the springs support riparian vegetation.

Tule Canyon

Tule Canyon originates on the east slope of Two Bar Ridge and flows approximately 5.25 miles to its confluence with Campaign Creek. Most of the Tule Canyon watershed lies in the Tule Pasture. The largest extent of riparian vegetation occurs in the middle of both the pasture and stream channel.

Key (upper perennial) reach. A series of springs (including Tule Spring) maintains perennial flow in a reach that is about 0.75 mile long. The riparian vegetation in the upper end of this reach ends abruptly and is replaced by upland vegetation. The valley bottom of this upper 0.5 mile reach is narrow (< 50 feet wide) with moderately steep (30-60%) side slopes. The channel is a "B" type with a small floodplain and is dominated by fine sediments with some cobble and boulder. In places, the channel is carrying a bedload of decomposed granite. The overstory is dominated by pole-sized (5-9 inch dbh) Fremont cottonwood and Goodding willow, with some Arizona sycamore, and a few velvet ash. Saplings and seedlings are also present. The relatively young age classes suggest a change in management that has allowed regeneration and establishment of riparian trees. Riparian shrubs include seep willow and California buckthorn. Herbaceous species include deergrass, Bermuda-grass, yellow monkey flower, American speedwell and rushes. Riparian shrubs are also found in this reach.

This reach was monitored in November 2001 after two months of use. Only 13 seedlings were measured on the transect. About 60% of the leaders were browsed. Use by weight on deergrass was 50%. Bank alteration was not measured, although

physical impacts were apparent along the reach. Some trailing along the narrow floodplain was observed. This same reach was visited in December 2007 following a seven week use period. Light use was observed but not measured. This reach is recommended as a key reach and designated monitoring area.

Lower perennial reach. The lower one-quarter mile of this perennial reach lies between a granitic slot canyon and a waterfall. It is generally inaccessible to cattle.

Intermittent/ephemeral reach. Below the waterfall, the channel transitions from intermittent to ephemeral. It is an "F" type stream in unstable condition. It has a high width/depth ratio and excessive sand and gravel in the channel. The upper end is mapped as a cottonwood stand, but trees are mature with little regeneration. Herbaceous vegetation is present with low density. The lower reach of Tule Canyon is ephemeral. Vegetation includes mesquite, hackberry, greythorn, catclaw and other xero-riparian shrubs.

According to the water points layer in the Forest's Geographic Information System (GIS) and information from the ranch manager, Tule Pasture contains ten springs, one stock tank and no wells (Table A4). Most of the water in this pasture is located in springs and streams, including Tule Canyon. According to the ranch manager, three springs outside of the creek are developed and three troughs are fed by Tule Canyon (Tule Spring). The status of the remaining springs is unknown.

Two Bar Canyon

Similar to Tule Canyon, the headwaters of Two Bar Canyon lie on the east slope of Two Bar Ridge. Most of the Two Bar watershed lies within the Two Bar Pasture. The stream channel is approximately 4.2 miles long above its confluence with Campaign Creek. It is also spring fed, but is only perennial just below the spring. The National Wetland Inventory maps delineate a one-quarter mile intermittent reach with riparian vegetation. The channel is an "F" type stream in severely impaired condition due to excessive sediment in the channel, eroding banks, active headcuts and low cover of herbaceous vegetation. As in Tule Canyon, the upper zone of riparian vegetation also ends abruptly, shifting to upland species. Trees include Fremont cottonwood and Arizona sycamore. Most of the trees are young, from seedling to pole size, with a few old, large trees. Other woody plants include net-leaf hackberry, velvet mesquite, buttonbush, seep willow, desert broom and burrobrush. Giant reed grass (*Arundo donax)* dominates the spring area. Herbaceous species diversity and cover along the channel is very low. There are small patches of Bermuda-grass and an occasional deergrass. According to Brandon Burgett, ranch manager, floods following a 2004 fire in the watershed removed areas of fine sediment held by riparian grasses. Below this intermittent reach, the valley widens, and there is little vegetation.

According to the water points layer in the Forest's Geographic Information System (GIS), Two Bar Pasture contains five springs, no stock tanks and no wells (Table A4). All of the water in this pasture is located in springs and streams. According to the

ranch manager Hackberry Spring and Two Bar Spring are developed with a trough. There is a corral near Horrell Spring which supplies Two Bar, Neck and Granite Pastures. The status of the remaining springs is unknown.

Spring Creek

Spring Creek is an intermittent stream that originates on the Pinto Creek Allotment above the Campaign/Bar V Bar Allotment east of the Nonesuch Rocks ridge. Its channel drains north approximately 7 miles to the confluence with Pinto Creek. About 4.5 miles of Spring Creek are included in the Campaign/Bar V Bar Allotment, with one-half mile located on the Spring Creek Ranch private inholding. The only stream channel segment that appears to be perennial with riparian vegetation is in the Spring Creek Ranch and the downstream Holding Pasture. A spring located on the ranch is the source of water for Spring Creek. The National Wetland Inventory delineates this reach as a mixed broadleaf deciduous riparian forest from the upper end of the ranch through the Holding Pasture. Field notes and photos provided by the Tonto Basin Ranger District personnel (Cress and Giroux 2008) document a low gradient (0-2%) cobble-dominated channel, with a narrow floodplain. There are small areas with fine sediments of silt and sand on the floodplain. The dominant riparian vegetation is Fremont cottonwood, with lesser amounts of velvet ash and Goodding willow. All tree age classes are represented. Livestock browsing is evident from this year as well as previous years. Some drought-related mortality of cottonwood was observed. Dominant shrubs include velvet mesquite, salt cedar and cat-claw. Herbaceous species include deergrass, a cyperus species, cat-tail and watercress. Canopy cover is low. Although this area appears to have received heavy grazing pressure, it has high recovery potential.

According to the water points layer in the Forest's Geographic Information System (GIS), the only water available in this pasture is in Spring Creek. According to the ranch manager, there is a corral near the ranch house with a water trough.

Climate Data

Climate on the Campaign/Bar V Bar Allotment is characterized by a bimodal precipitation pattern with about 60 percent occurring as frontal systems in the winter from December to March and about 40 percent occurring as monsoons in the summer from July to September. Summer storms can be more intense than winter storms but are generally of shorter duration and smaller aerial extent.

The nearest climate gauge to the allotment is Roosevelt 1 WNW. The period of record is 1905-present and the average annual precipitation is 16.89 inches (NOAA 2007). The data indicates eight out of the last ten years (1998-2007) have had below average precipitation, with 2002 being below 50% of average. At the same gauge, nine of the ten years 1996-2005 (the most recent years that have adequate data to analyze) have seen warmer than average temperatures (WRCC 2007).

Wild and Scenic Rivers

There are no designated or potential wild and scenic rivers on the Campaign/Bar V Bar Allotment.

Water Quality

The Arizona Department of Environmental Quality (ADEQ) evaluates the water quality status of waters within the state in a Nonpoint Source Assessment Report (2006). Campaign Creek is the only drainage within the allotment that has been evaluated for the 2006 report. The evaluated reach extends from the headwaters to Pinto Creek. Water quality standards for Campaign Creek are intended to protect the designated uses of aquatic and wildlife-warm water fisheries (A&Ww), full body contact recreation (FBC), fish consumption (FC), and AgL (agricultural livestock watering). Samples collected at the Superstition Wilderness boundary indicate Campaign Creek is "Attaining all uses".

Designated uses for non-ephemeral, unlisted tributaries above 5000 feet are aquatic and wildlife-cold water fisheries (A&Wc), fish consumption (FC), and full body contact recreation (FBC). Designated uses for non-ephemeral, unlisted tributaries below 5000 feet are aquatic and wildlife-warm water fisheries (A&Ww), fish consumption (FC), and full body contact recreation (FBC). Designated uses for ephemeral, unlisted tributaries are aquatic and wildlife-ephemeral water fisheries (A&We) and partial body contact recreation (PBC).

DESIRED CONDITIONS

Tonto Forest Plan Desired Conditions

The Tonto National Forest Plan (USDA Forest Service 1985, pp. 41-44) lists the following standards and guidelines (articulated as desired conditions) for riparian areas and streams:

- Coordinate with range to achieve utilization in the riparian areas that will not exceed 20% of the current annual growth by volume of woody species
- Coordinate with range to achieve 80% of potential riparian overstory crown coverage;
- Coordinate with range to rehabilitate 80% of the potential shrub and overstory canopy cover in riparian areas;
- Manage cottonwood and sycamore stands so that by 2030, over half of these areas include all age classes;
- Re-establish riparian vegetation in severely degraded but potentially productive riparian areas; and
- Avoid channel changes or disturbance of stream channels and minimize impacts to riparian vegetation.

The Forest Plan (USDA Forest Service 1985) also incorporated the following standards and guidelines (articulated as desired conditions) on pages 19-20 of the Regional Guide (USDA Forest Service1983):

- Manage riparian areas to protect the productivity and diversity of riparian-dependent resources…;
- Improve all riparian areas to satisfactory or better condition by 2030, with 25% of riparian areas in satisfactory condition by 2000. Satisfactory conditions are specified below:
    - Maintain 80% natural shade over water surfaces;
    - Maintain 80% of natural bank protection;
    - Maintain the composition of sand, silt and clay within 20% of natural levels; and
    - Maintain three age classes of woody plants with 10% in seedling and saplings age classes.

These standards and guides were developed with the intent of achieving the following riparian area goals and objectives from the Tonto National Forest Plan (USDA Forest Service 1985):

1. maintaining and improving wildlife and/or aquatic species habitat (USDA Forest Service 1985. pp 20, 33); and
2. enhancing riparian ecosystems by improved management (USDA Forest Service 1985, p. 19).

Desired condition of key reaches

Based on direction from FSH 2209.13 (Grazing Permit Administration Handbook) Chapter 90 (2007), specific statements of desired condition should be developed for each allotment within the context of the Forest Plan (USDA Forest Service 2007, p. 7). The following project-specific desired condition statements have been developed for the riparian areas and stream channels on the Campaign/Bar V Bar Allotment, with the intent of achieving stream channel proper functioning condition (Barrett et al, 1993). The most common conditions limiting proper functioning condition of stream channels are high width-depth ratios, and excessive erosion or deposition. The recovery of riparian vegetation is essential for attainment of stability or proper functioning condition for many stream types.

Desired conditions for key reaches include both short-term and long-term timeframes. The most important short-term desired conditions are to:

- Maintain residual herbaceous vegetation along the greenline or streambank whenever precipitation is expected;
- Minimize the annual impacts to seedling and sapling riparian woody species; and
- Limit physical impacts to alterable streambanks and greenlines.

The most important long-term desired conditions are to:

- Optimize riparian tree and shrub establishment, especially following episodic, regional winter storms;
- Increase the density, vertical and horizontal canopy cover of woody riparian tree species;
- Increase the proportion of obligate and facultative riparian species;
- Maintain or increase canopy cover of herbaceous species to at least 50% (or 5% to 25% for reaches now at trace to 1%);
- Decrease the greenline to greenline width;
- Optimize the establishment of floodplains and streambanks; and
- Improve stream channel function and stability.

Reaching desired conditions for riparian areas and stream channels will depend not only on management activities, but on climatic events. Both drought and floods have the potential to affect riparian areas and stream channels. High flows (> 10 year recurrence interval) are likely to scour impaired or unstable channels. Even moderate flows (> 2 year recurrence interval) could cause unstable channels to widen or incise.

APPENDIX A. SUMMARY OF DATA

The data listed below is on file at the Forest Supervisor's Office in Phoenix, Arizona.

2210 Range Allotment Planning Files. Prior to the 1992 Allotment Management Plan (AMP), there are few mentions of riparian areas in the Campaign or Bar V Bar Allotment files, except notes about unauthorized salting in Campaign Creek and concentrated livestock use in Tule Canyon. One of the seven management objectives of the 1992 AMP is to accommodate riparian recovery in Campaign Creek.

Aerial photos and maps. National Wetland Inventory (NWI) maps (Two Bar Mountain, Salt River Peak, Wildcat Hill, Haunted Canyon, and Pinyon Mountain Quadrangles, USDI, 1991-1995) and aerial photos were used to provide allotment-wide information (1:24000-scale) on stream flow regime (perennial or intermittent) and riparian vegetation cover type. These maps were used to prioritize field visits.

Table A1. Estimated number of stream miles delineated by the National Wetland Inventory (NWI) within each pasture that are perennial or intermittent and cottonwood, or mixed broadleaf forest.

Pasture	Stream Name	Perennial	Int. w/ Veg*
Grapevine			
Schoolhouse			
West Ridge			
Campaign			
Cholla			
Horse			
Dry			
Spring Creek			
Tidwell			
Holding Pasture	Spring Creek		0.25 RpSSMB
Jojoba			
Bobcat			
Creek			
Bull			
Tule	Tule Canyon	1.0 PF01A, FOCW	
Two Bar	Two Bar Canyon	0.25 RpSSMB	
Neck	Campaign Creek		0.25 RpFOCW
HN			
Fowler & Brake	Spring Creek	springs	
	Nonesuch Spring	springs	
Reevis	Campaign Creek	0.5 PF01A, FOCW	2.5 FOCW&MB
Granite	Campaign Creek	0.75 PF01A, FOCW	
TOTAL		**2.5 miles**	**3.00 miles**

Permanent photopoints. Lew Myers established four permanent photopoints in the Reevis Pasture and three in the Granite Pasture in 1989. Only the three in the Granite Pasture were re-photographed. Between 1993 and 1997 six additional photopoints were established in the Granite Pasture. They were last repeated in 1999. In 2008, Debbie Castle, Tonto Basin Ranger District range staff, established additional photopoints in the Granite Pasture.

Tonto Riparian Inventory and Monitoring Method (TRIMM). Lew Myers (retired Tonto National Forest riparian ecologist) collected data on Campaign Creek between 1989 and 1992 in the Reevis and Granite Pastures, and from the private land between these two pastures. The Reevis Mountain School occupies the approximately one-quarter mile long tract surrounding Campaign Creek, formerly the Upper Horrell Ranch. Livestock grazing has not occurred since 1981. Mr. Myers did a comparative analysis of the stream channels and riparian vegetation on these three sections of Campaign Creek. This data is on file at the Tonto National Forest, Forest Supervisor's Office. It is summarized in a letter to the Tonto Basin District Ranger (Martin 1992).

Riparian Use Monitoring. The Tonto National Forest's 2210 Range Allotment Planning folder includes the annual operating instructions for the years 1998 – 2008. Planned pasture dates are displayed for the following pastures in Table A2, although information in the folder indicates that actual use was different than planned. These pastures include the key reaches on the allotment. Campaign Creek is located in the Reevis and Granite Pastures. Tule Canyon is in the Tule Pasture. Two Bar Canyon is in the Two Bar Pasture.

Table A2. Grazing schedule for four pastures with riparian areas based on Annual Operating Instructions (AOI's) for eleven years (1998 - 2008). Riparian area monitoring occurred after cattle grazed in the pastures highlighted in yellow. Results are discussed in the existing condition narrative. Data and photos are located in the project record.

YEAR	PASTURE			
	REEVIS	GRANITE	TULE	TWO BAR
1998	11.01.97 - 02.28.98	03.01.98 - 06.30.98		07.31.98 -.10.31.08
1999	07.01.99 - 10.31.99			03.01.99 – 06.30.99
2000		11.01.99 - 02.29.00	06.16.00 – 09.30.00	10.01.00 – 02.28.01
2001		03.01.01 - 06.15.01	09.01.01 – 10.31.01	11.01.01 – 12.31.01
2002	09.08.02 - 11.02.02	06.16.02 - 07.27.02	07.28.02 – 09.07.02	09.08.02 – 11.02.02
2003				
2004		12.13.03 - 01.31.04		
2005				01.15.05 – 02.28.05
2006		04.21.06 - 05.31.06	07.09.06 – 10.06.06	
2007	12.22.07 - 01.19.08	11.04.07 - 12.21.07		01.13.07 – 02.28.07
2008			01.20.08 – 02.28.08	

Stream channel classification and condition assessment. Stream reaches selected for field visits for this analysis were chosen based on the extent of riparian vegetation indicated on the NWI maps (USDI 1991-1995), and accessibility to livestock. Reaches were classified (Table A3) according to the Rosgen (1996) system. Stream types are described in Appendix B.

Seven stream reaches within the allotment were visited. Condition was assessed using a condition assessment developed on the Tonto National Forest (Mason and Johnson 1999). Condition assessment is based on stream channel stability. Channel stability is defined as the ability of a stream to carry the water and sediment of its watershed while maintaining its dimension, pattern, and profile, without aggrading or degrading, over time and in the present climate (Rosgen 1996). The condition rating classes are stable, impaired (slightly or severely), or unstable. Parameters used to assess stability include depositional pattern, stream bank vegetative cover (Thompson et al. 1998), stream channel width/depth ratio, channel stability rating (Pfankuch 1975), and bank erosion hazard index (Rosgen 1996).

Table A3. Stream type and condition for reaches on the following streams.

Stream Name	Pasture	Date	Stream Type	Condition
Campaign Creek #1 – below private	Reevis	11/4/1992	B3	not assessed
Campaign Creek #2 – directly above private	Reevis	6/10/1997	B4a	Impaired
Campaign Creek #3 – in wilderness	Reevis	1/23/2008	B	Stable
Campaign Creek #4 – below 4th road crossing from trailhead	Granite	12/29/2003	F4	Unstable
Tule Canyon #1 – by springs, below waterfall	Tule	12/21/2007	F	Unstable
Tule Canyon #2 - by springs, above waterfall	Tule	12/21/2007	B	Slightly Impaired
Two Bar Canyon – from pasture boundary upstream to spring, 36-25381	Two Bar	1/23/2008	F3	Severely Impaired

Water Sources. The availability of alternative, developed water within a pasture can determine the amount of time cattle may spend in riparian areas. Waters on the allotment were located using the water points layer in the Forest's Geographic Information System (GIS) and revised with input from the ranch manager. This layer contains springs, tanks and wells for which the Tonto has water rights claims, as well as other sources indicated on the USGS topographic maps. Some pastures may have water piped into metal troughs from an adjoining pasture or private land. These are discussed in the Range section of the report and not included in Table A4. Eleven water developments have been inventoried (Table A5). One well was found to be not functioning, therefore was not included in Table A4. The condition of the remaining developments is unknown.

Table A4. Water sources by pasture.

Pasture	Springs	Tanks	Wells
Grapevine	1	0	0
Schoolhouse	0	0	0
West Ridge	0	1	0
Campaign	0	2	1
Cholla	0	6	0
Horse	0	0	0
Dry	0	0	0
Holding (west)	0	0	0
Spring Creek	0	1	0
Tidwell	0	0	0
Jojoba	0	1	1
Holding (east)	0	0	0
Bobcat	0	1	0
Creek	0	0	0
Bull	0	0	0
Tule	10	1	0
Two Bar	5	0	0
Neck	0	0	0
HN	0	0	0
Fowler & Brake	6	3	0
Reevis	12	0	0
Granite	7	0	0

Table A5. Condition of inventoried water developments.

Use Name	State File Number	Date	Water Present	Functioning
TULE SPRING	36-24278	12/21/2007	Yes	Yes
UNNAMED SPRING	36-25381	1/23/2008	Yes	Yes
HENDERSON TANK	38-25216	4/20/2008	No	Yes
SUBSTITUTE TANK	38-25221	3/31/2008	Yes	Yes
CHOLLA TANK	38-25222	3/24/2008	Yes	Yes
ROTHROCKS TANK	38-25224	3/24/2008	No	Yes
TULE CATCH BASIN TANK	38-25226	5/18/2008	Yes	Yes
LOWER DOUBLE TANK	38-25228	3/31/2008	No	Yes
UPPER DOUBLE TANK	38-25229	3/24/2008	No	Yes
SCHOOLHOUSE TANK	38-25230	3/24/2008	Yes	Yes
SCHOOLHOUSE WELL	55-601032	3/24/2008	No	No
WINDMILL SUPPLY	55-601054	4/20/2008	Yes	Yes

APPENDIX B. ROSGEN (1996) Stream Type Descriptions

B - "B" type streams are moderately entrenched, containing narrow floodplains, and have a moderate gradient (2-4%). “Ba” indicates a “B” type stream with a steeper grade (>4%).

F - "F" type streams are highly entrenched (downcut), with little or no floodplain to dissipate flood flows, consequently, high flows are concentrated in the stream channel rather than in overbank flow which results in streambank erosion and loss of riparian vegetation. They usually evolve from a more stable stream type due to some natural or management caused disturbance. "F" type streams have a high width/depth ratio (wide and shallow) and lack the stream power, or energy, necessary to move the sediment though the system, causing aggrading. These stream types are generally unstable and extremely sensitive to disturbance.

The numbers 1-6 indicate the dominant sediment size, 1=bedrock, 2=boulder (256-2048mm), 3=cobble (64-256mm), 4=gravel (2-64mm), 5=sand (.062-2mm), and 6=silt (<.062mm).

LITERATURE CITED

Arizona Department of Environmental Quality. 2006. Draft 2006 Integrated 305(b) Assessment and 303(d) Listing Report. http://www.azdeq.gov/environ/water/assessment/assess.html

Burton, Timothy A., Ervin R. Cowley and Steven J. Smith. 2007. Monitoring Stream Channels and Riparian Vegetation-Multiple Indicators (Version 3.0). Idaho Technical Bulletin 2007-01. USDI Bureau of Land Management, Idaho State Office. 47 p and appendices.

Cress, D. and K. Giroux. 2008. Report on file at the Tonto National Forest Supervisor's Office, Phoenix, Arizona.

Croxen, F. W. 1926. History of grazing on Tonto. Presentation at the Tonto Grazing Conference in Phoenix, Arizona, November 4-5, 1926. Unpublished paper. On file at the Tonto National Forest Supervisor's Office, Phoenix, AZ. 11 p.

Harbour, Karyn. 2008. Personal communication. Geologist for the Tonto National Forest, Phoenix, Arizona.

Haskett, B. 1935. Early history of the cattle industry in Arizona. Arizona History Review 6: 3-42.

Heffernan, J. B. 2008. Wetlands as an alternative stable state in desert streams. Ecology 89(5): 1261-1271.

Hendrickson, D. L. and W. L. Minkley. 1984. Cienagas-vanishing Climax Communities of the American Southwest. Desert Plants 6(3): 175 p.

Interagency Technical Team. 1996 (revised 1999). Sampling Vegetation Attributes. U.S. Department of Interior, Bureau of Land Management, Denver CO. p.3

Levick, Lainie, David Goodrich, Mariano Hernandez, Darius Semmens, Juliet Stromberg, Rob Leidy, Melissa Apodaca, D. Philip Guertin, Melanie Tluczek, William Kepner. 2007. Hydrology and Ecology of Intermittent Stream and Dry Wash Ecosystems. Southwest Region Threatened, Endangered, and At-Risk Species Workshop: Managing Within Highly Variable Environments. Oct. 22, Tucson, AZ. EPA/600/R-07/142, ARS/218464. 20 p.

Martin, R. C. 1992. Letter to Tonto Basin District Ranger dated 12-18-92, File Code 2520-6. On file at the Tonto National Forest Supervisor's Office, Phoenix, Arizona.

Mason, Lynette W. and Janet L. Johnson. 1999. Tonto National Forest Stream Assessment Method. In: AWRA Symposium Proceedings on Wildland Hydrology June 30-July 2, Bozeman, MT. American Water Resources Association, pp. 255-257.

Myers, L. 1991. Tonto (National Forest) Riparian Inventory and Monitoring Method. On file at the Forest Supervisor's Office, Phoenix, Arizona.

NOAA, 2007. National Weather Service Forecast Office, Phoenix, AZ http://www.wrh.noaa.gov/psr/DroughtPage.php?data=ALLDATA

Pfankuch, D. J. 1975. Stream reach inventory and channel stability evaluation. USDA Forest Service, R1-75-002. GPO #696-260/200, Washington, D.C. 26 p.

Rosgen, Dave. 1996. *Applied River Morphology*. Wildland Hydrology. Pagosa Springs, CO.

Thompson, William H., Robert C. Ehrhart, Paul L. Hansen, Thomas G. Parker, and William C. Haglan. 1998. Assessing Health of a Riparian Site. In: Proceedings AWRA Specialty Conference on Rangeland Management and Water Resources May 27-29, Reno, NV. American Water Resources Association, pp. 3-12.

USDA Forest Service. 1983. Regional Guide for the Southwestern Region. (On file at the Tonto National Forest Supervisor's Office, Phoenix, AZ).

USDA Forest Service. 1985. Tonto National Forest Plan. 257 pp.

USDA Forest Service. 2007. Forest Service Handbook (FSH) 2209.13 – Grazing Permit Administration Handbook, Chapter 90 – Rangeland Management Decision Making. FSH 2209.13-2007-1.

Western Regional Climate Center, 2007. http://www.wrcc.dri.edu/summary/climsmaz.html

CAMPAIGN / BAR V BAR ALLOTMENT
STREAM CHANNELS AND RIPARIAN AREAS
ENVIRONMENTAL CONSEQUENCES

Janet Grove and Lynn Mason
August 27, 2008

Environmental effects of grazing in the southwestern United States

Riparian areas have ecological importance beyond their small percentage of land area. This percentage is even smaller in the arid southwestern United States, and inversely, their importance more critical. Although volumes of literature have been written on riparian systems in the southwest, little actual research has been accomplished (Milchunas 2006). The limited research available shows that grazing has greater effects on southwestern riparian understory plant communities than adjacent upland plant communities. Southwestern riparian plant communities are more sensitive to livestock grazing, and more likely to experience reductions in plant species diversity, than plant communities that evolved with ungulate grazing (Milchunas 2006). Clary and Kruse (2003) concur that southwestern riparian systems have not had the intensive study that other regional riparian ecosystems have had. In their review of environmental impacts, management practices and management implications for Southwestern riparian areas, they state the necessity to rely on proven principles and practices from other similar riparian areas to fill the gaps in management applications in the Southwest.

Direct Effects. Riparian areas, with their high species diversity and structural complexity, provide critical terrestrial and aquatic habitat to wildlife species from adjacent upland and riparian area environments. Cattle tend to congregate in many riparian areas. They favor riparian forage and water availability, shade in warm months and gentle topography. Excessive grazing, trampling and trailing impacts can destabilize and break down stream banks, cause mechanical damage to shrubs and small trees, reduce or eliminate woody seedlings and saplings, expose soils, eliminate or shift native herbaceous species to weedy or exotic species with reduced root systems, and cause widening or incision of stream channels (Trimble and Mendel 1995, Clary and Kruse 2003). These changes may lead to loss of stream stability and function (Rosgen 1996). Stream channel profile, stream bank stability, streamside vegetation, channel bottom embeddedness, stream sediments and stream temperature are all aquatic species habitat features that can be directly or indirectly affected by livestock grazing practices. Maintaining native obligate riparian plants is extremely important to many streams because of their resistance to the erosive energy of flowing water (Clary and Kruse 2003). Herbaceous riparian vegetation is especially important to stabilizing stream bank, point bar and floodplain deposits, critical to the channel restoration process (Clary and Kruse 2003).

One of the most important factors influencing riparian conditions is utilization (Mosley et al 1999, Clary and Kruse 2003).

Indirect effects. Stream channels and riparian areas can also be affected indirectly by the effects of cattle grazing on adjacent uplands within the watershed. Soil compaction, decreased infiltration, and loss or alteration of upland vegetation can cause increased runoff and higher peak flows, leading to channel adjustments and decrease in stream function. Stream channels and riparian areas can also be indirectly affected by unstable or degraded channels and riparian areas that may occur upstream or downstream.

Environmental Consequences

Alternatives. The four alternatives include: Alternative 1 - Permittee Proposed Action, Alternative 2 -No Grazing, Alternative 3 – Modified Proposed Action, Alternative 4 – Seasonal Grazing.

Consistency with the Forest Service Plan and Directives. Direction for managing riparian areas on the Tonto National Forest is found in the Tonto National Forest Plan (USDA 1985, 1995) and Forest Service Directives. The Forest Plan goals, objectives, standards and guidelines focus on the importance of managing riparian areas for protection of water quantity and quality and wildlife habitat. Key standards and guidelines from Forest Plan (USDA Forest Service 1985, 1995) include:

- Coordinate with range to achieve utilization in the riparian areas that will not exceed 20% of the current annual growth by volume of woody species;
- Avoid channel changes or disturbance of stream channels and minimize impacts to riparian vegetation;
- Manage riparian areas to the level needed to provide protection and management; and
- Emphasize maintenance and restoration of healthy riparian ecosystems through conformance with forest plan standards and guidelines. Management strategies should move degraded riparian vegetation toward good condition as soon as possible. Damage to riparian vegetation, stream banks, and channels should be prevented.

The Southwestern Region of the Forest Service Soil and Water Conservation Practices Handbook (FSH 2509.22) also includes direction to mitigate effects of livestock grazing. It acknowledges that allowable use is set to meet the objectives of the Forest Land Management Plan and that the amount of livestock use is determined primarily through measurement of riparian utilization (FSH 2509.22.1). It advises “Assessment of streambanks to assure banks are not being degraded and contributing sediment to water courses” (FSH 2509.22.11.1e).

Mitigation measures common to all grazing alternatives. Riparian vegetation utilization, residual vegetation heights, timing of grazing, trailing of livestock, and livestock water development are the key grazing management activities likely to affect riparian area and stream channel condition and recovery. The following mitigation measures were developed to implement the Forest Plan (USDA Forest Service 1985, 1995) standards and guidelines and FSH 2509.22 direction that limit annual impacts to riparian vegetation and stream channels.

1. *Protecting existing riparian vegetation*. The utilization guidelines selected to minimize the direct effects of riparian vegetation browsing and grazing, the supporting rationale, and the monitoring protocol were originally presented in (McBride and Grove 2002). The guideline for riparian tree species remains the same. The guideline for deergrass utilization has been lowered and a stubble height guideline has been added for emergent species (rushes, bulrushes and sedges).

    - *Obligate riparian tree species* – browsing use will be limited to < 50% of the terminal leaders (top 1/3 of plant) on palatable riparian tree species accessible to livestock (usually ≤ 6 feet tall). The guideline is appropriate if the plants do not have a hedged form;
    - D*eergrass* - use will be limited to < 40% of plant species biomass; and
    - *Emergent herbaceous species* (rushes, bulrushes, sedges) - grazing should not reduce stubble height to < 6 – 8 inches of stubble height.

The riparian tree species guideline is an index of browsing intensity chosen as a more practical parameter to measure than the Forest Plan (USDA Forest Service 1985) standard that limits use to 20% of tree and shrub annual production by volume. Mathematical relationships between these parameters have been established in previous studies (Stickney 1966, USDA Forest Service 1991).

The goal of the herbaceous species guidelines is primarily to provide residual vegetation for stream channel protection, and secondarily to protect plant vigor. Clary and Kruse (2003) recommend conservative use of deergrass, especially when the riparian vegetation is in early seral ecological status (Clary and Webster 1989). Bunchgrass plants are usually more sensitive to grazing than rhizomatous species. For a 30 inch tall deergrass plant, 50% utilization reduces the plant to 4 inches of stubble height. This is inadequate residual vegetation especially when green line herbaceous canopy cover is usually less than 10%.

Emergent species are supported by perennial surface or subsurface water, and have high potential for regrowth following grazing. There are few scientific studies linking emergent species stubble height and stream channel

protection. Clary and Kruse (2003) recommend leaving 4 – 8 inches of stubble height where there is a dense sod of rhizomatous species. This is usually not the case on the Tonto National Forest, where canopy cover and density is usually lower, and streambanks are undefined. Therefore the recommended stubble height is at least 6 to 8 inches during the grazing period.

2. *Providing for riparian vegetation development.* The use guidelines are appropriate only if there is adequate cover or density of riparian vegetation. Generally speaking, riparian areas with perennial surface or subsurface water should support riparian vegetation. Grazing should be deferred on key areas with very low cover or density of riparian vegetation until livestock grazing impacts can be minimized though the application of utilization guidelines.

3. *Establishing riparian tree seedlings.* The riparian tree species guideline applies to established trees seedlings defined as at least one year old. It does not assure protection to first-year seedlings. Riparian tree species establishment is episodic and opportunistic, generally following moderate flood events with 5 – 10 year return intervals Mahoney and Rood (1998). First year seedlings are most likely to suffer negative effects from browsing. Use in riparian areas should be deferred during the first year of significant post-flood regeneration events.

4. *Limiting trailing in or adjacent to stream channels.* Trailing cattle through riparian areas, especially in small valley bottoms where cattle must walk in the channel, greenline and near floodplain, should be avoided.

5. *Introducing American bulrush into riparian areas*. American bulrush is a rhizomatous species that requires perennial surface and/or subsurface water. Establishment of American bulrush is expected to trap sediment, narrow the stream channel and initiate floodplain and streambank development. The species has a relatively high tolerance for grazing.

Criteria used to evaluate alternatives. The criteria used to evaluate and contrast the alternatives are based on the likelihood that the mitigation measures would be implemented, and as a result, project-specific desired conditions for riparian vegetation and stream channels would be achieved.

Monitoring. The implementation monitoring protocols used for measuring compliance with these mitigation measures include but are not limited to the Interagency Technical Reference (1996), McBride and Grove (2002), and Cowley and Burton (2007).

The attainment of standards and guidelines developed with the intent of achieving longer-term riparian vegetation and stream channel desired conditions

will be monitored at five to ten year intervals. Effectiveness monitoring protocols include but are not limited to the Interagency Technical Reference (1996), Cowley and Burton (2007), and Harrelson et al (1994).

Implementation and effectiveness monitoring will occur at the following key reaches for this allotment: Campaign Creek (Granite and Reevis Pastures), Spring Creek, Tule and Two Bar Canyons.

Cumulative effects common to all alternatives. Most of the stream channels and riparian areas on the Campaign/Bar V Bar Allotment are in impaired or unstable condition (Mason and Johnson 1999), functioning-at-risk or non-functioning (Barrett et al 1993). Historic grazing has had the most extensive effects within the allotment. The allotment has been grazed for over 100 years. The 2210 range files document poor distribution since 1929, with cattle concentrating on flat areas and near riparian areas. Lacking developed, off-channel waters, the cattle spent a disproportionate amount of time in the streams and springs, causing deterioration of the channels.

The existing grazing management activities have also affected riparian areas and stream channels but to a lesser degree than historical grazing due to management practices (reduced numbers, increased number of pastures, deferred and rest-rotation schedules, active herding, improved water distribution).

Travel management activities occurring on the allotment that may have impacted streams and riparian areas include roads, lack of road maintenance, and off-road vehicle use. Activities associated with the Reevis Mountain School, a private inholding located along Campaign Creek between the Reevis and Granite Pastures, include the diversion of water under an existing water right from Campaign Creek and springs that feed Campaign Creek, and riparian vegetation trimming near the channel. The Two Bar Fire of 2005 burned about 1800 acres with low fire intensity. There may have been increased post-fire flows in Two Bar Canyon. These activities or disturbances and their impacts vary from short-term (point-in-time) to chronic. They are generally localized and often have minimal and/or unmeasurable effects to stream channels and riparian areas

The exception to this is Forest Road # 449 that follows Campaign Creek from the highway (SR188) north to the Reevis Mountain School. From SR188 to the Cross P Ranch, Campaign Creek is wide, braided and dry and has low potential for recovery. Above the ranch, the valley bottom narrows and the road crosses the creek several times, introducing a significant amount sediment into the creek.

Introduction of a common herbaceous emergent species, American bulrush (*Schoenoplectus americanus*), should have a positive effect on the recovery of stream channels and riparian areas. American bulrush is relatively resistant to grazing pressure, however, limiting initial use after planting, and grazing

conservatively in subsequent years, should result in successful establishment and maintenance.

In addition to the above management activities, a statewide 10 year drought has likely had an effect on the Campaign/Bar V Bar Allotment according to the Arizona Department of Water Resources (2008). According to NOAA National Climatic Data Center data, there has been a marked upward trend in the globally averaged annual mean surface temperature since the mid-1970s (Shein 2006). Models used by Seager et al. (2007) to predict how climate change will affect the southwestern United States indicate that the current drought will intensify and continue for years to decades. However, the models are too broad-scale to predict how climate change might affect the monsoons, which contribute 40% of the total annual precipitation received on the Tonto National Forest (Lenart 2005). It is difficult to predict how global warming might affect the Campaign/Bar V Bar Allotment specifically, but it is likely to become warmer and dryer.

Alternative 1 – Permittee Proposed Action. This alternative would continue year-long grazing and all pastures could be used during each grazing year. In addition, yearlings could be placed on the allotment at any time of the year.

Direct Effects. The potential for adverse direct effects of cattle grazing to stream channels and riparian areas is the greatest under this alternative. All of the key reaches are in pastures where the water available to livestock is located primarily in springs and riparian areas. If the mitigation measures are implemented, the direct effects of grazing will be minimized and riparian areas and stream channels should continue to improve. The mitigation measures are generally more difficult to implement between May and the end of October.

The riparian utilization guidelines apply to Campaign Creek in the Reevis Pasture and Tule Canyon. The riparian use guidelines do not apply to Spring Creek and Two Bar Canyon, because of the lack of vegetation. Although these channels are impaired, if grazing use is deferred, they have moderate to high potential to support riparian vegetation. Limiting trailing impacts in Tule and Two Bar Canyons is key to maintaining and/or improving the riparian vegetation and stream channel condition.

Indirect Effects. Under this alternative, watershed condition of the pastures where key reaches are located, would be maintained or improved, minimizing any negative indirect effects to stream channels and riparian vegetation.

Cumulative Effects. If riparian mitigation measures are successfully implemented on an annual basis, the direct and indirect effects of this alternative, when combined with other past, present or reasonably foreseeable actions (cumulative effects) as listed above, should result in reaching desired conditions, although more slowly than under the No Grazing Alternative.

Consistency with the Tonto National Forest Plan. Complying with riparian mitigation measures will most difficult under this alternative. If successfully implemented, this alternative would meet the Forest Plan standards listed above to protect, manage, and restore riparian areas.

Alternative 2 - No Grazing. The permit would be canceled and cattle would be removed over a five year period.

Direct Effects. The No Grazing Alternative reduces the direct effects of cattle grazing to recovering stream channels and riparian areas in the Campaign/Bar V Bar Allotment. The potential and rates of recovery are variable and difficult to predict, but will be most rapid under the No Grazing Alternative.

Riparian areas are generally regarded as having high inherent potential for recovery from disturbance (Milchunas 2006). Stream channel and riparian area recovery are considered optimal when the direct effects of livestock grazing are eliminated (Clary and Kruse 2003). The amount of time required for riparian recovery after severe degradation can vary from several years to decades (Clary and Kruse 2003). Recovery is dependent on existing condition of the watershed, stream channel and riparian area (flow regime, channel gradient, dominant channel substrate, watershed area, type and extent of riparian vegetation) and future management, climate and natural disturbances (Kindschy 1987, 1994).

Recovery stream channel function of all the key reaches on the Campaign / Bar V Bar Allotment recovery is closely tied to riparian vegetation recovery. The degree to which the riparian flora has been compromised varies among the riparian areas, but structural and compositional diversity has been impacted by livestock grazing in all of the key riparian reaches. Rates of re-establishment of and recovery will vary. Riparian tree age class and species diversity is relatively high in Campaign Creek, Tule Canyon and Spring Creek, but low for in Two Bar Canyon. Shrub and herbaceous species diversity and cover are low in all key reaches except for Tule Canyon. Cottonwood and willow species have high potential for dispersement into riparian areas because their seeds are wind dispersed. For many other species, opportunities for natural re-introduction are low. The fragmented distribution of riparian areas will also influence the rates of species re-establishment.

Indirect Effects. Under this alternative, watershed condition of the pastures where key reaches are located, would be maintained or improved at the fastest rate.

Cumulative Effects. The direct and indirect effects of this alternative, when combined with other past, present or reasonably foreseeable actions (cumulative effects) as listed above, should result in reaching desired conditions at the fastest rate.

Consistency with the Tonto National Forest Plan. Under this alternative, the desired conditions described for stream channels and riparian areas will be achieved in the shortest timeframe.

Alternative 3 – Modified Proposed Action. This alternative would continue year-long grazing with two exceptions: Two Bar, Tule, and Reevis Pastures (containing key reaches) would be grazed only in winter months (November through March) to minimize direct effects to riparian areas. Grapevine, Badlands, Schoolhouse, West Ridge, Campaign, Spring Creek, Tidwell, and Jojoba Pastures would only be grazed when there is significant annual production to minimize use on jojoba and impaired soils.

Direct Effects. This alternative is intended to minimize the direct effects of cattle grazing in riparian areas in all of the grazed key reaches with the exception of Spring Creek. Grazing during the winter months provides a higher likelihood of implementing the riparian area mitigation measures.

As stated for Alternative 1, the riparian utilization guidelines are applicable for Campaign Creek in the Reevis Pasture and Tule Canyon. The riparian use guidelines do not apply in Spring Creek and Two Bar Canyons, because of the lack of vegetation. Although these channels are impaired, if grazing use is deferred, they have moderate to high potential to support riparian vegetation. Limiting trailing impacts in Tule and Two Bar Canyons is key to maintaining and/or improving the riparian vegetation and stream channel condition.

Indirect Effects. Under this alternative, watershed condition of the pastures where key reaches are located, would be maintained or improved, minimizing any negative indirect effects to stream channels and riparian vegetation.

Cumulative Effects. If riparian mitigation measures are successfully implemented on an annual basis, the direct and indirect effects of this alternative, when combined with other past, present or reasonably foreseeable actions (cumulative effects) as listed above, should be comparable to Alternatives 1 and 4.

Consistency with the Tonto National Forest Plan. If riparian mitigation, measures are implemented, this alternative would meet the Forest Plan standards listed above to protect, manage, and restore riparian areas. Efforts to comply with riparian mitigation measures are more likely to be successful for Alternative 3 than Alternative 1.

Alternative 4 – Seasonal Use. Under this alternative, livestock would be grazed seasonally October 1 through April 30. Each pasture could be used at any time during that period.

Direct Effects. Under this alternative, the direct effects of grazing to riparian areas and stream channels are similar to those discussed under Alternative 3.

The key difference is that October and April may be hot, riparian tree species will be leafed out, and implementation of mitigation measures may be more difficult. Because the riparian vegetation in Spring Creek and Two Bar Canyon is too sparse to monitor, this alternative would result in more impacts than Alternative 3 since the key reaches could be grazed during two additional months, October and April. These months are typically hot and cattle would spend more time in the riparian areas.

Indirect Effects. Under this alternative, watershed condition of the pastures where key reaches are located, would be maintained or improved, minimizing any negative indirect effects to stream channels and riparian vegetation.

Cumulative Effects. If riparian mitigation measures are successfully implemented on an annual basis, the direct and indirect effects of this alternative, when combined with other past, present or reasonably foreseeable actions (cumulative effects) as listed above, should be comparable to Alternatives 1 and 3.

Consistency with the Tonto National Forest Plan. If riparian mitigation measures are implemented, this alternative would meet the Forest Plan standards listed above to protect, manage, and restore riparian areas. Efforts to comply with riparian mitigation measures are more likely to be successful for Alternative 4 than Alternative 1, but less so than Alternative 3.

LITERATURE CITED

Arizona Department of Water Resources, 2008. Statewide Drought Program. http://www.azwater.gov/dwr/drought/

Barrett, Hugh, Jim Cagney, Ron Clark, Jim Fogg, Karl Gebhardt, Paul L. Hansen, Brenda Mitchell, Don Prichard and Dan Tippy. 1993 (Revised 1995). Riparian Area Management: Process for assessing proper functioning condition. Tech. Ref. 1737-9, Bureau of Land Management, Denver CO. 51 p.

Clary, W. P. and B. F. Webster. 1989. Managing grazing of riparian areas in the Intermountain Region. Gen. Tech. Rep. INT-263. Ogden, UT: USDA Forest Service, Intermountain Research Station. 11p.

Clary, Warren P. and William H. Krause. 2003. Livestock grazing in riparian areas: environmental impacts, management practices and management implications. [In]: Riparian areas of the southwestern United States. Eds: M.B. Baker, Jr., P.F. Ffolliott, L.F. DeBano, and D.G. Neary. Lewis Publishers, CRC Press Co. pp. 237 – 258.

Kindschy, Robert R. 1987. Riparian reminiscences. Rangelands 9(2). P 71-74.

Kindschy, Robert R. 1994. Riparian restoration and management. [In]: Interior Columbia Basin Ecosystem Management Project Science Integration Team Terrestrial Staff Range Task Group. Scientific Contract Report: 43-OEOO-4-9182, 58 p.

Lenart, Melanie. 2005. Monsoon Could Strengthen as Climate Warms. IN: Southwest Climate Outlook. June 2005.

Mason, Lynn and Janet L. Johnson. 2001. Affected Environment (Draft), Stream Channels and Riparian Areas, Tonto Basin Allotment. On file at the Tonto National Forest Supervisor's Office, Phoenix, AZ. 11 pages.

McBride, K. and J. Grove. 2002. Riparian Area Management Utilization Guidelines. On file at the Tonto National Forest Supervisor's Office. 25p.

Milchunas, Daniel G. 2006. Responses of plant communities to grazing in the southwestern United States. Gen. Tech. Rep. RMRS-GTR–169. Ft. Collins, CO: US Department of Agriculture, Forest Service, Rocky Mountain Research Station. 126 p.

Mosley, J.C., P.S. Cook, A.J. Griffis and J. O'Laughlin. 1999. Guidelines for managing cattle grazing in riparian areas to protect water quality: Review of research and best management practices policy. [Moscow, Idaho]. University of Idaho: 1997: v. 67p. (Report) (Idaho Forest, Wildlife and Range Policy Analysis Group); no. 15.

Rosgen, Dave. 1996. Applied River Morphology. Wildland Hydrology. Pagosa Springs, CO.

Seager, R., Ting, M., Held, I., Kushnir, Y., Lu, J., Vecchi, G., Huang, H.-P., Harnik, N., Leetmaa, A., Lau, N.-C., Li, C., Velez, J., and Naik, N. 2007. Model Projections of an Imminent Transition to a More Arid Climate in Southwestern North America. *Science*, Vol. 316, No. 5828. April 5, 2007. pp. 1181-1184.

Shein, K.A., ed., 2006. State of the Climate in 2005. *Bulletin of the American Meteorological Society*, ***87***, S1-S102.

Stickney, P.F. 1966. Browse utilization based on percentage of twig numbers browsed. Journal of Wildlife Management. 30(1):240-206.

Trimble, S.W. and A.C. Mendel. 1995. The cow as a geomorphic - A critical review. Geomorphology 13:235-253

USDA Forest Service. 1991. Monitoring plan for grazed riparian areas, Lolo National Forest.

USDA Forest Service. 1983. Regional Guide for the Southwestern Region. On file at Tonto National Forest Supervisor's Office, Phoenix, AZ.

USDA Forest Service. 1985. Tonto National Forest Plan. On file at Tonto National Forest Supervisor's Office, Phoenix, AZ.

USDA Forest Service. 1996. Record of Decision for Amendment of Forest Plans, Arizona and New Mexico. Southwestern Region.

USDA Forest Service. 2000. Forest Service Manual 2526. On file at Tonto National Forest Supervisor's Office, Phoenix, AZ.