

**PARTNERSHIP TO IMPROVE WATER QUALITY IN RED ROCK CANYON  
UPPER SANTA CRUZ WATERSHED**

**ADEQ WATER QUALITY IMPROVEMENT GRANT  
AGREEMENT NO. EV05-0021 (7-008)**



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**FINAL REPORT- March 28, 2008**

*The Coronado Resource Conservation & Development Area, Inc (RC&D) is a 501(c) 3 non profit organization that works with rural partnerships to improve natural resources and the sustainability of ecosystems in southern Arizona.*

*The RC&D works closely with tribal, state and federal partners in the implementation of projects, relying on their technical expertise to assure that projects are implemented in a sound and timely manner. NONE of the federal contributions to this project were used to meet the 40% matching requirement.*

**Project start date: February 4, 2005**

**Project close date: February 28, 2008**

*(a one year extension was requested and received to accommodate additional monitoring by the University of Arizona.*

**Project Partners:**

Arizona Department of Environmental Quality

Coronado RC&D Area

C6 Ranch LLC

Vaca Ranch

Open Cross Ranch

Red Rock Ranch

Santa Cruz NRCD

Santa Cruz County

US Forest Service

Natural Resources Conservation Service (NRCS)

University of Arizona - Range Science Division

University of Arizona - Agricultural Extension

Western Regional Sustainable Agriculture Research & Education

Arizona Department of Agriculture

**The guiding principle for this project is summarized in this quote from EPA publication 841-R-95-003, August 1995.**

*The Watershed Protection Approach is a strategy for effectively protecting and restoring aquatic ecosystems and protecting human health. This strategy has its premise that many water quality and ecosystem problems are best solved at the watershed level rather than at the individual waterbody or discharger level. The Watershed Protection Approach has four major features: targeting priority problems, a high level of stakeholder involvement, integrated solutions that make use of the expertise and authority of multiple agencies, and measuring success through monitoring and other data gathering.*

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## **I. ABSTRACT**

Red Rock Canyon lies in the scenic grasslands of the Canelo Hills, east of the Town of Patagonia in Santa Cruz County. It is an intermittent tributary

to Sonoita Creek and the Santa Cruz River, both of which are significant water bodies in southern Arizona. The climate is semi arid, typical of a steppe and receives between 10 and 20 inches of precipitation annually, coming in thundershowers in July and August. High intensity, short duration storms can support excellent watershed conditions if cover is adequate, allowing infiltration. If cover is lacking, sediment laden runoff can pollute streams that are vital to the ecosystem and sensitive species.

In 2002, several ranchers in the Canelo Hills watershed began working together to identify watershed issues, share science and management knowledge, work more effectively with agencies and develop projects that would address those issues. Improving water quality in Red Rock Canyon, was identified as the highest priority. This project was designed to improve water quality by reducing the amount of sediment generated on the 25,000 acre watershed and transported to the stream. US Forest Service calculations using the Revised Universal Soil Loss Equation (RUSLE) estimated the before project conditions were generating 4500 Tons/Acre/Yr of sediment that reached Red Rock Canyon.

About 95% of the Red Rock Canyon Watershed is contained in 5 grazing allotments administered by the Coronado National Forest. These allotments are integral components of four independent ranches, the C6, Vaca, Open Cross and Red Rock. During the planning process, the four ranches identified over grazing of low lands and riparian areas, inability to implement a rest rotation grazing system and lack of monitoring as barriers to water quality improvement. An agreement was developed with the University of Arizona to implement an extensive monitoring system and educate the ranchers and others in the area on monitoring methods and use of the data for management. The Partners identified Best Management Practices (BMPs) that could be implemented to reduce sediment. Those were water systems that would provide livestock water in the uplands and fencing to control and disperse livestock. With these new practices, all of the ranches now utilize a rest-rotation grazing system, riparian areas are fenced and monitoring data is used to make watershed management decisions. This project has resulted in a visible reduction of sheet and rill erosion in the uplands, the water in Red Rock Canyon now runs clear, diversity of riparian vegetation has increased, with the Forest Service giving it a rating of “functional” under their Proper Functioning Condition method of measurement and over 500 individuals have been reached with educational programs, presentations and materials.

## **II. GOALS/OBJECTIVES and METHODOLOGY**

### **Background:**

Red Rock Canyon is a perennial-intermittent stream with a few small areas of water connected by long, dry segments. During the monsoon

from July to September the creek may run water for its full length for a few weeks or days, depending on the amount and duration of rainfall. This provides limited habitat for the endangered Gila Topminnow, a live-bearing minnow once thought to be common in the Santa Cruz and other desert streams.

Grazing by Anglo ranchers in the watershed dates from the late 1800's. In the early years of open, unfenced range, stocking rates were uncontrolled. With the coming of the Forest Service in 1905, stocking rates were assigned to ranchers using the Canyon but the permitted numbers were often the same as what the rancher had been running. In 1910, a Forest Service range specialist stated that the land could probably support a cow for every ten acres (History of Land Use in the San Rafael Valley, Diane Hadley and Thomas E. Sheridan). This is about four times the maximum number currently allowed on the allotments today.

The Red Rock Watershed is approximately 25,000 acres of rugged, mountainous terrain above 4000 foot elevation, classified as Mexican Oak Savannah/Sonoran semi-desert grassland and located about 20 miles north of the border with Sonora, Mexico. Average annual rainfall varies from 10-20 inches. Almost the entire watershed is contained within the Coronado National Forest, administered by the Sierra Vista Ranger District. The watershed comprises part or all of four ranches: Collins C6 Ranch-Crittenden/Seibold Allotment, Vaca Ranch-San Rafael Allotment, Red Rock Ranch-Kunde Allotment and Open Cross Ranch-Papago Allotment. Total area of the 4 ranches is 51,000 acres of which the Red Rock makes up approximately 39%. In 1990 as a result of formal consultations with the US Fish & Wildlife Service on the impact of grazing on Topminnow, the Forest Service cut the number of permitted cattle in Red Rock by about 50% and fenced off the permanent waters. Two of the allotments, Seibold and Kunde, ran cattle year-round in the creek bottom and hadn't developed livestock water in the uplands. This practice had degraded the riparian area and was thought by the agencies to be harmful to the Topminnow. Historically, the Vaca and Open Cross ranches grazed their allotments only in the winter. The reduction in stocking numbers and grazing restrictions caused hardships, resulting in three of the four ranches being sold. Additional consultations with the US Fish & Wildlife Service in the late 1990's, threatened to close the entire watershed to grazing. As a result of the threat to grazing and concern over the lack of scientific data to support either side of the issue, the ranchers formed the Canelo Hills Coalition with the following objectives:

1. Contract with the University of Arizona for comprehensive vegetation monitoring and assessment of the condition of the vegetative communities.

2. Build and repair fences and develop new livestock waters in the uplands to bring cattle up out of the creek bottom, thus spreading grazing impacts over the entire allotments.
3. Involve the US Forest Service as a partner at all levels and involve other partners that can bring benefit to or benefit from knowledge gained in the watershed.

The goals of this Water Quality Improvement Project supported the initial objectives outlined by the Canelo Hills Coalition. Improvement of water quality in Red Rock Canyon for the Gila Topminnow was an initial priority with other benefits to improving water quality becoming apparent during the planning process. This was Initially a two year project, extended to three years and funded by EPA/ADEQ Water Quality Improvement Grant funds, **the goals of this project were:**

1. **Improve water quality in Red Rock Canyon by reducing livestock impacts.**
2. **Monitor changes in watershed conditions**
3. **Educate the public and other ranchers on the value and methods of improving and protecting water quality.**

#### **METHODS:**

##### **Monitoring:**

An agreement was developed with the University of Arizona to develop a monitoring strategy and implement it in the Red Rock Watershed. The objectives of the monitoring were to assess the condition of the rangeland, determine changes in condition with changes in management, provide a basis for management decisions and teach other ranchers and the public the methods and value of monitoring grazed watersheds. (Monitoring data is included as an appendix to this report)

Baseline data on ground cover, fetch, plant species frequency, vegetative production (lbs/acre) and plant species composition were collected using pace frequency and dry weight rank methods. In pace frequency, a 40cm by 40cm frame is placed on the ground along a previously established transect line, at every other step, until 100 frames have been recorded. transects, or monitoring sites, had been previously established by the Forest Service for their monitoring purposes using Parker Three Step Transects. In some case, new transects were established to replace Parkers, for example where pipelines or cow trails ran through transects.

**Precipitation** was measured at each site, broken down into summer and winter totals.

**Ground Cover-** For evaluating this, the frame has a fixed 1/8" point in the middle and the observer records ground cover at that point with each pace (bare ground, perennial plant base, litter, gravel, or rock). Each category is expressed as percent of the total frames (100). Litter, perennial plant base, gravel, and rock intercept and disperse the energy from raindrops before reaching the soil, and are considered beneficial from the standpoint of reducing erosion.



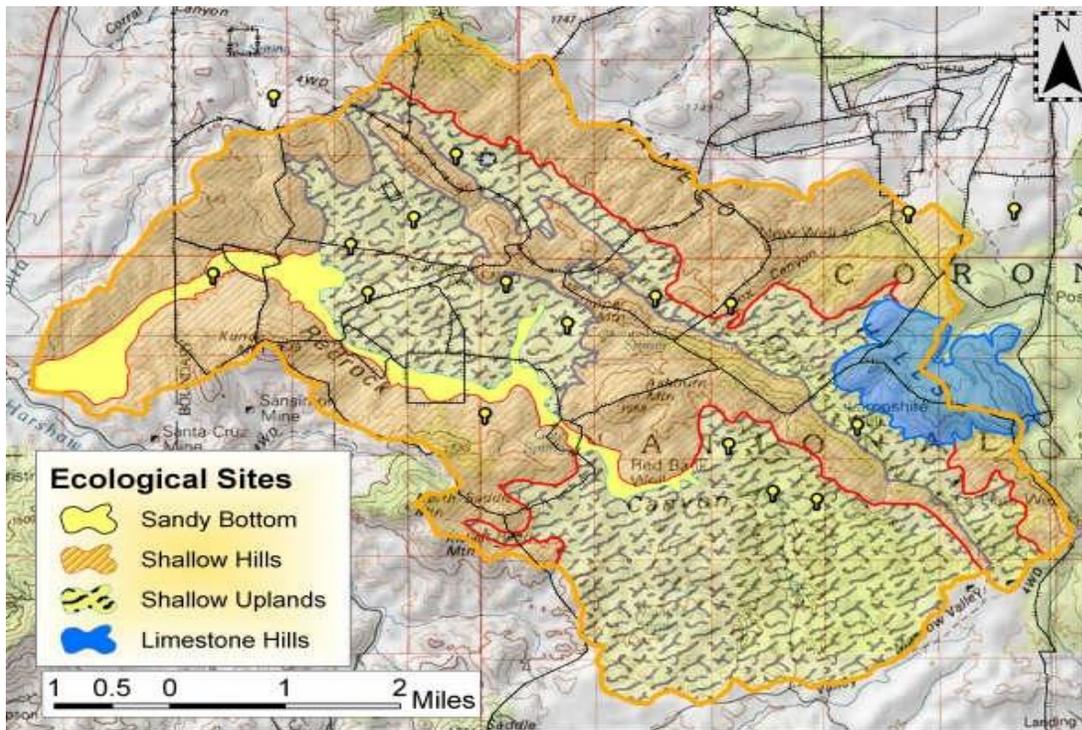
**Fetch** is the shortest distance from the 1/8" point to the base of the nearest perennial plant, taken on each of the 100 frames. Fetch is a measure of plant density, or spacing over the site, and indicates the potential for soil erosion. Close spacing (higher plant density) slows the flow of water over the soil.

**Plant Species Frequency** is the number of times a given plant species appears within the 100 frames. Plant frequency is an effective means to detect vegetation changes over time in a single location.

**Dry Weight Rank** is an expression of the relative importance or abundance of a plant species in the plant community at the monitoring site. The species occurring within the frame are assigned a percentage based on their yield, or their percent of the total dry weight of all plants within the frame. Dry weight rank data are computed as botanical composition by weight and are commonly used in evaluating range condition.

**Line Intercept** measures the canopy cover of live shrubs, trees and succulents along the transect line.

**Ecological site Description:** An ecological site is a distinctive type of land that differs from other types in terms of its physical characteristics especially soil properties and rainfall. A given ecological site will produce a distinctive kind and amount of vegetation. For example, the most common ecological site in the watershed is “Shallow Uplands”. Ecological site descriptions include information on potential natural vegetation if the site is in “excellent” condition which can be compared to transect sites as an indication of the transect’s condition or “health”. This is done through a **Similarity Index**.



**Similarity Index** estimates the similarity of a given ecological site, or transect, to the potential natural vegetation of a comparable site considered to be in excellent condition and is expressed as a per cent. The comparable site is a real time example, and not a theoretical expression of some “ideal climax community”. It has the same soil type, precipitation, exposure, and slope as the transect plot.

## IMPLEMENTATION OF BEST MANAGEMENT PRACTICES

**Best Management Practices (BMPs) that were installed include:**

1. Livestock water systems

- a) 4 wells on the Open Cross with solar pumping plants, 1 solar pumping plant on the C6
- b) 62,000 feet of pipeline on the Open Cross, Vaca, and C6 Ranches
- c) 5 storage tanks, 8 water troughs and/or drinkers on the Open Cross, Vaca and C6 Ranches
- d) 5 miles of fence on the C 6 and Red Rock Ranch ranches.

These BMPs provide alternative sources of water in the uplands that has allowed three of the four ranches to implement a rest-rotation grazing system. The Red Rock Ranch-Kunde Allotment has taken non use during the project term but will implement a rest-rotation system when the ranch is restocked. This system facilitates movement of livestock on a planned schedule and in response to watershed conditions, moving them across pastures to reduce impacts on sensitive areas yet improve livestock production. Riparian areas are rested each summer during the growing season and upland pastures are rested every other year

### **III. Results of Project**

Even during the short (3 year) project period, the watershed has shown recovery that has reduced sediment and been beneficial to water quality. Since the second year of this project Red Rock Creek has run clear during the summer rains as opposed to clouded with sediment prior to the project. The Forest Service has upgraded the condition of the Riparian area to “fully functional” using their Proper Functioning Condition rating criteria.

Diversity of riparian vegetation has improved to include deer grass, willow and a variety of trees and grasses not previously present.

Upland vegetative cover has improved steadily since the implementation of the project began (U of A data). Ranchers have seen a noted decrease in the percentage of bare ground, sheet and rill erosion. Richard Collins of the C6 Ranch states, “Headcuts have stopped and the reseeded areas in CCC Flats now have thick grass cover on 3:1 slopes instead.”

Over the five year period, massive amounts of data were collected. For example on the C6 Ranch alone, each years’ observations and data analysis added up to over 100 pages. Because of the size of the monitoring reports, they are submitted in electronic format in the appendix. The following is a general summary of the results as submitted by Richard Collins, C6 Ranch.

**Baseline:** The five consecutive years of monitoring on each selected site gives an adequate description of the extant vegetative communities in Red Rock Canyon Watershed. The five year interval included a drought in

2002-03, the second driest two year period since 1910, followed by 2006-07 when summer rainfall was near the long-term average, although winter precipitation was still somewhat less than average. Thus, changes could be observed in vegetative communities during drought, and during short-term recovery (through 2007). The five year study also provides a baseline from which we can follow mid and long term changes in future years.

**Precipitation:** Monitoring at each site in each pasture gives the manager valuable information on which to base movement of the herd through the ranch-length of time and intensity (number of animals) of grazing each pasture, and the sequence of pasture use. Recording daily rainfall at two locations on the ranch gives the frequency of rain during a season. Frequency and timing of rainfall can be a more precise indicator of range condition than total rainfall. For example, having summer rainfall of 10" total would be more beneficial if the total occurred over 20 days spread over July-September, than if the same total came in 10 days toward the end of summer.

**Funding for Range Improvements:** The monitoring program because it included an entire watershed and had been initiated by the ranchers and had worked in collaboration with the Forest Service and the University of Arizona the project was able to secure grant funds from several agencies. The Arizona Department of Environmental Quality (ADEQ), NRCS-Environmental Quality Incentives Program (EQIP), Arizona Dept of Ag-Crop & Livestock Conservation Program, and Quivira Coalition provided grant funding to install range improvements (fences, waters, new wells, solar systems, pipelines and troughs) valued at \$654,000.00. All granting agencies understood the need to work in partnership and improve the entire watershed and entire ranches to support the goals of watershed improvement.

**Herd Rotation:** In rough, mountainous terrain, cattle tend to congregate in the bottoms, over using those areas and under utilizing the upper areas. Rotation is required to maintain plant vigor, forage production and plant diversity.

**Impact of Grazing:** Monitoring concluded that the impact of grazing on the watershed was negligible compared to the impact of moisture (or lack of it). At the current stocking rates, drought is the driving force behind changes in vegetative communities over time. This can be seen by comparing monitoring parameters in grazed and ungrazed pastures; the trends are nearly the same, and both follow the rainfall pattern and not the presence or absence of livestock. An exception is the riparian pastures (see below)

**Plant Diversity:** We found 187 species and more could potentially be added if the riparian areas were included (sedges and rushes). This number is considered high diversity.

**Comparison of current and past data:** Existing Forest Service transects were used (Parker) as part of the monitoring. This enabled a comparison of the appearance of the same area from photos and data collected in the 1950-1970's with data collected during this project. Overall, bare soil decreased and ground cover, especially litter increased markedly from the 1950-1970's to the present. This is probably related to both reduced grazing intensity resulting from lower cattle numbers and in the Siebold allotment riparian areas (East and West Red Rock pastures), the switch from year-round grazing to short duration-high intensity grazing in the winter.

**Riparian Pastures:** Winter only grazing improved the riparian pastures markedly. On the Siebold (riparian part of the Crittenden Allotment), the C6 Ranch started its pasture rotation in 1998 resting East and West Red Rock pastures for approximately 10 months and grazing them only in November and December (dormant season) at relatively high stocking rates. By 2006, the creek banks had stabilized with soil deposition and abundant growth of deer grass. Young willows, cottonwood, walnut and shrubs had taken root and grown tall enough to shade the creek channel. When running water is present, trench pools and rills provide adequate fish habitat. Locating upland waters for livestock contributed to beneficial changes in grazing patterns, with cows spending more time in the uplands.

**Similarity Index:** SI determined from the data ranged from 41% to 90% throughout the watershed, and all but one was above 52%. According to Forest Service classification, these SI percentages indicated that the rangeland was in good to excellent condition.

### **Evaluation of Project:**

**Benefits:** A benefit to agriculture has been that grazing will be maintained in Red Rock Canyon Watershed. Comprehensive quality monitoring has provided data that shows that rangeland and riparian areas are in good to excellent condition and the ranchers have accurate, detailed descriptions of the vegetative communities.

There is a five year baseline to use for identifying long term trends in conditions, as each ranch continues its monitoring in the future. The Red Rock ranchers now understand the process of rangeland monitoring, why it is important in range management and to the agencies (Forest Service, US Fish & Wildlife Service). Water developments and fencing and

rotational grazing practices have improved ground cover (litter, live plants) thereby reducing soil erosion and loss, increased water retention and improvement in water quality being discharged by the watershed into Sonoita Creek. Preliminary estimates by the Forest Service using the Revised Universal Soil Loss Equation (RUSLE) indicated that soil erosion in the watershed was occurring at about twice the tolerable rate of 22,264 Tons/ac/yr, reducing the capacity of the watershed to produce vegetation and delivering 4500 tons/ac/yr of sediment into Red Rock and Sonoita Creek. Installation of the new grazing practices and improvements over the entire 51,000 acres (total area of the 4 ranches) are estimated to reduce sediment production by 50% over 10 years.

There have been significant local benefits with two of the ranches receiving significant increases in stocking rates because of monitoring results. On the C6 Ranch, weaning weights have increased ~50 pounds due to increased forage. Working relationships have improved between the ranchers and Forest Service as trust was built working toward the mutual goal of watershed improvement. Ranchers and Forest Service staff worked side by side in the field, gathering data and spent time analyzing the results and discussing them at meetings of the Canelo Hills Coalition. When people from diverse backgrounds get down on their hands and knees to look closely at plants and soils, stereotypes disappear, and a measure of mutual trust and respect can develop. They learn from each other and much of the confrontation and conflict disappear.

The Red Rock Watershed can be a positive example for other watersheds in the west. One example was the workshop on riparian grazing led by the National Riparian Grazing Team from the Bureau of Land Management and Forest Service in April of 2006. The workshop focused on Red Rock as a watershed where grazing in riparian areas had worked to benefit both the rancher and the land. In addition, a small grant from the Quivira Coalition funded the training of a local nurseryman (Jim Koweek) in field techniques of monitoring. Training was done by the U of A Monitoring team and we now have a local resource to use for future monitoring.

The Canelo Hills Coalition has expanded to 12 ranches, encompassing about 150,000 acres, including the watershed of the nearby Babocomari and Santa Cruz Rivers.

A project close out presentation seminar was given in November of 2007 at the Sonoita Fairgrounds. Forty seven people from the area, agencies and across the state attended. The project was summarized in a panel presentation by the ranchers and the monitoring methods and data were presented. Those in attendance had the opportunity to ask questions of all the project partners present.

In addition to the close out seminar, each of the ranches submitted an evaluation of the project guided by the following form with their answers summarized :

**Project evaluation:**

***The goal of this project was to improve water quality in Red Rock Canyon by implementing a rest-rotation grazing system.***

**Did the project meet the goals?**

A: Yes as evidenced by the fact that the Creek had no cover 10 years ago and has now recovered to Proper Functioning Condition with a diversity of plant life. When Red Rock Canyon flows, the water runs clear,

**Were you able to implement a rest-rotation grazing system or improve the one you had?**

A: Yes- (As applies to Vaca, C6 and Open Cross Ranches, Red Rock did not graze during the project term) There is now dependable water on the Open Cross Ranch allowing for a rest-rotation system and a two herd concept, giving more options for grazing. The C6 is now able to be fully stocked due to grazing options on all of the pastures.

**Was cover improved on your ranch?**

A: Yes- cover was improved on all ranches and measured by the University of Arizona monitoring team. Weaning weights on two of the ranches have increased by 50 pounds per calf. The US Forest Service has temporarily increased the allowed stocking rates on all of the ranches in the project.

**Did you see any visible changes in erosion or sediment movement?**

A: Yes-Red Rock has documented improvement in the riparian area and creek health (see photos). Open Cross has noted visibly less sheet and rill erosion, headcutting has been halted on the C6 in areas of concern.

**Was water quality improved in Red Rock Canyon? If so, how do you know? Were there conditions that made measuring water quality improvement difficult? Were there any physical changes that you saw?**

A: Yes-from limited measurements that were available. Riparian vegetation increased, water appeared clearer upon visual inspection and the Gila Topminnow population is thriving. Because of the time required for upland projects to have an impact on riparian areas and streams, other than sediment, specific water quality indicators were not monitored as part of the project.

**What were the greatest benefits of this project?**

A: Grazing options, greater weaning weights, greater stocking allowance. Wildlife-deer population used to leave Red Rock but now stays because there is water, cover and food year-round. Improved bat habitat, greater frog production, water for equestrian traffic on the Arizona Trail. Energy cost savings with the use of solar systems.

**What were the challenges of this project?**

A: Illegal traffic causing problems with pipelines, leaving gates open on water lots. Estimating the amount of time implementing a project will take is a challenge. It always takes longer than one would think.

**What would you do differently or recommend to someone else to do differently?**

A: Bury all pipelines, request funds to establish more water monitoring. Make water lots larger-make fences around springs and dirt tanks larger. Make sure the solar panels are mounted high enough and on sturdy poles to protect them from vandalism.

**How many people do you think you reached with information about the project during the 3 years we worked on it?**

A: Approximately 1000

## **OUTREACH**

A key component of this project was the outreach that was developed with the goal of teaching others about the project, the methods and benefits of using a watershed approach and long term monitoring.

The following is a list of outreach activities that were conducted as part of this project:

- Society for Range Management – Presentation by Richard Collins of the C6 Ranch to an audience of 70
- Arizona Cattle growers meeting-Payson-Presentation by Bob Hudson of the Vaca Ranch to 50, with brochure handout
- Southeast Arizona Ag Day- Presentation by Richard Collins of the C6 Ranch to 50
- Southeast Arizona Ag Day-Booth by Coronado RC&D- exposure to 250 attendees.
- Riparian Monitoring Workshop-presented by U of A monitoring team and attended by 70
- Range 101-monitoring education workshop- 30 attendees
- Monthly review by the Santa Cruz NRCD

- Santa Cruz County Fair-Santa Cruz County provided watershed dynamic education to 200 people using a watershed model. Informational brochure was provided as a handout.
- Tours-The project hosted a tour for the Western Region and Arizona Associations of Natural Resource Conservation Districts.
- Publications- A brochure was developed to use as a handout, project articles were featured in the RC&D newsletter

#### **IV. IMPLICATIONS & RECOMMENDATIONS**

This project is an example of a committed group of ranchers working together with each other and state and federal agencies in a win-win situation. As ranchers, their livelihoods are dependant upon their ability to raise cattle economically on grazing land. As leasees of federal lands, they must comply with regulations and stocking rates set by the administering federal agency. It is in their best interest as well as that of the federal agency to improve watershed health. The four ranchers in this project were the core of the Canelo Hills Coalition that has now grown to include 12 other ranches in the area. This group has shown that by working with multiple partners to implement sound management practices, there can be great mutual benefit.

Red Rock Canyon is the targeted water at the bottom of the watershed. By using the watershed approach, involving multiple stakeholders and improving watershed conditions starting from the top , water quality can be improved. Watershed based water quality management is the right thing to do because it protects, restores and maintains healthy ecosystems. It is an effective way to protect chemical water quality while at the same time protecting critical terrestrial and aquatic habitat, reducing soil erosion, and restoring aquatic communities. These benefits make the approach particularly useful for solving nonpoint source problems. (EPA publication 841-R-95-003, 1995)

Arizona watersheds are arid by nature, but each one drains to a wetland, creek or river that creates a unique oasis for wildlife to congregate and for the human population to find respite. In order to influence the health of these streams, the upper watershed must remain healthy. Accelerated runoff can cause serious downstream water quality concerns, destroying habitat and/or creating health hazards for humans. To make an impact on the upper watershed, it is necessary for landowners to work together to address upland issues through management practices. More upland acres improved translates into more miles of stream improved or protected.

Education is necessary to pass technical skills and information gained on to others with the goal of maintaining a long term watershed improvement ethic.

*Specific recommendations:*

- a) Use a watershed approach, working with neighbors to have the greatest impact possible*
- b) Set specific goals for your watershed*
- c) Create partnerships with Universities, state and federal agencies, and others that can provide the training and technical expertise you need.*
- d) Insure that all partners are committed to the goals for the long term*
- e) Select a project "leader" or "champion" that can lead or coordinate efforts.*