

CHAPTER 3 - AFFECTED ENVIRONMENT

LAND STATUS

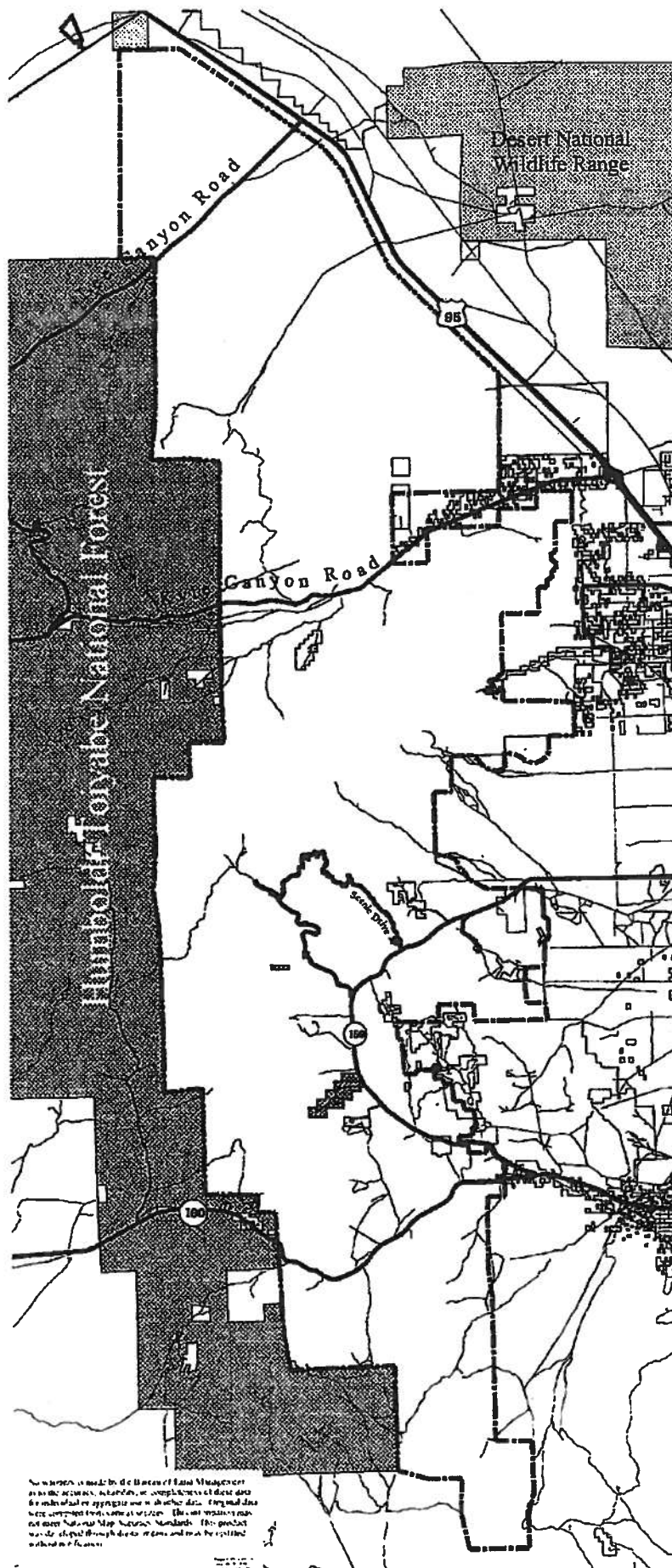
Red Rock Canyon presently consists of approximately 196,000 acres. Private and State of Nevada inholdings located within the legal boundary of RRCNCA include Spring Mountain Ranch State Park, the town of Blue Diamond, the community of Calico Basin, Bonnie Springs/Old Nevada, part of the James Hardie Gypsum mine, the Desert Sportsman's shooting range and several parcels along the Kyle Canyon Road including the "Williams" property. The Oliver Ranch near Blue Diamond, was acquired by the BLM in 1993 and increased the acreage of the NCA by an additional 300 acres (already included in the above acreage).

In 1990, when RRC became a National Conservation Area (NCA), all included lands were withdrawn from all forms of entry, appropriation or disposal under the public land laws; from location, entry, and patent under the mining laws; and from operation under the mineral leasing and geothermal leasing laws. An exception is valid existing rights (claims and rights-of-way established prior to NCA designation). The table below lists the mining claims that are still valid and remain active.

Mining Claims Located within the Red Rock Canyon NCA

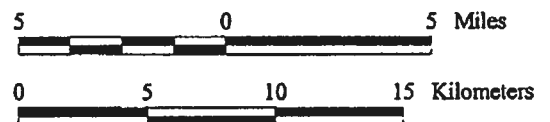
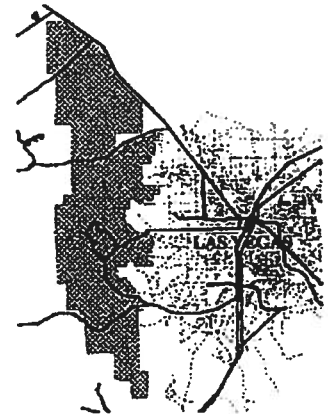
LOCATION	NMC NUMBER	NAME	TYPE	DATE FILED
T22S, R58E, SEC 18	125396	Copper Hill #5	Lode	07/01/43
T22S, R58E, Sec 18	125396	Copper Hill #6	Lode	07/01/43

Lands added through exchange or Congressional action following the initial designation of the NCA are immediately subject to the above limitations. Exchanges involving lands in Calico Basin, James Hardie Gypsum Mine, Summerlin and the Williams property are either ongoing or have been preliminarily discussed. An additional inholding of interest is the State owned parcel of land located in the Pine Creek vicinity.



LAND STATUS

Red Rock Canyon
National Conservation Area
General Management Plan



Legend

----- Red Rock Canyon NCA Boundary

Land Status

- Desert National Wildlife Range
- Humboldt-Toiyabe National Forest
- Indian Reservation
- Private
- Public Land
- State Land
- Spring Mountain Ranch State Park

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United States Department of the Interior
Bureau of Land Management
Las Vegas Field Office

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12/09/2000

FACILITIES - BUILDINGS, ROADS AND TRAILS

Buildings and Sites

Visitor Center

The RRC Visitor Center is a 7,600 square foot facility offering information and interpretation about recreation opportunities, wildlife, wild horses and burros, vegetation, geology, cultural resources and much more. The facility also offers a bookstore operated by "Red Rock Canyon Interpretive Association" (RRCIA), a non-profit organization with the mission of researching and sharing interpretive information about RRCNCA and assisting the BLM with endeavors related to interpretation.

In the same location as the Visitor Center is the "Red Rock Canyon Bicycle Pavilion". The pavilion offers a rest stop/destination location, with water and a restroom, for bicycle enthusiasts. It also includes benches and picnic tables providing opportunities for day use picnicking and group gatherings.

After eighteen years of use and increasing visitation, the Visitor Center is too small to handle current visitor loads, suffers from aging facilities and exhibits and does not provide adequate space for staff and volunteer needs. Space compromises and minor redesigns over the years have tried to meet needs, but they are not enough to compensate for the needs created by increased staff, volunteers and the success of the RRCIA bookstore.

No provision was made for a bookstore in the original design and the current bookstore is a major part of the visitor services being offered. Storage space for materials and supplies is both inadequate and hard to access. Staff has to crawl through displays to get to some areas and a stage area was sacrificed to provide storage for RRCIA's books and materials.

The exhibits still receive favorable comments from the public, but they are badly aged and out of date. Some of the principal problems are: none of the maps have been updated with the 1994 NCA boundary, signs are cracked and peeling, the recreation exhibit is dated and there is an inefficient use of space. Exhibit upgrading has been accomplished by the Interpretive Association, not BLM.

On a positive note, the completion of the office expansion has improved working conditions for BLM staff, volunteers and RRCIA.

A proposal developed and approved in 1996 is to pursue an addition to the current Visitor Center providing for additional restrooms, a small auditorium, meeting room(s), increased office space and increased storage. Actions taken to date to implement the proposed action and alleviate some of the problems listed above are:

- 1) A long-range concept plan has been prepared by the BLM's National Applied Research and Sciences Center in Denver. A multi-disciplinary team of engineers, architects and space planners conducted a needs analysis by observing current uses of the Visitor Center and interviewing staff, Red Rock Canyon Interpretive Association (RRCIA), Friends of Red Rock Canyon (FORRC) and other users. The concept plan recommends the addition of a three building complex, adding 12,000 square feet of space to the building site. The buildings would include one for restrooms and offices, one for an auditorium and one for meeting rooms and environmental education.
- 2) Congress allocated \$ 540,000 in Fiscal Year 1997 for the remodeling and upgrading of the existing Visitor Center to allow it to meet immediate needs until the concept plan can be implemented.
- 3) With the assistance of a \$ 25,000 grant from FORRC, a 600 square foot meeting room addition has been built on the west side of the Visitor Center.
- 4) RRCIA has moved its sales area into the remodeled center of the building providing expanded and secured space for sales items. RRCIA funded the cost of remodeling this area to suit their needs. This will provide security for sales items and allow more flexible use of the Visitor Center after hours.
- 5) The wand system has been replaced by a new more flexible system. The wands now carry the message and the visitor does not have to stand within radio loops to hear messages. The wands are able to be used outside the Visitor Center and carry several languages.
- 6) A new restroom facility has been constructed in the parking lot. This reduces pressure on the aging Visitor Center and is more convenient for visitors.

Oliver Ranch

In August 1993, BLM acquired the 300 acre Oliver Ranch through a land exchange. The ranch has been used for NCA administrative functions such as housing wild horse corrals, a fire station, employee and volunteer housing, and equipment storage.

The ranch has been recently visited by engineers by the BLM's Denver Service Center and the structures were deemed unsound. As a result, Oliver Ranch has been condemned for the present time while the cultural significance is reviewed by the State Historic Preservation Officer (SHPO) to determine eligibility for the National Register of Historic Places. After the determination has been made, a specific site plan for Oliver Ranch will be developed. One proposal that will

be considered in that plan will be the inclusion of an outdoor environmental education center.

Red Spring

Red Spring is another site in need of further review and the completion of a specific site plan. Due to the biological sensitivity of the area, more consideration will be given to the natural resources, while continuing to offer interpretive opportunities and picnic facilities.

Oak Creek Campground

The Oak Creek Campground has been closed and replaced by the 13 Mile Campground.

Wheeler Camp Spring Natural Area

Approximately 20 acres around Wheeler Camp Spring were fenced through a cooperative project with the Red Rock Audubon Society. The project was initiated to protect wet meadows, which were being damaged by off-road vehicle use, and allow overused riparian areas to recover. Increased vegetation growth is already evident. Eradication of tamarisk within the spring area should continue to be pursued if success in preventing regrowth can be expected. As part of National Public Lands Day in 1996 two check dams were constructed to slow flash flooding and rebuild streambed soils. The dams have already shown significant impacts through the slowing of flows and the deposition of materials in the streambed.

Scenic Drive Sites

A continuing problem along the Scenic Drive is parking. Not all of the planned parking areas and overlooks were constructed, and those that were built were under designed. This has resulted in the public's creating parking areas and pulling off to take photos at desired locations. Most of these locations coincide with sites originally planned for a pull-off. Calico I developed this way, and the High Point Overlook was developed on a hairpin curve at a point where many visitors stopped along the road to take photos. (See the following map M19 for locations of the following sites along the Scenic Drive)

Calico I Overlook and Trailhead

A very large percentage of visitors stop at this overlook because of its location and spectacular scenery. After re-construction in 1993 to correct original construction deficiencies, this site is adequate on most days. However, when both climbing and flower viewing activities are going on in the spring, the parking area is too small. Additional parking spaces were added on the right side of the road

just beyond the bus parking area in 1998 accommodating 10-15 more cars. The overlook area next to the parking lot has not been completed with a hard surface and interpretive signing. The trail, which has developed down the ridge from the overlook, is heavily used, but provides a hazard due to its slope and the natural gravel surface.

Calico II Overlook and Trailhead

This site has a significant parking problem due to its close proximity to the Gallery, a favorite climbing site. On many spring and fall days, the parking area is full of all day climber vehicles by 10:00 AM. This leaves no space for short visit sightseers and hikers. There is no potential to increase the size of the site, because it was built on the crest of the ridge and the ground falls away quickly on both sides. A permanent restroom was installed in 1998 using entrance fee revenues.

Sandstone Quarry Parking Area and Trailhead

This site is heavily used by visitors on hikes up the wash and to the top of the Calico Hills. In 1998, using entrance fee revenues and other funding, the parking area was re-designed and paved, increasing capacity by about 50%. Part of the exit road will be blocked off to move vehicles away from the historic townsite foundations along the road.

High Point Overlook

This site, planned in the original Scenic Drive design, was not completed until 1994 and was not paved until 1998. It solves a safety problem from visitors parking along the road curve at the highest point to take photos. The site is heavily used.

White Rock Road and Trailhead

This site provides access to the Keystone Thrust, Grand Circle and Willow Spring/La Madre trails. The road requires constant maintenance due to the rocky soil and should be paved as soon as possible. This location could provide an alternative to the crowded areas like Sandstone Quarry, Lost Creek and Willow Spring if it had a better access road and good signing making it more attractive to users. Several trail loops can be accessed from this trailhead including loops to Sandstone Quarry and La Madre Spring/Willow Spring/Lost Creek. A permanent restroom was installed at the end of the road in 1998 using entrance fee revenues.

Lost Creek Trailhead

This site provides access to the Lost Creek, Children's Discovery, Willow Spring Interpretive and White Rock trails. It is heavily used

by individuals and school groups and barely meets the needs for parking space and school bus access. A permanent restroom was installed in 1998 using entrance fee revenues.

Willow Spring Picnic Area

This is the oldest developed site in the NCA. Originally constructed with covered tables and picnic grills, this site had deteriorated to an unacceptable state due to vandalism and neglect. By 1992, all picnic shelters were gone, most tables damaged and the toilet was in dire need of repair. Through the efforts of many volunteers and Eagle Scouts, major improvements have been made in the last several years. New tables have been purchased, the spring water lines repaired and extensive landscaping installed. The venting system on the toilet has been reworked, and a handicapped toilet was added in 1995.

La Madre Spring Trail and Dam

In 1995 the road to La Madre Spring was blocked at the junction with the Rocky Gap road. This was necessary due to the damages associated with increasing vehicle use on the road. While in the past most users confined their vehicles to existing roads, in the last two years there have been an increasing number of problems with vehicles pioneering new or expanding existing roads. There have been two instances where vehicles simply drove by the impoundment dam and kept going up the drainage where there is no road. Both got stuck and had to be towed out. The dam is in good condition. Repairs by volunteers solved leakage problems at the old outlet pipe.

Ice Box Canyon Parking Area and Trailhead

With the parking expansion completed in 1993, this site is adequate. Paving of the dirt portion of the parking area and installation of a permanent restroom was accomplished in 1998.

Red Rock Wash Overlook

This site is the most under-utilized site on the Scenic Drive. There is no particular reason for visitors to pull off here because no facilities are evident (or provided). There is not any particular attraction provided at this site, but it is surrounded with a panoramic view in the distance of the Calico Hills, the La Madres and the Spring Mountains escarpment. This makes it a good location to direct weddings, with the normal availability of the site.

Pine Creek Overlook and Trailhead

This site has probably received the most damage from users due to serious under-design in capacity. The parking area is at best 1/3 the size needed, which has resulted in significant vegetation loss as

vehicles are parked wherever space is available. Recent parking controls to prevent further damage have resulted in vehicles parked along the Scenic Drive. Expansion of this area was planned in 1991, but never completed. This should be a priority project when funding becomes available.

Oak Creek Trailhead

This site is north of and provides a better access to Oak Creek than the old route from the old campground site. Use has increased as visitors learn of the easy access to Oak Creek. A permanent restroom was installed in 1998.

Red Rock Vista

Red Rock Vista, which is also referred to as the Dedication Site, was recently remodeled and expanded. It now accommodates 75 vehicles and facilities include toilets, picnic tables, and a short hike to the top of a knoll, which gives visitors some separation from the parking area and provides an excellent location for events such as small weddings.

The location is not actually along the Scenic Drive, but on the north side of State Route 159, midway between the entrance and exit of the Scenic Drive.

OVERLOOKS & PARKING

Name	Use	Capacity	Capacity on Scenic Drive
Calico I	Scenic view of Calico Hills/ Access to hiking, technical climbing, and rock scrambling	35 spaces designated	294 spaces
Calico II	Same as Calico I	Approximately 25 spaces	
Sandstone Quarry	Restrooms/ Access to hiking and scenic viewing in historical area	Approximately 30 spaces	
High Point	Scenic view of valley floor, Calicos, and escarpment from highest point on Scenic Drive	Approximately 30 spaces	
White Rock	Hiking access	Approximately 24 spaces	
Willow Spring/Lost Cr	Restrooms/ Hiking and picnicking/ Cultural resource interests	Approximately 69 spaces	
Ice Box Canyon	Scenic view of escarpment/ Trailhead	Approximately 34 spaces	
Red Rock Wash	Viewing point for Red Rock Wash	7 spaces designated	
Pine Creek Canyon	Restrooms/ View of escarpment/ Trailhead	15 spaces - most designated	
North Oak Creek Canyon Access	Trailhead to access Oak Creek Canyon from north	Approximately 25 spaces	
Red Rock Vista	Scenic view of RRC north of Red Rock Vista/ Interpretation and dedication site of RRC	Approximately 75 spaces	(not within Scenic Dr)
Red Spring	Picnicking/ Cultural resource interests	Approximately 39 spaces	(not within Scenic Dr)

Roads

Scenic Drive

The 13 mile Scenic Drive was completed in two phases - 1972 and 1978. It was designated a one-way road upon completion of the second phase in 1978. The road surface is in good condition, but district maintenance staff has noted that the increased number of cracks in the 1972 section indicates the need to consider a resurfacing (or lift) in the next few years. Because vehicle use is primarily passenger cars, the road does not exhibit the typical rutting of two lane roads used by heavy trucks. Uncontrolled desert willow and cliff rose growth along the edge of the road caused minor damage in several locations due to root growth.

The increasing number of motor vehicles and bicycles on the Scenic Drive has created several safety concerns. There has been a significant increase in recreational bicyclists as compared to bicyclists working on racing skills or conditioning. Drivers get distracted by the scenery and may not notice bicyclists riding two and three abreast or bike riders who overestimate their conditioning and turn around and ride back to the entrance against one-way traffic. The two lane width of the road offers some solution to the competition for space, but is probably not a long-term solution. A separate bike lane paralleling the Scenic Drive was included in the original Master Plan, but not constructed. There are differing opinions on whether this would solve or create problems if built.

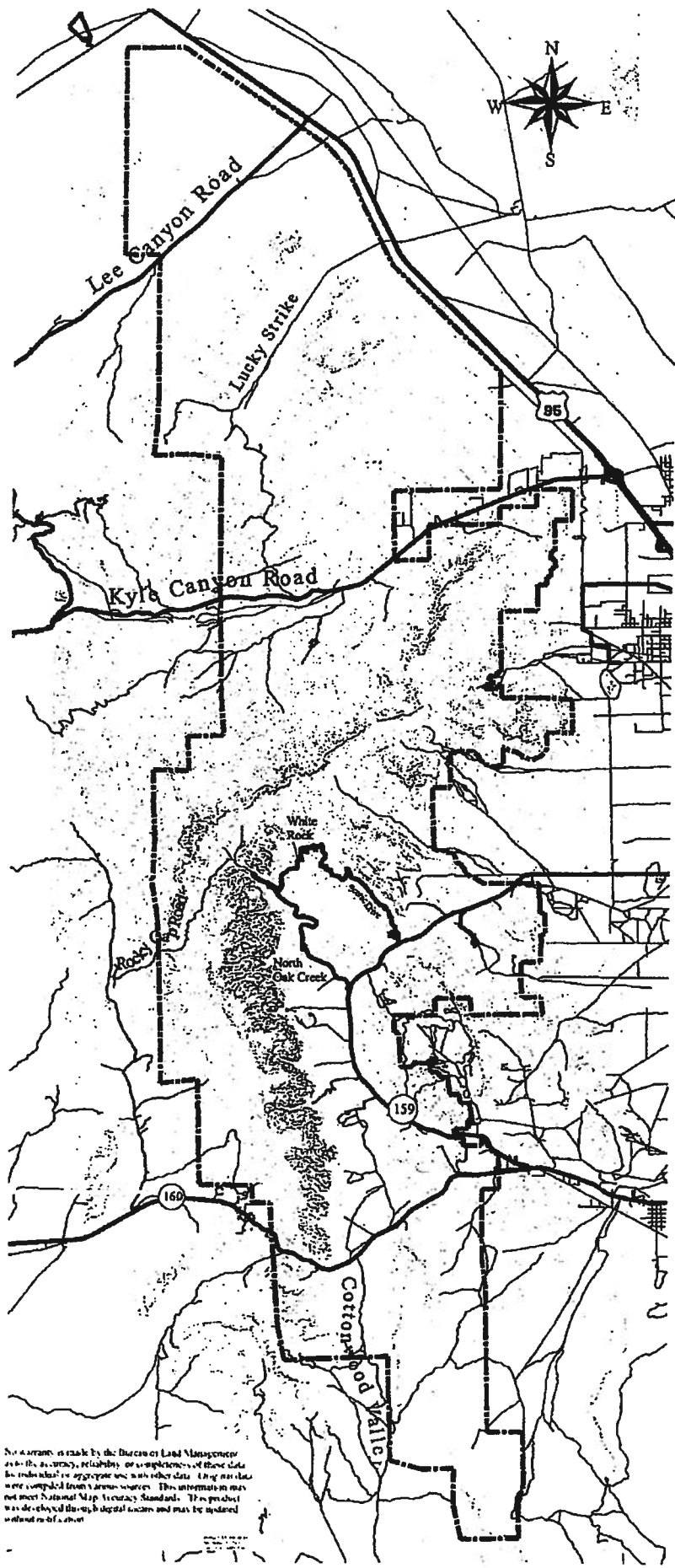
Major roads in addition to the Scenic Drive include State Highway 159 (Charleston Blvd. to Blue Diamond), State Highway 160 to Pahrump, the Rocky Gap Road over the escarpment to Lovell Canyon, the Cottonwood Valley Road to Goodsprings, the Kyle Canyon Road and the Lee Canyon Road.

Numerous dirt and gravel roads exist within the NCA. Some of these are used regularly while some are used rarely. Many of the older dirt roads in the vicinity of the Scenic Drive and along Highway 159 were closed when the Scenic Drive was constructed as the primary travel route in the area. Others, like the First Creek, Cave Canyon and Oak Creek roads, were closed when the amount of vehicle use began impacting the natural resources at unacceptable levels. These roads have been converted to hiking, horseback and mountain bike trails. Additional roads were listed for closure in the Interim GMP.

Many of the dirt roads in the NCA have been claimed by Clark County as Revised Statute (R.S.) 2477 rights-of-way. RS 2477 was a Federal law (now replaced by the provisions of the Federal Land Policy and Management Act - FLPMA) which granted public highway rights of way based upon the act of construction by a public entity rather than through prior application as is the practice today. Most of these rights-of-way were not formally documented until after the passage of

FLPMA in 1976, which required the States/Counties to submit a listing of RS 2477 right-of-way claims. Clark County submitted its list of RS 2477 roads in 1979. This issue clouds long-term management of vehicle use in the NCA, because many of the now abandoned or closed roads are claimed as county roads on the 1979 list. Discussions have been held with county officials about relinquishment of RS 2477 claims, within RRCNCA, not needed for county purposes. Final resolution has not been reached.

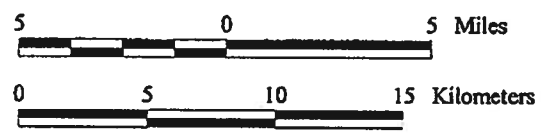
MAJOR ROADS			
Name	Type	Length	Length Totals
State Highway 159	Paved	11.9 miles	40.4 miles
State Highway 160	Paved	4.3 miles	
Scenic Drive	Paved	13.0 miles	
Lee Canyon	Paved	5.6 miles	
Kyle Canyon	Paved	5.6 miles	
Lucky Strike Canyon	Dirt	8.8 miles	19.1 miles
Rocky Gap	Dirt	6.0 miles	
White Rock	Dirt	.6 miles	
North Oak Creek	Dirt	.7 miles	
Cottonwood Valley	Dirt	3.0 miles	



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MAJOR ROADS

Red Rock Canyon
National Conservation Area
General Management Plan



Legend

----- Red Rock Canyon NCA Boundary

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Trails

While the 1976 Master Plan laid out a system of trails, the system was never implemented. Instead, a number of individual trails to specific locations evolved primarily through casual visitor use without effort to link them together. This resulted in numerous user created paths, particularly in the Calico Hills, which were beginning to cause serious erosion and visual problems.

In 1994 Public Lands Appreciation Day (PLAD) was used to kick off the implementation of a unified trail system. By Sept. 1995 (PLAD 1995) the major portion of the system had been completed. The core of the system is a loop trail, the Grand Circle, which leaves the Visitor Center and roughly parallels the Scenic Drive to Lost Creek and then returns to the Visitor Center via the old Willow Spring Road. This trail passes through Calico I & II overlooks, the Gallery, Sandstone Quarry and White Rock and provides connections with trails to the Moenkopi Loop trail, Calico Tanks, Keystone Thrust, La Madre Spring, Lost Creek and Willow Spring. A connector trail, south from Lost Creek, tying the core system with the Ice Box Canyon, Pine Creek and Oak Creek trails was completed in June of 1997. This connector terminates at the Oak Creek Trailhead.

Mountain Bike Trails

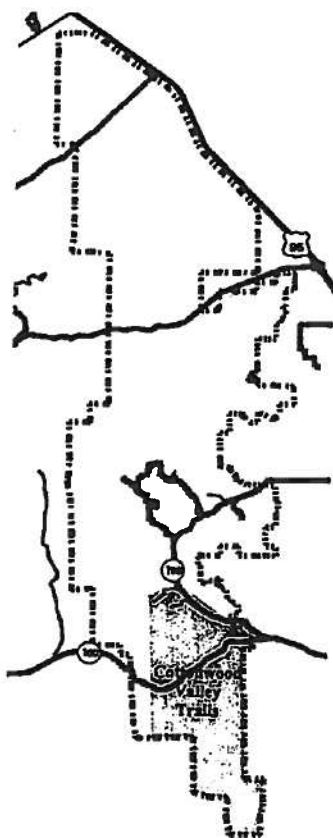
Mountain bikes are permitted on any of the paved or dirt roads in the NCA. Other than roads, mountain bikes are not allowed off designated trails. The main trails being designated for mountain bike use are those composing the Cottonwood Valley network. An EA for these trails was completed in May of 1996 and they have been officially designated (signed and marked) in the field. The following table is an inventory of the trails composing the network. There have been a few modifications and changes, some of which are still being evaluated, but the trails are basically as listed.

The trails listed in the following table fall into the intermediate and advanced levels because of length and technical aspects involved. Riders at the beginner level should start with the dirt roads and gradually work into the intermediate trails as their skills improve.

Additional bike trail possibilities will be considered in the north expansion area as the GMP planning process continues. 48 miles of trail, including opportunities for all challenge levels, have been scoped.

TRAIL NAME	LENGTH (miles)	CHALLENGE LEVEL
Land Mine Loop	8.1	intermediate
Loop du Jour	33.0	advanced
Cottonwood Valley Race Course	5.7	intermediate
Dead Horse Loop - 2 versions		
short version	14.0	intermediate
long version (w/Raven Spur)	18.0	intermediate
Original Horse Trail	17.6	intermediate
Badger Pass	14.8	intermediate
Late Night	7.1	intermediate
The New 33	32.9	advanced
The Mam Man	11.1	intermediate

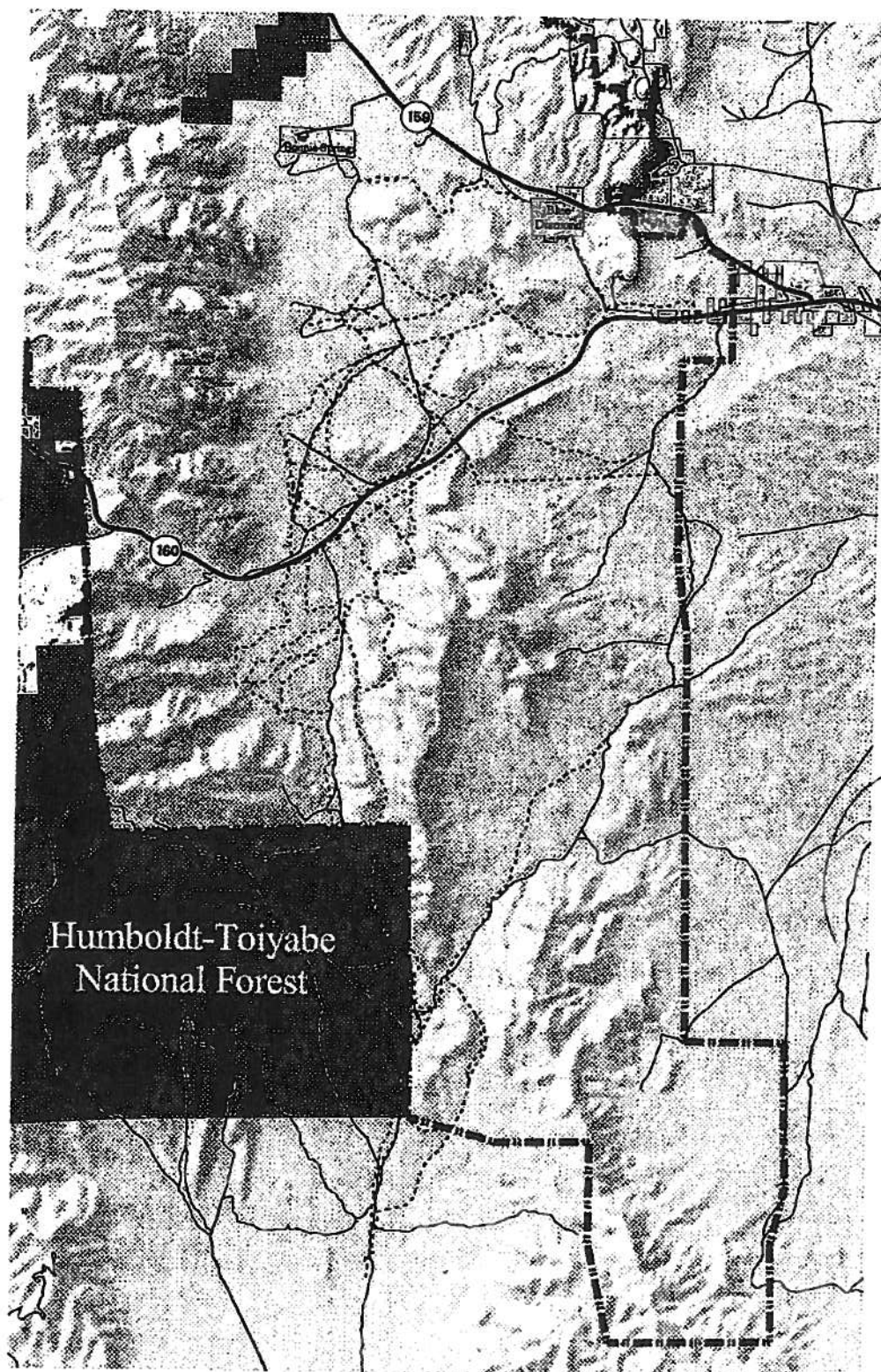
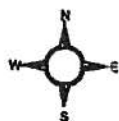
COTTONWOOD VALLEY TRAIL SYSTEM



Trails are designated multiple use for mountain bikes and equestrian use. Motorized vehicles are limited to designated roads.

Legend

- Red Rock Canyon NCA Boundary
- Trails



Humboldt-Toiyabe
National Forest

1 0 1 2 Miles

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BLM/RT/00/001

M19

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Hiking and Equestrian Trails

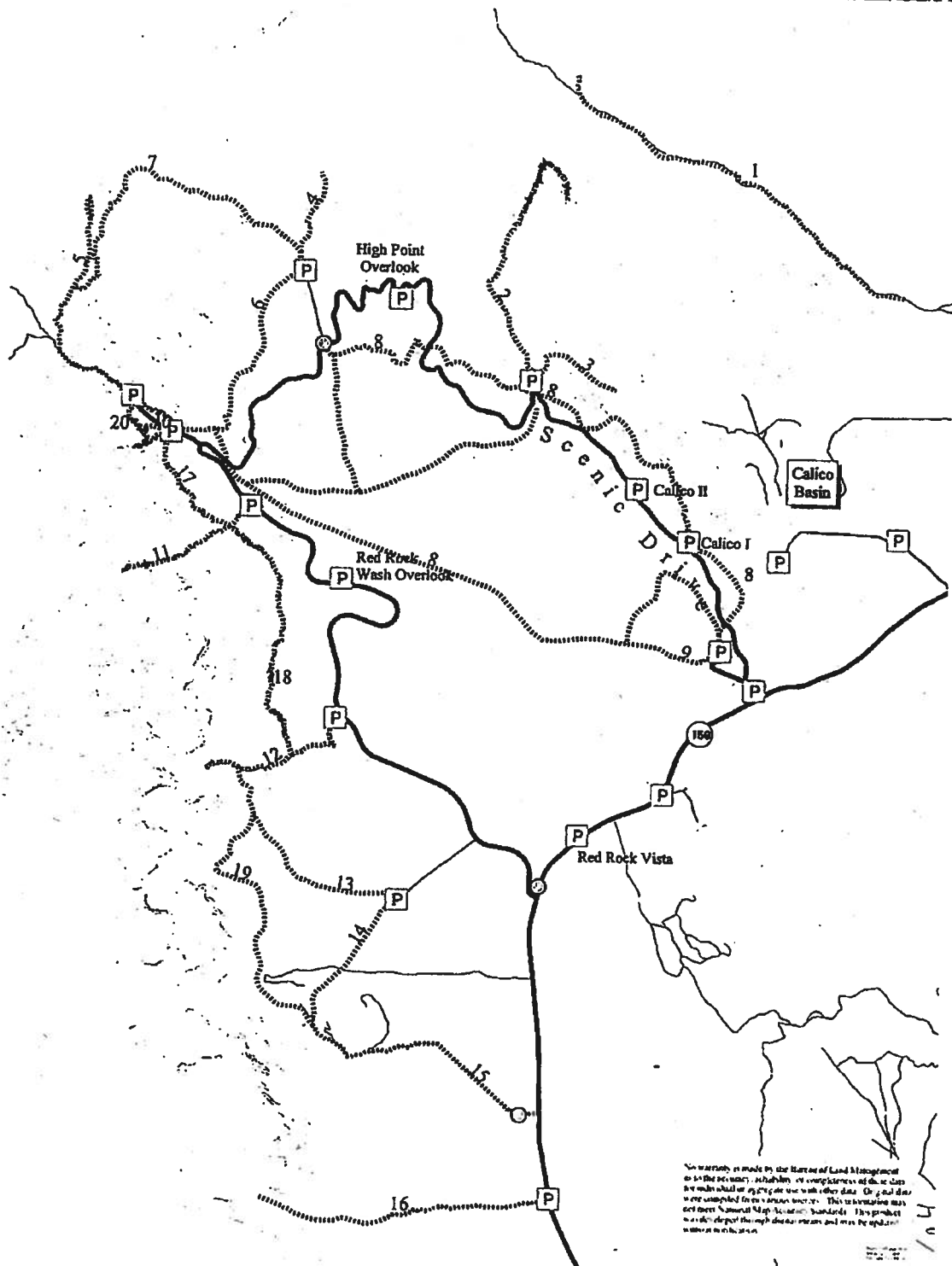
Existing and planned hiking and equestrian trails are in the IGMP, which includes the core NCA only. No trails have been designated in the expansion portions of the NCA, other than the mountain bike trails included in the Cottonwood Valley network.

Some of the trails in the Scenic Drive area are designated for hiking only, due to the amount of use they receive and the congestion that would be created with mixed use. Other trails are being reviewed in regards to use designation and compatibility of the different trail user groups.

A BLM trails brochure is distributed to hiking enthusiasts at the RRC Visitor Center. It includes popular hikes in the Scenic Drive vicinity and south as far as First Creek. There are many routes that exist and are used, but they have not been officially designated. They have been considered in this planning process to determine which should be designated and which should be restored back to a natural state.

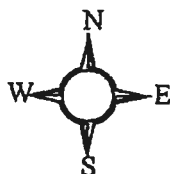
The following is a table of RRC hiking trails. The "loop" trails are hikes that end where they begin without retracing portions of the trail.

EXISTING TRAILS IN THE SCENIC DRIVE AREA



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Legend	
.....	Trails
Trailhead	
P	Parking
O	Parking-Equestrian Staging Area



1 0 1 Miles

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M20

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12/10/2000

NAME & NUMBER	MILES one way	REMARKS & CHALLENGE LEVEL (E) - easy (M) - moderate (S) - strenuous
1 Brownstone	1.7	Hike begins at gate on road, and occurs mostly in wash. (M)
2 Turtlehead	2.5	Destination (no constructed trail). A strenuous climb gaining 1,700 feet in elevation. Provides a most excellent view from summit. (S)
3 Calico Tanks	1.2	Destination, which consists of a large tinaja (natural water catchment). Requires some rock scrambling. (M-S)
4 Keystone Thrust	1.0	Area of geological interest. (E-M)
5 La Madre	1.5	Follows old road to small dam. (M)
6 White Rock - Willow Spring	2.0	Easy pleasant hike though ground level vegetation. (E)
7 White Rock Loop	6.0	Encircles White Rock Hills & includes trail 6 & portions of 4 & 5. Offers interesting diverse scenery. (M)
8 Grand Circle Loop	11.0	Connects sites throughout 1st half of Scenic Drive, then returns to Visitor Center from Willow Spring on old road. (M)
9 Moenkopi Loop	2.0	Interpretive trail beginning and ending at Visitor Center (E)
10 Children's Discovery Trail/Lost Creek	.7	Interpretive hike featuring year round creek, seasonal waterfall and a great diversity of plant life. (E)
11 Ice Box Canyon	1.0	A really cool hike which may involve some rock scrambling to view interesting features. (M)
12 Pine Creek	1.0 + .9 loop	Offers a diversity of features including an old homestead site, perennial creek and unique flora. 2nd half of trail is a loop. (M)
13 Arnicht	1.6	Begins at the N Oak Creek parking lot and enters the Pine Creek homestead site from the back. (M)
14 N Oak Creek	1.0	An easy hike into Oak Creek and an opportunity to take a 3.5 mile loop by including the Knoll and Arnicht trails. (E)
15 S Oak Creek	2.5	Follows old road from campground site off SR 159 to the mouth of Oak Creek Canyon. (M)
16 First Creek	1.5	The southern most trail in this network of trails leads you to the mouth of First Creek Canyon. (E-M)
<u>Escarpment Base Trail</u> - composed of trails 17, 18 & 19 and provides a nice scenic adventure. A good way to enjoy this trail is to hike with a friend and stage a vehicle back at your choice of several locations.		
17 SMYC	1.1	Section between Lost Creek and Ice Box. (M)
18 Dale	2.2	Very scenic section between Ice Box and Pine Creek. (M)
19 Knoll	1.9	Lower section running from Pine Creek to Oak Creek (will eventually continue to First Creek). (E-M)
20 Willow Spring Loop	1.3	Interprets cultural resources in the Willow Spring vicinity. (E)

VISITOR DEMOGRAPHICS

The following information is from the "Customer" survey completed in 1992 by the Outdoor Recreation and Wilderness Assessment Group (ORWAG), a research unit of the USDA Forest Service, Southeastern Forest Experiment Station. Assessments were made through on site interviews at RRC and written surveys distributed by mail.

Gender - Out of 908 interviews, approximately 55% were male and 45% female

Age - 40% were from 25-44 years of age
25% from 45-64
Approximately 10% in each remaining age group
11 and younger
12-14
65 and older

Race/Ethnic - 87% white
8% hispanic
The remainder composed of other minorities

Education - Highest level completed
14% bachelor's degree or equivalent
46% some college
26% high school diploma
14% did not receive high school diploma

Employment - 44% work full time (40 hour week)
16% retired
Other groups each around 7-10%
Not employed, student, self employed,
Part-time, homemaker

Annual Household Income - 35% from \$25,000 - \$50,000
Other groups each around 10%
Less than \$10,000
\$10,000 - \$24,000
\$50,000 - \$75,000
More than \$75,000
Would not disclose

Impairment - Slightly over 2% had some type of impairment, with half involving mobility and the other half including hearing, visual and mental

Instate-Outstate - 55% of visitors from instate and most residing in Clark County.
45% of visitors from outside of Nevada

WILDERNESS

Red Rock Canyon National Conservation Area (RRCNCA) includes portions of two areas which have been studied for consideration as designated wilderness areas. The La Madre Mountain Wilderness Study Area (WSA) includes the northern portion of the core (original) NCA and into the northern NCA expansion to the Harris Springs Road and the Kyle Canyon Road east of the Harris Springs Road. It is bordered to the southeast by the RRC Scenic Drive area and to the southwest by the Pine Creek WSA. The two WSAs are separated only by the Red Rock Summit Road (Rocky Gap Road) and included corridor. The Pine Creek WSA, within the NCA, continues south along the west boundary to State Route 160, and runs along the base of the Red Rock Escarpment as the east border (see map at end of this section).

The WSAs were studied under Section 603 of the Federal Land Policy and Management Act of 1976 (FLPMA) and were included in the Clark County Wilderness Recommendations/Environmental Impact Statement (EIS). The Final Wilderness EIS was filed in April, 1987.

The WSAs, encompassing 32% of the RRCNCA, will continue to be managed in compliance with the Interim Management Policy for Lands Under Wilderness Review (IMP), H-8550-1, until acted upon by Congress. If designated as wilderness, they will be managed under the provisions of BLM Manual 8560, Management of Designated Wilderness Areas, and under the regulations at 43 CFR 8560. If released from wilderness study they will no longer be subject to the IMP, and will be managed under the provisions of this management plan.

La Madre Mountain WSA

The La Madre Mountain Wilderness Study Area (WSA) (NV-050-412) encompasses approximately 61,630 acres of public land on the east side of the Spring Mountains, approximately 12 miles west of Las Vegas, Nevada. A large part of the south central portion of the WSA (41,918 acres) is contained within the RRCNCA.

The northern boundary of the WSA is identified by a dirt road and the Humbolt-Toiyabe National Forest boundary as it existed prior to 1990. The eastern boundary extends generally along section lines for approximately six and one-half miles to where it intersects private lands and then borders private lands adjacent to Brownstone Basin. The southern boundary is the Red Rock scenic loop drive, Willow Spring road and Red Rock Summit road between the Pine Creek and La Madre WSAs. The southwest boundary is generally identified by the Lovell Canyon road and utility line extending to private property in Lovell Canyon, the private property boundary around the Sky Mountain Preserve, and the Lovell Summit road between Lovell Canyon and Trout Canyon. The west boundary is the quarter section line in sections 15, 22, and 27, T. 20 S., R. 58 E., slightly east of the private

property in Trout Canyon.

The National Forest and Public Lands of Nevada Enhancement Act of 1988, adjusted administrative boundaries, placing approximately 20,324 acres, 33 percent, of the WSA within the Humbolt-Toiyabe National Forest. Approximately 18,955 acres (45 percent) of the area recommended for wilderness designation will be under Forest Service administration and 23,050 acres (55%) will be under BLM Management. The remainder of the area is recommended for uses other than wilderness.

The recommendation for this WSA, as identified in the Nevada BLM Statewide Wilderness Report (1991), is to designate approximately 42,005 acres of public land as wilderness because of its high quality values, its outstanding opportunities for both solitude and primitive and unconfined recreation, the lack of conflicts with uses of the area, and the overwhelming public support for designation of this area. Approximately 19,625 acres would be released for uses other than wilderness.

The recommendation differs from the proposed action in the Final EIS due to changed land status. The western end (west of Lovell Canyon) is now contiguous with designated wilderness (Mt. Charleston) and is a natural link between the existing wilderness and the area proposed for wilderness. Alternative A (with revised acreage figures) was then selected to replace the original proposed action and now is the recommendation.

The area is manageable as wilderness, due primarily to the extreme rugged terrain, dense vegetation and its relative inaccessibility to motorized vehicles. Much of the area recommended for wilderness designation is within the RRCNCA where off-highway vehicle (OHV) use is limited to existing roads and trails.

Areas of the WSA not recommended for wilderness designation includes the northern portion where there are conflicts with mining claim development, increased pressures from urban development, and increased OHV activity on an existing way. The western portion surrounds private lands within Lovell Canyon, where management of the area as wilderness would be difficult due to the sights and sounds of resort activity. The recommendation emphasizes maintaining access to the northern portion, for mineral exploration and development, and to the western portion for recreation development.

The entire WSA is predominately natural. La Madre Mountain and the other mountains, hills and valleys which comprise the area recommended for designation, are essentially untouched by man. Most OHV activity is concentrated outside this area on the northern and southeastern portion with the majority occurring outside of the WSA.

The area recommended for uses other than wilderness is primarily in a

natural condition, however, the influence of external activities decreases the quality of the experience. Mining claims, OHV activity, and future proposed development of private lands combine to reduce the natural qualities of the area.

Within the area recommended for wilderness designation, outstanding opportunities for solitude exist. The rugged complex of deep canyons, draws, summits, ridges and the pinyon-juniper cover provides excellent screening and secluded areas. In the portions recommended for uses other than wilderness, the influence of urban development, mineral activity, and sounds of OHV activity significantly diminish the quality of solitude.

Primitive and unconfined recreation opportunities are outstanding in the area recommended for wilderness because of the variety, quality, and accessibility of the activities. Day hiking, backpacking, rock climbing and scrambling, nature study and photography are all outstanding due to the unique special features of the area and the variety of destinations and levels of challenge. Access to the area is outstanding from all directions, primarily from locations within the RRCNCA.

Primitive recreational opportunities exist in the portions of the WSA recommended for uses other than wilderness, however, the quality and diversity of that opportunity is significantly less than in the area recommended for wilderness.

Red and buff colored sandstone formations in the Calico Hills, White Rock Hills, Brownstone Basin, and Little Red Rock area are of geological, ecological and scenic interest. The cross-bedded sandstone demonstrates their origin as former sand dunes. The brightly colored sandstone contrasts sharply with the rugged, spectacular limestone cliffs that backdrop them. La Madre Mountain and its sheer cliffs on the southeast side are the single most dominant feature within the area recommended for wilderness. The Keystone Thrust of the older limestone of the La Madre Range, that has been pushed over the younger sandstone, is dramatically evident above Brownstone Basin. This particular site is internationally regarded as the single finest example of a thrust fault and is of significant geologic and scientific interest.

The large variation in elevation (6,000 feet) allows for a variety of plant communities from Southern Mohave desert shrub to sub-alpine environments of white fir and ponderosa pine. Natural water impoundments in the sandstone provide near-perennial water sources that support a variety of wildlife. The area provides crucial summer habitat for a sizeable herd of bighorn sheep and a small herd of elk.

Prehistoric sites occur throughout the area recommended for wilderness. Site types include rock art panels (both pictographs and petroglyphs), agave roasting pits, rock shelters, camp sites, milling

sites, and lithic and ceramic scatters. Brownstone Canyon has been listed on the National Register of Historic Places because of the concentration and diversity of cultural site types, the occurrence of rare polychrome pictographs.

The area recommended for wilderness can reasonably be managed as wilderness. The area is a solid block of public land with no private inholdings, State lands, split estate lands or rights-of-way. No valid rights currently exist. Most of the area is in the RRCNCA and closed to mineral entry. Mineral resource potential has been identified as low and development of minerals is not expected.

Within the area not recommended for wilderness, a lack of natural and physical impediments to OHV access, and known sand and gravel and nonmetallic mineral resources make this area unsuitable for wilderness management.

Assessment of the mineral potential for that portion of the La Madre Mountain WSA recommended for wilderness found that stream sediments delineated a zone of slight silver, lead and zinc anomalies. However, the report judged the area to have low mineral resource potential for silver, lead, and zinc. No known deposits of nonmetallic minerals occur within the area, and discovery of significant near-surface deposits is unlikely. Sand, gravel and limestone suitable for construction materials are abundant within the area, but, because similar materials are available closer to major markets, occurrences were not classified as resources. The potential for petroleum resources is rated as low.

Pine Creek WSA

The Pine Creek Wilderness Study Area (WSA), (NV-050-414), is located approximately 15 miles west of Las Vegas, Nevada. It contains 24,618 acres of public lands, with no split estate or private inholdings. The majority of the WSA (19,952 acres) is inside the Red Rock Canyon National Conservation Area (RRCNCA), in the southern portion of the Spring Mountain Range. The west boundary of the WSA is identified by a utility line right-of-way and the Lovell Canyon road. Private land in the Mountain Springs area and a utility line right-of-way mark the southern boundary. The Red Rock Summit road marks the northern boundary of the WSA. The east boundary of the WSA follows the base of the Red Rock escarpment, skirting around two small parcels of State owned lands.

The National Forest and Public Lands of Nevada Enhancement Act (Public Law 100-550) adjusted the administrative boundaries for the Humbolt-Toiyabe National Forest, placing approximately 15 percent of the Pine Creek WSA within the new Forest boundary.

The recommendation for this WSA, as identified in the Nevada BLM Statewide Wilderness Report (1991), is to designate 22,966 acres of

public land, including 705 acres outside the WSA, as wilderness and release approximately 2,357 acres for uses other than wilderness. Wilderness designation is recommended because of high quality wilderness values and special features, its easy accessibility for primitive and unconfined recreational uses, the lack of conflicts with other actual or potential uses, and the overwhelming public support for wilderness designation of this area.

Designation would preserve and protect an undisturbed area for several solitude-dependent wildlife species, and numerous prehistoric and historic archeological sites. This offers residents of a booming metropolitan area outstanding opportunities for a quality wilderness experience within 15 miles of the urban sprawl.

Outstanding opportunities for solitude and primitive and unconfined recreation are available within the WSA. The numerous canyons and stands of ponderosa pine, pinyon, and juniper isolate visitors from one another and provide geological, ecological and scenic interest for hikers. The sheer sandstone cliffs challenge rock climbers and scramblers and serve as dramatic backdrops for photographers. Perennial springs, seasonally flowing streams, and waterfalls permit backpack camping yearlong. Wildlife viewing and nature study are particularly enjoyable in the cool, moist canyons which support a variety of small and large animal species and many rare and endemic plant types.

Within the area recommended for wilderness, extremely rugged terrain and dense vegetation have acted as a natural barrier, precluding motorized access. This inaccessibility enhances the manageability of the WSA. The RRCNCA encompasses most of the WSA where off-highway vehicle (OHV) use is limited to existing roads and trails.

Conflicts with other resource uses of the lands recommended for designation are limited. Seventy-five percent of the recommended area is contained within the RRCNCA and closed to mineral entry; the remaining western portion of the WSA is open to mining location.

Approximately 2,083 acres of BLM and 274 acres of Forest Service administered land, recommended as nonwilderness, are located along the eastern and western borders of the WSA. Adjustments to the eastern boundary delineated a more easily identifiable boundary along the base of the escarpment. This action would enhance the management of the WSA by providing a recognizable boundary for that portion of the WSA. The remaining acreage recommended as nonwilderness is located in a strip on the western boundary of the WSA, and includes areas where OHV use is ongoing and not impeded by natural physical barriers. Management of this area for OHV use is considered to be more appropriate than for wilderness values.

The 22,966 acres recommended for wilderness are predominately natural. The sandstone cliffs of the escarpment, narrow canyons of

Pine Creek, and the stands of ponderosa pine, pinyon and juniper have formed natural barriers to the intrusion of man. Rare and endemic plant species still flourish adjacent to the perennial stream and springs and along ephemeral water courses; solitude-dependent wildlife still find quality habitat within the WSA.

The majority of the area is free of man's imprints. A single 2 mile long cherry-stemmed way runs on the west side of the study area; this is a localized imprint visible only from the immediate vicinity.

Within the area recommended for wilderness designation exists outstanding opportunities for solitude. The rugged complex of canyons and ridges provides excellent topographic screening. The sandstone cliffs have differentially weathered into natural arches, bridges and pockets that create numerous secluded spots. These geologic features are heavily interlaced with dense stands of pinyon-juniper and ponderosa pine, forming isolated glades in which the visitor is remote from even relatively nearby groups. Willow, ash, and hackberry form a secondary vegetative cover along the canyon bottoms. These distinctive features combine to create an area where not only can outstanding solitude be found, but where its enjoyment is greatly complemented by natural and scenic values.

Opportunities for primitive and unconfined recreation are outstanding in the area recommended for wilderness designation because of the variety, quality, and accessibility of the activities. Day hiking, backpacking, rock climbing and scrambling, nature study and photography are all enhanced by the unique geology, scenic beauty, rare and endemic biota, and rich cultural manifestations. Perennial spring and seasonal catchments provide year-round water sources for backpack camping.

Several special features supplement the wilderness values of the area recommended for wilderness designation. The sandstone cliffs are the dominant landform feature. The cross-bedding of ancient sand dunes and the Keystone Overthrust of limestone are of geologic and paleontological interest. Weathering of the sandstone layers has created natural bridges, arches, and sloughs through which seasonal runoff cascades as waterfalls to the canyons below.

Canyons below the escarpment create micro-climates that sustain botanical resources dramatically different from those of the surrounding Mohave desert. They support species of milkvetch, penstemon, worts, and numerous ferns that are endemic to Red Rock Canyon and the Spring Mountains. Relic stands of ponderosa pine occur at unusually low elevations in the WSA.

Unique plant communities and reliable water sources of the Pine Creek WSA sustain a variety of solitude-dependent animals. A sizeable herd of bighorn sheep find crucial summer habitat within the area recommended for wilderness. The presence of kit fox, bobcat,

mountain lion, and a variety of raptors also offers excellent opportunities for scientific observation and nature study in this WSA.

A wide range of cultural resources are of special value in the reconstruction of regional history. High concentrations of rock art sites, with both petroglyphs and the more unusual pictographs, rock shelters, and campsites suggest that the unique biomes within the WSA were very important to early peoples. Milling stations and agave roasting pits point to the processing of local plant resources. The historic Spanish trail also passes through the extreme southern end of the WSA.

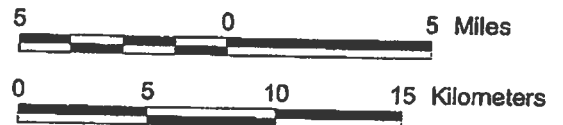
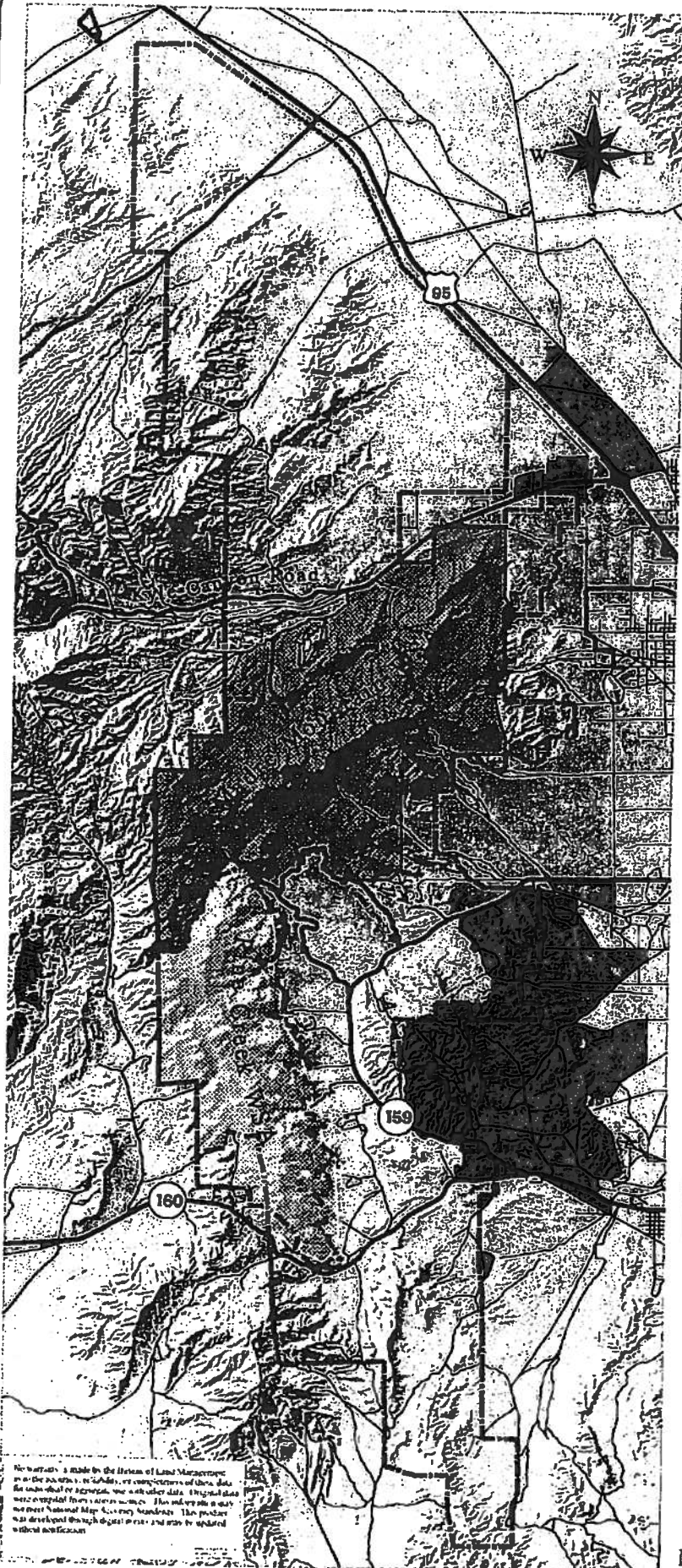
The entire WSA and the additional acreage recommended for wilderness designation could reasonably be managed as wilderness to preserve values now present in the area. The area is a solid block of public land with no private inholdings, State lands or rights-of-way. OHV use is confined to existing ways within the WSA, and designated roads in the RRCNCA.

The WSA has moderate favorability for oil and gas, low favorability for geothermal, and has low to no favorability for metallic minerals. The entire WSA has moderate favorability for sand and gravel resources.

Eighty-one percent (19,952 acres) of the WSA is contained in the RRCNCA, and thus segregated from mining laws, preventing mineral entry. An additional 150 acre area, Pine Creek Research Natural Area, is also withdrawn from mineral entry. There are twelve oil and gas leases covering 22,800 acres of the WSA. Approximately 35 post-FLPMA mining claims are located in the southwest portion of the WSA. This area is not recommended for wilderness.

WILDERNESS STUDY AREAS WITHIN RED ROCK CANYON NATIONAL CONSERVATION AREA

Red Rock Canyon
National Conservation Area
General Management Plan



Legend

- Red Rock Canyon NCA Boundary
- Area Recommended for Wilderness Designation

Wilderness Study Area (WSA)

- La Madre Mountain
- Pine Creek

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BIODIVERSITY

The *Affected Environment* of Red Rock Canyon National Conservation Area is more than an assemblage of individual biotic components. In its entirety, the Red Rock Canyon environment also comprises an integral portion of the *Spring Mountains ecosystem*.

LANDSCAPE ECOSYSTEM: SPRING MOUNTAINS

An ecosystem is a community of organisms that functions with its non-living environment as an integrated unit. The moisture and organic decomposition of a rotting log sustains a unique host of fungi, insects and various other organisms. The log is thus a microsite ecosystem within a larger riparian habitat ecosystem, and so on through ecosystems of canyon, watershed and mountain range scale. The function of ecosystems together span all of the complex linkages between energy flows; nutrient cycles; food chains; environmental processes and cycles; biotic succession; disturbance regimes; evolutionary change; community, population and species dynamics; and the flow of gene materials.

The appropriate ecosystem scale at which to evaluate the affected environment of Red Rock Canyon is the Spring Mountains landscape. Biotically, the distinct physical conditions of the Spring Range support communities and species that are unique from those of the adjacent open desert. Opportunistically, the Spring Mountain Range poses the increasingly rare case of an unfragmented landscape ecosystem that is wholly under public ownership, as well as protective management status (NCA; USFS National Recreation Area). A landscape-centered holistic focus offers the most cost-efficient solution to ecological conservation goals as comprehensive and complex as those of Red Rock Canyon National Conservation Area.

BIOLOGICAL DIVERSITY

Biological diversity (also *biodiversity*; *biotic diversity*) is the "variety and variability of living organisms ... (and) ... of the ecological complexes in which they occur; encompassing all levels of biotic organization from ecosystems to species to ... genes." (Office Technology Assessment; 1987). Biological diversity is a dynamic aggregate of ecosystem diversity, community diversity, species diversity, genetic diversity and diversity of ecological processes. Biotic diversity thus refers to viable populations of native species maintained in sustainable ecosystems. The degree of biological diversity that is present in the Spring Mountains is highly significant. This quality reflects not only the variety and rarity of area species, but also the variety of their communities and associations, and the intactness of the landscape ecosystem.

Biogeography

Many factors contribute to the great biodiversity of the Spring

Mountains. Geographically, the range lies in a transition zone between the Colorado River Plateau, the warm Mojave Desert and the Great Basin cold desert. This melding of physical and biotic influences heightens the variety of site adaptive niches to be filled by organisms, both at the species level and in numerous associations. Over time, as natural populations have dispersed into this "biological crossroads" region, the terrain relief of the Spring Mountains has presented habitat conditions suitable to both species with low elevation southern affinities (warmer and drier) and high elevation northern affinities (cooler, wetter). Biological niches are differentiated along gradients of wind, precipitation, sunlight, shade, humidity and soil conditions; which in turn are affected by the topographic variables of slope, aspect, exposure and elevation. Spring Range soil conditions are particularly diverse, owing to their broad spectrum of parent materials (dolomites, limestones, shales, gypsum, sandstones) and wildly variegated surface layer; these being the combined result of the area's unique geological history (thrust faulting, crossbedding) and routine weathering.

Springs

Another geological factor in the biodiversity of the Spring Mountains ecosystem is the unique abundance of springs and seeps. Many of the springs are controlled by impermeable fault contacts between rock strata of different density, eventually resulting in lateral movement of yearly precipitation that has percolated down to the impermeable layer. The other local springs discharge from perched or elevated water tables of respective aquifer systems. Also contributing to this favorable spring hydrology is the fact that the Spring Mountains receive more annual precipitation than other southern Nevada ranges (Bradley; 1965).

The local springbrooks are typically short, due to rapid water infiltration on alluvia largely composed of gravels and porous sandy soils. The passive discharge mechanism of these springs leads to wide fluctuations in their output, either seasonally or from year-to-year. Durations of surface flow also vary. While some springs function continuously throughout the year (perennial springs), others cease flowing during the hottest months of the year (intermittent springs). Local intermittent springs usually fail by mid-summer and resume flowing during the fall. Some very low-volume intermittent springs fail altogether in drought years or other extended periods of abnormal environmental conditions. Because the springs are all recharged by winter precipitation and infiltration, their peak output typically occurs during the late spring or early summer. Finally, there are also local perennial springs that exhibit patterns of interrupted flow (First Creek; Oak Creek), alternately sinking and resurfacing in the streambed as varied substrate densities are encountered.

Forty springs have been inventoried in RRCNCA (Appendix 10A); 17

historical records are pending verification (Appendix 10B). Nine other records, including citations from previous Red Rock Canyon planning documents, have recently been invalidated as duplicate or false reports (Appendix 9C). RRCNCA has 31 perennial and 9 intermittent springs, with discharges ranging from unmeasurable traces (wet soil only) to 100 gal/minute. Approximately 50% of the NCA springbrooks do not exceed 100 feet in length, nor do the longest streams (South Fork; La Madre) exceed 0.5-0.75 miles. In terms of biological significance, Red Rock Canyon possesses no fewer than 10 perennial springs with average minimum outputs of 25 gals/minute (La Madre, South Fork, Wheeler Camp, Lost Creek, Oliver Ranch, Oak Creek, Mormon Green #1, Pine Creek, Rainbow and Bootleg). The Red Rock Canyon and Spring Mountains landscape ecosystem is an oasis of life-giving surface water located amid an otherwise arid desert environment.

Surface Water Availability

Geologic weathering of the signature exposed sandstone strata in Red Rock Canyon has produced an array of water-holding depressions, called tinajas. These natural water catchments are distributed throughout the NCA, but are especially abundant in the Sandstone Escarpment and in the Calico Hills. Tinaja pools range in capacity from scant ounces to many thousands of gallons, with depths of water from inches to several feet. Regardless of individual size, tinaja water sources are vital to many Red Rock Canyon wildlife species, in particular the Bighorn sheep (Ovis canadensis). Tinajas occur in vicinities that lack spring sources (Brownstone Canyon; Little Red Rocks), and include pools that can persist beyond mid-summer, thus supplementing the diminished output from perennial springs or replacing altogether the waters from intermittent springs that have seasonally failed.

In addition, there are 9 artificial water catchments in Red Rock Canyon (see Appendix 11). Three have varied potential benefit to wildlife, particularly Bighorn sheep, for similar reasons as for tinaja waters. Two are circa-1930's Civilian Conservation Corps masonry reservoirs built onto rimrock faces in Brownstone Basin; the other is a mammal guzzler built in 1974 by the BLM and Nevada Division of Wildlife (NDOW) to improve Bighorn sheep habitat in the north drainage of La Madre Mountain. Six more NDOW guzzlers were erected in Cottonwood Valley in 1987 to specifically benefit two game birds, the native Gambel's quail (Callipepla gambelli) and Chukar (Alectoris chukar), an introduced Eurasian species. The guzzlers consist of sheet metal aprons that funnel rain and snow water into partly-buried tanks that are wildlife accessible.

The rugged terrain also contributes to the episodic formation of ephemeral streams in what ordinarily are dry channels or washes. These ephemeral streams are the immediate surface run-off from storm events, which occur primarily during the Gulf-produced monsoon season of late summer and early fall. The persistence of such streamflows is limited to the duration of the storm events, since the water is

quickly absorbed into the dry channel bottom. However, pools may persist for some days afterward, depending on soil and gravel substrate, shading and rainfall amount variables. Such ephemeral pools offer opportunistic wildlife benefits, from forage water for individual animals to providing the stimulus for localized population blooms, as happens in Red Rock Canyon with both the Red-spotted toad (Bufo punctatus) and Pacific chorus frog (Pseudachris regilla).

Riparian Areas

Just as the geology, hydrology and topography of the Spring Range gives rise to an abundance of local springs, these water sources in turn give rise to the landscape's unique plenitude of riparian areas. More than any other single factor, it is the presence of these riparian areas that accounts for the biodiversity which is, again, the fundamental unit of biological resource value posed by the Red Rock Canyon National Conservation Area. Just as the entire Spring Range ecosystem can be thought of as an island of enhanced biological diversity in comparison to its surrounding desert environs, the riparian areas can be viewed as representing smaller islands of biodiversity within this landscape as a whole. Because these riparian areas also invariably attract and sustain the highest amount of recreational use and feral horse and burro pressure, they pose one of the key management issues in RRCNCA as well.

The BLM classifies riparian-wetland areas as being inundated or saturated by surface or ground water at a frequency and duration necessary to support a prevalence of vegetation typically adapted for life in saturated soil conditions. However, not all riparian areas exhibit the hydric soils, hydrophytic plants and shallow or surfaced water table that is requisite of wetlands under the more ecologically appropriate definition. Bureau policy further defines riparian areas to be a form of wetland transition between permanently saturated wetlands and dry upland areas. The key factor is that these areas exhibit vegetation or physical features that demonstrate the influence of permanent surface or subsurface water, such as lands adjacent to perennially or intermittently flowing spring streams. Ephemeral streams and dry washes do not support plant species dependent on free soil water, and thus are not classified as riparian areas regardless of the fact that such wash vegetation is clearly distinct from that of the immediately adjacent landscape.

Riparian areas provide an array of important functional values in Red Rock Canyon. By physically and chemically trapping sediments in the runoff from upland areas, riparian vegetative cover helps maintain the water quality of the associated springbrook streams. Riparian areas serve as significant flood water storage sites due to the ability to decrease water velocities and increase sediment deposition in upstream locations. Properly functioning riparian

areas help to maintain high water tables and increase the assimilation of organic material into the soil (Medina; 1995). Riparian areas are crucial wildlife habitat as well, furnishing food, water, shelter, predation opportunities and transportation corridors to a multitude of organisms. Within the Spring Range and RRCNCA, many bat, bird, raptor and amphibian populations are especially dependent upon such riparian habitats.

It is the assemblage of riparian areas that is predominately responsible for the biodiversity quality of RRCNCA. The reason being that riparian areas characteristically produce greater biomass and offer more niche differentiation than upland dry habitats. This is also why these riparian areas harbor the greatest proportion of rare, sensitive and special status species found within Red Rock Canyon.

Water is the prime limiting factor in any biological environment. Because the springs in Red Rock Canyon are often the only source of available water across wide expanses of arid desert, riparian areas naturally attract and sustain higher concentrations of life than comparable lands that are without persistent surface waters. Nevertheless, the climate and physical conditions of the Mojave Desert and Great Basin cold desert work against the retention of permanently moist soils (i.e., critical to riparian vegetation). The extreme heat, preponderance of sunny days, low and infrequent precipitation, high evapotranspiration rates and sandy porous soils all combine to restrict the surface influence of the local spring waters. As a consequence, the riparian vegetation in Red Rock Canyon is predominately confined to narrow corridors along the immediate streamcourses.

The biotic value of riparian areas throughout the arid Southwest is disproportionate to their areal extent (Szaro; 1989). Riparian areas are estimated to provide habitat for approximately 80% of all terrestrial species within the Great Basin ecological region (Thomas; 1979). In appropriate recognition of this biotic circumstance, western riparian areas comprise one of the highest program priorities of the Bureau of Land Management today, though representing only approximately 9% of agency-administered lands (BLM; 1994). This resource protection focus is particularly applicable to the riparian areas managed within the Red Rock Canyon National Conservation Area.

Vegetative Communities

The unique biotic diversity of the Spring Mountains and RRCNCA extends as well to the associations formed by natural organisms. In regard to plant species, so great is the variety and variability of local microsite habitat niches, that standard classification schemes of vegetative units, plant communities or series associations are impractical (Myers; 1969) (Leary; 1996). Not only are the boundaries between vegetation groups typically obscure, but their species

composition often changes across quite short distances, even within communities that appear homogenous in structure. A second basic reason for the aggregate diversity is simply the large number of individual plant species; they can combine in more numerous permutations.

There are some general classification concepts that remain useful in describing the complex vegetative mosaic pattern of Red Rock Canyon. One is the universal fact that environmental phenomena tend to exist as gradients, with the result that in areas with topographical diversity (i.e., terrain relief) these gradients are steep enough to cause vegetative gradations that are distinct and visually obvious. Another is, within such elevation-stratified vegetation zones there exist various *biotic communities*. These are natural groupings of plant and animal populations that occupy a given locale, differentiated by their unique sets of shared environmental tolerances and life requirements. Finally, those biotic communities with similar yet different environmental tolerances can then be classified as *community types*.

The RRCNCA vegetative communities can be reasonably grouped into eight major community types, derived from the floristic classifications of Bradley & Deacon (1965) and Leary & Niles (1996). Except for the riparian community, all are *terrestrial types* characterized by the absence of permanent surface water. As the sole *hydric* vegetative type present, RRCNCA's riparian areas are both a generic resource type and a definitive plant community type. In terms of distribution, four are *zonal community types* (creosote bush; blackbrush; juniper-pinyon; pine-fir); four are *transzonal* (riparian; desert wash; chaparral; cliff communities). Species composition and occurrence in the former is determined by elevation gradients and in the latter by other environmental factors such as shade or soil moisture. The result is that the zonal vegetative communities demonstrate a clear pattern of stratified terrain distribution, while the transzonal communities are more variably and diffusely situated in the Red Rock Canyon landscape. In terms of vegetative structure, two of the community types are woodlands (juniper-pinyon; pine-fir), two are desert shrub types (creosote bush; blackbrush) and the rest are intermediate shrub/woodlands (desert wash; chaparral; cliff and riparian).

As to species composition, it must first be stated that all plant communities consist of species with diverse life cycles. Annual forbs (soft-stemmed plants) and grasses complete their full cycle within one growing season, usually in abrupt response to rainfall and temperature changes. The widespread, rapid growth of annuals often occurs from seeds that have lain dormant for years, due to unfavorable site conditions. In southern Nevada, winter annuals sprout after Pacific frontal storms and stay green for months if temperatures remain cool. The production of summer annuals from Gulf monsoon thunderstorms is more scattered and episodic. Biennials

(two-year cycle) and perennials (multiple-year growth and seedset) are more persistent, less susceptible to short-term environmental factors and thus more stable as community components. Though there are important grasses as well, most Red Rock perennials and biennials are woody-stemmed shrubs and trees. Table 1 is a brief outline of species composition in the major RRCNCA vegetative communities (see Appendix 4 for more detail). Ecological status and trend of these communities is discussed later, under Management Concerns.

Ecological Condition

The ecological condition of these communities is determined by comparing the existing plant community on a distinct ecological site with the potential natural community identified for the site. An order 3 soil survey is used to classify and differentiate homogeneous vegetative communities or ecological sites. An ecological site is the product of all the environmental factors responsible for its development, including soils, topography, climate and fire. It is a kind of land with potential for a specific plant community and with specific physical site characteristics. Ecological sites differ in their ability to produce vegetation and respond to management. The native community in an ecological site differs from that of other ecological sites in the kind or proportion of species or total production.

The ecological sites comprising most of the acreage in RRCNCA are Shallow Gravelly Loam 8-10 (Blackbrush (Coleogyne ramossissima) and desert needlegrass (Stipa speciosa)), Shallow Gravelly Loam 5-7 (Blackbrush and big galleta (Hilaria rigida)), Coarse Gravelly Loam 5-7 (Blackbrush, big galleta, spiny Menodora (Menodora spinescens), and winterfat (Cerotoides lanata)), Shallow Gravelly Slope 5-7 (Blackbrush), Shallow Gravelly Loam and Slope 7-9 (Blackbrush, big galleta and black grama (Bouteloua eriopoda)), Gravelly Fan 5-7 (White bursage (Ambrosia dumosa) and big galleta), Limy Fan 5-7 (Big galleta), Limy 5-7 (Creosote bush and white bursage), wash sites and a number of woodland sites dominated by Pinion or Juniper, co-dominant Pinion and Juniper, or Ponderosa Pine. Joshua tree is a common aspect species component of the blackbrush ecological sites.

The ecological condition is use-independent and is defined as the present state of the vegetation and soil protection of an ecological site in relation to the potential natural community for that site. It is an ecological expression of the relative degree to which the kinds, proportions, and amounts of plants in the present plant community resemble that of the potential natural community. A range of classifications from Potential Natural Community through Late, Mid and Early Seral condition with early seral condition being the farthest from the potential of the site. Formal ecological site mapping for RRCNCA has not been accomplished.

Areas that would probably be classified as early seral ecological

condition are predominantly located in blackbrush communities that have been burned by wildfire or subject to past heavy grazing pressure. These areas are in early successional stages. When blackbrush is disturbed by fire, overgrazing or other surface disturbing activities, purple threeawn (Aristida Purpurea), Indian ricegrass (Oryzopsis hymenoides), globemallow (Sphaeralcea ambigua), baileya (Baileya multiradiata), brittle bush (Encelia actoni), and broom snakeweed (Gutierrezia sarothrae) are some of the native species that increase. Red brome (Bromus rubens), Russian thistle (Salsola kali), and cheatgrass (Bomus tectorum) often invade the site. Some of the early seral condition fall within localized areas around riparian areas.

Four one acre exclosures were established in the RRCNCA to study wild horse and burro impacts and to better understand the ecological sites present. Quantifiable vegetative trend and condition data for three of these exclosures is lacking. However, a trend study was done for the Mud Spring exclosure (Mud Spring #1) in 1999. The apparent trends on the burn areas, based on one exclosure (Burn Site #2), when they are subject to re-burn, are downward. No data exists for the burn areas that have not re-burned in recent times. The apparent trends on the Kern River Pipeline seeding (Blondie #3) are strongly upward, but this is based on recovery of a highly disturbed construction site and not the normal conditions found on lands in RRCNCA.

The following table examines vegetative trends and conditions for the Mud Spring exclosure. The analysis and interpretation of the exclosure data looks at the changes inside and outside separately and independently. Relative, not absolute, comparisons over time between the inside and outside would provide information on wild horse use.

TABLE Mud Spring #1 Established May 1, 1990 Coarse Gravelly Loam 5-7 30XB107NV Blackbrush, big galleta, winterfat, & spiny menodora Late Seral Ecological Condition				
Cover/ Plant Species	1990 Percent Cover or Frequency	1993 Percent Cover or Frequency	1999 Percent Cover or Frequency	Analysis and Discussion
INSIDE EXCLOSURE DEEPER SAND SHEET COVER OVER SANDY LOAM MORE PRODUCTIVE LOCATION TREND IS UPWARD due to increase in cover, Indian ricegrass, & big galleta.				
Vegetative Canopy Cover Perennial Only	27.7	29.3	38.3	More mormon tea and larger shrubs.

TABLE
Mud Spring #1 Established May 1, 1990
Coarse Gravelly Loam 5-7 30XB107NV
Blackbrush, big galleta, winterfat, & spiny menodora
Late Seral Ecological Condition

Cover/ Plant Species	1990 Percent Cover or Frequency	1993 Percent Cover or Frequency	1999 Percent Cover or Frequency	Analysis and Discussion		
Red Brome	39.5	64.5	79	Clearly invading the site management action should be considered at sources for seed eg old burns using green stripping etc.		
Indian Ricegrass	9	13	20	Increase is related in part to the deeper sand sheets. Plants clearly 2 to 5 years old.		
Big Galleta	15	20	23	Plants show little growth & low vigor may be ambient temperature related.		
Mormon Tea	13	14.5	10.5	1990 was a very productive year for shrub species while 1992 was 600 lbs/acre less production. Other than the sandier soils inside, it is not clear why Mormon tea and Menodora are less.		
Spiny Menodora	23.5	18	16			
Black Brush	42	37.5	41			
OUTSIDE EXCLOSURE THIN SAND SHEET OVER SANDY LOAM LESS PRODUCTIVE LOCATION TREND IS STATIC TO UPWARD DUE TO COVER, & INDIAN RICEGRASS.						
Vegetative Canopy Cover Perennial Only	36.3	30.6	36.3			
Red Brome	37.5	64.5	78.5	Clearly invading the site. Management action should be considered at sources for seed, eg old burns using green stripping etc.		
Indian Ricegrass	2	5	5.5	Showing a relative increase. However, the sample size is too low for statistical analysis. Use varied from 20 to 60 percent on individual plants in transect area.		

<p style="text-align: center;">TABLE Mud Spring #1 Established May 1, 1990 Coarse Gravelly Loam 5-7 30XB107NV Blackbrush, big galleta, winterfat, & spiny menodora Late Seral Ecological Condition</p>				
Cover/ Plant Species	1990 Percent Cover or Frequency	1993 Percent Cover or Frequency	1999 Percent Cover or Frequency	Analysis and Discussion
Big Galleta	3.5	3.5	1.5	Plants show little growth & low vigor may be ambient temperature related. Use varied from 20 to 80 percent on individual plants in transect area.
Mormon Tea	8	5.5	10.5	Young Mormon tea plants noted in transect. 1990 was a very productive year for shrub species while 1992 was 600 lbs/acre less production. It is not clear why Mormon tea and Menodora vary in frequency.
Spiny Menodora	24	17	20	
Black Brush	76	67	66	The difference in 1990 is unclear other than the heavy production and potential for counting a shrub more than once in 1990.

The overall trend is upward inside the exclosure and static to approaching upward outside the exclosure, due to a slight increase in Indian Ricegrass and existing cover.

The 1998 use levels on galleta and ricegrass outside the exclosure are ranging from 20 to 80 percent on individual plants in the transect area with an average use of 50 to 60 percent. This falls within the moderate range of use. Use at 50 percent or less is preferred to minimize stress on the plants.

Red brome is increasing from 1990 to present at a steady rate. Research on the Nevada Test Site show that this is a natural phenomenon. This means that we are in the beginning stages of a Red Brome invasion. The increase is the same outside as inside the exclosure. The increase has been consistent since 1990.

SPECIES DIVERSITY

Based on species diversity alone, the Spring Range has long been recognized as the most biologically significant portion of Clark County (WESTEC; 1980). Recent scientific investigations have expanded this recognition to assume national, if not global

proportions (Nachlinger; Sada; Morefield; Ramsey; Leary; others). Besides topography and geology, a third biological factor has to do with the combined effects of the climatological history of southern Nevada and the physical isolation of the Spring Mountain range during that time. The cooler, wetter conditions that prevailed throughout the Pleistocene Epoch allowed northern-adapted species to extend their distribution into this southern region. Roughly 11,500 years ago, during the climatic drying and warming trend of the Holocene, many such species were only able to survive in the cooler conditions found at higher elevations. As the drying and warming trend persisted over time, the lower elevation valleys and basins gradually became deserts, essentially trapping many of the cooler-adapted northern species within their respective mountain territories, such as the Spring Mountain Range. Over subsequent centuries this geographical isolation has borne three distinctive traits on the biota of the Spring Mountains and RRCNCA as it exists today.

Table 1. Vegetative Community Types (Summary of Key Species)

<u>COMMUNITY TYPE</u>	<u>[Distribution]</u>
1) Dominant/Codominants 2) Associates- Shrub, Tree 3) Associates- Grass, Forb	
<u>CREOSOTE BUSH</u>	[Below 3600'; Valley floors and benches]
1) <u>Larrea tridentata</u> (Creosote bush); various codominants- <u>Ambrosia dumosa</u> (Bursage) 2) <u>Lycium andersonii</u> (Desert-thorn); <u>Gravia spinosa</u> (Hopsage); numerous cacti 3) Introduced annuals- <u>Bromus rubens</u> (Red brome); <u>B. tectorum</u> (Cheatgrass)	
<u>BLACKBRUSH</u>	[3500-6000'; Bajada terraces with shallow soil]
1) <u>Coleogyne ramosissima</u> (Blackbrush); <u>Yucca brevifolia</u> (Joshua tree) on some sites 2) <u>Yucca baccata</u> (Banana yucca); <u>Ephedra</u> spp. (Mormon tea); <u>Tetradymia</u> (Horsebrush) 3) <u>Hilaria rigida</u> (Galleta); <u>Achnatherum speciosum</u> (Desert needle grass)	
<u>JUNIPER-PINYON</u>	[4000-7000'; upper bajadas and mountain slopes]
1) <u>Juniperous osteosperma</u> (Utah juniper); <u>Pinus monophylla</u> (Singleleaf pinyon) upslope 2) <u>Artemisia tridentata</u> (Sagebrush) 3) Typically barren understory- <u>Elymus elymoides</u> (Squirreltail) not uncommon	
<u>PONDEROSA PINE-WHITE FIR</u>	[Generally above 6500'; upper mountain slopes]
1) <u>Pinus ponderosa</u> (Ponderosa pine); <u>Abies concolor</u> (White fir) on La Madre Mountain 2) <u>Quercus turbinella</u> (Scrub oak); <u>Cercocarpus ledifolius</u> (Mountain-mahogany) 3) Numerous species, many in common with lower elevational community types	
<u>DESERT WASH</u>	[Bisects CREOSOTE BUSH, BLACKBRUSH communities]
1) Highly varied- <u>Chrysothamnus</u> (Rabbitbrush); <u>Prunus fasciculata</u> (Desert almond) 2) <u>Chilopsis linearis</u> (False Willow); <u>Prosopis pubescens</u> (Screwbean mesquite) 3) Similar to adjacent traversed terraces (ie, CREOSOTE BUSH, BLACKBRUSH types)	
<u>CHAPARRAL</u>	[Within upper washes and escarpment canyons]
1) Scrub oak; <u>Garrya flavescens</u> (Silk tassel); <u>Rhus trilobata</u> (Squaw bush); others 2) <u>Rhamnus</u> (Coffee berry); <u>Cercis canadensis</u> (Redbud); <u>Amelanchier</u> (Service berry) 3) Mirrors traversed communities (ie, BLACKBRUSH, JUNIPER-PINYON, PINE-FIR types)	
<u>CLIFF COMMUNITY</u>	[Crevices in upland sandstones and limestones]
1) Highly varied- <u>Haplopappus cuneatus</u> (Golden bush); <u>Agave</u> spp. (Century plant) 2) <u>Petrophytum caespitosum</u> (Rock spirea); <u>Forsellesia</u> spp. (Grease bush) 3) <u>Monardella odoratissima</u> (Pennyroyal); <u>Heterotheca</u> (Golden aster); various cacti	
<u>RIPARIAN COMMUNITY</u>	[Restricted to permanent surface water sites]
1) Varied- <u>Baccharis</u> (Waterweed); <u>Pluchea</u> (Arrow weed); <u>Fraxinus</u> spp. (Ash) 2) <u>Populus</u> spp. (Cottonwood); <u>Salix</u> spp. (Willow); <u>Vitus arizonica</u> (Canyon grape) 3) <u>Carex</u> & <u>Eleocharis</u> (Rushes); <u>Juncus</u> (Sedges); <u>Agrostis</u> & <u>Polypogon</u> (Grasses)	

Relict, Disjunct and Endemic Species

A large number of relict species populations are present, these being descended from those plants and animals which found mountain refuge during the Holocene desertification of the surrounding lowlands. Another relict feature is that some Red Rock species have persisted in ecological habitat niches from which they long ago disappeared in other areas. For example, the White fir (Abies concolor) at the south head of Pine Creek Canyon and Ponderosa pine (Pinus ponderosa) gallery forest on lower Pine Creek both occur at elevations that are significantly lower than those now normally associated with these species. Many of the RRCNCA relict species also represent *disjunct* populations that are geographically separate and apart from the species' main territorial range. Isolation heightens the potential for genetic variation to independently occur within such populations; in turn favoring the eventual creation of distinct sub-species. This enhanced speciation process rate likewise holds true for the Spring Range biota in general. This isolation, climatology and biogeography generated entirely new, locally-evolved species. As a result, many of the plants and animals of the NCA are *endemic* species, occurring nowhere else on earth except southern Nevada, the Spring Mountains or Red Rock Canyon.

PLANTS

Plants not only make up a large part of the total RRCNCA species diversity, but serve critical ecological functions. The body and roots of plants help stabilize soils against erosional loss from storm water run-off and wind. The decay of their organic content is key to the soil-building process itself. Plants produce free atmospheric oxygen while also filtering some airborne pollutants, as chemical by-products of their dual photosynthesis/respiration phenomena. Plants furnish the basic survival needs for animal life, either directly in the form of food and cover, or indirectly by ameliorating such biotic habitat conditions as surface temperature, humidity, shading and soil moisture retention.

For a summary of floristic groups and families, see Appendix 3. Specific species was taken from A Flora of Red Rock Canyon National Conservation Area (Leary/Niles; 1996).

Though conducted as a baseline survey of formal scientific merit, the Flora does not fully reflect the plant species diversity in Red Rock Canyon. The number of missed species is likely small, and almost certainly so if factored with the sizable list of potentially resident species cited by Leary and Niles (based on the close proximity of outside populations and the presence of suitable NCA habitat conditions). The Red Rock Canyon floristic inventory results are extremely impressive (Table 2), especially when the limited survey acreage is considered. This significance applies not just to the overall species number, but also to the diversity of floristic

families represented, as well as to the extraordinary size of the fern species contingent.

Table 2. Plant Species Numbers

FLORISTIC GROUP -Description	Common Name	Species Known/P*	Families
FERNS & FERN ALLIES -Reproduce by spores	<i>Ferns</i>	1407	07
GYMNOSPERMS -Repro by seed[cones]; no flowers	<i>Evergreens</i>	09/--	03
ANGIOSPERMS (DICOTYLEDONS) -Repro by seed[fruit]; flowering	<i>Broad-leafs: shrubs/trees</i>	515/139	69
MONOCOTYLEDONS -Repro by seed; (simple embryo)	<i>Blade-leafs: grasses/herbs</i>	114/42	09
SPECIES TOTAL:		652/188*	88
*Potential			

RRCNCA gymnosperms include two types of cone-bearing (coniferous) species: the signature trees of the juniper-pinyon and fir-pine communities [Table 1]; five shrubs in the genus Ephedra (Mormon tea), also called joint-firs for the fact that their leaves have been completely replaced by thin, green (photosynthetic) stems. Drastic leaf modifications are also common to many of the shrubs and trees in the angiosperm group in Red Rock Canyon. As in any desert environment, plants have evolved morphologically to cope with the extremes of temperature, humidity, solar radiation, lack of precipitation, and accelerated evapotranspiration rate. Leaf modifications are perhaps the most visibly apparent, whether in the form of reduced size, epidermal sheathing (waxy, resinous or hairy), alteration into spines, or total replacement (i.e., cacti). Numerous shrubs and trees in the lower elevation creosote bush, blackbrush and desert wash communities exhibit pronounced desert adaptations. Meanwhile, other counterpart species in the cooler, higher elevation plant communities display the classic broadleaf appearance, such as Redbud (Cercis canadensis) and Canyon grape (Vitus arizonica). With 69 families represented, the angiosperms of RRCNCA run the biotic gamut: parsleys, honeysuckles, mustards, mints and poppies to sunflowers, roses, buckwheats, gourds, cacti, ashes, maples, elms, beeches (oaks) and willows.

The Red Rock monocotyledons are likewise diverse, though more by reason of species and family taxonomy than desert morphological adaptations. What is lacking in species numbers is made up for in historical, ecological and aesthetic distinction. The Century plant (Agave sp.) was a key staple food of local indigenous peoples, as evidenced by the size and number of roasting pits dotting the Red Rock landscape today. All three area Yucca species (Yucca spp.) are integral sources of cover, forage and even pollen to a sizable contingent of closely-associated insects, reptiles, small mammals and birds. In fact, the Joshua tree (Y. brevifolia) is scientifically and popularly acknowledged as the emblem plant of the Mojave Desert. There is diversity inherent in the floristic make-up of this group of non-woody species, which incorporates the grasses, forbs (herbs), rushes and sedges. Distributionally, the grasses and forbs are pandemic throughout the NCA landscape, whereas the majority of rushes and sedges (grass-like plants) are exclusively adapted to riparian, or otherwise marshy, habitats.

RRCNCA harbors an unusual number of fern species in comparison to most desert environments in the region, including mountain ranges of like elevation. Several of the species are also individually distinctive, on the basis of distribution, biology or morphology. An example of the latter is the Giant chain fern (Woodwardia fimbriata), which thrives to a height of five feet or more in the shade of Pine Creek Canyon, and is by far the largest of all Nevada fern species. The ferns are the only spore-reproducing plant species in the Red Rock Canyon ecosystem.

Those same extraordinary shade, humidity, temperature and surface water conditions that make life possible for ferns, benefit numerous other species as well. These comparatively moister, cooler conditions are predominately found in the deep, narrow, east-facing canyons of the central Red Rock escarpment; which explains why this small portion of the NCA landscape constitutes the very biological core of the Red Rock Canyon natural environment. Persistent water is a habitat trait shared by the riparian, chaparral and cliff plant communities. These few limited extent communities (perhaps 15% of NCA acres) not only comprise the bulk of Red Rock Canyon's vegetative species diversity, but all three are distributed primarily in or near this same central escarpment terrain. These communities and this same critical habitat harbor the majority of all distributionally significant and Special Status species in RRCNCA (Tables 3 & 4).

As Table 3 illustrates, Red Rock Canyon NCA supports an important number of plant species that embody some manner of distributional distinction. The relative degree of biotic significance involved here varies from species whose only worldwide occurrence is known from solitary RRCNCA populations to species that are uncommon in this area, but are widely distributed elsewhere. This last category includes ten species which occur in single known RRCNCA populations (see Appendix 3), which even though of no particular outside

importance, do represent discrete increments of Red Rock Canyon biodiversity and are subject to less room for site disturbance.

Table 3. Species of Distributional Significance

GROUP	Relict	Endemic (Region)	Disjunct or Other
FERNS/ALLIES	--	--	02 Rare in Nevada 02 Locally uncommon
GYMNOSPERMS	01	--	--
ANGIOSPERMS	01	02 Red Rock Canyon 03 Spring Range 08 Southern Nevada	03 Nevada record 02 Rare in Nevada 03 NV range extension 05 Locally uncommon
MONOCOTYLEDONS	--	--	04 Nevada record 06 NV range extension
SPECIES TOTAL:	02 Relict	13 Endemic	27 Disjunct or Other

Distributional importance, beginning with the disjunct group, include seven species that are Nevada Records, meaning that they are not known to occur anywhere else statewide. Juncus macrophyllus (Large-leaf rush) is known in Red Rock only from two First Creek Canyon locations. Others include a fern, Asplenium resilens (Ebony spleenwort), and a fern ally, Selaginella utahensis (Utah spikemoss), known from Nevada only in the Spring Range on sandstone outcrops.

Red Rock Canyon's relict species features were discussed earlier (Ponderosa pine, and also the relict elevational distribution of both this species and White fir). The other plant thus recognized (Leary; 1996) is Viola purpurea var. charlestonensis (Spring Mountains violet), which is important for being the larval host plant of Speyeria zerene carola, an endemic Spring Range butterfly on the Fish and Wildlife Service Nevada Species of Concern list (see Appendix 1).

Endemic and/or Special Status Plants

Referring to Table 4, fully 12* of the 13 endemic species in RRCNCA possess some degree of special administrative or legal protection status. The Special Status designations fall into two distinctive categories of protection. Opuntia whipplei var. multigeniculata, as a Candidate for Listing under the federal Endangered Species Act of 1973, possesses full legal protection. The remainder of RRCNCA

Special Status species all refer to agency-originated administrative designations on the part of Clark County, NV or the federal Fish and Wildlife Service (FWS) and BLM at their statewide jurisdictional levels.

The Blue Diamond cholla (Opuntia whipplei var. multigeniculata) is significant for the fact that its NCA habitat represents the single known worldwide population of this species. The potential vulnerability inherent to such a degree of geographic restriction is compounded by the actual site location as well. Of the species' 312-acres of occupied habitat, 17% is owned by the James Hardie Corporation in conjunction with a major open pit gypsum mine. Though having occurred before this plant's taxonomic uniqueness had yet been identified, incidents of mining damage (from road-building and tailing piles) to the chollas and their habitat resulted in the FWS decision to federally list the Blue Diamond cholla as a Candidate Threatened or Endangered Species. This decision was followed in 1994 with an NCA expansion (which added 880-acres of occupied or adjacent cholla habitat to the Red Rock Canyon NCA) and in 1997 with the signing of a Conservation Agreement between the FWS, RRCNCA and the James Hardie Corporation. This document stipulates the conservation actions to be undertaken on the species' behalf.

Ionactis caelestis (Red Rock Canyon aster) is also endemic to Red Rock Canyon, and occurs in a single known worldwide population (see Appendix 2: Bridge Mountain). This small member of the Sunflower family is notable for being new to science in 1992 (Leary; Nesom). Based on present knowledge, this species is entirely restricted to Aztec Sandstone bedrock, within an area of approximately 10 acres. The plant almost exclusively occupies crevice habitats, which when coupled with the site's relatively remote location, works in favor of this species' conservation and protection. Nevertheless, the extremely small size of its known occupied range and the significantly increasing recreational use of this same general vicinity over the past three years represent cause for concern.

Spring Range endemic plants Angelica scabrida and Astragalus remotus occur in numerous sites dispersed throughout a large area of the NCA, and additional small populations continue to be found. An especially rare species, Astragalus aequalis was reported for Red Rock by only one author (Deacon; 1964) and never again verified during field inventories, causing a reasonable doubt as to its actual NCA occurrence status.

Of the eight southern Nevada endemics, all but the Penstemons occupy remote, inaccessible higher elevation habitats in Red Rock Canyon and do not appear to be faced with any significant current threats. All but one of these species are known from three or fewer scattered locations, including one solitary population of Pedicularis semibarbata var. charlestonensis. Penstemon bicolor ssp. bicolor, occupies numerous sites throughout the NCA.

Table 4. Endemic and/or Special Status Plants

Genus Species	Endemism	Special Status
<u>Opuntia whipplei</u> var. <u>multigeniculata</u> ¹	RRCNCA	Candidate- T&E Species List
<u>Ionactis caelestis</u> ¹		Species of Concern- FWS; BLM
<u>Angelica scabrida</u> ¹	Spring Range	Species of Concern- FWS; BLM
<u>Astragalus remotus</u> ¹		Species of Concern- FWS; BLM
<u>Astragalus aequalis</u> ¹		Species of Concern- FWS; BLM
<u>Penstemon bicolor</u> ssp. <u>bicolor</u> ²	Southern Nevada	Species of Concern- FWS; BLM
<u>Salvia dorrii</u> var. <u>clokeyi</u> ¹		Species of Concern- FWS; BLM
<u>Townsendia jonesii</u> var. <u>tumulosa</u> ¹		Species of Concern- FW
<u>Eriogonum heermanni</u> var. <u>clokeyi</u> ²		Species of Concern- BLM
<u>Pedicularis semibarbata</u> <u>charlestonensis</u> ¹		Species of Concern- FWS
<u>Erigeron uncialis</u> var. <u>conjugans</u> ¹		Clark County MSHCP
<u>Penstemon thompsoniae</u> var. <u>jaegeri</u> ¹		Clark County MSHCP
<u>Phacelia hastata</u> var. <u>charlestonensis</u> *		None [³ Status potential]
<u>Arctomecon merriamii</u> ¹	Non-local	Species of Concern- FWS
<u>Calochortus striatus</u> ¹		Species of Concern- FWS; BLM
<u>Glossopetalon pungens</u> var. <u>glabra</u> ¹		Species of Concern- FWS; BLM
<u>Ivesia jaegeri</u> ¹		Species of Concern- FWS; BLM
<u>Astragalus mohavensis</u> v. <u>hemigyris</u> ²		Species of Concern- FWS
<u>Viola purpurea</u> v. <u>charlestonensis</u> ¹		Clark County MSHCP
<u>Castilleja martinii</u> var. <u>clokeyi</u> ¹		Clark County MSHCP
<u>Coryphantha vivipara</u> ssp. <u>rosea</u> ³		Clark County MSHCP
<u>Selaginella utahensis</u> ³		Clark County MSHCP
<u>Penstemon bicolor</u> ssp. <u>roseus</u> ³		Clark County MSHCP
<u>Ferocactus acanthoides</u> v <u>lecontei</u> ³		Clark County MSHCP
<u>Cryptantha tumulosa</u> ³		Clark County MSHCP
SPECIES TOTAL:	24 Special Status	[12 Endemic; 12 Non-endemic] [15 Federal/County; 09 County]
MSHCP= Multiple Species Habitat Conservation Plan ¹ Covered Species ² Evaluation Species ³ Watch List Species		

The Clark County Multiple Species Habitat Conservation Plan is intended to incorporate and expand the provisions of the Clark County Desert Tortoise Conservation Plan. *Evaluation Species* are those for which additional information is required (or for which appropriate management prescriptions are unlikely to be sufficiently definable). *Watch List Species* are those for which information is not available to assess biological conservation potential (or else that are considered not to be at risk during the effective planning period).

While known from only a single RRCNCA site, Arctomecon merriamii (White bearpaw poppy) is now evaluated in the regional context as being reasonably secure, due to the recent discovery of abundant plant populations on the Nellis Air Force Range. Relative to Red Rock Canyon alone, Glossopetalon pungens var. glabra has also been found to be more widespread than formerly thought. This species, along with Ivesia jaegeri and four of the NCA's endemic, special status plants, all occupy overlapping habitats on Bridge Mountain (see Appendix 2: Priority Management Areas), thereby collectively posing a "biological hotspot" of the first order. Likewise of no particular individual concern due to their relative NCA abundance are the Castilleja, Coryphantha, Ferocactus and Cryptantha spp. from Table 4, as well as Penstemon bicolor ssp. rosea. Similarly widespread through the Spring Range, but nonetheless individually important (endemic butterfly hostplant), the aforementioned Viola sp. also occupies this same key Bridge Mountain habitat area.

In complete contrast, Calochortus striatus (Alkali mariposa lily) and Astragalus mohavensis var. hemigyus are considered to be of high priority concern, within the context of Red Rock Canyon NCA as well as the Mojave region at large. In regard to the mariposa lily, the NCA situation is compounded by the fact that all known populations occur in heavy recreation use areas within the Calico Basin. The exceedingly rare Astragalus mohavensis sp. has been reported from only two small NCA sites by a lone source (Nevada Natural Heritage Program), and has not since been field verified.

There are several additional locally endemic and/or special status species that may well occur in RRCNCA, based on the close proximity of known off-site populations and the presence of suitable Red Rock Canyon habitat. Among such potential NCA residents are two Spring Range endemics listed as Nevada Species of Concern by the FWS: Arenaria kingii ssp. rosea and Glossopetalon clokeyi. And Haplopappus compactus is a southern Nevada endemic plant that is likewise recognized by the FWS.

WILDLIFE

The geography, geology, hydrology and resultant vegetative variety of Red Rock Canyon give rise to an extraordinarily diverse faunal community in turn, as well as one of exceptional biotic sensitivity (with nearly one-in-ten species possessing some degree of special status protection). Local endemism and disjunct populations are less

prevalent among the animals (due to their mobility and dispersal capability).

The RRCNCA wildlife species groups basically fall under two broad sets of shared biological criteria, each entailing highly different resource management implications (Table 5). Based on ecological sensitivity factors (of individuals, populations and/or habitats) the three groups of priority management concern are the bats, raptors (birds of prey) and reptiles and amphibians. On the basis of numbers of species, the primary groups are the small mammals, passerine (perching) birds and non-passerine birds, whose species respectively make up 9%, 43% and 10% of the entire NCA wildlife cohort. The *small mammals* include both rodents (kangaroo rats, mice, squirrels, chipmunks, gophers) and lagomorphs (rabbits and hares). *Passerine birds* include swallows, flycatchers, jays, crows, nuthatches, thrushes, vireos, finches, orioles, wrens, sparrows and warblers, just to name some of the families. The *non-passerine birds* are even more loosely associated in terms of shared biology, and include waders (herons, egrets), roadrunners, hummingbirds, doves, kingfishers, woodpeckers, nightjars and fowl-like birds (Chukar, quail).

The remaining NCA wildlife group, *carnivores and hoofed animals*, represent a mix of unrelated species, none of which adequately fit under the two descriptive criteria (ecological sensitivity or numbers of species) being used here. While not particularly strong in species number, or in regard to any uniqueness of biotic sensitivity (i.e., in the NCA-external context), some of the species do warrant heightened management concern. An example is the Bighorn sheep, whose overall population status and trend in the NCA portion of the Spring Range is a key management issue. NCA carnivores include foxes, coyotes, ringtails, badgers, bobcats and mountain lions. The hoofed animals are mule deer, bighorn sheep and elk (an occasional seasonal migrant).

To the casual visitor, such species numbers may seem to be highly exaggerated, given their own typical wildlife viewing experiences at Red Rock Canyon. But there are many factors which explain why a landscape so often seemingly devoid of animal life, in reality supports a rich community of nearly 300 diverse species. The NCA faunal species are universally adapted to the hot and dry (xeric) living conditions that prevail within the regional desert environment (Mojave, Great Basin and Colorado Plateau). In addition to numerous physiological and anatomical specializations (maximum moisture-retention digestive tracts, etc.) these animals

Table 5. Wildlife Species Numbers

GROUP		Species Total	Special Status Spp. (Group %)	-Management Concerns [* Key Priorities]
MAMMALS		[55]	<u>10</u> (see Bats)	
Small mammals		26	01 ¹	- <u>Tamias palmeri</u> ¹
Carnivores, Hoofed Animals	12	00		-Bighorn sheep herd
Bats		17	09 (53%)	-Roost conditions* [Unconfirmed species report]
BIRDS		[168]	<u>06</u>	
Passerine (perching) birds	119	04		-Riparian habitats
Nonpasserine birds		28	00	-Game bird hunting
Birds of prey (Raptors)		21	02 (10%)	-Nest protection*
REPTILES & AMPHIBIANS		[41]	<u>05</u> (12%)	-Overall status*
Lizards, Skinks, Geckos		19	04	-General environment
Snakes		19	00	-General environment
Tortoises, Toads, Frogs		03	01	-Riparian habitats
RCNCA Total:		273	21 (08%)	

also have developed behavioral adaptations, many of which serve to preclude their casual daylight observation. In deserts, even the diurnal species (daylight active) pattern their routine actions and movements in order to minimize their open exposure to full sunshine. This is achieved by limiting their daily activity periods to the relatively low temperature and high humidity hours of dawn and dusk, or by consistently keeping to deep shade cover such as in rock crevices, live-standing or dead and down plants, and underground burrows. Because body moisture conversion and loss is an unavoidable by-product of any metabolic activity, desert fauna often restrict not only the time and place of their daily exertions, but the overall extent as well.

Being cold-blooded animals that require external heating in order to accomplish normal bodily function, reptiles and amphibians can better tolerate the harsh desert sun. Various lizard species may be commonly observed basking on rocks and fenceposts in virtually any area of the NCA landscape. But there are many other reptiles that cannot tolerate full sun and thus exhibit similar avoidance behaviors as their mammalian counterparts; including at least one lizard (Gambelia sp.) that routinely takes daytime shelter in the burrows of small mammals. Many other reptiles are nocturnal, including two-thirds of all NCA snake species, the geckos and the night lizards (Xantusia sp.). But because snakes as a group are extremely reclusive as well, even diurnal species such as gopher snakes, coachwhips and kingsnakes are not commonly seen.

Two thriving amphibian populations (Red-spotted toad; Pacific chorus frog) occur in a numerous, widespread distribution pattern within the

Conservation Area landscape, while amphibians in general have been in serious decline globally for some years now (Bury; 95). Amphibians are not considered to be one of the more common faunal species groups associated with desert environments, particularly in this area.

The numbers of resident bird species in desert habitats are typically quite small, owing to the lack of vertical vegetative structure. Arborescent canopies, whether of trees or taller shrubs, provide both nesting and escape cover and represent one of the prime limiting factors affecting bird species distribution patterns in desert habitats. Of the 33 bird species commonly associated with Creosote bush and Blackbrush vegetation in this area, nine are permanent residents (Bradley/Deacon; 1965), and only two are seen with any regularity (ravens and black-throated sparrows). Two particularly critical habitats are in lower Pine Creek and at Wheeler Camp Spring, which is actually cooperatively managed as a National Audubon Sanctuary. The majority of the NCA species list (Appendix 8) is based on sighting from this same location. Though most are also non-residents of Red Rock Canyon, instead being occasional accidental visitors or seasonal migrants.

Table 6. Wildlife Species Numbers: RRCNCA versus Clark County and Nevada

Species Group	Location	Species	RRCNCA	NCA %
Mammals ¹	Clark	142	56	39%
Birds ¹	Clark	392	168	43%
Reptiles & Amphibians ¹	Clark	63	41	65%
Bats ²	NV-south	22	17	77%
Raptors ³	Nevada	25	21	84%

¹ Desert Tortoise Short-term HCP; RECON; 1991.
² Bat Species Status Report; M.A. Ramsey; 1997.
³ Nevada Raptors: Biological Bulletin No. 8; NDOW; 1985.

The other RRCNCA species lists are found in Appendices 5, 6 and 7: Mammals, Bats, and Reptiles and Amphibians respectively. Although they are mammals, the bats are broken out separately to emphasize their significant occurrence, diversity and ecological sensitivity. These RRCNCA species lists incorporate the best available information, but are not intended to be viewed as either all-inclusive or unfailingly accurate. Table 6 gives dramatic perspective to the actual magnitude of Red Rock's wildlife diversity, especially when considering that the 196,000-acre NCA makes up less than 5% of the Clark County land base.

Special Status Species

Eight percent of all wildlife species reported for RRCNCA possess special protective status, including two federally-listed as Threatened or Endangered. The respective vegetative numbers are significantly smaller: 19 special status of 652 total (3%), and zero federally-listed T&E species. As Table 7 shows, Red Rock Canyon harbors one-half to three-quarters of all Special Status Species listed for Clark County and/or the entire State of Nevada.

Table 7. Special Status Wildlife: RRCNCA versus Clark County and Nevada

Status Category	Location	Species	RRCNCA	NCA %
[All Species*]				
ESA, federal T&E Species	Nevada	04	02	50%
BLM, Sensitive Species	Nevada	25	10	40%
FWS, NV Species of Concern	Clark	23	13	57%
MSHCP, Covered Species	Clark	18	12	67%
MSHCP, Evaluation/Watch List	Clark	70	35	50%
[Bats Only]				
FWS, NV Species of Concern	Clark	12	09	75%
*Excluding fish and invertebrate species [NOTE: Inflated species numbers reflect overlapping agency protective status designations.]				

The 21 Special Status wildlife species in RRCNCA are individually listed in Table 8. (MSHCP Evaluation and Watch List species are listed in Appendix 1, since the designations do not confer actual legal or administrative protections).

Two wildlife species are federally-listed as Threatened and Endangered. On purely biological terms, the Desert tortoise habitat in RRCNCA (ie, Creosote bush community) is classified by the Bureau as low density occupied species; nor are there any current major threats to the population. The Peregrine falcon situation in Red Rock Canyon is totally different. The entire population is thought to consist of only two birds, which are suspected to be an adult nesting pair. The number of statewide nest pairs is one of the major evaluation targets stipulated by the FWS Pacific Coast Recovery Plan for the species. At present there are only six known nesting pairs in all of Nevada. The presence of this rare species is clear

indication of the quality of RRCNCA's raptor habitat. 84% of Nevada's raptors have been reported in Red Rock Canyon.

Table 8. Special Status Wildlife Species: Vertebrates

<u>Genus Species</u>	Common Name	Status
(02) Federally Listed Species		
<u>Gopherus agassazii</u> *	Desert tortoise	Threatened
<u>Falco peregrinus anatum</u> *	American peregrine falcon	Endangered
(14) Nevada Species of Concern ²		
<u>Idionycteris phyllotis</u>	Allen's big-eared bat	FWS & BLM
<u>Myotis ciliolabrum</u>	Small-footed myotis (bat)	FWS & BLM
<u>Myotis thysanodes</u>	Fringed myotis	FWS & BLM
<u>Myotis volans</u> *	Long-legged myotis	FWS & BLM
<u>Euderma maculatum</u> ³	Spotted bat	FWS
<u>Myotis evotis</u> *	Long-eared myotis	FWS & BLM
<u>Myotis yumanensis</u> ¹	Yuma myotis	FWS & BLM
<u>Plecotus townsendii pallescens</u>	Townsend's big-eared bat	FWS & BLM
<u>Nyctinomops macrotis</u>	Big free-tailed bat	FWS & BLM
<u>Tamias palmeri</u> ^{3*}	Palmer's chipmunk	FWS
<u>Accipiter gentilis</u>	Northern goshawk	FWS
<u>Phainopepla nitens</u> *	Phainopepla	BLM
<u>Heloderma suspectum cinctum</u>	Banded Gila monster	FWS
<u>Sauromalus obesus obesus</u> *	Western chuckwalla	FWS & BLM
(05) Clark County MSHCP Species.		
<u>Guiraca caerulea</u>	Blue grosbeak	Covered
<u>Pyrocephalus rubinus</u>	Vermillion flycatcher	Covered
<u>Piranga rubra</u>	Summer tanager	Covered
<u>Coleonyx variegatus</u>	Banded gecko	Covered
<u>Dipsosaurus dorsalis</u>	Desert iguana	Covered
RRCNCA Total:	21 Species	
<p>MSHCP - Multiple Species Habitat Conservation Plan; * = Covered Species.</p> <p>¹ - Potosi Spring reports (USFS) indicate high probability of RRCNCA occurrence.</p> <p>² - Nevada Species of Concern = FWS List + BLM Nevada Sensitive Species List.</p> <p>³ - Report solely based on heard vocalizations, not direct observation.</p>		

Eight of the 14 Nevada FWS/BLM special status species in Table 8 are bats. The same habitat features that favor high raptor density and diversity in RRCNCA are almost identical for these flying mammalian predators as well. One critical limiting factor is the stable existence of an abundant, diverse prey base. Reptiles, small mammals and smaller birds all can be typically encountered in greater numbers near the vicinity of springs and riparian areas, as well as many of the insect species that form the prey base of most local bats (versus fruit-eaters). Bats require certain minimum surface-areas of water to be able to skim their drinking intake while in full flight. Major bat-use springs are listed in Appendix 12. White Rock Spring, along with Potosi Spring (USFS), had by far the highest diversity and abundance of bat species use documented for the Spring Range during an intensive, three-year research survey (Ramsey; 97).

Another key limiting factor is the suitability of Red Rock's rugged, vertical terrain for reproductive purposes, as expressed in the number, variety and isolation (relative protection) of the brood-rearing habitats afforded. Numerous high cliffs and craggy ridges satisfy the raptors' need for nesting sites which are inaccessible to other predators, and provide the broadest field of view of their own adjacent foraging territories. Brood-rearing conditions for bats are even more specialized; often translating into site types that are both uncommon and extremely narrow in their parameters. Roosts are critical to the long-term survival of bat populations, yet are the most limited in supply of all bat-use resources. Maternity roost habitats are even more essential and less abundant. Bat populations are now experiencing drastic declines on a global scale, and in the United States the single most important factor in this downward trend is the loss of roost sites (Ramsey; 94). Red Rock Canyon provides caves, rock crevices and large tree cavities (Ponderosa pine) that are suitable to many different bat species.

The remaining species from Table 8 basically fit the description given for the Desert tortoise: beyond the inherent importance of their special protective status there are no identified specific threats to these species in Red Rock Canyon, nor are they acutely restricted in distribution outside the NCA.

As Table 9 shows, Red Rock Canyon harbors special status species from the invertebrate animal kingdom, all of which are significant for being locally endemic. In terms of rarity and direct threats, foremost among these are the two springsnail species. These minute, aquatic creatures are endemic exclusively to five springbrook habitats in RRCNCA, sites which also receive active recreation use and in some cases have been altered to accommodate that use. These species are only recently known to science, and their populations in Willow Spring disappeared before management was made aware of their presence, as the site has been developed with recreation facilities. Riparian habitat restoration and population re-introduction efforts at the site are in progress, as are preventative protection measures

at Red Spring (another high-profile recreation site).

Table 9. Special Status Wildlife Species: Invertebrates

<u>Genus Species</u>	<u>Common Name</u>	<u>Status</u>
(09) Nevada Species of Concern ²		
<u>Pyrgulopsis</u> sp. nov.1a* [RRCNCA endemic]	Springsnail nov.1a	BLM
<u>Pyrgulopsis</u> sp. nov.58* [RRCNCA endemic]	Springsnail nov.58	BLM
<u>Limenitus weidemeyerii nevadae</u> [Southern NV endemic]	Nevada admiral (butterfly)	FWS & BLM
<u>Chlosyne acastus</u> ³ [Spring Range endemic]	Spring Mtns acastus checkerspot (butterfly)	FWS & BLM
<u>Euphilotes enoptes</u> ssp. ³ [Spring Range endemic]	Dark blue butterfly	FWS & BLM
<u>Euphydryas anicia morandi</u> ³ [Spring Range endemic]	Morand's checkerspot	FWS
<u>Hesperia comma</u> spp. ³ [Spring Range endemic]	Spring Mtns comma skipper	FWS & BLM
<u>Plebejus icarioides</u> ssp. ³ [Spring Range endemic]	Spring Mtns icarioides blue (butterfly)	FWS & BLM
<u>Speyeria zerene carolae</u> ³ [Spring Range endemic]	Carole's silverspot butterfly	FWS
* - Covered Species, Multiple Species Habitat Conservation Plan. ² - Nevada Species of Concern = FWS List + BLM Nevada Sensitive Species List. ³ - Unconfirmed in Red Rock Canyon.		

The paucity of survey-generated occurrence data is such that a species list would be under-representative. Undoubtedly, the diverse NCA natural environment supports an invertebrate species community as proportionately rich and varied as those of the higher forms of animal life already described. Typical Mojave Desert invertebrates are the insects (crickets, termites, beetles, ants, flies, moths, butterflies, etc.) and the arachnids (scorpions and spiders), including one high-profile member in Red Rock Canyon, the Desert

tarantula (Aphonopelma chalcodes). The unique local moisture conditions of the Spring Range support any number of centipedes, millipedes and molluscs (both terrestrial and aquatic snail species).

WILD HORSES AND BURROS

On December 15, 1971, Congress enacted the *Wild and Free-Roaming Horse and Burro Act*, mandating that BLM manage wild horses and burros on public lands where they existed at that time. The Act mandated that wild and free-roaming horses and burros be protected from unauthorized capture, branding, harassment, or death. They are to be considered an integral part of the natural system, based on their distribution at the time the law was enacted.

While horses originated in the America's, for some unknown reason they eventually became extinct throughout the western hemisphere. Horses were re-introduced to this country by early Spanish explorers and missionaries. The Native Americans took advantage of the animals and used them extensively. When ranchers and farmers came, they brought horses with them and commonly turned them loose to let nature cull and produce strong ranch or work animals. They would periodically round up and take the best animals to sell or use as ranch horses. The Old Spanish Trail/Mormon Road passed through RRCNCA at Cottonwood Spring at the present site of Blue Diamond and from 1844 through 1898, brought horses and burros to the area. Mining in the late 1800's and early 1900's brought more burros, used as work animals for the old sourdoughs, and the burros escaped or were released when the miner's luck turned.

An early Nevada rancher named Frank Allen ran horses at White Rock Springs near Sheep Mountain in the early 1930's. Allen sold his horses to Lee Simpson in the 1940's. Simpson ran the horses at Goodsprings and bred primarily palominos and watered the horses with well water. Fransis Thorn ran appaloosas with Simpsons palominos from the 1940's to the 1950's. The horses ran free on the range and were gathered to get the best animals and turned loose again. The horses were abandoned in the 1950's. These animals are considered the original ancestors of the Red Rock HMA wild horses. Some of the other ranchers such as the Wilson Ranch also contributed animals to the herd. The Wilson Ranch passed to Vera Krupp, Howard Hughes and Fletcher Jones before being purchased by the State of Nevada.

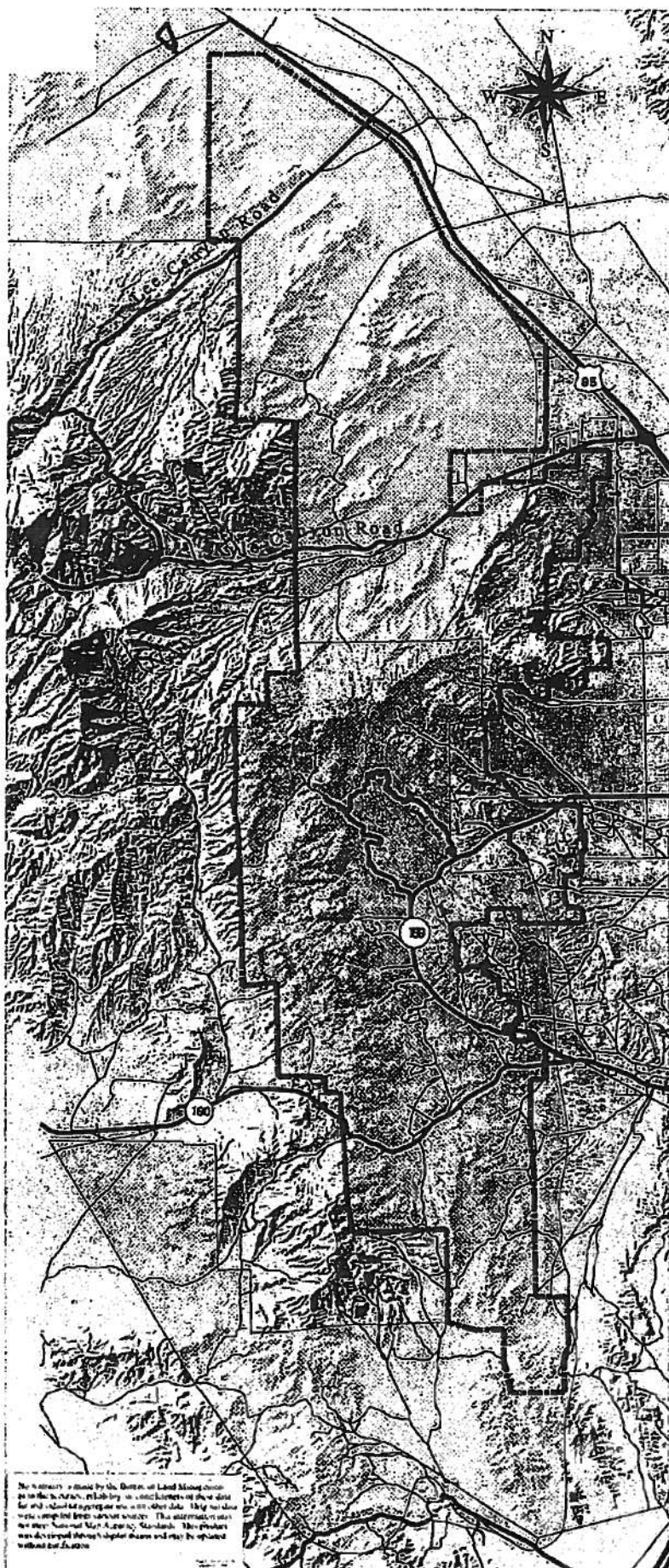
Herd Management Area (HMA) boundaries are not entirely clear. Four different HMA maps exist. The Clark County Grazing Environmental Impact Statement dated August 13, 1982 delineated the wild horse and burro populations into zones of historic use referred to as Herd Management Areas (HMAs). The Management Framework Plan (MFP) Major Land Use Decision Summary and Environmental Impact Statement Record of Decision, dated January 9, 1984, formalized the HMA's boundaries through decision, using the 1982 grazing EIS maps. Two other maps,

of about the same vintage, show differing boundaries. The boundaries shown in the 1998 Las Vegas Resource Management Plan, which replaced the 1984 MFP, differ from the 1982 EIS/1984 MFP boundaries.

Documenting where wild horses and burros existed at the time of passage of the Act (1971) has been difficult, as little definitive data exists. The best known documentation may be contained in two Nevada Division of Wildlife Desert Bighorn Sheep reports; Red Rock-La Madre (McQuivey 1976) and South Spring Mountain Range (McQuivey 1978). The Red Rock-La Madre report, based on random observations and aerial surveys from 1969 to 1976, documents burro populations in Lucky Strike Canyon and on the north side of La Madre Mountain, in Kyle Canyon; on Blue Diamond Hill; near Lone Grapevine spring; and in Lovell Canyon. No mention is made of burros in the Calico Basin area or horse use at all. The South Spring Mountain Range report, based on field observations and intensive aerial surveys between 1973 and 1978, relates a slow expansion of burro populations into the South Spring Mountains from populations in the Clark Mountain Range, further south. Both reports state that burros/sheep competition was minimal at the time. Both reports discuss the need for available water, especially during the hot summer months.

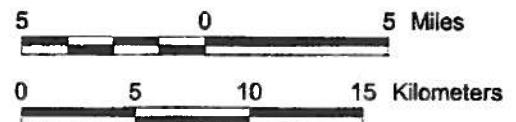
The 1971 law provides that wild horses and burros be managed in wild free roaming herds in a thriving natural ecological balance within the HMAs. There are two HMA's which include portions of RRCNCA, the Wheeler Pass and Red Rock HMAs. These HMAs are portions of the larger, original, Spring Mountain HMA, which was broken into three smaller HMAs in the 1998 RMP. The Wheeler Pass HMA includes RRCNCA north of La Madre Mountain. RRCNCA lands make up about 15% of the Wheeler Pass HMA. Most of the remaining portion of the RRCNCA falls within the Red Rock HMA. RRCNCA lands make up about 60% of the Red Rock HMA.

The management objective for wild horses and burros is to maintain animals at a population level which provides a thriving natural ecological balance consistent with multiple use management objectives. This population level is referred to as the Appropriate Management Level (AML) and is derived from field studies which determine the amount of available forage and water, and combined monitoring of the effects of the animals on other resources. HMAs in the Las Vegas Field Office are currently under review to determine the appropriate carrying capacity. AMLs for the portions of the HMAs managed by the USFS Spring Mountain National Recreation Area were set in the Forest Plan Amendment of 1998.



HERD MANAGEMENT AREAS



Red Rock Canyon
National Conservation Area
General Management Plan



Legend

----- Red Rock Canyon NCA Boundary

Herd Management Areas (HMA)

-  Red Rock
-  Wheeler Pass

No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for and subject to any other data. This statement was prepared from various sources. The statement was prepared from various sources. The statement was prepared from various sources. The statement was prepared from various sources.

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The Red Rock HMA has an existing estimated population of 41 wild burros and 47 wild horses. The wild horse herd currently has a sex ratio of 2 studs to 1 mare. The animals usually run in family groups of 3 to 5 animals with a few bachelor bands of 2 to 3 stud horses. The colors of wild horses in the Red Rock HMA are 27 percent palomino, 29 percent sorrel, 15 percent bay, 10 percent paint, with the remaining 19 percent being buckskin, black, white or chestnut.

In 1988, the BLM census data showed 42 wild burros and 31 wild horses in the Red Rock HMA. From 1987 through 1990 there were 28 wild burros and no wild horses removed by BLM for entry into the animal public adoption program. During that same time period, 17 horses were shot, 10 horses and 15 burros were killed by cars, and 10 horses died due to drought (in 1990), for a total reduction in numbers of 37 horses and 15 burros. During the drought of 1990, BLM documented that wild burros migrated into the Bonnie Springs area from Potosi Mountain, seeking forage and water. This caused a growth in the wild burro population.

From 1992 through 1998, 127 wild burros and 15 wild horses removed by BLM from the Red Rock HMA. While it is known that mountain lions take some of the wild horses and burros, it has not been possible to document the numbers. Through removals and the other herd reduction occurrences, the population levels have stayed fairly constant since 1987, except during the wild burro immigration period from 1991 to August 1995, across SR 160 from Potosi Mountain.

The Red Rock wild horses have historically trailed back and forth, across SR 160, in pursuit of food and water sources. Lone Grapevine, Muddy, Wheeler Camp and Shovel springs exist on the north side of the highway. Bird and Tunnel springs are on the south side of SR 160. The springs that the animals have historically relied on during drought or the hot summer months are located to the north. The wild horses typically moved farther south towards Goodsprings and Bird Springs during the fall, winter and spring, when physiological water demands were less. Forage is not a limiting factor south of SR 160. The south western part of the HMA is lacking a permanent water source and is only receiving use during the cooler months.

In 1987, the BLM recognized the increasing safety problem present along SR 160, due to the growth in Clark County and associated vehicle traffic. In 1995, the Nevada Department of Transportation (NDOT) notified the BLM of their intention to fence both sides of SR 160, through the NCA, for safety purposes. The plan included the installation of 3 large culverts to handle the natural flow of water across the roadway. The BLM and NDOT worked together to design the underpass/culverts to facilitate wild horse and burro travel under SR 160.

In August 1995, the three underpasses/culverts and the fences were completed on SR 160. The culvert design not only provided safe and

unrestricted movement of wild horses and burros, but safe passage to bicyclists, hikers and equestrians recreating in RRCNCA.

Balancing highway safety, public interest, and the continued free movement of wild burros and horses along SR 159 is a ongoing challenge. The wild burros and horses have been a tourist attraction to RRCNCA since the 1980's when the numbers of visitors to the area began to increase. Visitors actively travel to RRCNCA seeking out the wild burros on SR 159 and wild horses near the Goodsprings road. Greeting cards displaying photographs of the Red Rock wild horses and burros were initiated in 1991 and are a big seller at the RRCNCA visitors center. The animals are also an enhancement to various off highway tours offered by some of the Red Rock Canyon permittees.

Due to the domestic and intelligent nature of the burros, they are easily attracted to SR 159 by the many tourists looking for them in order to photograph, pet and/or feed a wild burro. When the burros are present, congestion occurs as motorists congregatre to observe and feed the animals. Although there are signs along the road directing the public to not feed the burros, feeding persists. The situation has been further complicated with the recent increase of the speed limit along SR 159 from 40 mph to 60 mph.

In the Red Rock HMA, the historical primary use area of the wild horses is from Bonnie Springs south to Bird Spring and Goodsprings. The wild burro primary use area is from Bonnie Springs north and east all the way to White Rock and Red Springs. There is overlap in the use areas around SR 160. The historic separation of the horses and burros has been due to existing old livestock fences across the HMA at Oliver Ranch, Bonnie Springs and Spring Mountain Ranch. The Wheeler Pass animals use the lower elevations in the fall and winter and upper elevations on adjacent lands administered by the USFS in the spring and summer.

In 1989 and 1990, the need for more dependable waters for wild burros and horses and the need to reduce impacts to riparian habitat at spring sources was recognized. The BLM fenced four spring sources and reconstructed the spring developments to provide water outside for wild horses and burros and wildlife. The projects are at Bird and Tunnel springs in the Red Rock HMA, and Grapevine and Grassy springs in Wheeler Pass HMA. In 1994, the BLM continued to fence the riparian spring sources while providing water outside for the animals on Wheeler Camp, Lone Grapevine, Mud, and Shovel springs in the Red Rock HMA.

The Wheeler Pass HMA has approximately 96 wild horses and 16 wild burros. Census data in 1988 counted 22 wild horses and 3 burros. The cover provided by pinion pine and juniper trees in this HMA makes aerial counts difficult and animal census is not considered very accurate. The herd colors in Wheeler Pass HMA are predominantly black, bay and sorrel. This herd is managed jointly with the

Humbolt-Toiyabe National Forest.

Spring and Riparian Areas Impacted

Significant impacts to riparian vegetation and spring sources has been documented at Wheeler Camp, Lone Grapevine and Shovel Springs. Lesser impacts have been noted at Mud Spring # 1. All four springs have been fenced within the last four years. Wheeler Camp and Lone Grapevine Springs have shown significant recovery and replacement of riparian vegetation since fencing.

Bird and Tunnel Springs no longer support a riparian area as the waters from these two sources are now captured in storage tanks and dispersed in water troughs. Tunnel Spring is no longer producing reliably and is being considered for reconstruction, which may or may not result in restored flow. Repairs attempted in the summer of 1998 appear to have failed and may in fact have reduced flows significantly as a result.

SOILS

Throughout the Red Rock Canyon National Conservation Area (RRCNCA, there is a sharp contrast in physiography between mountainous areas and lowlands. Soils in the area developed under different environmental influences. Under the arid conditions which prevail at all but the highest elevations, little downward movement of the soluble constituents of the soil occurs. Most leaching is confined to the translocation of the soluble material (usually lime) from the surface to the subsoil, with the resultant formation of a hardpan. These soluble salts are usually leached only to a depth of 1 to 2 feet.

In this climate, rocks tend to break down by disintegration rather than by decomposition. Mechanical breakdown (spalling) is more common than chemical action. As a result, mountains are covered with a thin veneer of rock fragments. Cloud bursts and showers sweep large quantities of this material into ravines and valleys, forming alluvial fans of the coarser material. Finer-grained sediments are washed into the lowlands.

Wind is also an active agent in soil genesis. Wind-blown sand is common, with the greatest accumulations found in the lower valleys, often forming dunes. Wind-blown silts, mixed with the fine alluvium washed down from the slopes, comprises the soil mantle of the lowlands. The term "blow sand" arises from the fact that much of the surface soil is wind-deposited.

Organic matter in most desert soils is far less than the average 3 to 5 percent by weight contained in soils formed in humid regions. Even in a wet year when spring annuals are abundant, much of the vegetal

matter is oxidized by the summer heat before it can be turned into humus. A gravelly surface, referred to as "desert pavement", can be found in the planning area. This surface is stable and resistant to erosion. Erosion is normally active on surfaces lacking a desert pavement. The sparse cover of vegetation does little to reduce wind and water velocities. Wind erosion is a major factor in recharging surface soils with carbonates through the movement and deposition of calcareous dusts.

Soils in the RRCNCA are primarily Entisols and Aridisols; a few Mollisols occur at the upper elevation of the Spring Mountains. These are described in detail below. The Entisols have little or no evidence of development of pedogenic horizons. They are located in areas where the soils are actively eroding (steep slopes) or receiving new deposits of soil materials (alluvial fans and floodplains).

Aridisols have one or more pedogenic horizons that may have formed in the present environment or that may be relics from a former pluvial period. These soils do not have water available to plants for long periods of time and the surface is generally bare. Aridisols are often associated with desert pavement.

Mollisols are the very dark colored, base rich soils of high elevations. A few Mollisols are found high in the Spring Mountains where environmental conditions permit the accumulation of organic materials.

Soils in the RRCNCA have been surveyed previously by the Natural Resources Conservation Service (NRCS). Soils in the eastern one third adjacent to Las Vegas were mapped as a part of the Soil Survey of Las Vegas Valley Area Nevada, 1985. Soils in the western two thirds of the area adjacent to the mountains were mapped as a part of the Draft Soil Survey of Clark County Area Nevada. The surveys contain detailed soils descriptions, supporting data, and maps. The published survey for the Las Vegas Area and advanced information on the unpublished survey for the Clark County Area are available through the Las Vegas NRCS office.

Soil erosion involves two processes: (1) a detachment or loosening influence, and (2) transportation by means of floating, rolling, dragging, and splashing. Freezing and thawing; flowing water; and rain impact provide the detaching agents. Raindrop splash and especially running water facilitate the carrying away of loosened soil. On comparatively smooth soil surfaces, the beating of rain drops results in most of the detachment.

During the high intensity, short duration thunderstorms that are common in the region, raindrop impact tends to destroy soil aggregates, enhance sheet and rill erosion, and encourage considerable transportation by splashing. A hard crust often

develops upon drying. This crust impedes seedling emergence, greatly reduces infiltration for the next storm, and limits the possibilities for vegetative shielding which, by absorbing the energy of rain impact, prevents the loss of both water and soil and reduces degranulation to a minimum. However, in some desert locations, this surface crust does cover loose, fine soil particles, resulting in limited protection from wind erosion. In the vegetation types offering generally sparse cover, little interception of precipitation or protection from overland flow of water occurs.

As is the case with water erosion, the loss of soil by wind movement also involves detachment and transportation. The abrasive action of the wind results in some detachment of tiny soil grains from the granules or clods of which they are a part. When the wind is laden with soil particles, its abrasive action is greatly increased. The impact of these rapidly moving grains dislodges other particles from soil clods and aggregates. The cutting and abrasive effects, especially of sand, upon tender leaves and vegetation is harmful.

Erosion susceptibility is a measure of the erosion potential of a soil whose surface has been disturbed. Wind and water erosion potential are used to determine susceptibility in an area. Soil surveys conducted by the Soil Conservation Service, now the National Resource Conservation Service, were used in the development of erosion susceptibility ratings for the planning area. All of the Las Vegas District falls within the low to moderate susceptibility range with the exception of a few relatively small areas rated as high in the northeast portion of the Las Vegas District. Approximately 90,550 acres in the planning area have a high erosion susceptibility rating, 1,306,620 acres have a moderate rating, and 1,480,440 acres have a low rating.

Wind erosion potential is classified as low, moderate or high. Soils with a Natural Resources Conservation Service wind erodibility group rating of 1 or 2 are classified as high. A moderate rating is given to soils with a wind erodibility group rating of 3 or 4 and a rating of low is given to soils with a wind erodibility rating of 5 or more.

Each soil also has a high, moderate, or low water erodibility rating. The K value is the soil erodibility factor used in the Universal Soil Loss Equation for estimating erosion. It is derived from data collected in Natural Resources Conservation Service soil survey field notes and is primarily a combination of soil surface texture, structure, organic matter content modified with cover such as rock fragments. It is always less than 1.0. Soils with a high K value have a soil texture that is more erodible than one with a low K value. In general, if the slope multiplied by the K value of a soil is 2.5 or less, the soil is in the slight erosion hazard category. If the slope times the K value is between 2.5 and 7.5, the soil is rated as having a moderate erosion hazard, and values above 7.5 will place the soil into the severe hazard category. It is emphasized

that these break points are only general guidelines and are not the only factors used to place a soil in an erosion susceptibility class. For example, a soil with a slope times K value of 2.4 may be placed in either a slight or moderate erosion hazard class depending on information provided in soil survey field notes. This soil would not, however, be classified as having a severe water erosion potential.

Erosion condition data was compiled from several inventories, including the BLM Watershed Conservation and Development program (1977) and the *BLM Clark County Range Survey* (1979). Determinations of a soil surface factor were used to portray the erosion condition of an area. Erosion condition ranges from slight to critical, with most of the area falling into the slight to moderate erosion condition classes. There are 96,994 acres in critical erosion condition, 1,137,968 in moderate erosion condition, 1,286,420 in slight erosion condition, and 36,970 acres are in stable erosion condition; the remainder is undetermined. These erosion condition classes are defined as follows:

Stable (0-20) - There are no signs of soil movement. Surface litter is usually accumulating in place. Surface rock, if present, will be evenly distributed over the area. No pedestalling, rills, or flow patterns are apparent. Gullies may be present in a stable condition.

Slight (21-40) - Some movement of soil particles and surface litter is apparent. Surface rock may be present but collection of small particles may be spotty. No pedestals are apparent. Rills less than one-half inch deep occur at infrequent intervals of more than ten feet. Visible flow patterns have been formed by surface water. Deposition of pavement particles may appear in flow patterns. Gullies may be present, but with little evidence of streambank or streambed erosion.

Moderate (41-60) - Moderate movement of soil is plainly visible and recent. Moderate movement can be recognized by slight terracing caused by the accumulation of material deposited against litter, vegetation or rocks. The terraces will generally be less than one inch in height. Moderate movement of litter is apparent. Some surface rock may be exposed in bare spots where fine soil particles have been recently removed by wind and/or water. Small rocks and plants on pedestals occurring in the flow patterns may be noticed. Small rills are apparent in exposed places. These rills will be between one-half and six inches deep at intervals of approximately ten feet. Sediment deposits are visible intermittently in flow patterns and against small obstructions elsewhere.

Critical (61-80) - The soil mantle is in a critically eroded condition. Soil movement occurs with each runoff. Transported

soil and debris caused by wind and water is deposited throughout the area against minor surface obstructions. Extreme movement of litter is apparent. Recent exposure of surface rock is common on gravelly and stony soils. Small rocks and plants on pedestals are generally evident and roots are exposed. Large rills are apparent on exposed areas. Flow patterns contain easily noticeable silt and sand deposits and alluvial fans. Actively eroding gullies are present on ten to fifty percent of the area being considered.

Severe (81-100) - Subsoil is exposed over much of the area. Embryonic dunes and wind-scoured depressions may be evident. Only minimal traces of surface litter remain. Surface rock or fragments are dissected by rills and gullies. Most rocks and plants are pedestalled and rocks are exposed. Flow patterns are numerous and readily noticeable, showing large barren fan deposits. Large rills are apparent on exposed areas at intervals of less than five feet. Actively eroding gullies are present on more than fifty percent of the area.

WATER RESOURCES

The Red Rock Canyon National Conservation Area (RRCNCA) contains portions of two hydrographic regions or basins: the Central Region and the Colorado River Basin. These two regions are further divided into five hydrographic areas (listed below) which are partially contained within the planning area.

<u>Hydrographic Area</u>	<u>Region/Basin</u>	<u>Number</u>
Pahrump Valley	Central Region	162
Mesquite Valley (Sandy Valley)	Central Region	163
Ivanpah Valley (Northern Part)	Central Region	164A
Three Lakes Valley (Southern Part)	Colorado River Basin	211
Las Vegas Valley	Colorado River Basin	212

The Central Region is a topographically closed drainage system primarily located in Nevada. The three hydrographic areas within this region are, for the most part, internally drained.

The two hydrographic areas within the Colorado River Basin are tributary to the Colorado River. The southern part of Three Lakes Valley, however, discharges flood water out of Lee Canyon onto an alluvial fan. Depending on which channel the flood water enters, the flow goes either to the Colorado River or to the dry lake within the southern part of Three Lakes Valley.

Approximately 172,137 acres (88%) of RRCNCA drains into the Las Vegas Valley Hydrographic Basin and eventually to the Colorado River. The remaining 23,473 acres (12%) of the RRCNCA drains into the other four

hydrographic areas: approximately 3,912 acres (2%) into the Pahrump Valley, 9,781 acres (5%) into the Mesquite Valley, 1,956 acres (1%) into Ivanpah Valley and 7,824 acres (4%) into Three Lakes Valley.

Surface Water

Surface water occurrence is far less abundant than groundwater and is limited to ephemeral streams and springs. Streams such as Pine Creek, First Creek, Oak Creek and Lost Creek, during most years, flow short distances for short periods of time, primarily during early Spring. Numerous ephemeral washes transect the planning area, conveying flows only in response to storm events. These drainages are subject to short duration, high intensity thunderstorms which produce rapid runoff and at times "flash" flooding of downslope areas. Red Rock Wash and Cottonwood Wash are the more significant drainages. Both have been classified as Flood Hazard Areas by the Federal Emergency Management Agency (FEMA). Other areas below the escarpment have also been identified. Flood Hazard Areas are zones subject to the 100 year flood.

High intensity thunderstorms often produce rapid runoff and "flash" flooding which can result in floodwater and sediment damage within the region. Flash flooding, which has been on the increase, usually occurs from tropical depressions out of the south or southwest. It is believed that the increase in this flooding can be attributable to both increased recording of flood events as well as a result of population growth expanding into previously undeveloped areas (USDI, BLM, 1990). In an effort to improve the long-term safety of the public and protection of property from flooding, the Clark County Regional Flood Control District has been implementing a program in which siting, design and installation of flood control facilities is guided by a master plan. Most of the existing and proposed control facilities, including detention basins and conveyances, are located on public land. Several flood detention basins are located just outside the RRCNCA boundary. Flood waters exiting RRCNCA flow toward the valley bottoms. A majority of the flood waters enter the Las Vegas Wash where a mean annual flow has been measured at 57.6 cubic feet per second (cfs), with a peak discharge of 6,510 cfs recorded in 1975 and a low flow of 4.8 cfs in 1960 (Emett, 1993).

Springs are important water sources in RRCNCA as with the rest of southern Nevada. A total of 40 springs have been identified within the planning area (27% of all the springs in the Las Vegas District). See Appendix 11 to view location and discharge for each spring source. The average flow of these springs is 12 gallons per minute (gpm), with some springs being nothing more than a seep area with little discernable flow, while others measured as high as 100 gpm (this average may be misleading in that a few streams with large volume flows have raised the average significantly).

Ground Water

The importance of ground water is obvious in this region of few surface water sources. With the exception of communities that obtain water from major surface water sources such as the Colorado River, developments are restricted by the availability of suitable ground water supplies. The most developed and utilized water-bearing stratum is valley fill alluvium. Although numerous springs are found in association with carbonate rock or sandstone layers, development of these aquifers is relatively difficult. The carbonate rock system is composed primarily of limestone and dolomite deposited during the period when the area was covered by water. The rocks are usually very fractured and locally contain solution channels (openings that occur from the dissolving of soluble materials by water moving through pre-existing interstices or fractures). The carbonate system is regional in nature and provides an avenue for interbasin flow. The ability of the carbonate aquifers to store and transmit water is known to differ depending on location, but characteristics of the carbonate aquifers are largely undetermined at this time. The permeability of sandstone is much less than the valley fill alluvium releasing its stored water very slowly. The carbonate aquifer, as well as the alluvial aquifers, of several hydrographic basins, are currently being looked at by water purveyors within the Las Vegas Valley, as an alternative to meeting future water demands.

Depth to water varies throughout the planning area, but it can be generally characterized as ranging from at or near the surface to several thousand feet in the case of the carbonate system.

Most ground water recharge in southern Nevada is derived from winter and spring precipitation, representing approximately one-half of the total annual precipitation. The moisture is stored in snowpack, at elevations of 7,000 to 8,000 feet and higher. Precipitation reaches the groundwater reservoirs by way of streams which eventually discharge onto alluvial aprons or by infiltrating directly into consolidated rock and percolating vertically and laterally to the valley fill aquifer. Additional inflow is received from localized intense storms and ground water discharge from adjacent areas. Natural discharge of ground water in the basins occurs as a result of transpiration from phreatophytes (deeply rooted plants that obtain water from the water table or the soil layer just above it), spring discharge, evaporation from bare soil, interbasin flow, and base flow to streams such as the Las Vegas Wash.

As is the case throughout most areas of the arid West, water is a limited resource in southern Nevada and its availability is impacted by human population growth. Of the 5 hydrographic basins wholly or partially contained within the Las Vegas District, all have committed resources which exceed perennial yield (Coche, 1995). These basins, including Las Vegas Valley, are in a water overdraft situation.

The Las Vegas Valley is currently experiencing rapid growth and development. Heavy demands are being placed on an already over-utilized water resource. Entities within the Valley obtain water from both groundwater sources and the Colorado River. The groundwater system within Las Vegas Valley has been in an overdraft condition since 1945. In 1993, approximately 67,356 acre-feet of groundwater was extracted from the principal aquifer, far exceeding the estimated recharge of 30,000 acre-feet (Barrick, 1995).

This overdrafting has resulted in most of the groundwater problems currently found in the Las Vegas Valley, including declining water levels, land subsidence, declining water quality by incursion of water possessing higher concentrations of dissolved solids and nitrate, and the loss of vegetation dependent on groundwater (Morgan, 1994). These problems are not limited to the Las Vegas Valley. Although not to the same degree as that occurring in the Las Vegas Valley, all overdrafted basins realize some of the problems previously identified.

An artificial recharge project was initiated in 1987 and in 1993 resulted in the injection of 24,535 acre feet of Colorado River water back into the Valley's groundwater basin (Barrick, 1995). The project offset some of the groundwater withdrawal resulting in a net pumpage of 42,821 acre feet in 1993, still exceeding annual recharge. This groundwater withdrawal represents 13 percent of Las Vegas Valley's water withdrawals, with the remaining 87 percent (292,803 acre feet) obtained from surface waters, as Nevada's entitlement to waters of the Colorado River (SNWA, 1995).

Of particular concern because of the damage caused to property, is land subsidence. It is primarily associated with over pumping and resultant water level declines and has continued to be a problem in the Las Vegas Valley since the mid 1940s. The decline in water levels and consequential reduction in artesian pressure has resulted in an increase in the stresses imposed upon the sediments from which the water is extracted. In areas containing fine-grained deposits (silt and clay), the increase in effective stress has resulted in compaction of the sediments. This sedimentary compaction is seen on the land surface as subsidence. Although a good portion of the valley is sinking, it is at a uniform rate and most structures are not impacted. Where pre-existing faults occur however, more damage results as fissures are formed and large differential settlement occurs (Bell, 1991). Through artificial recharge, the rate of subsidence in the valley has decreased.

Within the boundaries of the RRCNCA and the Las Vegas Valley, numerous wells have been drilled on public lands. These wells provide permanent and reliable water in an arid environment where natural water sources, such as springs and seeps, are often unpredictable or intermittent.

Water Quality

In southern Nevada, one critical water resource problem is the poor quality of much of the surface and ground water. Several factors contribute to the high quantities of chemicals and solids in the regional water. High evaporation rates leave concentrations of salts at or near the soil surface after rainfall. The composition of rocks and soils, often containing calcium, magnesium, carbonates, silicates, metallic and nonmetallic minerals, also affects water quality. As water moves slowly into and through the soil profile, it dissolves and acquires these constituents. In addition, dust containing salts is blown from playas onto standing surface water and onto soil where it enters both surface and groundwater. A water quality sampling program was initiated in 1979 to obtain baseline water quality data for Clark County. Samples were collected in spring, summer, and fall and analyzed for biological, chemical, and physical parameters. The primary and secondary drinking water standards, as defined by EPA, were applied to these samples. These standards refer to the maximum contaminant levels allowable for public water supplies, which if exceeded, could adversely affect public health. It is important to note that these drinking water standards are for public water supplies, not necessarily springs, seeps, and others found in the natural environment. These standards may, however, be used to evaluate the quality of naturally occurring waters in terms of suitability for consumption, untreated, by humans.

Results of the three sampling periods indicate that water at many springs does not meet the Federal Drinking Water Standards. The major contaminant in the springs was found to be fecal coliform bacteria, generally considered to be an indicator of fecal contamination. Fecal coliform bacteria, which form a portion of the total coliform group, are restricted to the intestinal tracts of warm-blooded animals and carry disease-causing organisms.

Levels for turbidity, total dissolved solids, sulfate, chloride, manganese, iron, and nitrate nitrogen also exceeded Federal standards in several springs. Many of these levels do not pose health hazards; only nitrate nitrogen is potentially dangerous. This chemical was found to react with hemoglobin in the blood to produce an anemic condition commonly known as "blue baby" in infants under three months of age.

Salinity contributions to the Colorado River have become a concern both nationally and internationally. The Colorado River currently carries approximately 6.6 million tons of dissolved solids annually. Of this total load, it is estimated that only 38,000 tons of dissolved solids emanate from the approximately 6 million acres of public lands within southeastern Nevada (Westenburg, 1995). The contribution from the public lands within the Las Vegas District is a fraction of the 38,000 tons.

The quality of ground water varies throughout the planning area, as it does in the remainder of the state. In general, groundwater in areas of recharge has low chemical concentrations, but as it moves through the ground water system to discharge areas (i.e. valley bottoms), it dissolves sediments and rock materials. The extent to which chemical constituents are dissolved is largely determined by these factors: 1) the solubility, volume, and distribution of the materials; 2) the length of time that the water is in contact with the materials; 3) the distance that the water travels from the point of recharge; and 4) the temperature and pressure within the ground water system.

Little is known about ground water quality in much of the Las Vegas District. Several hydrographic basins were investigated at varying levels of intensity. Due to its large urban population, prior research focused primarily on the Las Vegas Valley. The shallow aquifers within the Las Vegas Valley are generally in poor quality. Total Dissolved Solids concentrations are as high as 8,000 milligrams per liter (mg/l). Such high concentrations are suspected to be the result of recharge from landscape irrigation and possible seasonal fluctuations in the water levels of the shallow aquifers. The concentrations of Total Dissolved Solids have increased over the last few years. High nitrate concentrations also contribute to the poor quality of the more shallow aquifers. In the deeper aquifers (200 to 450 foot depths) of Las Vegas Valley, water quality varies by geographic location. In the northern and western portions of the valley, Total Dissolved Solids concentrations range from 200 to 400 mg/l, with a calcium-magnesium-bicarbonate consistence. Groundwater in the southern and southwestern portions of the valley is a sodium-potassium-bicarbonate type with Total Dissolved Solids concentrations ranging from 700 to 1,500 mg/l. A mixed-cation sulfate type water of generally poor quality characterizes the remainder of the deep aquifer system in the Las Vegas Valley. Further degradation of this system can be anticipated, as the lowering of the water table accelerates the infiltration of poor quality water into adjacent aquifers (USDI, BLM, 1990).

The other hydrographic basins in the Las Vegas District exhibit groundwater quality characteristics similar to the Las Vegas Valley, that is, water quality deteriorates from the higher areas to the valley bottoms. In the carbonate and volcanic rock aquifers to the northwest of Las Vegas, water quality is generally acceptable. Water of a calcium-magnesium-bicarbonate composition is found in the carbonate aquifers while a sodium-potassium-bicarbonate composition is associated with the waters of the volcanic rock aquifer. To the east and southeast of Las Vegas unacceptable water, with a mixed cation-sulfate composition, can be found. The area west of the Arrow Canyon Range shows a marked increase in water quality and with further investigation may be a good water supply. The area lying west of the Sheep Range, although little or no data exists, is assumed to generally possess good to fair water quality with the

exception of isolated areas of poor quality water (Lyles, 1987).

RECREATION

In 1967, Red Rock Canyon (RRC) was designated as a Class 1, High Density Recreation Area under the Bureau of Land Management (BLM) classification system. Along with that designation came the title "Red Rock Canyon Recreation Lands" (RRCRL) and at that time RRC consisted of 62,000 acres.

In January of 1984, the Clark County Management Framework Plan (MFP) was approved for management of the BLM lands within Clark County, including RRC. The MFP called for the RRCRL to be managed as set forth in the 1975 Environmental Impact Statement (EIS) for RRC, and the 1976 Red Rock Canyon Master Plan. However, the MFP was still the "umbrella" plan and set forth objectives and regulations governing RRC. The MFP called for public land in Clark County to be managed in a way that maximized recreation opportunities. It further stated "Ensure that management actions are not allowed that degrade, preclude use of, or deny access to principal recreation areas.

The MFP recommended that the public lands within the Spring Mountains area (above 5,000' elevation) should be primarily managed for recreation values to accommodate the needs of Southern Nevada residents. It projected that recreation use would continue to grow along with the increasing population and that managing the area primarily for recreation would help protect the resources. It further stated that other resource plans and programs would be coordinated and subordinated to the recreation plan developed for the area. Recreation uses listed at the time included camping, picnicking, sightseeing, trail-bike riding, hiking, hunting, OHVing and horseback riding.

The MFP divided the area that is now the NCA into two basic OHV designations. The area to the north of State Route 160 limited OHV use to designated roads (no cross-country travel) and disallowed high speed competitive events. The area south of State Route 160 also limited OHV use to designated roads, but allowed high speed competitive events with certain seasonal restrictions. The current direction, as stated in the Interim General Management Plan, disallows motorized vehicle and bicycle events involving speeds in excess of the normal posted speed limit (generally referring to past events held on the Scenic Drive) and no competitive motorized vehicle events are allowed in the NCA.

In November of 1990, legislation passed which changed Red Rock Canyon from "Recreation Lands" to "National Conservation Area" (NCA) and increased the size to 83,100 acres. Although the NCA designation obviously calls for a more stringent effort to preserve the natural resources, there is not a clear definition as to what exactly an NCA

is. There is a strong sentiment from a portion of the local community that the "conservation" designation infers limited recreational use and an abundance of planned actions to protect and enhance the natural resources "...for the enjoyment of present and future generations". Basically, any form of enjoyment derived from what the NCA has to offer is recreational, thus conserving the resources is accomplished through effective recreation management.

The legislation designating the NCA also calls for a General Management Plan (GMP) to be completed for the area. The challenge involved with the GMP is developing a plan which adequately conserves the resources of RRC, while accommodating the rapidly growing Las Vegas community, and increasing visitor use at an international level.

When the Red Rock Canyon Master Plan was approved in 1976, the population of the Las Vegas community was around 350,000 and the east boundary of RRC was about 8 miles from the west edge of Las Vegas. At present, the Las Vegas community has grown to over 1,000,000 and houses are being built directly adjacent to the NCA's eastern boundary. The remaining buffer directly north and south of Charleston Blvd/State Route 159 is planned for community development and will disappear in a few years.

Along with the challenge of managing for the increasing population, is the growing popularity of recreational activities that were of minimal consideration several years ago. Neither the Red Rock Canyon Master Plan nor the Clark County MFP mention mountain biking or technical rock climbing, which are both major recreational pursuits in the NCA today.

In November of 1994, legislation was passed which expanded the NCA boundaries by over 112,000 acres, so the present total NCA acreage is approximately 196,000. Most of the expansion is to the north, although there is a sizeable increase to the southern boundary taking in the Bird Spring Range (see map showing expansion boundaries). The expanded areas offer dispersed recreation activities with very little in the way of facilities. Other than the Kyle Canyon and Lee Canyon Roads, there is no paved access. Recreation activities presently occurring in the expansion include hiking, horse riding, mountain biking, hunting, shooting, rock climbing, and 4-wheeling.

Visitor Use

The majority of visits to the NCA occur in the Scenic Drive vicinity. In 1998 the Scenic Drive broke the one million visits barrier. The number of visits to the Visitor Center has increased an average of 15.7 percent per year since the first full year of service in 1983, with a visitor count of 397,400 for 1998. Dispersed use includes most of the visitor use outside of the Scenic Drive influence. Dispersed use for the last year is estimated at around 40,000, but

this figure is based on observation, limited data collection and projection for various activities including mountain biking, horseback riding, hiking, OHV use and commercial use. The actual use may be higher than estimated.

Seasonally, the highest visitor use in the NCA usually occurs from the beginning of February through April, with peak visitation occurring in early April. Moderate use occurs from around the end of September to mid November. The lowest visitor use generally occurs from June through August and November through January when temperatures are at extreme highs and lows. Actual visitor use corresponds closely to weather conditions, with temperature being the most common factor.

Sightseeing

Sightseeing is by far the heaviest recreational pursuit in the NCA. Most of the visitation concentrates at the Visitor Center, Scenic Drive and along State Route 159 between the NCA entrance from Charleston Blvd. and the town of Blue Diamond. Scenic touring also occurs in the dispersed areas of the NCA, but most of the roads in these areas are dirt and require 4-wheel drive or at least a vehicle with high clearance. Some of the dirt roads receive minimum maintenance and can be negotiated only with 4-wheel drive.

The typical agenda for visitors not familiar with the local area begins with a tour of the Visitor Center where they can become familiarized with what the NCA has to offer through viewing displays, perusing informative literature and conversing with the Visitor Center interpretive staff. The information most often requested at the information desk includes:

- what attractions to look for along the Scenic Drive and State Route 159;
- what hikes are available and what would be a good hike to take;
- where the wild burros can be found;
- information about picnicking, climbing, mountain biking and camping.

A stop at the Visitor Center is normally followed by a tour of the Scenic Drive and on south as far as the town of Blue Diamond, with stops along the way at points of interest.

Technical Rock Climbing

Technical rock climbing is an activity which was not considered in earlier land use plans, but has grown to the point where it is now a

major recreational use in RRC. In fact, RRCNCA has become an international attraction for climbing enthusiasts. The Calico Hills offer numerous sport climbs, while the canyons of the escarpment offer longer routes, some requiring 2 or 3 day excursions. There are estimated to be over 1,000 different existing routes in RRCNCA, offering a wide range of challenge.

With the expansion of the NCA, in November of 1994, additional climbing opportunities are now located in RRCNCA at three areas referred to as the "East Test Site", "West Test Site" and "Area 51". These sites are actually located just south of the Kyle Canyon Road about 5 miles from the junction with Highway 95. They offer an opportunity to climb routes on limestone as opposed to the more common sandstone routes offered in the center of the NCA.

Current climbing policy is included in the IGMP (June 1995). It includes the first written climbing management that any document has provided for Red Rock Canyon.

Resource concerns, where climbing is involved, include trail braiding of approach trails, various impacts to rock surfaces, potential impacts to rock art sites, visual intrusion of hardware and slings left on climbing walls, effects on raptors, bats and wildlife in general, and impacts on vegetation. The impacts on vegetation include the trail braiding, trampling along the base of climbing routes, and disturbance of certain plant species that inhabit the crevices and ledges of cliff faces. The cultural and nest site concerns are mostly a need for making restricted sites and policy known to the climbing community, who have generally supported this policy, although there could be reservations depending on the potential extent of imposed restrictions. The most complex and difficult issue to resolve involves bolting in wilderness areas. The canyons along the escarpment and the climbing areas off the Kyle Canyon Road fall within Wilderness Study Areas (WSA). The bolting issue is being pondered at all agency (BLM) levels as well as within the U.S. Forest Service and National Park Service, and basically involves the interpretation of the Wilderness Act of 1964. Until the lands under consideration for wilderness are either designated or released, the Bureau of Land Management will manage these lands by the policies set forth in the "Interim Management Policy For Lands Under Wilderness Review" (IMP). In regards to rock climbing, the IMP states:

"Rock climbing and caving will be allowed as long as these activities meet the nonimpairment criteria. The use of power driven (i.e. fuel or electric) rock drills or permanent anchors (e.g. bolts) is not allowed. No marring, scarring or defacing resulting in adverse impacts to the wilderness value of naturalness will be permitted, nor will permanent installations be permitted. Exceptions to the above may be allowed for: (a) emergencies, such as search

and rescue operations; and (b) authorized actions needed for access travel within WSAs which are the minimum necessary for public health and safety in the use and enjoyment of the wilderness values. Any impacts from emergency actions (a, above), must be reclaimed to a substantially unnoticeable condition following the emergency situation."

In the last few years, the climbing community has become increasingly more responsible for climbing activity occurring in the NCA. Although climbers, in general, leave sites relatively clean upon completion of their activity, they have taken it upon themselves to participate in annual clean-up events of areas where heavy climbing takes place during the year. The Climber's Liaison Council discussed in the IGMP has come to fruition and they are actively involved in tackling local climbing issues.

Bicycling

Bicycling, like rock climbing, has increased dramatically over the last decade. The increase has occurred in both street cycling and mountain biking. Street cycling occurs along State Route 159 and around the Scenic Drive. Mountain biking occurs on a network of trails in the Cottonwood Valley area, to the north and south of State Route 160. Some of the trails extend into the southern expansion with one loop trail traversing approximately three miles of Humboldt-Toiyabe National Forest land. An Environmental Assessment (EA) for this trail network was completed in 1996, and the trails have been formally designated on the ground. Mountain biking also occurs on existing trails in the expansion area north of Kyle Canyon Road in the vicinity of Grassy and Grapevine Springs. The Kyle Canyon and Lee Canyon Highways also receive bicycle use.

The primary problem that has been occurring in the Cottonwood Valley area and within the Pine Creek WSA, is the unauthorized construction of trails on sites not previously disturbed. In the case of Pine Creek WSA, mountain bikes are not allowed in wilderness or WSAs, yet a trail now extends from Bootleg Spring toward First Creek and continues to extend in a northerly direction. A similar problem is the attraction for mountain bikers to explore any disturbance remotely resembling a trail, whether designated or not. This converts subtle horse paths to definite resource disturbance.

Factions of the mountain bike community have become very active in rectifying past and reoccurring impacts. Some of the mountain bike event coordinators have initiated proactive programs where individuals are awarded credit toward event standing for trail maintenance accomplished prior to the actual event.

Camping

The 1976 Master Plan called for 3 supervised campgrounds in RRC.

Locations included Oliver Ranch, which was privately owned at the time, Spring Mountain Ranch, which belongs to the State Parks system, and Oak Creek. A campground was constructed in the Oak Creek area, but it is located adjacent to State Route 159, whereas the Master Plan proposed the location at the mouth of Oak Creek Canyon. This campground has been closed.

The 13 Mile Campground is the only formally designated campground in RRCNCA. Other areas have been utilized to handle overflow but have not been considered official campgrounds. Use of these overflow sites has now ceased. In 1993 the access road to Oak Creek Canyon was so eroded and visually unappealing that it was closed to allow for restoration. The campground was in a similar state. In the IGMP the decision was made to close Oak Creek. After a site review and selection process, 13 Mile was chosen as the new campground location.

Overnight camping is allowed in higher elevations of the core NCA as designated on the included camping map. The map does not refer to campgrounds in the core area or camping designations in the 1994 NCA expansion.

Hunting and Shooting

There is no shooting allowed in the NCA other than at the Desert Sportsman's Rifle & Pistol Club shooting range, which is an inholding, located where Charleston Boulevard enters the NCA. In fact, it is illegal to have a loaded firearm in the NCA, except in designated hunting areas during open season, in accordance with State law. Included in the supplementary rules published in the Federal Register as proposed rules, on December 13, 1991, was a proposal for a target range in the NCA. After review of feedback during the public comment period, the proposal was dropped.

Although shooting is not allowed, there has been an abundance occurring throughout roaded portions of the NCA away from the heavier visitor use areas, and in several locations along the eastern boundary, including some areas of moderate visitor use. Bullet shells, especially the colorful shotgun variety, are seldom collected and lay scattered around at various pull-offs and guzzler sites.

Hunting is allowed in accordance with State law, except within areas designated as closed to hunting. In the core NCA, closed areas include the area north of State Route 160, on the east side of the Spring Mountain range, below 5,000 feet in elevation. There are two specific locations below 5,000 feet where bighorn sheep may be hunted. The no-hunting restrictions are primarily a public safety concern. Presently, there are no hunting restrictions in the north and south ends of RRCNCA.

Trails Use

Trails planning and management for the original NCA boundaries established in the 1990 Act, are included in the IGMP. Many of the trail locations utilize existing disturbance, such as wild horse and burro trails or routes that climbers have established. These trails offer good visitor access without creating new disturbance to vegetation. The trails offer a variety of experiences for hiking, mountain biking, and horse riding. New trail construction has taken place in locations where other options were not available or existing disturbance is not suitable due to resource concerns or desired experience.

There are no designated limits set for hikers in the NCA. Any trails may be hiked on, but hikers do not normally utilize trails primarily designated for mountain biking, because the locations do not offer the high level of hiking appeal that can be found in other areas. Most hiking takes place in the general vicinity of the Scenic Drive. For the more independent hiker, the Wilderness Study Areas (WSAs) offer an experience requiring more self-reliance.

Equestrians also have access to most trails within RRCNCA, with the exception of high use hike only trails in the Scenic Drive vicinity. Equestrian use seems to be fairly disbursed.

The major mountain bike use occurs in a network of designated trails in the Cottonwood Valley area. The majority of these trails are included in the IGMP, but some of the system is within the southern NCA expansion, which is not included in the IGMP, and approximately 3 miles of trail traverse U.S. Forest Service land. A separate EA, which focuses specifically on the Cottonwood Valley trails network was completed in May of 1996. The trails have recently been designated on the ground with trailhead signs and route markers at intersections and other locations of possible confusion. This will help prevent illegal trail construction and limit riders to appropriate routes. Prior to ground designation, it was very difficult to distinguish between trails in the system and existing wild horse routes not included in the designated network.

All of the trails systems need to be more visitor friendly. The BLM is currently improving ground designation of all approved trails systems in the NCA and updating the corresponding maps.

Hiking, horse riding and mountain biking all occur in the areas added to RRCNCA in 1994. Hiking and mountain biking are less prevalent than in the core NCA, due to difference in proximity to the city of Las Vegas and perhaps because the scenery is less captivating. Mountain biking does occur in the north expansion on existing trails in the Grassy and Grapevine Springs area. The level of equestrian use in the expansion areas is more comparable to core area use than are other trail user groups. The expansion lands offer less

congestion and fewer roads, making it more appealing to horse riders. Most of the riding to the north occurs in the Kyle Canyon vicinity. The first 5-6 miles of the Kyle Canyon Road accessing RRCNCA are bordered by private land, of which many of the residents are horse owners.

For existing trail information, see the "Facilities" section in this chapter.

OHV Opportunities

All motor vehicle use in the NCA is limited to designated roads. There are no trails designed for ATVs or dirt bikes. Competitive motor vehicle speed events are not permitted. The core NCA is more intensely managed in this respect and offers relatively few opportunities for off highway experiences. The primary 4X4 road is the Rocky Gap Road, which begins at the back end of the Willow Spring area, climbs to the Red Rock Summit, then continues into Lovell Canyon, within the Spring Mountain National Recreation Area (SMNRA), which is managed by the U.S. Forest Service.

North of State Route 160 is the "Wildhorse Loop" and access to the Black Velvet area. Access to Black Velvet via the west leg of Wildhorse Loop is 2.6 miles and is traversable by two wheel drive. Other dirt roads in the this vicinity are rougher. To drive the entire 4.45 miles of the Wildhorse Loop would require a minimum of a high clearance vehicle. There is also an old non-maintained jeep road that bisects the Wildhorse Loop. This road is .86 miles at the point of intersection and is recommended for four wheel drive vehicles only.

Within the area south of State Route 160, the Cottonwood Valley Road is the only dirt road slated to remain open. It heads south from State Route 160 for 3 miles before exiting the NCA and entering U.S. Forest Service land and continuing south all the way to Goodsprings. Presently there are a few laterals off of this road within the NCA, but the IGMP calls for their closure.

The expansion portions of the NCA are accessible mainly by dirt roads. The only paved roads are the Kyle Canyon and Lee Canyon State Routes. Some of the dirt road system is suitable for 2 wheel drive, although in many cases the driver runs into spots that require a 4 wheel drive to negotiate. At present, use of the roads is allowed until decisions have been made as to which will be designated and which will be closed.

Commercial Use

In the past, commercial and competitive activities have been permitted openly as long as an environmental analysis concluded that projected impacts would fall within acceptable limits. In 1984, the

approval of the Clark County Management Framework Plan (MFP) began introducing restrictions by limiting ORV use in Red Rock Canyon (RRC) to designated roads, with high speed events allowed south of State Route 160 only.

The Interim General Management Plan (IGMP), which is the current management plan for RRCNCA, prohibits any mechanized events involving speeds in excess of the normal speed limit. Competitive events which normally occur in the NCA include running event, mountain bike races, and long distance equestrian events.

Interest in commercial ventures has been on the increase. Almost all of the commercial endeavors involve filming (video or still photography) or schooling/guiding activities. Filming generally includes movies, television commercials and professional still photography. Guiding activities generally include technical rock climbing, bike tours, hiking tours, equestrian trail rides, four-wheel drive tours and charter tours. Proposals, however, are not limited to the activities listed above.

The IGMP was approved in June of 1995 and imposes additional restrictions concerning commercial operations. The number of rock climbing permits has been limited to 6 full time permits at any one time and 10 guest permits, which are temporary and allow guiding/schooling businesses two 5 day visits for the calendar year issued. Guided equestrian trail ride operations have also been limited, with no more than 5 being issued at any one time, and no overlap of geographical operations between any two permittees. The IGMP further states that additional limits may be imposed if necessary for resource protection.

Full time commercial permits currently operating in RRC include 5 rock climbing permits, 3 equestrian trail riding permits, 5 four-wheel drive tour permits, 5 guided hiking permits and 3 guided bicycle tour permits. The numerous charter tour permits that have been in effect are being closed out and will not be reissued. Charter tours now pay an entrance fee upon admission and no longer need to be under individual permits.

VISUAL RESOURCE MANAGEMENT

Red Rock Canyon has long been recognized for its scenic values. In 1964, after the passage of the Classification and Multiple Use bill, the BLM placed 10,000 acres in withdrawal status. In November of 1990, the Red Rock Canyon National Conservation Area Establishment Act was passed. This act changed the designation of Red Rock Canyon from "Recreation Lands" to "National Conservation Area" (NCA), and included a total of 83,100 acres. Finally, in November of 1994, additional legislation was passed which expanded the NCA boundary to include an additional 112,210 acres, bringing the total size to

approximately 196,000 acres (other minor acquisitions have occurred).

One of the dominant features of Red Rock Canyon is the geologically unique Keystone Thrust Fault running north-south along the west boundary. It is composed of sandstone which is covered and protected by a layer of older and more weather resistant limestone. To the east, and also running north-south for a stretch of 2 1/2 miles, are the Calico Hills, a multicolored sandstone formation which features an array of arches, domes, potholes and other interesting natural architecture.

Therefore, it is no surprise that scenic viewing is the activity that attracts the highest percentage of visitors to Red Rock Canyon. A study completed in 1992 (Customer) found that even when involved in other activities, including biking/running, hiking, rock climbing and picnicking/day use, the primary reason for participating in these activities at RRC is the scenery.

In 1976, the Federal Land Policy and Management Act (FLPMA) was passed. One result of FLPMA is the placement of scenic resources on an equal basis with other resources. It makes the consideration of scenic resources mandatory throughout the land management activities of the BLM. It is practiced according to guidelines published as BLM Manual Handbooks 8410-1 *Visual Resource Inventory* and 8431-1 *Visual Resource Contrast Rating*.

An in-depth Visual Resource Management (VRM) study was made in 1980, which covers that portion of the NCA included in the original legislation of 1990. There have not been any exhaustive VRM studies done for portions of the NCA added in the 1994 expansion. However, an abbreviated visual inventory was conducted in winter of 1998 to assign VRM Classes for the expansion areas so that they coordinate with the Forest Service's assigned Visual Quality Objectives (VQOs) on adjacent lands published in their 1996 Forest Plan Amendment.

The practice of VRM in BLM land use planning inventories landscape character according to the four basic visual elements of form, line, color and texture, and is used to analyze impacts of development. The planning area is first evaluated and assigned values for several visual elements based on a numerical point system. The total points assigned to a given area are then used to determine an existing scenic quality class.

The next step is to combine the assigned scenic quality classes with distance zones and viewer sensitivity factors. That step yields the VRM classes as follows:

Class I - Natural ecological changes and very limited management activity are allowed. Any contrast created must not attract attention. This classification is applied to wilderness areas, wild and scenic rivers, and other similar

situations.

Class II - Changes in any of the basics (form, line, color, texture) caused by a management activity, should not be evident in the characteristic landscape. Contrasts are seen, but must not attract attention.

Class III - Contrasts to basic elements caused by management activity are evident, but should remain subordinate to the existing landscape.

Class IV - Any contrast attracts attention and is a dominant feature of the landscape in terms of scale, but it should repeat the form, line, color and texture of the characteristic landscape.

The following map depicts the most recent VRM classes assigned for the RRCNCA including the expansion areas.

The boundaries of the Wilderness Study Areas (WSAs) are also shown on these maps. Both the La Madre Mountain and Pine Creek WSAs will be managed as Class I, the most restrictive class.

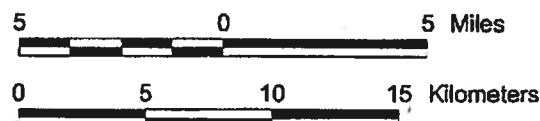
When specific projects are proposed, further visual analysis will occur, on a case by case basis, to determine the impacts of any proposed actions on scenic quality. The level or degree to which various actions affect or degrade the scenic quality of the landscape depends to a great degree on the amount of contrast created by the activity in relation to the existing landscape character. The landscape will also be studied from several key viewpoints to analyze the potential effects of proposed projects on the basic visual elements of form, line, color and texture. When the need arises, Visual Simulations and Seen Area Determinations will be conducted with a computer program, Visual FX, Ver. 2.0, to further determine impacts of proposed projects.

Certain projects may require modification or mitigation measures to lessen contrast so that the project complies with the assigned VRM Class of its location. An example of this would be selecting paint colors to camouflage or render less conspicuous, tanks and buildings. Another example would be changing the proposed route of a road or powerline to hide it from a popular overlook. In other instances, rehabilitation, revegetation, etc., may be recommended to lessen the visual impact of existing conditions of high contrast so that an area will more closely reflect its assigned VRM Class.



VISUAL RESOURCE MANAGEMENT CLASSES

Red Rock Canyon
National Conservation Area
General Management Plan



Legend

- Red Rock Canyon NCA Boundary
- WSA (Interim VRM Class I)

VRM Classes

- I
- II
- III
- IV

Wilderness Study Areas are managed under an interim designation of VRM Class I until such time as Congress acts upon the Bureau recommendations. At that time, areas designated as wilderness will be managed as VRM Class I and areas released from wilderness consideration will be managed according to underlying VRM Class designations.

No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or specific use. This map data was compiled from various sources. This map data does not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

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GEOLOGY

Red Rock Canyon is located in the Spring Mountains of southern Nevada in the Basin and Range province. It straddles the margin of the Great Basin with westward drainage into the Great Basin, and eastward drainage into the Colorado River. The rocks are Paleozoic marine and Mesozoic terrestrial sedimentary rocks that have been shaped into striking cliffs and canyons by uplift and major faulting, followed by erosion.

The most striking feature is the towering cliffs of Aztec sandstone that run from the Cottonwood fault to the eastward bend of the Keystone thrust fault. Less apparent is the unconformity caused by the Keystone thrust, which drove dark, lower Paleozoic carbonates over the lighter Mesozoic sandstone. Arid conditions limit vegetative cover and large areas of bedrock are exposed, allowing for easy observation of rock layers. Interpretation of tectonic movement is difficult, because fault movements have scrambled small crustal blocks, with vertical displacements of thousands of feet and horizontal displacements of tens of miles. Soils are generally thin and poorly developed, and bedrock type greatly influences vegetative cover by controlling availability of water. The large areas of exposed carbonates at the higher elevations rapidly absorb precipitation, allowing almost no run-off except during periods of torrential downpours in summer. These waters reappear briefly as springs along fault lines and contacts between rock units, flow for short distances, and are then absorbed by coarse gravels that form extensive alluvial fans.

South of State Route 160, which follows the trace of the Cottonwood Fault through the Mountain Springs, surface rocks consist of Paleozoic marine sediments broken into numerous fault blocks by thrust faulting in the Bird Springs area. North of the Cottonwood Fault, that closely follows State Route 160, are the Mesozoic shales and sandstones that form the Wilson Cliffs. The cliffs are topped by several hundred feet of Paleozoic marine limestones driven up from the west along the Keystone Thrust. A portion of the Keystone Thrust extends to the east of the sandstone cliffs to form La Madre Mountain, a steep limestone cliff that divides Red Rock into two sections. North of La Madre the landscape consists of numerous blocks of Paleozoic marine sediments that are broken by faults and dissected by drainages on the east side of Mt. Charleston.

PALEOZOIC ERA

The Paleozoic era is represented by approximately 11,000 feet of sediments ranging from deep marine limestones and dolomites of Cambrian age to near shore, evaporite and terrestrial deposits of Permian age. The oldest rocks are found at the highest elevations, due to displacement by fault movement. These carbonate rocks rapidly absorb most precipitation, with little run-off except during

extremely heavy rains. Water moves down through joints and faults to reappear as springs in canyons and at impermeable rock layers. The presence of permanent springs has had a profound effect on plant and wildlife communities. Endemic plants grow around many of the springs, and plants normally restricted to wetter climates survive the harsh Mojave Desert climate. Several caves have developed in these rocks, including the cave in the Kaibab and Toroweap formation near the Visitor Center, and Tea Kettle Cave in the Monte Cristo Limestone east of Brownstone Canyon.

The marine limestones contain rich invertebrate fossil deposits with brachiopods, corals, sponges, and crinoid fragments well represented in many areas.

MESOZOIC ERA

The Mesozoic era is represented by rocks that show a gradual change in the environment from marine conditions to shallow swamps and finally desert. Limestones of the Virgin Member of the Moenkopi are superseded by the sandstones and shales of the Chinle Formation and the wind-blown sands of the Aztec Sandstone. Rocks younger than the Aztec have either been removed by erosion, or were not deposited.

CENOZOIC ERA

Cenozoic deposits are limited to gravels and cemented caliche on alluvial fans, and tufa deposits around springs.

CULTURAL RESOURCES

Cultural resources are the tangible remains of past human activities. They include anything that humans have made or modified for their use. The study of cultural resources enhances our present knowledge of plants and animals, and man's interaction with plants, animals and fellow man. It allows us to understand the process that has led us to where we are today, and can help us deal with future situations. The more intact a cultural site is, the more likely it is to yield valuable scientific information. The study of cultural resources (archaeology) is divided into historic and prehistoric categories. Prehistoric archaeology involves time before Native American contact with European populations (before written history). Historic archaeology in southern Nevada began approximately 170 years ago with Jedidiah Smith's exploration of the area in 1824 and the beginnings of the Spanish Trail in 1829.

Prehistoric

Cultural resources give evidence of the presence of prehistoric Native Americans as early as 13,000 years before present (B.P.) time. Between 5,550 and 13,000 B.P., several phases of occupation occurred in the southern Nevada region, with the different phases being determined by changes in the types of cultural resources recovered. The Little Lake Pinto Gypsum Phase lasted from 5,500 to 2,000 B.P. and consisted of Native American culture acclimated to a desert environment. This period included occupation of the Red Rock Canyon (RRC) area, which was an attractive site due to a higher availability of water than is found in most desert environments. Next came the Ancestral Puebloans (Anasazi) from 2,000 B.P. through 850 B.P. The southern Paiutes were occupants during the late Puebloan phase and were here when early Americans from the United States and Mexicans entered southern Nevada approximately 170 years ago.

Aboriginal peoples commonly used natural formations such as rockshelters or caves for shelter and as storage areas for small quantities of collected resources, tools, and other personal possessions. Evidence of their fires can be found in the blackened staining on the walls and ceilings of such caves. The remnants of food processing equipment and toolmaking activities, as well as seeds, baskets, sandals, and other perishable items, are often preserved within habitation sites. Roasting pits are also often found in association. Roasting pits are circular pits that were used primarily to roast bulbs from the agave plant. They are often associated with milling stones or other food processing equipment, lithic materials, and sometimes ceramics.

Shelters that were extensively used often contain layers of organic deposition called midden within the floor and surrounding the entrance. This midden usually shows blackened soil and is filled with artifacts; a midden that has not been disturbed has excellent

potential for yielding significant information on the prehistory of the region.

An area that possesses quantities of lithic material, such as stone flakes or formed tools, ceramics, animal bone or plant materials, milling equipment, and often the remains of a cooking fire within a hearth, is considered a campsite. These are generally reflective of temporary locations, on a path from spring to spring or resource to resource. Campsites are found in all areas, but are most prevalent on terraces overlooking major drainages and surrounding springs.

Other types of prehistoric archeological sites include stone features, such as rock rings, and rock art locales. Rock art is defined as the modification of a rock face by pecking (petroglyphs) or painting (pictographs) figures or designs. Rock art panels are common in certain areas, generally near water sources, along game trails, or near resource procurement locations. Sandstone with a stained or patinated surface is perhaps the best medium for illustrating this kind of aboriginal visual creativity.

The RRC area is rich with cultural resources left by Native American inhabitants. When the first Americans of European heritage entered southern Nevada, the southern Paiutes were still in the area, so there are some written records of their presence and lifestyle. Other than that, much of our knowledge about ancient Native Americans is derived from the cultural resources they left behind.

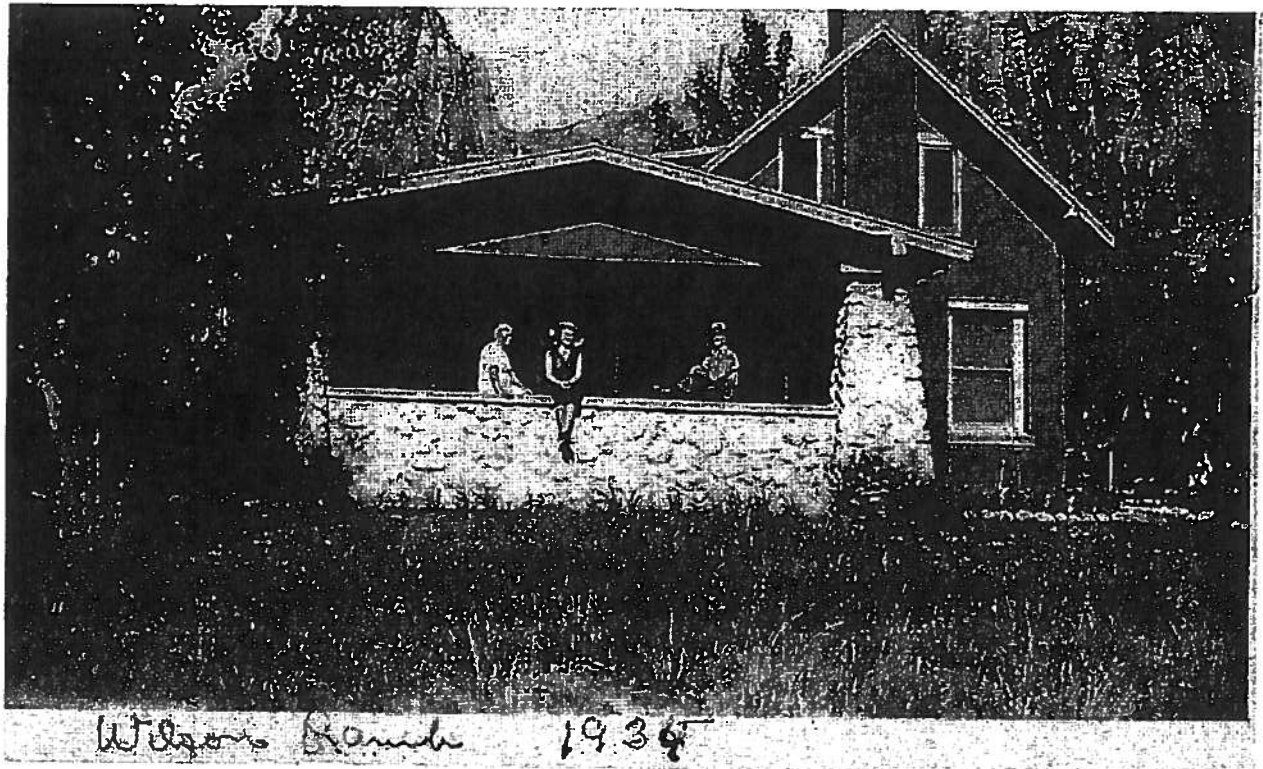
Historic

Commercial travel of the Old Spanish Trail/Mormon Trail began in 1829/30 and the last major mule trail to pass through the area was in 1848. Both Mountain Springs and Blue Diamond served as watering spots. During this period Blue Diamond was known as Cottonwood Springs and Mountain Springs was often referred to as Paiute Springs. Very little evidence of their passing was left by the trail users.

The first white settler in the Red Rock Canyon vicinity was James Wilson, who staked out the Sandstone Ranch (now Spring Mountain Ranch) in 1876. Another homesteader was Horace Wilson, who set up residence in Pine Creek Canyon in 1922.



The Wilson Ranch located at Pine Creek. Photographs taken in 1934.



Red Rock Canyon Sites

Cultural resources have been well inventoried in the northern end of RRC, especially in Brownstone Canyon, Sandstone Quarry, Lost Creek, Willow Spring, Calico Spring and Ice Box Canyon. Over 326 sites have been inventoried at RRC. These sites include mainly prehistoric lithic scatters, agave roasting pits and middens. Lesser known sites consisting of petroglyphs, pictographs, shelters, ceramics, fire hearths and other man made or altered features have been inventoried. The most common artifacts of the historic period in RRC are related to farming, ranching and mining themes. These cultural resources include roads, building foundations, cut stone blocks, developed water holes/springs, mine shafts and adits, and small trash sites consisting mainly of tin cans and broken glass.

Inventory and study of sites to the south is less comprehensive. However, Bird Spring, which is the first recorded cultural site in Clark County, is located on RRCNCA's southern boundary. In general, the vicinity of any stable water source could include cultural sites.

The Willow Spring and Brownstone Canyon areas represent the most significant archeological values in the northern portion of RRCNCA. Long term prehistoric use of the areas is indicated by the presence of significant numbers of rock shelters, roasting pits and petroglyphs.

Sites within RRCNCA have experienced low to moderate levels of damage. Willow Spring, Brownstone Canyon and Sandstone Quarry have sustained much of the vandalism and disturbance.

Paleontological Resources

Paleontological resources (fossils) are remains or traces of plants and animals that existed during the 600 million year geological history of southern Nevada. Fossils are unique, nonrenewable resources which provide clues to the history of life on earth and, as such, are considered to have scientific value. A minimal amount of paleontological research has been conducted in this region. The majority of fossils recorded in RRC are from the Paleozoic and Mesozoic Eras. The fossil record representing this era includes brachiopods, gastropods, crinoids, corals, sponges and petrified wood.

AIR QUALITY

Air quality is determined by several factors, including landform, the amount of contaminants emitted into the atmosphere, and by meteorological conditions. In southern Nevada, stable atmospheric conditions, low mixing heights, and light winds during night and morning hours provide opportunities for contaminants to accumulate.

Atmospheric dispersion of pollutants generally improves by mid-afternoon.

The effects of ambient air quality within an air basin depend mainly on the characteristics of the receptors and the type, amount, and duration of exposure. As defined in 40 CFR 50.1(e), ambient air is "that portion of the atmosphere, external to buildings, to which the general public has access." As required by the Clean Air Act and established by the Environmental Protection Agency, National Ambient Air Quality Standards specify the concentration and duration for which pollutants may cause adverse health effects. National primary ambient air quality standards define levels of air quality, with an adequate margin of safety to protect the public health. National secondary ambient air quality standards define levels of air quality, with an adequate margin of safety, to protect the public welfare from any known or anticipated adverse effects of a pollutant. Where differences in local and national standards exist, the more stringent standards apply. The National Ambient Air Quality Standards, shown in Table 3-1, were adopted by the State of Nevada and Clark County. The National Ambient Air Quality Standards were established for carbon monoxide, nitrogen oxides, ozone, particulate matter, sulfur oxides and lead.

Carbon monoxide is produced primarily by incomplete fuel combustion in motor vehicles. The major effects of carbon monoxide occur near its sources (busy streets and freeways). The highest carbon monoxide measurements usually occur in the winter when winds are light and temperature inversions trap air near the ground surface from early evening through mid-morning preventing pollutant dispersal. Traffic peaks in early morning and late afternoon produce corresponding peaks in carbon monoxide concentrations, a trend which occurs throughout the year. Although the 1-hour standard for carbon monoxide has never been exceeded, the 8-hour standard is exceeded on a seasonal basis. According to Clark County Comprehensive Planning, the overnight buildup of pollutants causes violations of the Carbon monoxide 8-hour air quality standard in a limited area surrounding the East Charleston monitoring station. Carbon monoxide has a toxic potential to human health. When breathed, Carbon monoxide impairs oxygen transport because of its affinity for hemoglobin. Adverse effects in the cardiovascular system and the central nervous system can result. The magnitude of the health effects increases with the level, as well as the duration of exposure (Seinfeld, 1986).

The primary contributor of PM_{10} throughout the Las Vegas District is fugitive dust, both naturally occurring in a desert environment and man-caused. It is the man-caused sources that are largely responsible for excesses of the PM_{10} National Ambient Air Quality Standards within the Las Vegas Valley. The major sources of PM_{10} emissions in the Valley are: paved and unpaved roads, construction activities, industrial/commercial facilities, motor vehicle exhaust, and disturbed vacant land. Particulate matter less than 10 microns

in size is of special concern, because it is inhaled deep into the lungs. The ultimate effects of particles on human health are difficult to determine however. There is little data available regarding the effects of industrial particulates versus those of soil-related dust. Because most health studies have examined only fossil fuel generated particulates, and most of Las Vegas Valley's particulate concentrations are due to soil-related dust, it is inappropriate at this time to estimate the health effects induced by particulate matter concentrations in the Valley.

Ozone is produced through a series of chemical reactions. A reaction between reactive hydrocarbons and nitric oxides, both of which are primarily emitted by motor vehicles, forms nitrogen dioxide and other compounds. The formation of nitric oxide and an oxygen atom follows the photodissociation of the nitrogen dioxide by sunlight. The oxygen atom then combines with oxygen molecules to form ozone. Ozone is an irritant of the respiratory system. It inhibits proper functioning of the lungs and can cause symptoms of chest tightness, coughing and wheezing. These symptoms can occur after short-term exposure of between 294 and 490 $\mu\text{g}/\text{m}^3$ (Clark County Comprehensive Planning, 1980).

Lead is primarily emitted through the combustion of leaded fuel in motor vehicles. Indications are, however, that lead emissions are on the decline due to reductions in the use of leaded fuel. Once absorbed by the respiratory tract and then into the blood stream, lead is accumulated in the kidneys and liver. The nervous system may also be effected through inhalation of lead in the air (Clark County Comprehensive Planning, 1980).

Nitrogen dioxide forms in the high temperature combustion of fuels, motor vehicle exhaust and the burning of organic wastes. At high concentrations, nitrogen dioxide has been shown to cause lung damage. The effects at the current levels both indoors and outdoors are difficult to characterize (Seinfeld, 1986).

Sulfur dioxide forms during the combustion of all sulfur-containing fuels, such as coal and oil. Effects of sulfur dioxide on human health is primarily associated with the upper respiratory system, particularly in asthmatics.

Air pollutants not only have the potential to affect humans, but also other components of the environment, including wildlife, fish, and vegetation. Wildlife can be affected by air pollutants through inhalation, adsorption and/or ingestion. Their populations can be directly affected through injury or death or indirectly through contamination of their food chain or loss of habitat (U.S.D.I., FWS, 1980).

There are several air pollutants that are known to be harmful to vegetation. These include sulfur dioxide, ethene and peroxyacetyl

nitrate. Chlorine, hydrogen chloride, mercury and ammonia are also harmful, but to a lesser degree. Pollutants enter the plant via the stomata during normal respiration. Once in the leaf, they destroy chlorophyll and disrupt photosynthesis resulting in damage ranging from growth rate reduction to actual death of the plant (Cooper, 1986).

Visibility is generally referred to as the relative ease with which objects can be seen through the atmosphere under various conditions. Particulate matter and gases introduced into the atmosphere either absorb or scatter the light, thus reducing the amount of light a person can receive from a viewed object. The effect is a degraded aesthetic value of surrounding landscape. The Clean Air Act specifies that pollution be prevented that would interfere with visibility in the mandatory Federal Class I areas. Mandatory Federal Class I areas refers to international parks; national wilderness areas and memorial parks greater than 5,000 acres in size; and national parks greater than 6,000 acres in size. Although there are no Class I areas within the Las Vegas District, there are such areas located downwind. The closest to the planning area is the Grand Canyon National Park in Arizona. Others include Bryce Canyon National Park and Zion National Park both located in the southern most portion of Utah. Currently, no data exists that definitively indicates that southern Nevada, in particular the Las Vegas Valley, presents an impact to these parks. The Grand Canyon Visibility Transport Commission, which is managed by the Environmental Protection Agency and the Western Governor's Association, is currently investigating visibility impairing pollutants and their effect on these as well as other parks and wilderness areas of the Colorado Plateau (Shivley, 1995).

According to the Clark County Health District, a haze day is classified as an average reading for one hour or more between 5:00 AM and 11:00 AM when the visual range is less than 12 miles. If the visual range for one hour is less than 4.8 miles, haze is considered to be intense. Late fall and winter, when night and morning inversions are most frequent and stagnant conditions exist, tend to produce the highest haze levels. There are currently two locations in the valley where visibility is measured (metropolitan Las Vegas and Henderson). The greatest number of haze days recorded at these locations for a one year period was 194 and 157, respectively. The greatest number of intense haze days for a one year period was 93 and 30, respectively. The data gathered to date indicates that there is an improvement in Henderson and a deterioration of visibility in Las Vegas. At this time there is no visibility standard for the rest of Clark County.

Air quality is generally considered acceptable if pollutant levels are less than or equal to established standards on a continuous basis as is the case for those areas lying outside Las Vegas Valley. These areas are characterized by a sparse population and few pollution

sources. The Las Vegas Valley, however, presently exceeds standards for inhalable particulate matter (PM₁₀) and carbon monoxide and, consequently, has been termed a non-attainment area (an area which exceeds any national ambient air quality standards). Approximately 173,124 acres or 88% of the RRCNCA is within the Las Vegas Valley Non-Attainment Area.

Although air quality outside the Las Vegas Valley is in conformance with the National Ambient Air Quality Standards, there are several primary sources of pollutant emissions. The largest contributors are the two power generating stations, Reid Gardner Power Plant located in the northeastern part of the planning area at Moapa, Nevada and the Mojave Generating Station located in the far southern part of the planning area at Laughlin, Nevada. According to 1994 data, the Reid Gardner Power Plant emits 2,398 tons of PM₁₀, 8,740 tons of NO_x and 9,652 tons of SO₂ annually. The Mojave Generating Station is the largest pollutant source with 2,505 tons of PM₁₀, 21,704 tons of NO_x and 35,852 tons of SO₂ emitted annually.

FIRE HISTORY SUMMARY 1980-1997, RRCNCA

Fire occurrence in the Red Rock Canyon NCA is described in terms of cause, frequency and acres. Fire occurrence is summarized both for the NCA as a unit, and for its two constituent fire management zones. These zones consist of woodlands (escarpment/canyons) and mixed grass/shrublands (desert basin) and represent the two major fuel types found in the area. The wildfire history during the years 1980-1997 is summarized for the NCA as follows:

Cumulative Fire Occurrence

Cause	-natural ignition (lightning):	108	(37%)
	-human ignition (all sources):	<u>186</u>	(63%)
Frequency	-total number of fires:	294	
Acres	-natural ignition (lightning):	157	(6%)
	-human ignition (all sources):	<u>2448</u>	(94%)
	-combined acreage burned:	2605	
	-average acreage per fire:	8.9	

Annual Average Fire Occurrence

Cause	-natural ignition:	6
	-human ignition:	<u>11</u>
Frequency	-all causes:	17
Acres	-average acres/year:	153

The patterns of wildfire activity in the two fire management zones vary greatly, as seen in the following:

Cumulative Fire Occurrence

[Woodland]

Frequency	-(number of fires):	69
	-(percentage of NCA total):	23%
Acreage	-(total combined acreage):	146
	-(percentage of NCA total):	6%
	-(average acreage per fire):	2.1

[Shrubland]

Frequency	-(number of fires):	225
	-(percentage of NCA total):	77%
Acreage	-(total combined acreage):	2459
	-(percentage of NCA total):	94%
	-(average acreage per fire):	10.9

As shown, 37% of the fires that occurred within the NCA were natural or lightning caused, which amounted to only 6% of the total acres burned. This can be attributed to the fact that most of the human caused fires occurred in the shrubland vegetation type, where the fuels are more continuous, allowing for a more intense burn. The acreage per fire for lightning is low, because many occur in the timber community where a tree of two burn, but the ground fuels are generally too sparse to carry the fire.

The statistics can also be somewhat misleading in that 4 of the human caused fires occurring in the shrub community accounted for 2249 acres (86%).

For more in-depth information regarding fire, see Appendix 16.

* Note: a single 1983 fire (1250-acres) constitutes 85% of the NCA's cumulative fire acreage for the years 1980-1992.

