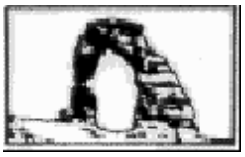

Visitor Experience and Resource Protection Implementation Plan

June 1995

ARCHES National Park - Utah
United States Department of the Interior - National Park Service - Denver Service Center

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The General Management Plan / Development Concept Plan / Environmental Assessment (NPS 1989) for Arches National Park was approved by the Rocky Mountain regional director in August 1989. That plan required that a visitor use management plan be completed when visitation exceeds the projected visitation for the year 2005. This requirement is met by this implementation plan. The visitor experience and resource protection (VERP) process started in 1992 and was developed with considerable public input. This VERP document is an approved implementation plan for the General Management Plan / Environmental Assessment, and no additional National Environmental Policy Act documentation was prepared.

Noel R. Poe May 25, 1995
Superintendent, Arches National Park

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INTRODUCTION

Arches National Park is one of America's scenic wonders, attracting visitors from around the world. Like many other national parks, Arches' popularity has grown rapidly in recent years. Visitation increased from approximately 290,000 in 1980 to 777,000 in 1994 -- an increase of 168%. During August 1994, an average of approximately 3,710 people visited the park each day. The number of visitors has already passed the level the National Park Service projected in the 1989 Arches General Management Plan for the year 2005. Use is expected to continue to increase for the foreseeable future.
Increasing use is affecting Arches' resources, visitors, infrastructure, and management.

- Visitors walking off of trails have severely trampled some areas, damaging fragile cryptobiotic soil crusts and altering grass and shrub communities. Such trampling has changed the nutritional content of fescue and blackbrush, which in turn may be affecting wildlife populations in the park. Day hikers are inadvertently damaging Canyonlands biscuitroot (*Lomatium latilobum*), a rare plant occurring in the park's fin areas. Trampling also is affecting water infiltration rates, water retention capabilities, and invertebrate populations in soils; it is also increasing soil erosion.

- Visitor use is affecting the park's cultural resources. Graffiti, looting, the displacement of artifacts, and littering are the primary impacts that have been monitored at cultural resource sites in Arches.

- The quality and diversity of visitor experiences at many popular attractions in Arches have changed over the years. Traffic congestion and crowding are occurring more and more frequently, particularly at parking areas, trailheads, and popular arches. Noise from vehicles and visitors is often apparent in these areas. Increased use of the backcountry by day hikers has resulted in a loss of solitude at Fiery Furnace, the Devils Garden primitive loop, and Klondike Bluffs. During holiday weekends, long lines of cars queue up to enter the park in the mornings. The parking areas at Balanced Rock, the Wolfe Ranch/Delicate Arch trailhead, the Devils Garden trailhead, and the Windows parking area are filled to capacity on most summer days. Visitors then park their cars on road shoulders, which damages the vegetation and the shoulder soils.

  The park's single campground is filled nightly from March through October. The visitor center also is often overcrowded during the spring, summer, and fall. As a result of all of these changes, an unknown number of visitors have either been displaced to other parts of the park or no longer visit Arches.

- The park staff is devoting increased time and resources to addressing the problems resulting from the growing number of visitors. More of the park's limited funds are being devoted to law enforcement, traffic management, the installation of barriers, and the restoration of disturbed areas.

In short, increasing use at Arches is increasing congestion, cultural and natural resource impacts, and conflicts among visitors. The National Park Service is finding it increasingly difficult to meet its mission to allow visitors to enjoy the park and still conserve park resources in an unimpaired condition for future generations to appreciate.

The primary purpose of the Arches visitor experience and resource protection (VERP) plan and program is to safeguard both the quality of the visitor experiences and the resources at Arches National Park. The plan is intended to institutionalize an ongoing program in which park staff would continuously monitor resources and visitors, identify when discrepancies occur between existing and desired visitor experiences and resource conditions, and take action to achieve desired conditions. In addition, the program is intended to provide a rationale that park managers can use to explain to the public why they are taking certain actions.

THE CARRYING CAPACITY MANDATE AND THE ARCHES GENERAL MANAGEMENT PLAN

In the past the question of how much public use is appropriate in a national park has been framed in terms of visitor "carrying capacity." The Park Service is required by law to address carrying capacity in planning for parks: the 1978 National Parks and Recreation Act (P.L. 95-625) requires each park's general management plan to include "identification of and implementation commitments for visitor carrying capacities for all areas of the unit."

In 1989 the *General Management Plan / Development Plan / Environmental Assessment* (NPS 1989) for Arches National Park was approved. This plan gives general guidance and direction for managing the park's resources, visitors, and facilities. The authors of the plan recognized that the effects of increasing visitor use would have to be addressed and called for the development of a new program to address this issue. The new program was called a visitor impact management (VIM) program. The VIM program was supposed to identify key indicators and standards for analyzing the impacts of visitors, compare these standards with existing field conditions, and determine appropriate management strategies to deal with the probable causes of the impacts. The program was to address impacts on natural resources, cultural resources, and visitor experiences in both frontcountry and backcountry areas.

The *General Management Plan* provided the following directions for addressing visitor use and facility capacity:

- The Park Service was required to prepare a VIM-type program when park use exceeded the management plan's visitation projections for the year 2005. (This event happened in 1991.) The VIM plan was to be initiated at least three years before the beginning of comprehensive design for any construction beyond that proposed in the General Management Plan.

- No expansion of roads, parking, and other facilities beyond the proposals in the *General Management Plan* was permitted until the VIM program determines that additional visitors could be accommodated without causing "unacceptable deterioration of natural or cultural resources or visitor experiences."

- Until the VIM program was operational, increases in use were to be accommodated only to the extent that excess demand could be redistributed to underused areas.

- The VIM program was to determine whether or not visitor facilities could be expanded further at Balanced Rock.

- Using the information gathered for the VIM program, parking and other trailhead facilities at Devils Garden, the Wolfe Ranch, and the Delicate Arch viewpoint were to be expanded to accommodate the 1989 summer weekend demand.

The *General Management Plan* noted several other focuses for the VIM program, including raptor nesting areas, the use of the Colorado River shoreline, the removal and burning of wood, and the improper disposal of human waste.

In 1992 the Park Service made a commitment to develop a visitor use management / carrying capacity process that could be integrated with its general management plan program. Incorporating the concepts of the VIM program and the Forest Service's limits of acceptable change (LAC), the Park Service developed its own process to help national park planners and managers address visitor carrying capacity and make sound decisions about visitor use. This process is called visitor experience and resource protection -- VERP. Arches National Park was selected in 1992 as the first park to test the VERP process.

In the VERP process carrying capacity is defined as

> the type and level of visitor use that can be accommodated while sustaining the desired resource and social conditions that complement the purposes of the park units and their management objectives

In other words, the VERP program interprets carrying capacity not so much as a prescription of numbers of people, but as a prescription of desired ecological and social conditions. Measures of the appropriate conditions replace the measurement of maximum sustainable use that are often used to measure other types of carrying capacities (e.g., range capacity for domestic ungulates or wildlife habitat) (Dassmann 1964).

THE ARCHES *VISITOR EXPERIENCE AND RESOURCE PROTECTION IMPLEMENTATION PLAN*

The Arches VERP program consists of four key elements -- a parkwide management zoning scheme; indicators and standards for each zone; management actions that address visitor use and infrastructure in each zone; and a monitoring program. Together, these elements will help park managers make sound decisions about visitor use. The VERP plan described in this document focuses primarily on the zoning scheme and indicators and standards, which form the foundation of the program. (The Arches VERP plan was developed following a nine-step process. This

process is briefly described in appendix A. For more details on the process, see the working draft "VERP: A Process for Addressing Carrying Capacity in the National Park System" (NPS 1993).)

The **management zoning scheme** is based on the park's purposes and significance and the range of desired visitor experiences and resource conditions that park managers intend to provide. The park's resource constraints and sensitivities and existing infrastructure are also factored into the zoning scheme.

Indicators and standards enable park managers to determine whether or not a park's resources are being adequately protected and desired visitor experiences are being provided. Each zone identified in this Arches VERP plan has specific indicators and standards. Indicators are specific, measurable variables that reflect the overall condition of a zone -- they define in measurable terms how management objectives can be met. Resource indicators measure impacts on the biological and/or physical resources of a park; social indicators measure impacts on park visitors that are caused by interactions with other visitors or with park or concession employees. Standards are quantitative or highly specific measures that provide a base for judging if conditions are acceptable. *It is important to note that standards do **not** represent desired conditions or goals for an area but rather are triggers for management actions (i.e., the points where conditions become unacceptable).*

When standards are reached, managers must take action to get an indicator back within its defined standard. A variety of **management actions**, such as altering visitor use patterns and infrastructure (e.g., roads, parking areas, trails), may be taken in each zone to rectify discrepancies with exceeded standards.

The final element of the VERP program is **monitoring**. Monitoring provides periodic, systematic feedback to park managers to ensure that standards are not exceeded over the long term. It is a way of objectively evaluating the effectiveness of individual management actions and the overall effectiveness of the park's VERP program.

It is worth noting what the Arches VERP plan and program are **not**.

- This VERP plan does not specify the total number of visitors that the park, as a whole, can accommodate at one time. Such an aggregate figure would mask problems at "hot spots" and would not provide managers with useful guidance for addressing use-related problems.

- The VERP program and this Arches VERP plan are not driven by the capacity of existing infrastructure. Building new facilities does not necessarily solve the problems resulting from increasing use. Rather than infrastructure, the VERP program is driven primarily by desired resource and visitor experience conditions.

- The Arches VERP plan does not propose major changes in the directions in the park's *General Management Plan*; the VERP plan is not an amendment to the management plan but rather implements part of the management plan. All of the management directions in the

management plan are taken as givens in the VERP plan. Amending the management plan can only change management plan directions.

- This VERP plan does not address impacts resulting from sources other than visitor use. Impacts from adjacent landowners, mineral development, fire suppression, poaching, etc., are addressed in the park's *General Management Plan* and *Resource Management Plan* (NPS n.d.).

- The Arches VERP program does not stop with the implementation of this plan. Visitor use patterns, desired visitor experiences, resource conditions, and park management all change with time. The VERP program is an iterative process of monitoring, evaluation, and adjustment.

THE ARCHES GENERAL MANAGEMENT PLAN AND THE VISITOR EXPERIENCE AND RESOURCE PROTECTION IMPLEMENTATION PLAN

The following VERP plan for Arches National Park incorporates the general philosophy and direction for visitor impact management in the *General Management Plan*. The VERP plan addresses most of the elements listed on pages 2-3 and thus satisfies the intent of the management plan. However, for the Balanced Rock area it does not address engineering/design questions regarding the expansion of the parking area -- this is beyond the scope of this document. An engineering study is needed in the future to determine if space is available for such expansion. Any proposed development sent to the public for input must take this VERP plan into account.

The *General Management Plan* also called for the VIM program to focus on the impacts of use of the Colorado River shoreline, the removal and burning of wood, the improper disposal of human waste, and the possible disturbance to raptor nesting areas. The VERP plan does not directly address these concerns. There is no data to indicate that these issues raised in the General Management Plan are significant problems or, more importantly, that they are related to increasing visitor use. (In the case of raptor nesting, environmental factors, such as rainfall, may be involved, which makes this topic a poor indicator for the VERP process. If there is a need to take specific action to protect access to some nests, the Park Service can simply close access to the nests independent of any other actions.) In addition, it is not clear how to monitor some of these impacts if they are occurring. The VERP team consequently decided to use different indicators to monitor for the impacts of increasing visitor use.

BACKGROUND

This section provides background information on the park, its regional context, its purposes and significance and describes some of the effects visitors are having on key resources and on other visitors. This information all shaped the development of the Arches VERP plan and program.

REGIONAL CONTEXT OF ARCHES NATIONAL PARK

Much of the use that is affecting Arches National Park is also affecting the surrounding public lands. Any actions the Park Service proposes at Arches that alter use levels or patterns will affect these other public lands -- and vice versa. Therefore, it is helpful to understand the broader context of the park before discussing the VERP plan.

Arches National Park is in southeastern Utah, adjacent to the Colorado River, in high desert country known as the Colorado Plateau (see Vicinity map). It is 5 miles north of the city of Moab, Utah, 100 miles west of Grand Junction, Colorado, and 240 miles southeast of Salt Lake City, Utah.

Arches is surrounded by some 7 million acres of public lands, which are drawing increasing numbers of visitors. Some of the major tourist attractions in the nearby area include: Canyonlands National Park, Natural Bridges National Monument, Dead Horse Point State Park, the Colorado, Green, and San Juan Rivers, the La Sal Mountains, Newspaper Rock Recreation Area, Canyon Rims Recreation Area, Grand Gulch, Cedar Mesa, and San Rafael Swell. Within a half-day's drive of Arches are additional popular national parks, monuments, and recreation areas. These lands provide a wide variety of recreational opportunities, including backpacking, camping, hiking, hunting, mountain biking, four-wheel driving, whitewater rafting, photography, rock-climbing, horseback riding, exploring cultural sites, sightseeing, snowmobiling, and cross-country skiing.

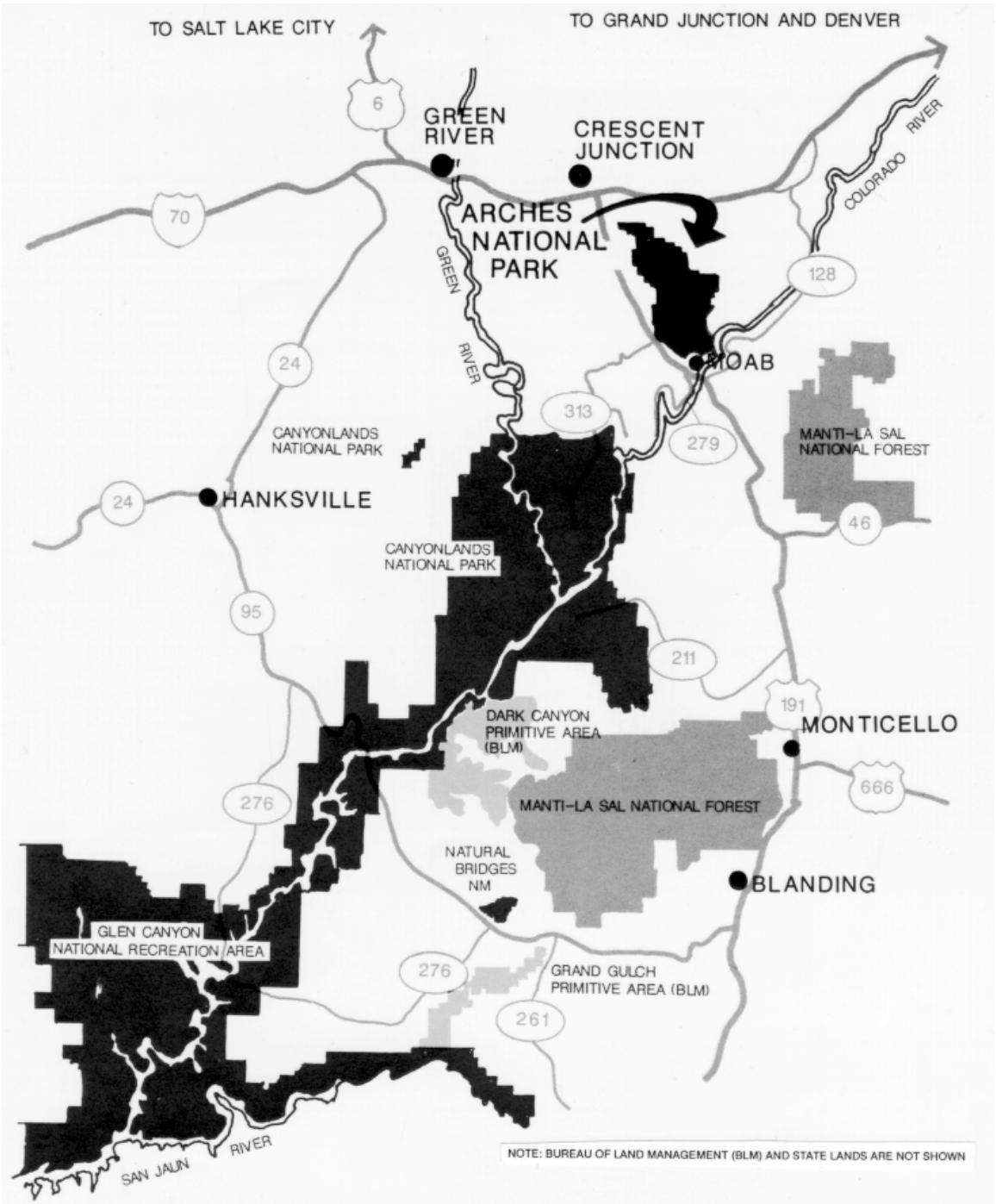
The Bureau of Land Management (BLM) administers over 5 million acres near the park. Mountain biking, four-wheel driving, backpacking, and whitewater rafting opportunities are nationally known and bring many visitors to the area. There are numerous mountain bike and four-wheel-drive trails in the area, including Kokopelli's Trail and the Moab Slickrock Bike Trail (which had 103,000 riders in 1994). Whitewater rafting on the Colorado River also is a very popular activity. About 71,500 people per year float the "daily" section of the Colorado, which is about 10 to 20 miles upstream from Moab.
One BLM-administered area directly adjacent to Arches is attracting heavy use. The Colorado River and Colorado Riverway (Highway 128) parallel the park's southeast boundary for about 12 miles. Lack of road access to the river from the park severely limits users from the park side. However, on the other side of the river, with the nearby highway, the ease of river access results in an intense level of recreational activities, including camping, boating, picnicking, swimming, hiking and auto touring. In high use periods, as many as 2,000 people camp along the riverway. To help accommodate this use, the Bureau of Land Management maintains several developed recreation and picnic sites and campgrounds. In the past few years, concern over impacts (mainly

from human waste, fire rings, vegetation damage, and offroad travel) led the Bureau of Land Management to designate a number of dispersed campsites and close other areas to camping.

Several special events, which occur annually on BLM lands, draw great numbers of visitors to the Moab area. Many people visit Arches while in the area for these events. For example, the Easter Jeep Safari draws over 1,600 four-wheel-drive vehicles for a week of guided tours. The Fat Tire Festival attracts about 2,000 mountain bikers for a week of tours and other activities. Moab Rocks is a mountain bike race and hill climb with about 400 contestants.

The U.S. Forest Service administers nearly 750,000 acres near Arches. The most heavily used area is the La Sal Mountains, about 20 miles southeast of Arches National Park. The La Sals provide scenic backdrops to the park (most notably in the Windows section and at Delicate Arch). Peaks in the La Sals rise to over 12,000 feet (3,600 m) in elevation, get considerable snow in winter, and provide a high-elevation experience not found elsewhere in the area.

The town of Moab is the center of visitor services for Arches National Park visitors. The town has grown rapidly over the past 10 years. In 1990 the U.S. Census reported that 4,200 people lived in Moab and 2,800 people lived in unincorporated areas (mostly in the Moab environs) in Grand County. However, in the visitor season the population significantly increases. With the growth in recreation use in the region, many new tourism/recreation businesses have started in Moab, including motels, restaurants, campgrounds, rental and shuttle services, mountain bike shops, river float companies, and air tour operators.



VICINITY

ARCHES NATIONAL PARK
VISITOR EXPERIENCE AND RESOURCE PROTECTION PROGRAM

UNITED STATES DEPARTMENT OF THE INTERIOR
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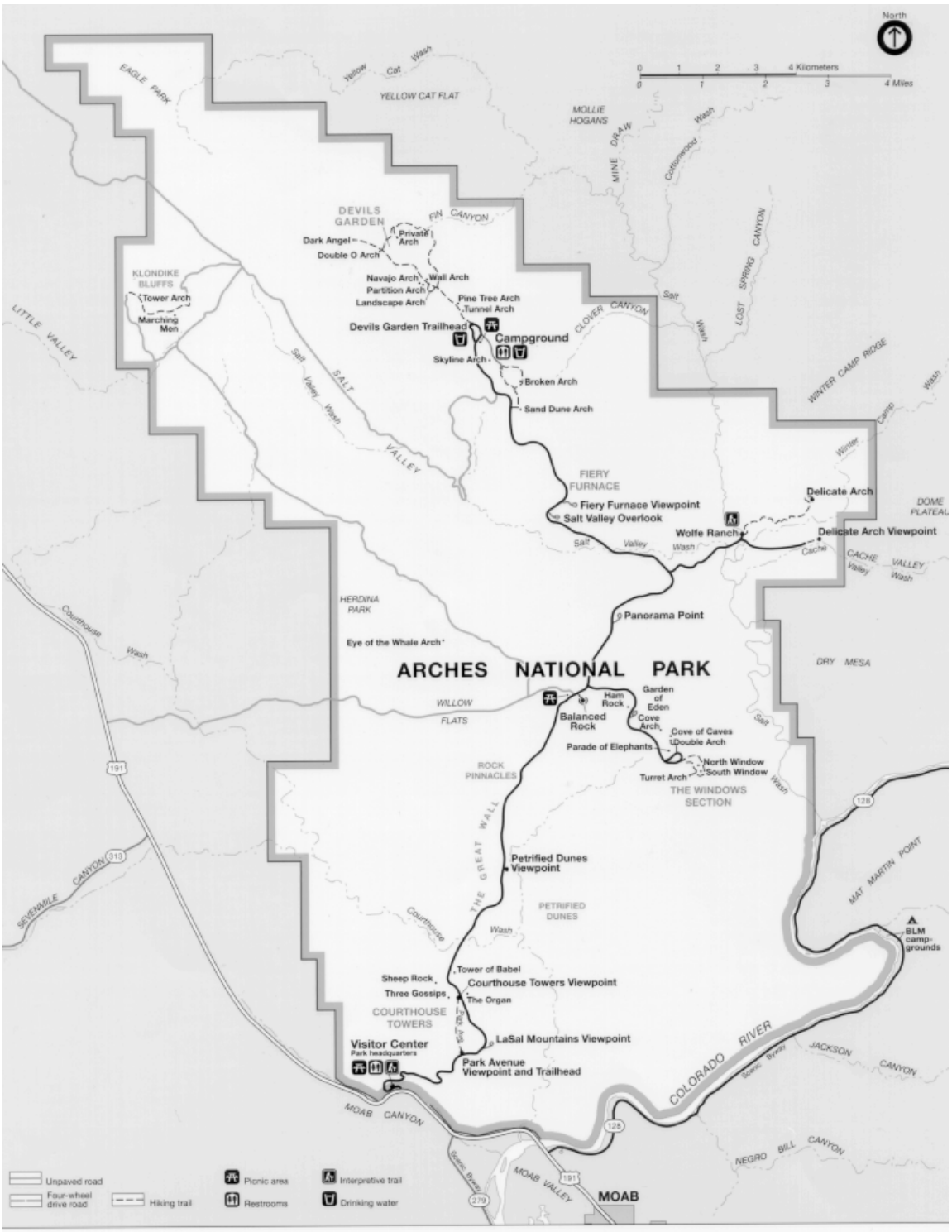
OVERVIEW OF ARCHES NATIONAL PARK

Lying entirely within Grand County, Arches' 73,379 acres (29,700 ha) are dominated by sandstone canyon walls, slickrock terraces, towering monoliths, and intricately eroded arches (see Parkwide map). Distant landscapes extending well beyond the park boundary form a highly scenic background for the park's dramatic sandstone features. The park's arid climate is characterized by hot, dry summers, with temperatures often exceeding 100 F (30C) , and cool to cold winters. The average annual precipitation of the area is 7.95 inches (20 cm). Besides the Colorado River, Salt Wash and lower Courthouse Wash are the only perennially flowing streams in Arches.

The vegetation and wildlife in Arches are typical of that found on the Colorado Plateau. Vegetation is sparse in the park, and soils are poorly developed. The piñon-juniper woodland community is the most extensive plant community, covering 46% of the park area, followed by the blackbrush community (30% of the park), and the Indian ricegrass/galleta/ Mormon tea grassland community (12%).

Cyanobacterial crusts, composed primarily of cyanobacteria, lichen, and mosses, are common on soils in piñon-juniper areas and in shrublands. Wildlife found in the park include mule deer, desert bighorn sheep, coyote, bobcat, jackrabbit, cottontail rabbit, kangaroo rat, raven, piñon jay, golden eagle, red-tailed hawk, prairie falcon, whiptail lizard, and collared lizard.

Although Arches is primarily known for its natural resources, prehistoric rock art and archeological sites that represent at least three Indian cultures are present in the park as well as historic remains of past ranching activity.



PARKWIDE

ARCHES NATIONAL PARK
VISITOR EXPERIENCE AND RESOURCE PROTECTION PROGRAM

UNITED STATES DEPARTMENT OF THE INTERIOR
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PARK PURPOSES, SIGNIFICANCE, AND PRIMARY INTERPRETIVE THEMES

The purposes, significance, and primary interpretive themes of Arches National Park and its significance are the foundation for the VERP plan. The park's purposes tell why was Arches set aside as a unit of the national park system. The significance of the park addresses what makes the area special -- why it is important to our natural and/or cultural heritage. These statements help describe the park's environment and are basic to all assumptions about the area and the ways in which it should be used and managed. The park's primary interpretive themes focus on what key ideas all visitors should understand when they leave the park.

Based on the park's enabling legislation, legislative history, NPS policies, park plans, public input, and the knowledge and insights of NPS staff, the following purpose and significance statements and primary interpretive themes were identified for Arches National Park.

The **purposes** of Arches National Park are to

- protect extraordinary examples of eroded sandstone formations and the setting in which they occur
- protect other features of geological, historical, prehistoric, and scientific interest
- provide opportunities for visitor appreciation and education that leave park resources unimpaired

Arches National Park is **significant** because

- the park contains one of the largest concentrations of arches in the world
- the park's numerous extraordinary geologic features are easily accessible, many of them by vehicle
- the park has striking foreground and background views created by contrasting colors, landforms, and textures
- the juxtaposition of shale, gypsum, and sandstone substrates in a protected area provides unusual research opportunities
- the park contains cultural resources, many of which are listed on or eligible for the National Register of Historic Places
- the park contains part of the most concentrated dinosaur megatrack site in the world; this well-preserved site is also one of the few known Jurassic megatrack sites
- the park is inseparable from a complex of parks and other public lands; this complex provides a wide range of nearby visitor experiences and activities
- as one of the 10 Colorado Plateau parks, Arches provides important research opportunities for studying protected ecosystems and environmental change over long periods
- the park preserves part of the Colorado Plateau ecosystems, which have unusual nutrient and energy cycles

The **primary interpretive themes** all visitors should understand at Arches National Park are that

- ongoing geological processes -- deposition, uplift, collapse, and erosion -- create and destroy the features we see today

- organisms on the Colorado Plateau have evolved into cold desert ecosystems that depend heavily on microorganisms in the soils; these soils are very sensitive to trampling and recover slowly
- protected areas are essential for understanding natural processes and predicting the results of human-caused changes in other areas
- humans have used the Arches area for a long time, and we must preserve the clues to the past to understand who they were and how they lived

PARK RESOURCES

The following section generally describes the key resources in Arches that have been and are being adversely affected by visitors (For more information on the park's resources, see the Arches General Management Plan / Development Concept Plan / Environmental Assessment (NPS 1989) and Resource Management Plan (NPS n.d.)).

The potential for additional impacts on these resources are of concern to the Park Service.

Natural Resources

The biological resources in Arches that are of key concern with regard to the VERP plan are the cryptobiotic soils, vegetation, and threatened and endangered species that occur in the park. Visitors in large portions of the park have affected these resources.

Cryptobiotic Soils. Much of Arches National Park is covered by cryptobiotic soil crusts (also called a microbiotic, microphytic, or cryptogamic crust). Well-developed, dark brown soil crusts originally covered most of the park's desert area. In the cold deserts of the Colorado Plateau region they may represent 70%-80% of the living ground cover (Belnap 1990). The crust is composed of cyanobacteria (formerly called blue-green algae), lichens, algae, mosses, and fungi. Filamentous cyanobacteria, such as *Microcoleus vaginatus*, are the dominant group of organisms. The sticky, mucilaginous sheaths from these cyanobacterial filaments form an intricate webbing of fibers through the soil. This webbing increases the soil's stability, which protects the soil surface from wind and water erosion.

The cryptobiotic soil crusts contribute in many ways to the park's ecosystems: they enhance soil stability; increase rainfall infiltration and reduce sediment production; contribute nitrogen and other nutrients for plant growth; enhance germination and establishment of some vascular plants; and may stimulate vascular plant growth and nutrient uptake (Belnap 1994; Harper and Marble 1988; Harper and Pendleton 1993; and Evans and Ehlringer 1993). The nitrogen-fixing role of the cyanobacteria is particularly important in desert ecosystems, where nitrogen levels are low and often limit the system's productivity.

Visitors walking off trails trample and crush the crusts. When they are dry, the crusts are very brittle and easily smashed. When researchers compared an untrampled area with a trampled area at Arches, they found the crustal integrity had been destroyed in the trampled area while the

untrampled area had thick, well-developed crusts. The soil crustal communities also had changed: instead of a rich diversity of lichens and cyanobacteria present in the untrampled area, only one cyanobacteria species and no lichens were found in the disturbed area (Belnap 1995).

Trampling the crusts in Arches results in several other changes. When the crusts' fiber connections are broken, the soils are destabilized and susceptible to both wind and water erosion. In addition, trampling soil crusts may impair soil fertility and soil moisture retention and adversely affect the establishment and survival of vascular plant seedlings. Crushed crusts also contribute less nitrogen and organic matter to the ecosystem (Belnap 1995, Belnap and Gardner 1993).

The natural recovery of the crusts can take many years. Under the best of circumstances, a small, thin veneer, consisting of one or two cyanobacterial species, may return in five to seven years. Full recovery of all of the crust components may take more than 250 years depending on the type and extent of disturbance, the availability of nearby inoculation material, and the temperature and moisture regimes (Belnap 1993).

Other Impacts on Soil and Vegetation. Visitors have affected Arches' soils and plants in several other ways besides impacting the soil crusts. Studies done at Arches and Canyonlands National Parks in spring 1992 and 1993 demonstrated that visitor trampling has significantly impacted nutrient levels in the parks' shrubland and grass ecosystems. A dramatic drop in nitrogen input in the disturbed areas was observed, with virtually no nitrogen-fixing activity detected in cyanobacterial populations after a single footprint in the soil crust (Belnap n.d. "Nitrogen Input"). Significantly less nitrogen-fixing activity was detected overall in trampled areas compared to less used areas. Total nitrogen content in sampled plants was much lower in the trampled areas: fescue (*Festuca octoflora*), the dominant annual grass, had 13% lower total nitrogen content in its tissues compared to the less-trampled areas; twistflower (*Streptanthella longirostris*), the dominant annual forb, had 31% less; and blackbrush (*Coeleogyne ramosissima*), the dominant shrub, had 9% less. Levels of other essential nutrients, including phosphorous, potassium, iron, calcium, and magnesium, were also found to be lower in fescue in areas lacking intact crusts. In addition, fescue had an average weight that was 50% less in the trampled areas compared to the less used areas (Belnap 1995). Fescue is important forage for rabbits and mice, while blackbrush is important forage for bighorn sheep. Changes in the abundance and nutrient content of these plant species thus could ripple through the entire ecosystem, affecting the animals that depend on them.

Trampling was found to alter the soil food webs, which can profoundly affect the park's ecosystems. At Arches, nematode populations were significantly reduced in trampled areas and fewer soil invertebrates and numbers of individuals were found at sites studied in Canyonlands. Both soil bacteria and fungi were reduced in active biomass compared to a pristine site. Plant litter therefore may take longer to decompose, which in turn means nutrients in the litter are not as available to living vascular plants. In short, trampling could disrupt natural nutrient cycles. Bacteria to fungi ratios were also higher in the trampled area. Higher ratios either lead to, or are associated with, a shift from perennial to annual plant communities -- which in fact was observed at the Arches' site (Belnap 1995).

Several other changes have been observed in the soil and vegetation in trampled areas. Trampling of vegetation has affected plant community structure at Arches, particularly in the Park Avenue, Windows, and Landscape Arch areas. Plants were spaced farther apart, and there were fewer individuals in the studied area. More annual plant species, or species that act like annuals, were present, while a less trampled area had more shrub species (Belnap 1995).

Fewer, larger individuals of blackbrush were found in the trampled area, interspaces were significantly larger, and hummocks under the shrubs were four times higher. As a result, small animals seeking cover under these plants must cross wider bare spaces and face a higher risk of predation compared to untrampled areas. In addition, exotic grasses contributed significantly to grass cover in the trampled area. Soil bulk density was significantly higher and soil porosity was significantly lower in the trampled area. Water infiltration rates were 90% lower in the trampled site. There was up to a 50% increase in surface albedo (reflectance of sunlight) in trampled surfaces, and surface temperatures were significantly different compared to the untrampled surfaces. Temperature changes can affect plant nutrient uptake rates, soil water evaporation rates, seed germination time, seedling growth rates for vascular plants, and the survival of many small desert animals (Belnap 1995).

Based on the above studies, it is clear that off-trail activity in Arches has had a major effect on the park's ecosystems.

Threatened and Endangered Species. Several plant and animal species that are on federal lists as endangered or threatened animal species, and plant and animal species that are candidates for listing, occur in or near Arches National Park. For most of these species there is no evidence that they are being affected by increasing numbers of visitors in Arches. However, there is evidence that park visitors have directly and indirectly affected two category 2 plant species -- alcove bog-orchid (*Habenaria zothecina*) and Canyonlands biscuitroot (*Lomatium latilobum*). (Category 2 species are under consideration for listing, but there is as yet no conclusive data on their biological vulnerability and threat.)

Populations of the alcove bog-orchid have been identified in the park near Delicate Arch, in a side canyon of Salt Wash, and in Courthouse Wash. This plant has been adversely affected by people hiking off trails to explore the alcoves. People walking on them easily erode the shallow soils in the alcoves. Sluffing of the soil in turn kills the bog-orchid, either by exposing their roots or causing the plants to fall over. People hiking off trails to explore the alcoves could easily extirpate this species.

The Canyonlands biscuitroot is the most studied of the candidate plant species known to occur in the park. This perennial endemic occurs between rock fins in the Entrada sandstone formation. The park populations are an important "stronghold" for the species, and there appear to be large numbers of individuals present. Populations are known to occur in the Devils Garden fins, the Tower Arch region of Klondike Bluffs, and the Fiery Furnace and Windows areas. The Fiery Furnace has the largest known population of Canyonlands biscuitroot (Floyd-Hanna and Hanna 1993).

Floyd-Hanna and Hanna observed that the greatest threat to the park's Canyonlands biscuitroot populations is due to trampling, soil compaction, and soil erosion caused by people. Areas between the park's fins are accessible and vulnerable to impacts. Although the park still has the only large, healthy populations of Canyonlands biscuitroot, visitors have affected the park's plant populations. Individual mature plants and seedlings in frequently visited areas, such as Devils Garden and the Fiery Furnace, have been trampled. Researchers observed that the number of reproductive mature plants has decreased consistently from 1990 to 1992 in the Devils Garden area (although the number of immature or new "germinants" increased in 1991 and 1992 relative to 1990) (Floyd-Hanna and Hanna 1993).

The plants also have died when the sand substrate has been eroded away by visitors walking off of trails. Erosion of the sand substrate under the plants exposes the roots or causes the plant to topple over. If enough mature plants and their clones die, the plant population on a given site may not survive other environmental changes.

Cultural Resources

As noted in the "Introduction" section, visitors are affecting the park's cultural resources. Many cultural resources throughout the park have been altered, removed, or destroyed, including rock art panels, historic buildings and structures, lithic scatter sites, and middens. However, it is not clear that most of these impacts relate to the increase in park visitation (see the later "Cultural Resources" heading in the "The VERP Plan" section).

PARK VISITORS AND EXPERIENCES

Most visitors coming to Arches are family groups on vacation, which is true for most visitors going to the southeastern Utah parks and other destinations on the Colorado Plateau. Almost all visitors arrive by private vehicle. Most stay less than half a day, although some stay longer for extended camping or hiking. The peak visitor season traditionally runs from May through September. August is usually the peak month, followed closely by June and July. Visitation is fairly steady throughout the week except during Easter, Memorial Day, Labor Day, and the Utah Education Association weekends -- the heaviest use times during the year (NPS 1989).

Most visitors come to Arches to hike, see the arches, take pictures, and take scenic drives. Other activities include picnicking, backpacking, four-wheel driving, mountain biking, nature walks, rock-climbing, and horseback riding. Some Arches visitors also camp in the 53-unit campground. About half of the park visitors hike for an hour or more to see specific park features; the remaining visitors hike for less than an hour or stay near their vehicles. Backcountry hiking and backpacking peak in the spring when water sources are more reliable and temperatures are moderate. Backpacking use decreases dramatically during July and August, when temperatures are in excess of 100 degrees and there is a lack of water, and then rebounds in the fall when temperatures cool off (NPS 1989).

To better understand the Arches visitors and their characteristics, several visitor surveys were conducted in 1993. Approximately 774,000 people visited the park in 1993, mostly between May and September. The typical 1993 visitor was a first-time visitor, on a long trip away from home. An average of 2.6 persons per vehicle came into the park. About 72% of the park visitors spent only one day in Arches. The Windows was the most visited site in the park, and most visitors also went to Devils Garden, the visitor center, and Balanced Rock. The most frequently hiked trails, excluding the Windows, were the Delicate Arch, Landscape Arch, and Double O Arch trails (NPS 1994).

There is little visitor use data available that indicates what experiences people are seeking in Arches or whether they are being affected by the increasing numbers of visitors. However, there are indications that at least some visitors in some areas of the park are being affected. Crowding and its effects are an important element in determining the quality of many park visitors' experiences, according to a 1993 survey of visitors in seven locations in the park (Lime, Manning, et al. 1994). Respondents at all locations stated that the absence of large groups of visitors, the absence of noise caused by visitors, and the absence of human impacts on soil and vegetation were all fairly important to the quality of their experience; conversely, a small number of other visitors present was also important.

In several locations visitors reported that they felt slightly crowded, including Delicate Arch, North Window, the trails to Delicate Arch and North Window, and the Devils Garden trail to and beyond Landscape Arch. Between 25% and 40% of the visitors at these locations reported they felt moderately to severely crowded, with the highest percentage being reported by the Devils Garden trail users.

Many visitors interviewed in 1992 also reported that they were concerned with crowding-related issues (Manning, Lime, et al. 1993). Although this was not a representative study of park visitors, most visitors interviewed felt there were problems with the number of people at major park attractions (e.g., Windows, Devils Garden, and Delicate Arch), the number of people on the trails, and the impacts on soil and vegetation caused by people walking off trails.

There is one other indication that the growing use levels are affecting park visitors. Park staff believe that some visitors no longer revisit Arches due to the crowds, although there is no data to estimate how many people have been displaced from the park.

THE VERP IMPLEMENTATION PLAN

INTRODUCTION

This section is divided into three parts, which together form the VERP plan for Arches. The first part presents the management zones, which describe the desired resource and social conditions for different parts of the park. The second part identifies the indicators and standards that have been set for each of the zones. The standards identify the points when resource and social conditions become unacceptable, triggering management actions. The third section identifies the management actions the Park Service will be taking in Arches, beginning in summer 1995, and that they may take in the future, to manage use in areas where the standards are reached or exceeded. This section also includes a brief discussion of monitoring -- another key element of the VERP program.

The VERP planning team went through several steps in developing the management zones and identifying where to apply them on the ground. This resource and visitor experience analysis and the other steps in the VERP process are summarized in appendix A.

CULTURAL RESOURCES

As noted in the "Background" section, visitors are affecting the park's cultural resources. However, the VERP process was not applied to Arches' cultural resources for several reasons. Unlike natural resources, which are usually renewable, cultural resources are considered primarily nonrenewable. Under federal law, the Park Service cannot accept any damage to significant cultural resources -- there is no threshold of acceptable change. The VERP team therefore did not identify indicators and standards for cultural resources.

It also is not clear that most cultural resource impacts in Arches are due to increasing levels of use. A single visitor, either unwittingly or purposefully, can cause as much or more damage to a cultural resource site than an entire season of use. In other words, vandalism is an illegal activity that does not necessarily relate to the impacts of increasing visitation. More visitors can increase the potential for vandalism, but the distance a site is from a road and the perceived level of management it receives also affect the potential for impacts.

Although this plan does not address the management of visitors to achieve desired cultural resource conditions, the Park Service recognizes that there is a need to deal with this carrying capacity issue. More work needs to be done on how to set indicators and standards to manage use levels for cultural resources. In the interim, at Arches the following management direction will be followed:

> *No adverse impacts on cultural resources due to visitor use will be permitted in any of Arches' management zones. Should it be determined that visitor use is impacting these resources, the Park Service in consultation with the state historic preservation officer*

and the Advisory Council on Historic Preservation will develop mitigation strategies to avoid these impacts.

MANAGEMENT ZONES

The VERP program relies on the concept of management zones (Although the names and definitions of the zones described in this section differ from what has been done in previous Park Service plans, the VERP zones are consistent with Park Service general planning guidelines. All of the VERP zones described here supplement either the natural zone or the park development zone described in chapter 2:7 of the Park Service's Management Policies (NPS 1988). Specifically, the VERP development and motorized sightseeing zones fall under the traditional "park development zone"; the other seven VERP zones are part of the traditional "natural zone.") that identify how different areas in the park will be managed to achieve desired resource and social conditions. Each zone has a unique combination of physical, biological, social, and managerial conditions, and different actions will be taken by the Park Service in different zones with regard to the types and levels of uses and facilities. The VERP management zoning scheme is consistent with the purposes of Arches National Park and with the overall direction and management actions called for in the park's *General Management Plan*; however, the VERP plan supplements the management zoning scheme in the *General Management Plan* by subdividing and providing more details about the zones and by prescribing more specific management directions.

Nine management zones for Arches were identified and then reviewed by the public; these zones are based on the resource and visitor experience analysis described in appendix A. Table 1, at the beginning of the section, summarizes the characteristics of each of the management zones. The parkwide management zoning scheme for Arches is shown on the following map. Five additional maps show the zones in heavily used portions of the park in greater detail.

Pedestrian Zone

The pedestrian zone is comprised of high use trail corridors that access prime park features. The zone includes the developed trails in the Windows area, the trail from Devils Garden trailhead to Landscape Arch, and the trail to Delicate Arch and Delicate Arch viewpoint. As shown on the zone maps, the pedestrian zone includes the narrow high use trail corridors. For monitoring purposes, pedestrian trail corridors are defined as extending 8 feet (2.5 m) on each side of the trail centerline. This width accommodates most of the inadvertent trailside impacts caused by trail maintenance and by visitors momentarily stepping off the trail to take photographs or to move out of the way of other users.

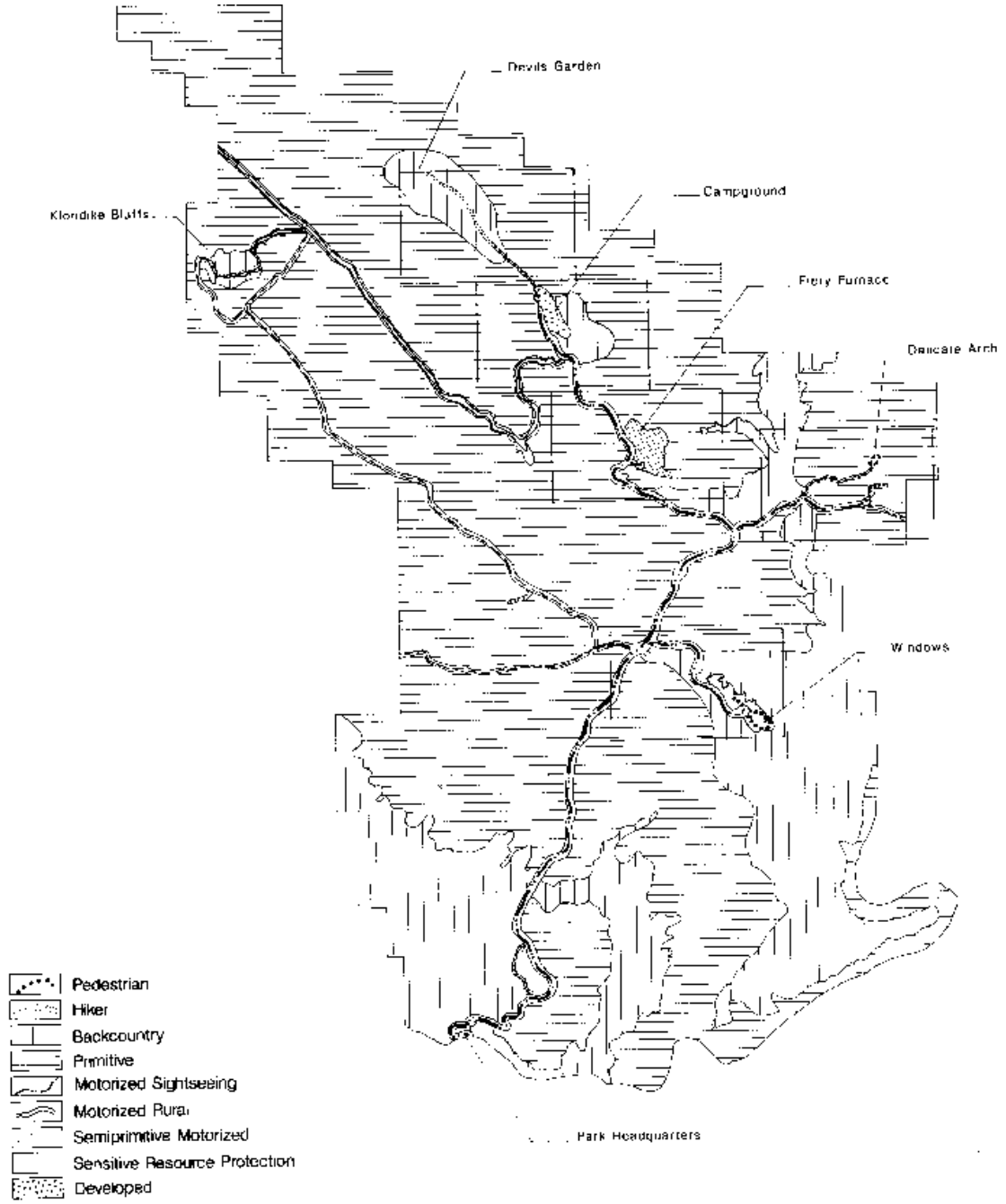
The areas in this zone are predominately natural, but with much evidence of the sights and sounds of people. Visitors can see, touch, smell, and hear park resources as they walk along a well-defined trail, but they will not feel like they are far from their cars or conveniences. Paved or hardened trails and small interpretive structures are the only facilities present. Some trails would be accessible to visitors with disabilities. To use this area, visitors must make a short time commitment and physically exert themselves to some degree. There are limited opportunities for

challenge and adventure, and the need for outdoor skills is relatively unimportant. The probability of encountering visitors is very high, and moderate for encountering NPS staff; many people may be present. No vehicles or stock are permitted in this zone.

Visitors, sites, and trails are intensively managed in the pedestrian zone to ensure resource protection and public safety (e.g., with fences, intensive law enforcement, and restrictions on visitor activities). Resources can be modified for essential visitor and park operation needs, but they are changed in a way that harmonizes with the natural environment. Except for these essential changes, the Park Service's tolerance for resource degradation here is low.

TABLE 1. SUMMARY OF THE CHARACTERISTICS OF THE MANAGEMENT ZONES

	PEDESTRIAN ZONE	HIKER ZONE	BACKCOUNTRY ZONE	PRIMITIVE ZONE	MOTORIZED SIGHTSEEING ZONE	MOTORIZED RURAL ZONE	SEMI-PRIMITIVE MOTORIZED ZONE	SENSITIVE RESOURCE PROTECTION ZONE	DEVELOPED ZONE
ZONE CHARACTERISTICS									
Challenge and Adventure of Experience	low	moderate	moderate–high	moderate–high	very low	low	moderate	N/A	very low
Dependence on Roads, Trails, or Other Facilities	high	low–moderate	low	none	very high	high	moderate	N/A	very high
Visitor Encounter Expectations	very high	moderate–high	low	very low	very high	moderate	low	N/A	very high
NPS Staff Encounter Expectations	moderate	moderate	low	very low	moderate	low	very low	N/A	very high
Identified Corridors Highest Standards — Roads	N/A	N/A	N/A	N/A	paved	graded dirt	dirt/rock	N/A	N/A
Identified Corridors Highest Standards — Trails	surfaced, 6′ wide	unsurfaced, 2′ wide	unsurfaced, 18″ wide	N/A	surfaced, 6′ wide	N/A	N/A	N/A	surfaced, 6′ wide
Management Action for Resource Protection and Safety	very high	high	moderate	very low	very high	high	moderate	very high	very high
Tolerance for Resource Degradation	low	low	very low	very low	moderate	low	low	none	high
Opportunity for Solitude	very low	low	moderate	high	very low	low	moderate	N/A	very low
Noise Level	moderate	low	low	very low	high	moderate	moderate	N/A	high
Need for Offsite Interpretation	high	high	high	high	high	moderate	moderate	very high	high
Appropriateness of Onsite Interpretation	high	moderate	low	very low	high	low	very low	none	high



MANAGEMENT ZONES - PARKWIDE

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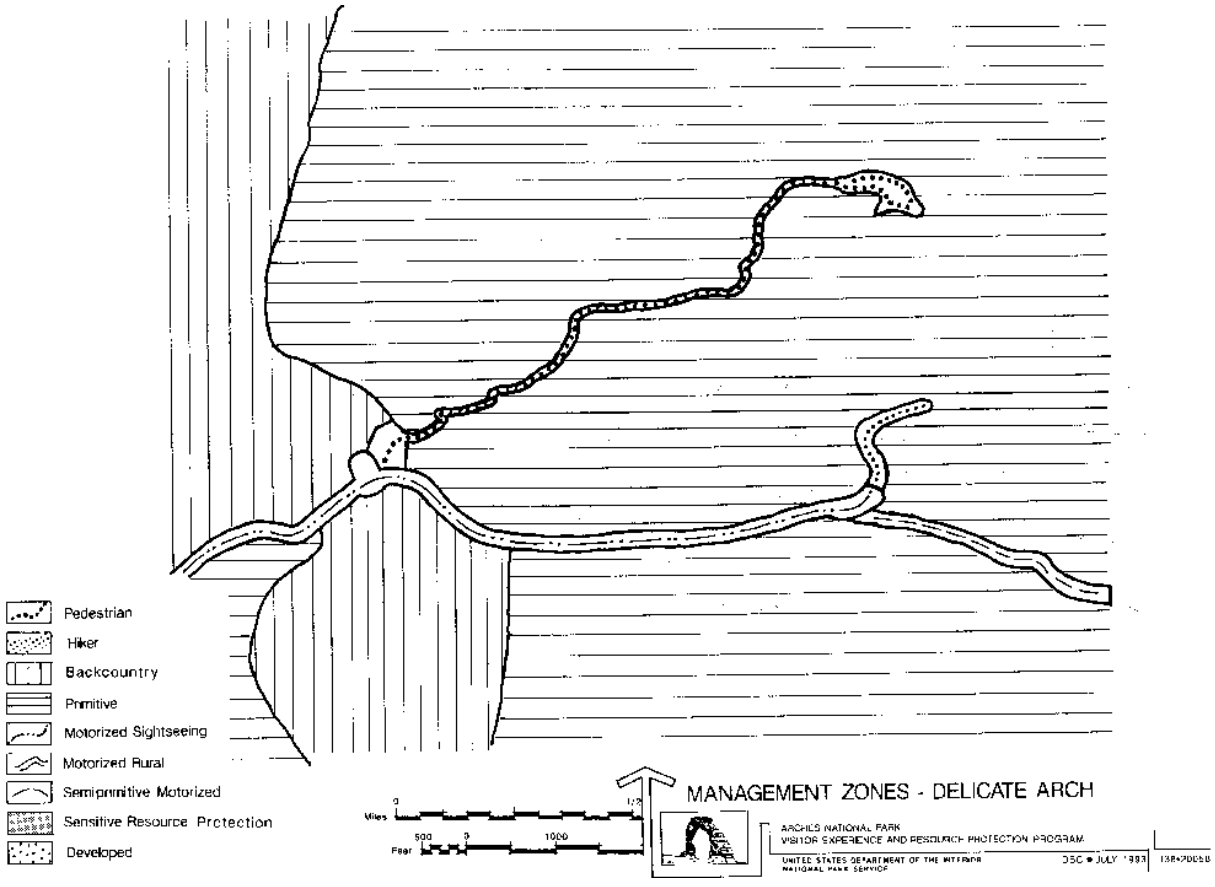
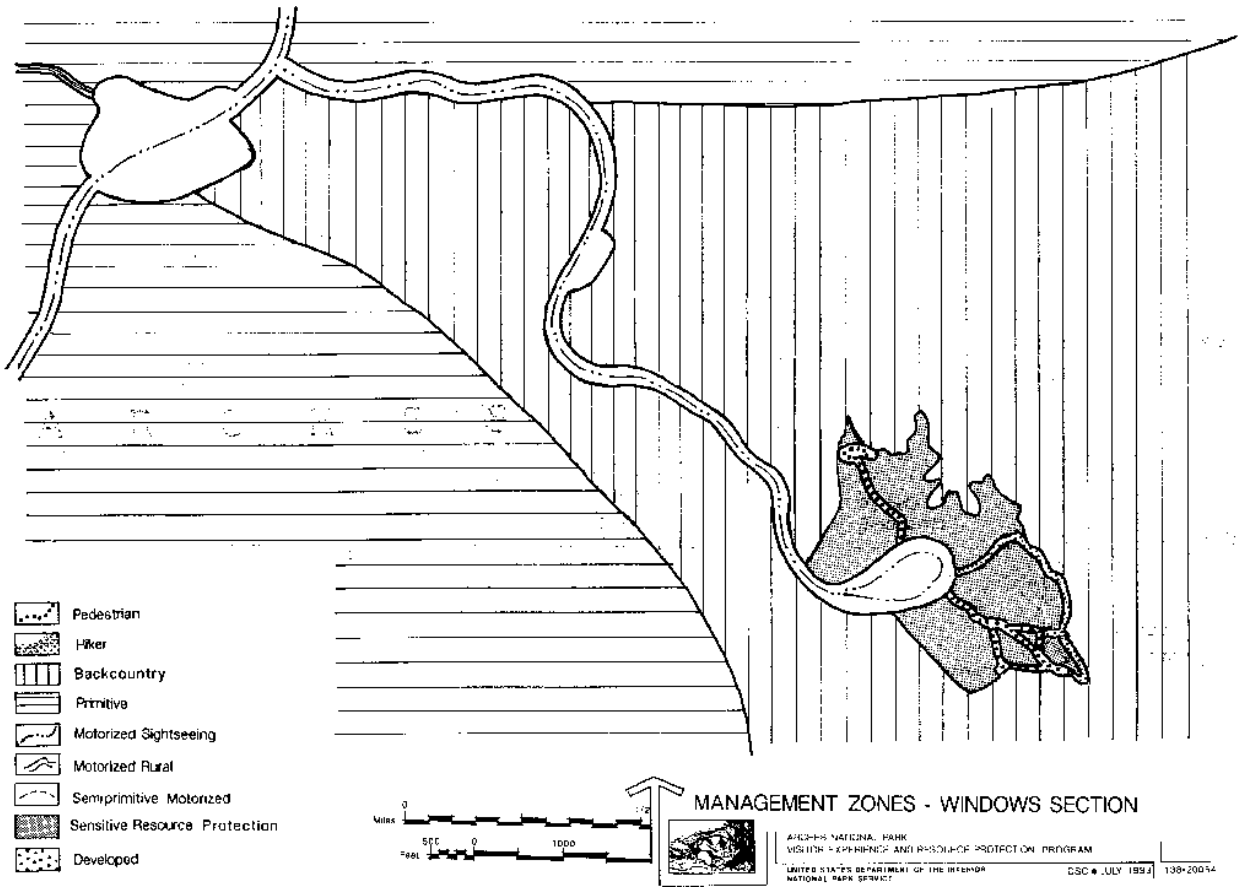
VISITOR EXPERIENCE AND RESOURCE PROTECTION PROGRAM

United States Department of the Interior
National Park Service

DSC • MARCH 1995 | 138 • 20060A


Pedestrian
Hiker
Backcountry
Primitive
Motorized Sightseeing
Motorized Rural
Semiprimitive Motorized
Sensitive Resource Protection
Developed
0
Miles
1/2
500
0
1000
Feet
MANAGEMENT ZONES - DELICATE ARCH
ARCHES NATIONAL PARK
VISITOR EXPERIENCE AND RESOURCE PROTECTION PROGRAM
UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
DSC • JULY 1993



MANAGEMENT ZONES - WINDOWS SECTION

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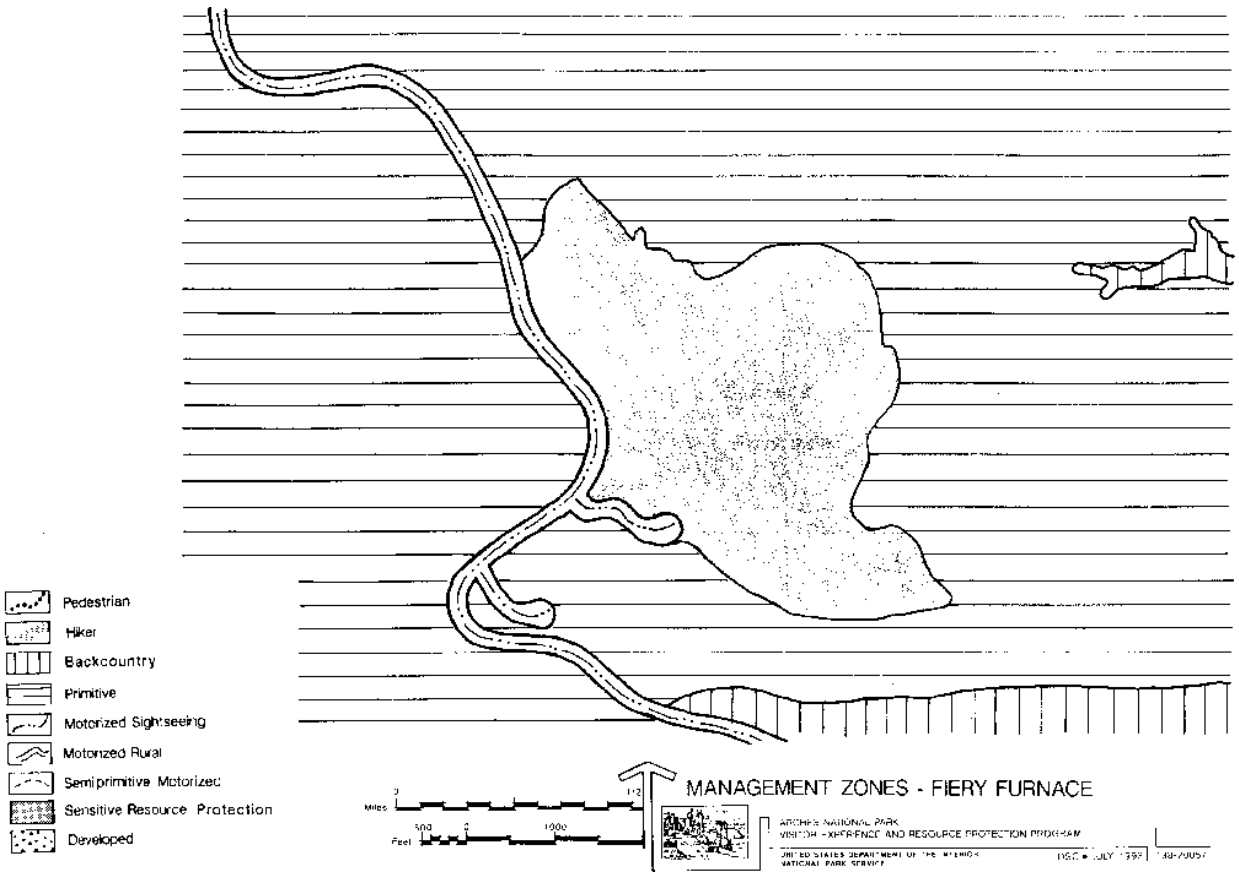

MANAGEMENT ZONES - FIERY FURNACE

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NATIONAL PARK SERVICE

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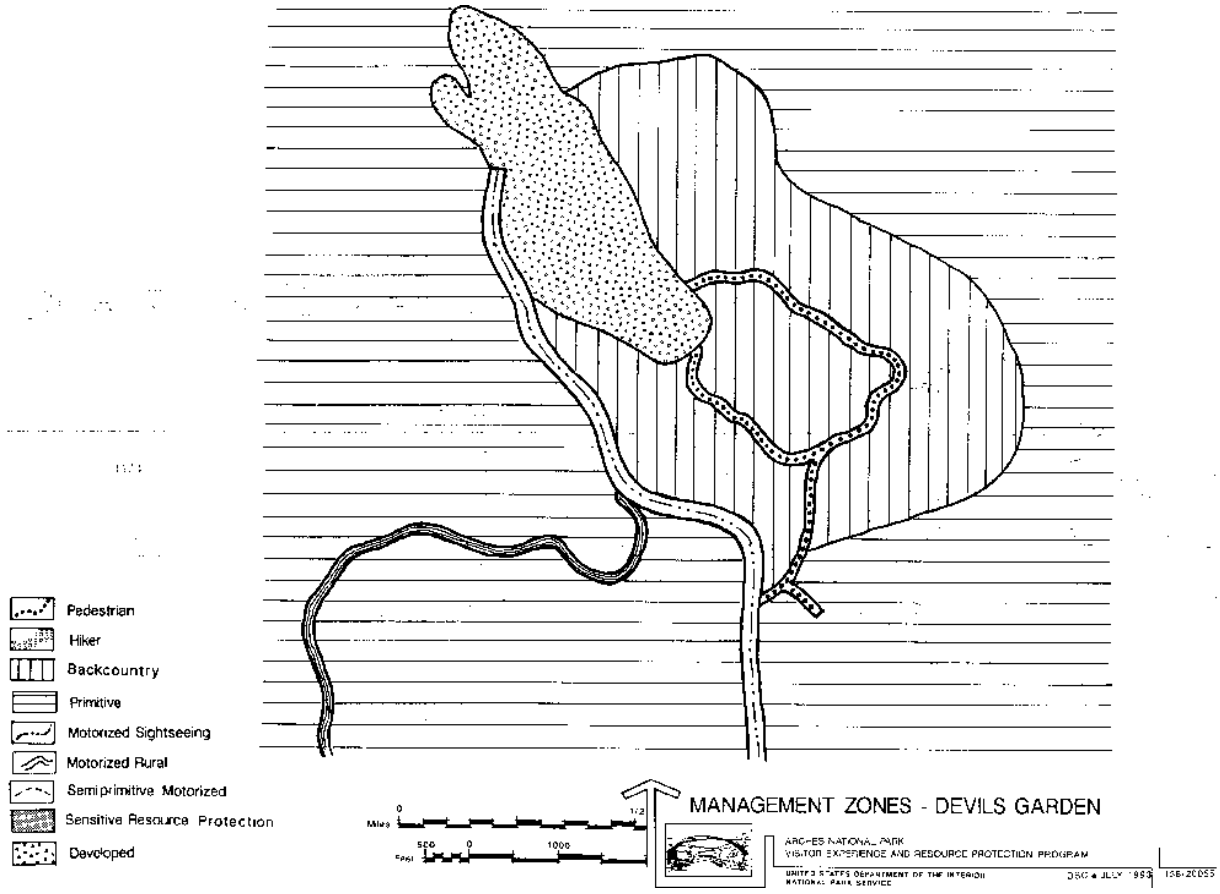
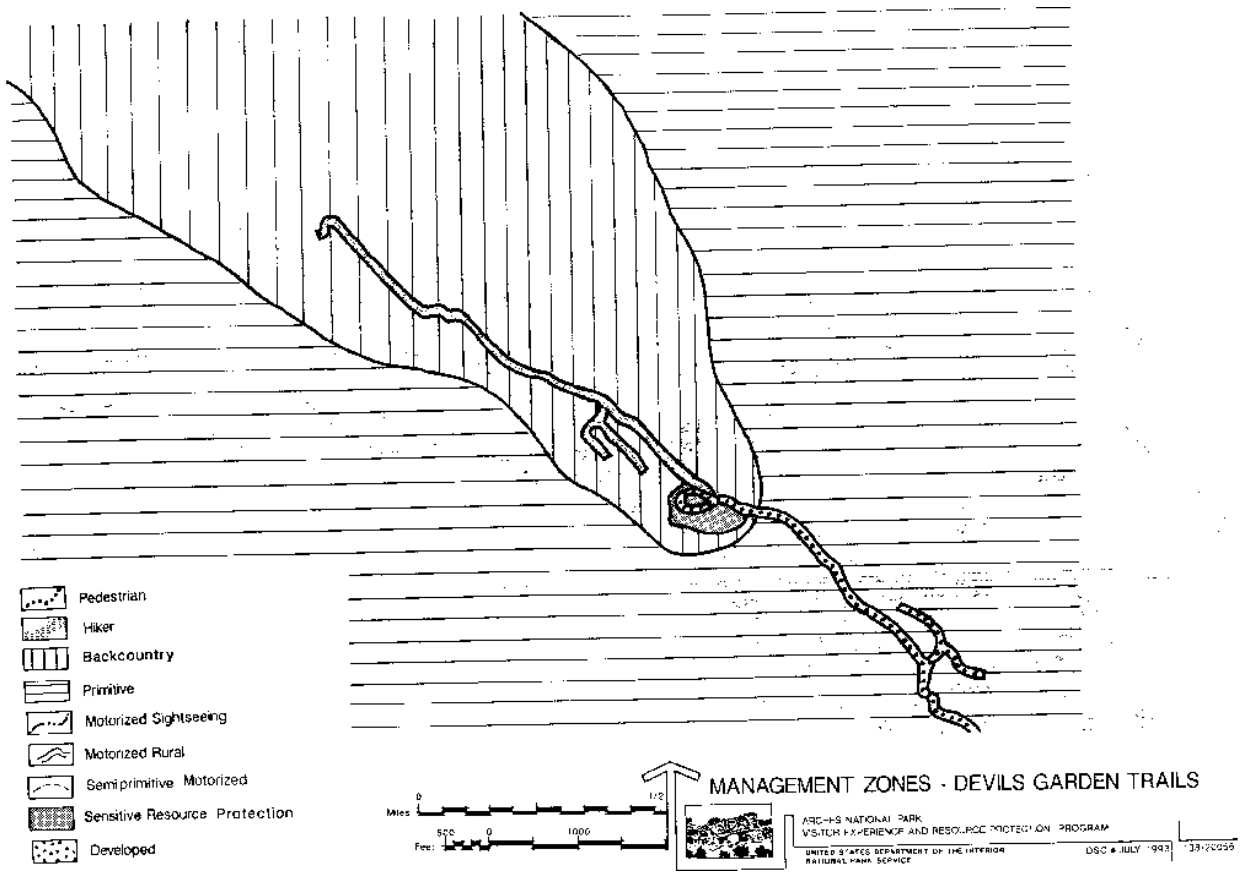

Pedestrian
Hiker
Backcountry
Primitive
Motorized Sightseeing
Motorized Rural
Semiprimitive Motorized
Sensitive Resource Protection
Developed
0
1/2
Miles
500
0
1000
Feet
MANAGEMENT ZONES - DEVILS GARDEN
ARCHES NATIONAL PARK
VISITOR EXPERIENCE AND RESOURCE PROTECTION PROGRAM
UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
DSC • JULY 1993
156-20055



MANAGEMENT ZONES - DEVILS GARDEN TRAILS

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NATIONAL PARK SERVICE

DSC & JULY 1993

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Hiker Zone

This zone is applied to trail corridors and areas of a somewhat more primitive nature than those in the pedestrian zone. The Klondike Bluffs trail, Park Avenue trail, the trail section from Landscape Arch to Double O Arch, and the Fiery Furnace are included in the hiker zone. With the exception of the Fiery Furnace (which is a subzone due to its special qualities), the zone includes the narrow moderate to high use trail corridors. The hiker trail corridor extends 5 feet (1.5 m) on each side of the trail centerline to take into account impacts caused by trail maintenance work and by occasional visitor movements off of the trails.

The hiker zone provides a sense of being immersed in a natural landscape and feels somewhat distant from most comforts and conveniences. Unpaved, maintained trails and sometimes cairned routes are the only facilities in this zone. Opportunities exist to experience challenge and adventure. Visitors must commit a block of time, have some outdoor skills, and do some physical exertion to use the area. The probability of encountering other visitors is moderate to high (although there are opportunities for solitary experiences), and moderate for encountering NPS staff. No vehicles or stock are permitted here.

A high level of management is provided for resource protection and safety purposes in the hiker zone (e.g., placing stones along trail edges and restricting off-trail use and group sizes). Some resource modifications are evident, but they harmonize with the natural environment. The Park Service's tolerance for resource degradation here is low.

Backcountry Zone

This zone encompasses lightly used areas of the park where visitors hike cross-country, along washes, or on primitive trails or marked routes. Key areas in this zone include Courthouse and Salt Washes and the Devils Garden primitive loop from Double O Arch to Landscape Arch.

Like the hiker zone, the backcountry zone provides a sense of being immersed in a natural landscape but feels farther away from comforts and conveniences than the pedestrian and hiker zones. No facilities are in this zone except for a few cairned routes and primitive trails. Use of this area requires a relatively long time commitment and high level of physical exertion. The environment offers a moderate to high degree of challenge and adventure. Opportunities for independence, closeness to nature, tranquility, and the application of outdoor skills are moderate to high. The probability of encountering other visitors and NPS staff is low. Vehicular use is not permitted, but stock use may be permitted in certain environments.

A moderate level of management is provided for resource protection and safety purposes. Subtle onsite controls and restrictions may be present, such as placing rocks along the trail edges, restricting off-trail use, and requiring that visitors demonstrate knowledge of environmental sensitivity before entering the zone. A few resource modifications may be evident, but they harmonize with the natural environment. The Park Service's tolerance for resource degradation due to visitor use in this zone is very low.

To ensure that the backcountry zone remains largely without trails, a limit has been placed on the number of miles of primitive trails and cairned routes that can be provided for visitor access or resource protection purposes: no more than 5 additional miles (8 km) of established routes, including trails on slickrock and washes, will be permitted in all of the park's backcountry zone. (There are currently about 5.5 miles [8.9 km] of established routes in the zone.)

Primitive Zone

The primitive zone includes areas where very low use is desirable to protect views seen from adjacent zones (such as the views from the main park road, Salt Valley road, and scenic overlooks), pristine resource areas (such as Eye-of-the-Whale, Eagle Park, and the Petrified Dunes area), and areas of the park that are difficult to access. This is the largest zone in the park.

Visitors in the primitive zone experience an untouched, primeval environment, devoid of the works of people. No stock are present, and no trails are evident. Use of this zone requires a relatively high degree of physical exertion and a long time commitment. The environment offers a moderate to high degree of challenge and adventure. Opportunities for independence, closeness to nature, tranquility, and the application of outdoor skills are high. There is a very low probability of encountering other visitors or NPS staff. Similarly, evidence of other visitor impacts is minimal.

Management for resource protection and safety within the primitive zone is very limited; the area is managed in such a way that onsite controls and restrictions are minimized and those that are present are subtle. However, offsite management of visitors may be intensive (e.g., eligibility requirements that must be satisfied before one enters the zone, limits on length of stay in the area, and reservation requirements). The tolerance for resource modifications and resource degradation here is very low.

Motorized Sightseeing Zone

The motorized sightseeing zone is a substantially developed area. The paved roads, pullouts, overlooks, and associated short trails and small picnic areas, parking areas, and other facilities that support visitor touring are included in this zone. The zone is a fairly narrow corridor. For monitoring purposes, the zone extends 50 feet (15 m) from the edge of roads and pullouts.

Visitors for touring the park, enjoying scenic overlooks and interpretive media, and gaining access into other park zones use the paved roadways and associated developments in the motorized sightseeing zone. Visitor attractions are convenient and easily accessible. The visitor experience is generally dependent on a vehicle or bicycle, involves driving along a well-maintained, paved road, and is perceived as being linear/sequential and vicarious in nature. Observing the natural environment is important, and there may be a sense of adventure, but there is little need for visitors to physically exert themselves, apply outdoor skills, or spend a long time in the area. The probability of encountering other visitors is very high, and moderate for

encountering NPS staff; many visitors may be present. Some trails and most facilities would be accessible in this zone.

Intensive management is provided in the motorized sightseeing zone to ensure resource protection and public safety (e.g., with fences, intensive law enforcement, and restrictions on visitor activities). Resources can be modified for essential visitor and park operational needs. The Park Service's tolerance for resource degradation in this zone is moderate.

Because the number of social (i.e., unofficial) pullouts has grown over the past several years, it is necessary to identify the number of pullouts that will be allowed in the zone. In August 1994 the park staff identified 40 approved pullouts on 20 miles of paved roads, excluding Delicate Arch, for an average of two per mile. New pullouts may be developed if there is a documented need and traffic safety considerations permit; however, the total number of pullouts permitted along the paved roads will not exceed 48, which would be a 20% increase over the current conditions.

Motorized Rural Zone

This zone includes the maintained, unpaved, two-wheel-drive Salt Valley road and the short spur to Klondike Bluffs. As shown on the maps, like the other motorized zones the motorized rural zone includes narrow areas alongside the roads.

The motorized rural zone provides a two-wheel-drive experience (although opportunities exist for nonmotorized forms of recreation) along unpaved roads, which gives visitors a sense of being in the country. Although the areas are predominately natural, there is evidence of the sights and sounds of people. A few support facilities, such as vault toilets, may be present. Visitors usually do not need to physically exert themselves, use outdoor skills, or make a large time commitment to use the area. Challenge and adventure opportunities associated with more primitive types of recreation are not very important. The probability of encountering visitors is moderate, and it is low for encountering NPS staff.

A high level of management is provided in this zone for resource protection and safety (e.g., with signs, barriers, and temporal restrictions). Resource modifications are evident, but they harmonize with the natural environment. The Park Service's tolerance for resource degradation in the motorized rural zone is low.

Because the graded dirt roads in this zone can grow wider with time, due to visitors driving off the roads and maintenance work, it is necessary to specify road widths and approved pullouts. The Salt Valley road will be maintained at a width of no more than 20 feet (6.1 m); the Klondike Bluff trailhead road will not be widened unless necessary, and in no case will it be wider than 20 feet (6.1 m). (However, necessary drainage ditches may extend into adjacent zones.) There are currently two pullouts along the 10-mile (16 km) Salt Valley road and none along the Klondike Bluff spur road. New pullouts will only be developed where there is a documented need and traffic safety considerations require a pullout to get parked vehicles off the roadways. No more than eight additional pullouts will be permitted along the Salt Valley road; no new pullouts will be permitted on the Klondike Bluff spur road.

Semiprimitive Motorized Zone

This zone encompasses the four-wheel-drive roads in the park, including the Four-Wheel-Drive, Willow Flats, and Cache Valley Roads and two other short spurs along the west boundary. Like the other motorized zones, the semiprimitive motorized zone encompass the roads and narrow areas that parallel the roads.

This zone provides a four-wheel-drive experience (although opportunities exist for nonmotorized forms of recreation), which gives visitors a sense of being in wildlands. Unpaved, minimally maintained roads are the only facilities present. Although visitors in vehicles usually do not need to physically exert themselves, they may need to use outdoor skills and make a relatively large commitment of time to use the area. The area offers moderate opportunities for challenge and adventure. The probability of encountering other visitors is low, and it is very low for encountering NPS staff.

Management for resource protection and safety purposes is moderate in this zone. Onsite controls and restrictions are minimal, and those that are present are subtle (e.g., berms, rocks, and vegetation). Some resource modifications may be evident, but they harmonize with the natural environment. The Park Service's tolerance for resource degradation in this zone is low.

As with the motorized rural zone, it is necessary to specify the widths of the roads because they can increase with time. In an August 1994 survey the park staff determined that the Four-Wheel-Drive Road averaged 9 to 10 feet (2.7-3 m) wide (except where it crossed the Klondike Bluffs Ridge and averaged 9 to 14 feet [2.7-4.3 m] wide). The Willow Flats Road averaged just over 12 feet (3.6 m) wide. The other two unnamed road spurs on the west boundary are maintained as two-track trails and do not have any widenings, pullouts, or improvements. The travelled portion of all these roads will be maintained at their current widths, except the Willow Flats road will be reduced to 12 feet wide. However, there are a number of widenings along the roads, outside of the two tracks, where one vehicle pulls over to park, let another vehicle pass, or bypass rocks and bad ruts. Although some of these wide areas are necessary in certain locations due to environmental factors, their number will be kept to a minimum (see also the later discussion on indicators and standards). In no case will a widening be over 12 feet wide (3.6 m) and 30 feet (9.1 m) long.

Sensitive Resource Protection Zone

As shown on the zoning maps, this zone includes lands adjacent to the trail system in the Windows area and in the immediate vicinity of Landscape Arch. These are critical viewshed areas where the presence or evidence of people detracts from the park's purpose of protecting both geologic features and the natural setting in which they occur. They also are areas that have been severely impacted by past use and where intensive restoration activities will be required.

The Park Service's tolerance for additional resource degradation due to public use in the sensitive resource protection zone is zero. Consequently, with only a few exceptions people are not allowed in the zone. Researchers could be allowed access to the zone under special permit, park

staff could enter the zone for resource management purposes, and users that are entitled to access under federal laws, such as the American Indian Religious Freedom Act, would be allowed to enter the zone under permit. Prohibiting public use in this zone will necessitate a very high level of management outside the zone (e.g., with fences, intensive law enforcement, and visitor education efforts).

Developed Zone

This zone includes areas with major visitor and administrative facilities. The park visitor center, headquarters, and administrative areas, and the Devils Garden campground and picnic area are included in the developed zone. Also included in this zone is the area contiguous to the campground that campers use for family recreation activities.

Although buildings, structures, and the signs of people are predominant, there are natural elements present. The facilities are convenient and easily accessible; there is little need for visitors to physically exert themselves, apply outdoor skills, or make a long time commitment to see the area. Opportunities for adventure are relatively unimportant. Many of these areas provide opportunities for social experiences, and the probability of encountering other visitors or NPS staff is very high.

Resources are modified for visitor and park operational needs. Most facilities would be accessible to visitors with disabilities, and there might be some accessible trails. The Park Service's tolerance for resource degradation here is relatively high. Visitors and facilities are intensively managed in this zone for resource protection and safety purposes (e.g., with fences, intensive law enforcement, and restrictions on visitor activities).

RESOURCE AND SOCIAL INDICATORS AND STANDARDS

A major premise of the VERP process is that management zone characteristics, which are qualitative in nature, must be translated into something measurable through the use of indicators and standards. Measurable indicators have been selected for monitoring key aspects of the visitor experiences and resources at Arches and are described below. Standards that represent the points where visitor experience and resource conditions become unacceptable in each zone were then assigned based on management goals. The indicators will be monitored in each zone, and when necessary, management actions will be taken to ensure that visitor use and resource impacts remain within the established standards.

It is important to remember that standards do not represent goals or desired conditions for a zone. Rather, standards represent the trigger points that define when conditions become unacceptable for a zone.

Selection of Resource Indicators and Standards

The soil and associated biological community are very important to the health of the ecosystems. Therefore, most of the selected resource indicators measure the effects of visitor use on soils. Other indicators were considered, but they were discarded because they were not easy to measure consistently, measurement resulted in resource damage such as trampling, or they were found to be too dependent on environmental variables such as rainfall.

Based on research conducted at Arches (Belnap n.d. "Effects of Visitor Use" and 1995), the VERP team selected eight resource indicators to monitor in the park. These indicators were placed in a two-tier system. The first tier should be measured on short-term cycles (probably annually).

- **Cryptobiotic Soil Crust Condition** -- A cryptobiotic soil crust forms on nearly all soils on the Colorado Plateau. The condition of the crust is the most informative indicator of overall health of the park's ecosystems. The crust is very sensitive to visitor use and is easy to measure and quantify visually. The crust condition is assessed using a 10-point scale (see table 2). (See appendix B for photographs of these various conditions.)

- **Density of Social (Unofficial) Trails** -- This indicator is an effective measure of off-trail use and shows how much of an area away from designated trails is being trampled by visitors.

- **Road Widenings** -- This indicator measures impacts resulting from visitors widening road tracks by driving their vehicles around obstacles, passing each other, or driving cross-country.

The second tier of indicators requires more expertise or cost to measure. These five indicators, however, more directly measure the integrity of the ecosystem and will act as a check on the sensitivity and appropriateness of the first-tier indicators. These second-tier indicators will be monitored every five years.

- **Relative Soil Compaction Levels** -- Specifically, percent porosity will be measured, which is the pore space in the soil. This indicator measures the degree to which trampling affects the soil's density and permeability. Increased compaction is detrimental to ecosystems because it disrupts nutrient and hydrologic cycles. Soil compaction is easily and accurately measured, sensitive to visitor use, and responds to reductions in trampling.

- **Cover and Frequency of Vascular Plants (by species) --** Measuring plant cover and frequency will establish the effects of visitor use on the vegetative community, which in turns affects animal communities. Specifically, this indicator will be monitored to determine if trampling is resulting in three adverse effects: introduction of exotics, reduction in vegetative cover, and conversion of interspace vegetation from perennials to annuals.

TABLE 2. SOIL CRUST CONDITION ASSESSMENT INDEX

0	no soil crust is left
4	no lichens and mosses are left, but cyanobacteria are still present and have formed a well-developed microtopography
6	some lichens and mosses are present as well as cyanobacteria
10	the crust is well-developed and relatively undisturbed

- **Elemental Tissue Content of Dominant Plants** -- Research has shown that trampling affects the nutrient levels in plants and plant growth. Plants in trampled areas become less nutritious for wildlife (Belnap n.d. "Effects of Visitor Use" and 1995).

- **Ground Cover (percent cover and frequency of litter, cyanobacteria, mosses, and lichens)** -- Trampling affects the ground cover, which is important for soil stability and properly functioning nutrient cycles.

- **Soil Characteristics (percent clay/sand/silt, acidity, amount of organic matter, and macro- and micronutrients)** -- Soil characteristics are greatly altered by trampling, which in turn affect nutrient and hydrologic cycles. Over time this will affect plant and animal communities. Measuring these soil characteristics will tell managers if visitors are adversely affecting soils' physical or biological functioning.

The selection of appropriate standards for the resource indicators in each zone was based on the relative tolerance for resource impacts in the zone definitions and on the judgement of park planners and resource managers about the minimum degree of "naturalness" needed to maintain the visitor experience described in each zone.

Selection of Social Indicators and Standards

The VERP team initially had little information about what would be good social indicators for Arches. A research effort therefore was undertaken to identify social indicators to measure the quality of visitors' experiences in different parts of the park. An extensive survey of park visitors was conducted in summer and fall 1993 to determine the relative importance of potential indicators and to enable planners and managers to set standards of quality (Lime et al. 1994). Potential indicators that were analyzed included visitor facilities, visitor crowding, visitor behavior and activities, perceived resource impacts of visitor use, and park management activities. Based on the results of the research and the VERP team's professional judgment, four social indicators were selected to be monitored at Arches. All of the indicators directly relate to levels of crowding:

- **The number of people at one time at major attraction sites or on trail segments --** This indicator is an important factor in the visitor experience at high use areas in Arches, and it can be easily and accurately monitored.

- **The number of different parties seen while traveling on or off trails or on backcountry roads --** This indicator is an important factor in the visitor experience at low use areas in Arches, and it can be monitored fairly easily through observation and visitor surveys.

- **The ability of backcountry parties to camp out of sight and sound of other campers --** Research in other areas shows that visitors' backcountry experiences are often affected more by encounters with other parties at their campsites than by encounters along trails. For this reason a campsite encounter indicator will be monitored in appropriate zones. This indicator can be monitored relatively easily through visitor surveys.

- **Traffic congestion on major paved park roads** -- An additional indicator was selected for application to high use roadways in the park. This indicator was not selected based on research conducted in the park, but rather on the VERP team's opinion on what could affect the Arches' visitor experience in the future. It is measured through a traffic congestion index developed by the Transportation Research Board (1985). Six levels of service are included in the traffic congestion spectrum, ranked from A (free-flowing traffic with little or no restrictions) through F (traffic volumes exceed capacity and there are substantial reductions in speeds and stoppages due to congestion). (A summary of the full traffic service index is provided in appendix C.) This indicator can be monitored easily and accurately.

Many of the Arches social indicator standards were based on over 1,500 visitor responses to surveys conducted between July and October 1993 (Lime et al. 1994). Sampling was conducted in six of the nine park zones (sampling was not done in the developed, sensitive resource protection, or motorized sightseeing zones), and questions were keyed directly to those specific areas.

In the pedestrian and hiker zones visitors were shown a series of computer-generated photographs of arches and trails with varying numbers of people at one time and asked to rate their acceptable level of crowding. The point when the average response of visitors clearly changed from acceptable to unacceptable was identified as the standard. In the motorized rural and semiprimitive motorized zones a written questionnaire was used to identify the point when the number of motor vehicles became unacceptable. In the backcountry and primitive zones, the selected standards were based on research conducted at Arches as well as in other similar areas.

The VERP team selected the standard for traffic congestion based on what it felt was the point where the level of service would no longer be consistent with the desired visitor experience described for the zone; the identified level of congestion would not be tolerated in the park.

Indicators and Standards Selected for the Management Zones

The standards developed for the following zone descriptions reflect the results of research and the team's best judgment on what level of impacts could be tolerated within the described characteristics of each zone.

Pedestrian Zone (e.g., Broken Arch, Delicate Arch, trail to Landscape Arch). The resource indicator that will be monitored in the pedestrian zone will be the condition of the soil crust. Based on the definition of this zone, the view from the trail should be primarily natural in appearance, recognizing that some impacts on the soil will be unavoidable in such high use areas. The standard was set to ensure that about 70% of the area viewed within the zone appears natural. If 30% or more of the tests show a crust condition with a rating of less than 4 (see table 2), management action would be required to improve the condition. Testing of the soil crust will be done in areas 8 feet (2.5 m) from trail centerlines to accommodate most of the inadvertent trailside impacts caused by trail maintenance and by visitors momentarily stepping off the trail to take photographs or to move out of the way of other visitors.

Social crowding -- people perceived at one time at an attraction site or on a trail segment -- will be monitored in the pedestrian zone. Visitor surveys in representative areas in this high use zone indicated that photographs showing more than 20 people at one time at arches or on a trail segment were unacceptable to most visitors. (See appendix D for examples of the simulated photographs of visitors on trail sections and at arch viewing sites.)

Based on this information, a general standard of 20 people at one time was established for this zone. (Special circumstances at Delicate Arch and the Windows area resulted in somewhat different standards for those areas; see below.) Because occasional surges in visitation are unavoidable, such as from the arrival of a tour bus, management action would be taken if conditions exceed the standard in 10% or more of the peak use hours of the peak months. The peak use hours of the peak months is the monitoring period for most of the Arches' social indicators. This is the period with the highest level of use during the year; if a standard is not exceeded during this period, it likely will not be exceeded during the remainder of the year. Peak use months for the entire park currently run from May through September. Peak hours vary depending on several factors, such as the month and location of the site. Peak hours and peak months will be specified in the monitoring plans that are being developed for each of the indicators in each of the zones.

At the Windows area the same 20 people at one time standard would apply, but because of the high number of bus tours using the area, more brief surges in numbers of visitors are anticipated and need to be accommodated. Therefore, the VERP team modified the standard slightly for this area. Management action would be taken if conditions exceed the standard in 20% or more of the peak use hours of the peak months.

A separate standard also was set for Delicate Arch. The individual treatment is deemed appropriate because of the special significance of this site to park visitors. Many visitors want to see Delicate Arch and expect some crowding because of the site's popularity. Because the trail is largely on slickrock, the resource can accommodate high levels of use without being measurably

impacted. Accordingly, the Park Service believes it is appropriate to allow the maximum number of visitors to hike to the arch while still providing an acceptable experience for most visitors. Surveys at Delicate Arch showed that most visitors rated photos containing fewer than about 30 visitors as acceptable. (See appendix D for a simulated photo of 26 people at the Delicate Arch area.) The standard, then, requires management action if conditions reach or exceed that represented by the acceptable photo in 10% or more of the peak use hours of the peak months.

SUMMARY OF THE INDICATORS AND STANDARDS FOR THE PEDESTRIAN ZONE:

Resource Indicators and Standards:

Indicator: Condition of soil crust -- Soil crust index measured 8 feet (2.5 m) from the trail centerline
Standard: 30% or more of the soil samples are rated as less than 4 on the soil crust index

Social Indicators and Standards:

General

Indicator: Social crowding -- number of people at one time (PAOT) at an attraction site or on a 0.1-mile (0.2 km) section of trail during peak hours of peak months
Standard: 20 or more PAOT observed for 10% or more of peak hours of peak months

Windows

Indicator: Social crowding -- number of people at one time (PAOT) at the site during peak hours of peak months
Standard: 20 or more PAOT observed for 20% or more of the peak hours of peak months

Delicate Arch

Indicator: Social crowding -- number of people at one time (PAOT) at the site during peak hours of peak months
Standard: 30 or more PAOT observed for 10% of more of the peak hours of peak months

Hiker Zone (e.g., Park Avenue, trail from Landscape Arch to Double O Arch). As in the pedestrian zone, the soil crust condition will be monitored in the hiker zone. Because of the more primitive nature of the hiker zone, the crust will be evaluated in areas measured 5 feet (1.5 m) from trail centerlines, and management action would be triggered if 5% or more of the samples are rated below 4 on the crust index (see table 2).

The five second-tier resource indicators listed in the "Selection of Resource Indicators and Standards" section will be monitored every 5 years in this zone. Measurements of surface soil compaction will be taken 5 feet (1.5 m) from trail centerlines. Management action would be

triggered if 5% of the soil samples exhibit 50% or less than the porosity of a relatively undisturbed control site. (A soil that is compacted 50% greater than at a relatively undisturbed site means a high level of trampling is occurring.)

For the vascular plant cover/frequency indicator, samples will be taken to determine the presence of exotic species, reductions in vegetative cover, and replacements of perennials by annuals in the interspace vegetation. To be consistent with the soil crust indicator, if 5% or more of the sample points exhibit any of the above three impacts, the area will be considered to be out of standard. Similarly, for the ground cover indicator management action would be required if 5% or more of the soil surface samples (excluding active, sandy washes) are bare ground (i.e., not covered by litter, cyanobacteria, mosses, lichens, or other vegetation).

With regard to the dominant plant elemental tissue and soil characteristic indicators, major changes would need to be occurring to be detected on instruments. Degradation must be severe to register any reduction in plant nutrient levels or to cause negative impacts on the soil characteristics being monitored. Thus, the standard for these two indicators is zero: any measurable reduction in plant nutrient levels in the samples or impacts on the soil characteristics is considered unacceptable, requiring management action.

Social crowding will be monitored in terms of people at one time on a representative 0.1-mile (0.2 km) section of trail. Visitor surveys indicated that photographs showing more than eight people at one time on a trail segment was unacceptable to a majority of visitors in the zone. Based on this information, if eight or more people at one time are counted on the representative 0.1-mile trail section during 10% or more of the peak use hours of the peak months, the area will be considered out of standard.

The social crowding standard is different for the trail from Landscape Arch to Double O Arch and for the Fiery Furnace due to special circumstances. In the case of the Landscape-Double O trail, visitors first must walk through a pedestrian zone to enter the hiker zone. Standards for the two adjacent zones must be compatible. Statistical models based on the current proportion of visitors that hike only to Landscape Arch and the visitors who continue on to Double O suggest that the standard in the hiker zone here needs to be more lenient in order not to unfairly limit visitation in the pedestrian zone. For this reason the standard on the trail to Double O was increased to be 10 or more people at one time in 10% or more of the peak use hours of the peak months.

In the case of the Fiery Furnace, a trail encounter indicator does not work due to the unique qualities of this area: it is possible for visitors to encounter large ranger-guided groups in the untrailed furnace, but it is also possible for many people to be in this untrailed area without being seen. The number of parties seen per hour is a better indicator of social crowding in this situation, and therefore this will be monitored in the Fiery Furnace. No data were collected from visitors in the furnace to determine the standard for this indicator. Based on the impressions of park staff, seeing two or less different parties per hour was acceptable in the furnace. Management action would be taken if three or more different parties are seen per hour for 10% or more of the peak use hours of the peak months.

SUMMARY OF INDICATORS AND STANDARDS FOR THE HIKER ZONE:

Resource Indicators and Standards:

Indicator: Soil crust index -- condition of soil crust measured 5 feet (1.5 m) from the trail centerline

Standard: 5% of the soil samples are rated at less than 4 on the soil crust index

Social Indicators and Standards:

General:

Indicator: Social crowding -- number of people at one time (PAOT) on 0.1-mile (0.2 km) section of trail during peak hours of peak months

Standard: Eight or more PAOT are counted for 10% or more of the peak hours of peak months

Trail From Landscape Arch to Double O:

Indicator: Social crowding -- number of people at one time (PAOT) on 0.1-mile (0.2 km) of trail during peak hours of peak months

Standard: 10 or more PAOT counted for 10% or more of the peak hours of peak months

Fiery Furnace:

Indicator: Social crowding -- different parties seen in that zone per hour during peak months

Standard: Three or more different parties seen per hour for 10% or more of the peak hours of peak months

SUMMARY OF SECOND-TIER RESOURCE INDICATORS AND STANDARDS FOR THE HIKER, BACKCOUNTRY, PRIMITIVE, AND SENSITIVE RESOURCE PROTECTION ZONES:

Indicator: Soil compaction (surface or subsurface), measured 5 feet (1.5 m) from the trail centerline

Standard: 5% of the soil surface samples exhibit a porosity 50% or less than a relatively undisturbed site

Indicator: Cover and frequency of vascular plants -- presence of exotics, reduction in vegetative cover, or conversion of interspace vegetation from perennial to annuals, measured 5 feet (1.5 m) from the trail centerline

Standard: 5% or more of the sample points exhibit exotics, or a reduction in cover, or a conversion of interspace vegetation from perennial to annuals

Indicator: Ground cover -- percentage of the soil surface (excluding sandy washes) covered by litter, cyanobacteria, mosses, lichens, or other vegetation

Standard: 5% or more of the soil surface is bare ground (excluding sandy washes)

Indicator: Elemental tissue content of dominant plants -- nutrient levels measured in dominant plants 5 feet (1.5 m) from the trail centerline

Standard: Any measurable reduction in nutrient levels compared to levels measured in adjacent relatively undisturbed areas

Indicator: Soil characteristics -- percent clay/sand/silt, acidity, amount of organic matter, macro- and micronutrients, measured 5 feet (1.5 m) from the trail centerline

Standard: Any measurable change in the above parameters.

Backcountry Zone (e.g., upper and lower Courthouse Wash). In areas included in the backcountry zone the greatest impact resulting from visitor use is the creation of social trails. The density of social trails, therefore, is the resource indicator that will be monitored in this zone. The existing density of social trails will be established in 1995. Once this baseline is established, less than 10% additional linear feet of social trail per square mile would be permitted.

As in the hiker zone, all five second-tier resource indicators will be monitored every 5 years in the backcountry zone. All of the standards are also the same for the two zones.

Three social indicators will be monitored in the backcountry zone. Two indicators of crowding are the number of different parties seen on and off trails in the zone. The third indicator is the ability of parties to camp out of sight and sound of other parties. (Backcountry camping is a minor use at Arches, but maintaining the quality of the camping experience is important to those visitors.)

The off-trail social standards were set based on studies of visitors in wilderness areas, which indicate that three to five parties encountered per day is what average visitors are willing to accept (Manning 1986; Patterson & Hammitt 1990; Shelby & Heberlein 1986; Forest Service 1973; Forest Service 1980; Vaske et al. 1986; Vaske et al. 1992; Whittaker & Shelby 1988). Due to the absence of visitor survey data, the standard for on-trail use was set based on the VERP team's best judgment of what would be unacceptable for the few trails in this zone given the desired visitor experience being provided here. The standard for the backcountry camping indicator was set based on the above-listed recreation research.

Management actions would be required in the backcountry zone if any of the following standards are reached or exceeded: if four or more parties are seen per day while traveling off-trail during 10% or more of the peak months; if five or more parties are seen per hour while traveling on trails in 10% or more of the peak hours of the peak months; or if 10% or more of the backcountry parties cannot camp out of sight and sound of other parties during the peak months.

SUMMARY OF INDICATORS AND STANDARDS FOR THE BACKCOUNTRY ZONE:

Resource Indicators and Standards:

Indicator: Density of social trails

Standard: 10% or more additional linear feet of social trail per square mile than present in 1995

Social Indicators and Standards:

Indicator: Number of different parties seen in that zone while traveling off-trail per day during peak months

Standard: Four or more parties per day seen during 10% or more of the time during peak months

Indicator: Number of different parties seen on a trail or from a trail per hour during peak hours of peak months

Standard: Five or more parties per hour seen during 10% or more of the time during peak hours of peak months

Indicator: Opportunity to camp out of sight and sound of other parties during peak months

Standard: 10% or more of parties cannot camp out of sight and sound of other parties during peak months

note: Second-tier resource indicators for the backcountry zone were listed previously.

Primitive Zone (e.g., Eye-of-the-Whale, Petrified Dunes). The resource indicators and standards and five second-tier resource indicators and standards for this zone are the same as for the backcountry zone. The social indicators and standards are the same as described for off-trail use and backcountry camping in the backcountry zone.

SUMMARY OF INDICATORS AND STANDARDS FOR THE PRIMITIVE ZONE:

Resource Indicators and Standards:

Indicator: Density of social trails

Standard: 10% or more additional linear feet of social trail per square mile than present in 1995

Social Indicators and Standards:

Indicator: While traveling, number of different parties seen in that zone per day during peak months

Standard: Four or more parties per day seen 10% of the time during peak months

Indicator: Opportunity to camp out of sight and sound of other parties during peak months

Standard: 10% or more of parties cannot camp out of sight and sound of other parties during peak months

note: Second-tier resource indicators for the primitive zone were listed previously.

Motorized Sightseeing Zone (e.g., main park road, Balanced Rock, Park Avenue viewpoint). The condition of the soil crust is the resource indicator that will be monitored in this zone. Similar to the pedestrian zone, the visual quality of the landscape will be protected by taking management action if 30% or more of the soil samples are rated below 4 on the soil crust index. However, the soil crust will be monitored 50 feet (15 m) from the edge of the road, approved pullouts, trails, or viewpoints.

The social indicator for the motorized sightseeing zone is a quantitative traffic index that evaluates the level of traffic congestion. Traffic on the roadway will be monitored and will be considered out of standard if congestion is rated at a level C or worse at any time. (The C level indicates there is relatively stable traffic flow, but most drivers cannot select their own speed, change lanes, or pass when they want due to the traffic volume; see also appendix C.)

SUMMARY OF INDICATORS AND STANDARDS FOR THE MOTORIZED SIGHTSEEING ZONE:

Resource Indicators and Standards:

Indicator: Condition of soil -- soil crust index, measured 50 feet (15 m) from the edge of pavement or from the edge of approved road pullouts

Standard: 30% of the soil samples are rated at less than 4 on the soil crust index

Social Indicators and Standards:

Indicator: Roadway level of service during peak hours of peak months

Standard: Congested if rated at a level C or worse at any time

Motorized Rural Zone (e.g., Salt Valley road). Because very few off-road resource impacts are occurring in this zone, no resource indicators will be regularly monitored. If this situation changes, an appropriate indicator will need to be identified and monitored.

The social indicator for this zone is the number of motor vehicles encountered on the roads. The standard was set based on visitor surveys conducted on the Salt Valley road, which indicated that five or more motor vehicles encountered per hour of traveling time was unacceptable. Based on this information, management action would be required if five or more motor vehicles are encountered per hour for 10% or more of the peak use hours of the peak months. (Cars parked in the Klondike Bluffs parking area would not be counted as part of the encounter indicator because they are stationary for long periods of time.)

SUMMARY OF INDICATORS AND STANDARDS FOR THE MOTORIZED RURAL ZONE:

Social Indicators and Standards:

Indicator: Number of motor vehicles encountered per hour during peak hours of peak months (excluding the Klondike Bluffs parking area)

Standard: Five or more motor vehicles encountered per hour for 10% or more of the time during the peak hours of peak months

Semiprimitive Motorized Zone (e.g., Willow Springs road, Four-Wheel-Drive Road). In this zone the primary impact of visitor use results from vehicles widening the road tracks, sometimes unavoidably, by driving around obstacles, passing each other, or driving cross-country. Thus, the resource indicator that will be monitored is the number of widening in the roads. In summer

1994 the park staff surveyed the roads and identified the existing widening along the roads.(A widening is defined as an area where one vehicle pulls over to park or to stop and allow another vehicle to pass. Widenings were not counted on wash bottoms or on slickrock (i.e., where there was no disturbance to soil crust or vegetation). The standard was set based on this survey of road conditions, use patterns, and the park staff's best judgment of how many widenings could be tolerated within the described characteristics of the zone. Management action would be taken if 11 or more widenings per mile per year are counted on any of these roads.

The social indicator for this zone is the same as for the motorized rural zone: the number of motor vehicles encountered on the roads. The standard was set based on visitor surveys conducted on the Four-Wheel-Drive Road, which indicated that about three motor vehicles encountered per hour of traveling time was unacceptable. Based on this information, three or more motor vehicles encountered per hour for 10% or more of the peak hours of peak months would be considered to be out of standard. (Cars parked in Eye-of-the-Whale and other formal parking areas would not be counted as part of the encounter indicator because they are stationary for long periods of time.)

SUMMARY OF INDICATORS AND STANDARDS FOR THE SEMIPRIMITIVE MOTORIZED ZONE:

Resource Indicators and Standards:

Indicator: Number of widenings of the track/mile/year

Standard: 11 or more widenings per mile/year

Social Indicators and Standards:

Indicator: Number of motor vehicles encountered per hour on the drive during peak hours of peak months (excluding the Eye-of-the-Whale and other formal parking areas)

Standard: Three or more motor vehicles encountered per hour for 10% or more of the time during the peak hours of peak months

Sensitive Resource Protection Zone (e.g., base of Landscape Arch). Two resource indicators and standards were identified for this zone: the condition of the soil crust and the presence of social trails or evidence of visitors. The standards for these indicators were very strict, in keeping with the described characteristics of the zone. Management action would be required if any soil samples rate less than 6 on the crust index or if there are any visible social trails or evidence of people walking in the zone. In some portions of the sensitive resource protection zone, such as the area adjacent to the trail system in the Windows, resource impacts are so severe that these standards will continue to be exceeded far into the future. In highly impacted areas monitoring will be used to measure the improvement in soil crust conditions under the no-use management policy in this zone.

As with the hiker zone, all five second-tier resource indicators (previously listed) will be monitored every 5 years in the sensitive resource protection zone. All of the standards are also the same for the two zones.

Because the definition of this zone prohibits public use, except in a few limited instances, no social indicators and standards were set for the sensitive resource protection zone.

SUMMARY OF INDICATORS AND STANDARDS FOR THE SENSITIVE RESOURCE PROTECTION ZONE:

Resource Indicators and Standards:

Indicator: Soil condition -- soil crust index measured anywhere in the zone

Standard: Any sample that rates less than 6 on the soil crust index

Indicator: Number of social trails

Standard: Any social trails or evidence of visitors

note: Second-tier resource indicators for the sensitive resource protection zone were listed previously.

Developed Zone (e.g., visitor center, park headquarters). Because of the high level of resource impacts accepted in this zone, resource indicators will not be monitored. Visitor carrying capacities and the size of the facilities in this zone are determined by visitor service and park administrative needs.

MANAGEMENT ACTIONS TO ADDRESS INCREASING VISITOR USE

This section describes the actions the Park Service will be taking, and may take in the future, in each of the management zones to ensure that standards for desired resource conditions and visitor experiences are not exceeded. Specific actions are identified in those zones where standards are exceeded. These actions will begin to be implemented in spring 1995. This section also briefly discusses monitoring and introduces the issue of overall park capacity.

It must be stressed that changes in visitor use levels and patterns in the future probably will result in the need for additional actions besides those being implemented in spring 1995. Some of these potential future management actions are suggested in the following pages. Before any new management action is taken, a determination will need to be made on whether or not there is a need to prepare environmental documents to comply with the provisions of the National Environmental Policy Act.

Management Actions by Zone

Pedestrian Zone. Based on visitor surveys, social crowding standards are being reached or exceeded at Delicate Arch, the Windows, and Devils Garden during peak visitation times (Lime et al., 1994). In summer 1993 about 23% of U.S. visitors and 22% of foreign visitors surveyed reported experiencing conditions that were more crowded than the proposed standard at Delicate Arch. At North Window about 35% of surveyed visitors reported experiencing conditions that exceeded the proposed standard. At Devils Garden, about 12% of surveyed visitors stated the conditions on the trail to Landscape Arch were more crowded than the standard, and 26% of the visitors going beyond Landscape Arch reported that conditions exceeded the standard.

Park managers and planners believe the first action that should be taken to return use levels to acceptable conditions is to reduce the areas available for parking. Controlling the size of the areas available for parking should control how much crowding occurs at the arches or on trails -- with the proper size parking areas, the social crowding standards for the arches or trails should not be violated. The VERP team has been experimenting with statistical models to establish relationships between the size of the parking areas and the use levels visitors have indicated are acceptable at popular sites in the park. Available data enabled the team to set parking area limits that should help reduce visitor crowding at Delicate Arch, the Windows, and Devils Garden. Based on this data, the Park Service will be taking the following actions.

- **Wolfe Ranch/Delicate Arch** -- At the Wolfe Ranch parking area (trailhead for Delicate Arch) parking will be limited to the 75 striped parking spaces currently provided. Impromptu "overflow" parking on the sides of the road and in unlined spaces in the parking area will be eliminated through the use of barriers, signs, and ticketing of violators. This action is consistent with the park's 1989 General Management Plan (as is true for the actions that will be taken at the other two parking areas).

  Some visitors may then be unable to park at Wolfe Ranch on first arrival during peak use times in the summer months. It may be necessary to return to the area later in the day, plan a visit for early in the morning, or pass up the hike to Delicate Arch. If elimination of overflow parking does not bring crowding at the arch into acceptable standards, additional management actions, including a reduction in the size of the parking area, may be necessary.

- **Devils Garden --** Similarly, at Devils Garden the Park Service will be reducing overflow parking. Parking will be limited to about 150 cars. A 150-car parking area is a major increase over the existing "legal" parking area size but also reflects a 33% decrease in the overflow parking that has occurred at peak times. As with the Wolfe Ranch parking area, if monitoring shows that visitor use levels in the Devils Garden area continue to reach or exceed the social crowding standard, additional reductions in the area available for parking may be necessary.

- **Windows --** The Park Service will also be limiting parking at the upper Windows parking area to the current 35 striped spaces. At peak times, 40-50 cars have been recorded in the

upper Windows parking area. By eliminating overflow parking it is hoped that the level of social crowding will be brought back under the standard.

Although visitation patterns will change in response to the above parking area adjustments, it is not possible to accurately predict the nature of the changes or the extent to which they will occur. A season or two of monitoring will be needed to fully understand the implications of the changes in the parking areas.

As a result of the above actions some visitors coming to Arches at peak times will experience frustration and inconvenience trying to find a place to park. Visitor center staff will try and help visitors by suggesting less-crowded times to visit certain sites and by recommending alternative trails to walk and arches to see. Efforts also need to be taken to contact visitors about the above changes before they arrive at the park so they know what to expect.

Hiker Zone. In most of the hiker zone the VERP team does not believe the resource and social standards are being reached or exceeded, so no new management actions are being proposed at this time. In the Fiery Furnace there are signs that the resource standards are being reached or exceeded, but additional monitoring is needed to verify this. In the meantime, the Park Service will continue the permit system for visitors going into Fiery Furnace: all visitors (excluding those who go on ranger walks) will continue to need to get a permit at the visitor center and watch a slide show before entering the furnace. This action is intended to encourage visitors to minimize their impacts in this sensitive area. The permit system also enables park managers to monitor how many people are entering the area and establishes a framework for taking additional action in the future, if necessary, to comply with the standards (e.g., in the future the Park Service may limit the number of parties in the furnace at one time).

Backcountry and Primitive Zones. The Park Service is not proposing to take new actions in these zones because there is no indication now that conditions are out of standard. The permit system for overnight use will continue as it has in the past. If future monitoring indicates that resource or social standards are being reached or exceeded, the Park Service may look at taking other actions, such as establishing a permit system for day users, modifying overnight use permits (for example reducing the numbers of permits issued or limiting the length of stay), or, if absolutely necessary, eliminating overnight use in these zones.

Motorized Sightseeing Zone. Currently there are no indications that the use levels along the park's paved roads are out of standard. Additional monitoring is needed to determine whether or not resource conditions are within standards in the zone. However, the park staff will begin taking two management actions to eliminate resource impacts in the zone and ensure that the zone boundaries are maintained. Specifically, the park staff will close off and reclaim unapproved social pullouts along the main roads. Barriers or road construction techniques will be used to discourage social parking. Parking also will be prohibited along the main roads except at designated sites, and the park staff may ticket visitors if they stop and park anywhere besides an approved pullout or parking area.

Motorized Rural and Semiprimitive Motorized Zones. Additional monitoring is needed to determine whether or not conditions are within standards in these zones. No actions are being proposed at this time.

Sensitive Resource Protection Zone. Off-trail trampling has heavily impacted many areas within the sensitive resource zones at the base of Landscape Arch and in the Windows area. The resource standards have been exceeded in these areas and are expected to be out of compliance for some time because of the slow recovery rate of the soil crust. Some measures already have been taken by the Park Service to eliminate or reduce visitor impacts in these zones, including the installation of fences and rope barriers to discourage social trails and increased efforts to make visitors aware of and sensitive to their impacts on the environment.

Additional actions that may be taken in adjacent zones in the future to discourage visitors from going into the sensitive resource protection zones include rerouting trails; widening and hardening nearby trails to better accommodate heavy use; elevating trail surfaces or edging trails with rocks to deter visitors from stepping off the treadways; installing more interpretive and regulatory signs; installing barrier railings or fences; and increasing ranger patrols and enforcing regulations (i.e., issuing citations).

Overall Park Capacity

Although the VERP team has focused on management actions in certain park management zones, in the future the park's overall carrying capacity may need to be addressed. If visitor use levels continue to increase, eventually some people will not be able to find places to park at any of Arches' primary attractions. It is not possible to predict when this will happen until more is known about how use patterns change in response to the zone-specific actions. But when significant numbers of visitors cannot park to experience Arches' primary attractions, the park can be considered to have exceeded its overall carrying capacity. The Park Service would then have to look at taking further actions to manage use, such as limiting numbers of parties entering the park. These types of actions would require further public review and input.

Monitoring

Monitoring is a key element in the Arches VERP program. It is vital to have reliable, up-to-date data on resource conditions and visitors so that the park staff can determine if discrepancies are occurring between desired and existing conditions. Resource and visitor data need to be regularly collected to tell if standards are being exceeded. Monitoring also plays a large role in determining what management actions to take to ensure that standards are not exceeded.

Detailed monitoring plans will be developed at Arches to ensure that data are properly collected and to minimize the potential for misinterpretations and other errors. These technical plans will describe how, where, and when each indicator in each zone will be monitored. The VERP team is still in the process of preparing these plans. When they are completed they will be on file at the park.

Beginning in spring 1995 the park staff will begin monitoring the resource and social indicators during the peak use season. This will be an ongoing, permanent activity. Every year the park staff will prepare a monitoring report, which will document current conditions, note where standards are being exceeded, and identify what actions are being proposed to get back under the standards.

To implement a VERP program, a commitment must be made and funding must be available to monitor the indicators and standards. The cost of monitoring will depend on the indicators selected and the complexity of the standards. At Arches National Park monitoring the social standards will require 0.7 full-time-equivalent employee (FTE) and appropriate dollars for support costs. Annual biological monitoring will require 0.5 FTE plus support costs. About 0.3 FTE will be necessary for compiling data and management analysis and review. The second-tier biological monitoring will require about $10,000 of laboratory tests and 0.5 FTE.

REVISION OF THE VERP PLAN

Although the Arches VERP plan identifies certain indicators to be used in each zone, these indicators may be modified if managers identify better ways to measure changes in resource or social conditions, if the indicators prove not to be sufficiently sensitive to measuring changes caused by increasing visitor use levels, or if the indicators prove not to be cost-effective to check regularly. All of the selected indicators thus should be periodically reassessed and modified if necessary.

The indicators and standards identified in this document need to be tested to see how they are working. It may be necessary to make minor adjustments in the standards after the completing the first year or so of monitoring. However, after this initial testing phase has been

completed, changes can be made in the standards for a given indicator only if the park's General Management Plan is formally amended. Similarly, management zone descriptions or locations cannot be changed (except for minor boundary changes) without formally amending the General Management Plan and the VERP plan.

If standards are reached or exceeded in the future, the management actions in this plan may need to be altered or new management actions may need to be taken. Environmental documents may need to be completed for new management actions, depending on their nature. The management actions subsequently should be appended to this plan.

Finally, it should be remembered that the VERP plan is a step-down plan from the park's General Management Plan. In general, general management plans have a time horizon of 10 to 15 years. Under NPS policy, general management plans are periodically reviewed and revised or amended as conditions warrant. The Arches VERP plan should be reviewed and updated at the time the park's General Management Plan undergoes a thorough review and revision and should be incorporated into the new management plan.

PUBLIC INVOLVEMENT

Because the VERP program has the potential to significantly affect how the Park Service manages Arches' resources and visitors, public participation was sought throughout the VERP planning process. Interested individuals and groups were periodically informed of the team's progress, and opportunities were provided at key points in the process for people to provide their views on the proposed elements of the VERP program.

The VERP team published five newsletters, several of which had response forms for interested people to provide their comments (see table 3). In particular, the views of the public were sought on the park's purpose and significance, the management zoning scheme, and the standards being proposed. Focus group sessions and public meetings and open houses were also held at several points during the two-year planning process (see table 4).

A two-phase research project was also undertaken to help identify indicators of quality park experiences and help set standards for use levels. During summer 1992, 10 focus group sessions were held and 112 visitors were interviewed.

Researchers gained insights about general visitor use and behavior at Arches and about what conditions visitors felt were important in determining the quality of their park visits. A more intensive study in summer and fall 1993 surveyed 1,500 visitors, both onsite and via mailback questionnaires. Visitors responded to questions about their reasons for visiting Arches, opinions about management activities at the park, opinions and perceptions about crowding, and their ideas about standards for acceptable levels of use in different park areas.

Overall, public response to the VERP project and plan for Arches was positive. Most meeting participants and newsletter respondents expressed recognition that the park must find a way to manage and control dramatically increasing visitation.

There was some variation in acceptance of social standards. Although most people agreed that the proposed standards were acceptable, some believed that the standards should be either more or less restrictive. Few comments were received that indicated opposition to the process or the resulting plan.

During public review of the draft management zoning scheme, the team received numerous negative comments about the proposed "trekker zone." The public was concerned about the size of the zone (it was considered too large), the name of the zone, and the way in which the zone was defined. The primary concern was that the Park Service would construct too many trails in the zone, changing the primitive, largely untrailed nature of the zone. The VERP team subsequently changed the name from "trekker" to "backcountry" zone, reduced its size, and redefined it to limit the amount of additional trails or marked routes allowed within the zone. Little public comment was received in response to these changes.

TABLE 3. NEWSLETTERS PUBLISHED DURING THE ARCHES VERP PLANNING PROCESS

VOLUME NUMBER	DISTRIBUTION DATE	SUBJECT
1	July 1992	General information about the process
2	March 1993	Update, draft purpose and significance statements
3	August 1993	Draft management zoning
4	June 1994	Update, social research data
5	November 1994	Update, revised management zones, indicators, standards, and proposed management actions

Attendance was very low at the November 1994 open houses where indicators, standards, and proposed actions were discussed. Because people usually attend meetings when concerns are high, the VERP team assumed that the standards and proposed actions were not surprising and that people felt that the presentation of information in the newsletter was sufficient. It is not known, however, how visitors will respond when they are affected by proposed actions -- such as the control of parking at primary park features.

Concurrently with the Arches project, extensive review was undertaken of the VERP process itself. Comments from land management agencies, planning professionals, and researchers were extremely positive and supportive. The VERP team has received many requests for information and briefings on the process from around the United States and from several other countries.

TABLE 4. PUBLIC MEETINGS, OPEN HOUSES, AND PRESENTATIONS ON THE ARCHES VERP PLAN

DATE	LOCATION/ATTENDEES	MEETING TOPIC
January 1992	Utah State University of Logan; students and professors	Visitor use management planning orientation
July 1992	Moab, NPS Office; selected individuals and organizations	Scoping meeting
July 1992	Arches National Park; park visitors and staff	Scoping meeting
September 1992	Salt Lake City, REI Building; selected individuals and organizations	Scoping meeting
December 1992	Salt Lake City, SUWA conference room; selected individuals and organizations	VERP process update
March 1993	Moab; USFS/BLM recreation specialists	VERP process
May 1993	South Dakota; focus group with NPS regional superintendents	VERP process
July 1993	Denver, CO; National Parks and Conservation Association	Project update and management zoning
August 1993	Moab Civic Center; focus group, selected individuals and organizations	Project update and management zoning
August 1993	Moab Civic Center; public meeting	Project update and management zoning
October 1993	Utah State University seminar; students and professors	Indicators and standards
March 1994	Moab; BLM/USFS recreation short course; BLM and USFS employees	Indicators and standards
April 1994	Moab Chamber of Commerce	Results of demographic survey Indicators and standards
May 1994	Price, Utah, Governor's Conference on Economic Development and Tourism; general public	Indicators and standards
June 1994	Moab Chamber of Commerce	Revised management zoning, indicators, standards, and proposed management actions
November 1994	Salt Lake City and Moab; public open houses,	Same as above

APPENDIX A: SUMMARY OF THE VERP PROCESS AND DEVELOPMENT OF MANAGEMENT ZONES

For the past several years NPS planners and consultants have been developing a process intended to help park planners and managers make sound decisions about visitor use. This appendix summarizes this process, called the visitor experience and resource protection (VERP) process (NPS 1993), and describes in more detail how the planning team developed the management zones for Arches. However, it is important to note that the VERP process is still being refined and has not yet been formally adopted by the National Park Service.

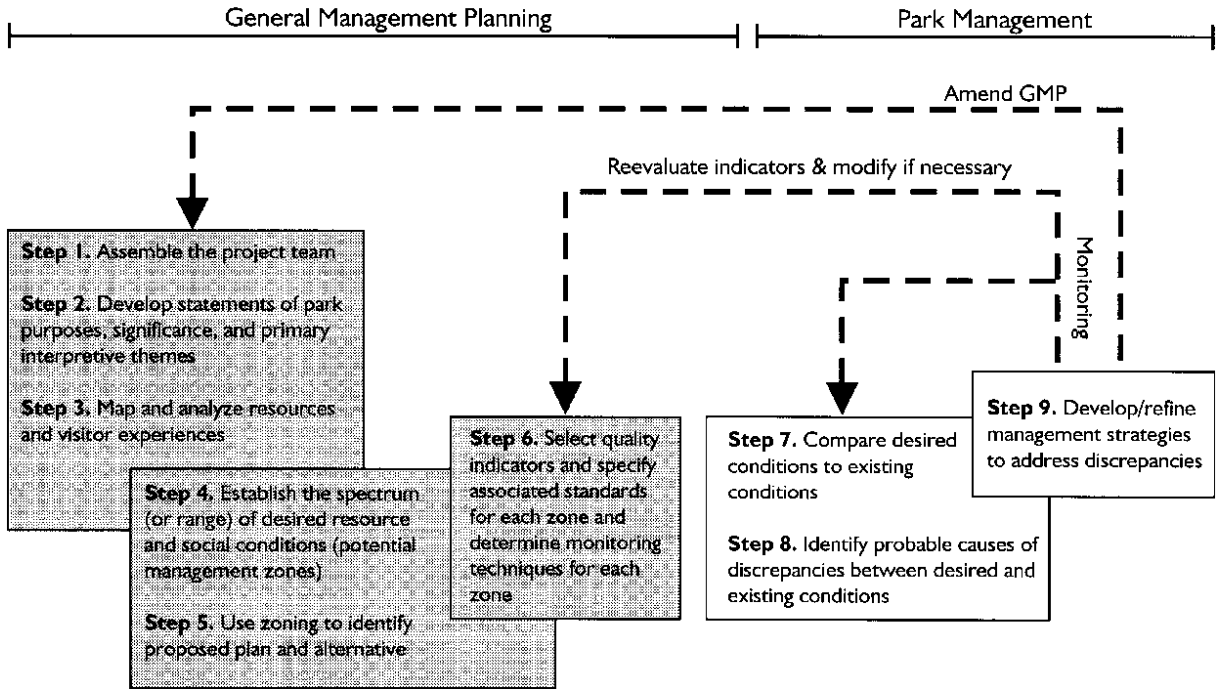
THE VERP PROCESS

As noted in the "Introduction," the VERP process interprets carrying capacity not so much as a prescription of numbers of people but as a prescription of desired ecological and social conditions. Measures of the appropriate conditions replace the measurement of maximum sustainable use. Based on these conditions, the process identifies and documents the kinds and levels of use that are appropriate as well as where and when such uses should occur. The prescriptions, coupled with a monitoring program, are intended to give park managers the information and the rationale needed to make sound decisions about visitor use and gain the public and agency support needed to implement those decisions.

The VERP process is based on many of the same elements and techniques included in the Forest Service's limits of acceptable change (LAC) and the National Parks and Conservation Association's visitor impact management (VIM) methodologies (Forest Service 1985; Graefe et al. 1990). A major premise of the VERP process is that the Park Service should manage visitor use continuously, the same way it manages resources. Visitor use management begins with a plan, but this is only a starting point; it continues as an iterative process of monitoring, evaluation, and adjustment.

As shown in the following figure, the VERP process consists of nine steps. The first six steps are requirements of general park planning and ideally should be part of each park's general management plan. The later steps in the process require annual review and adjustment and are more appropriately handled through park operations and management activities.

Process for Addressing Visitor Experience and Resource Protection in the National Park System



- **Step 1** is assembling an interdisciplinary project team.

- **Step 2** consists of developing clear statements of park purposes, significance, and primary interpretive themes. This step clarifies the most basic assumptions about the park's use and management and sets the foundation for the rest of the process.

- In **Step 3** the park's important resources and potential visitor experiences are mapped and analyzed. The product of this step is a set of overlay maps showing the spatial distributions of important resources, landscape units, and the range of visitor experience opportunities.

- In **Step 4** the team identifies potential management zones that cover the range of desired resource and social conditions consistent with the park's purposes -- this is where the process becomes prescriptive. Different actions will be taken by the Park Service in different zones with regard to the types and levels of uses and facilities. The zones are defined by carefully analyzing resource constraints/sensitivities, potential visitor experience, and management goals for the park. The existing park infrastructure (roads, parking areas, etc.) is not a deciding factor in determining the zones.

- In **Step 5** the team applies the potential management zones on the ground to identify a proposed plan and alternatives. Overlaying the potential management zones on the areas

where the team believes that different visitor experiences should occur in the park identifies a zoning scheme. The park's purposes, significant resources, and existing infrastructure are also factored into this analysis. Different configurations of the potential management zones can lead to different alternatives.

- **Step 6** is selecting quality indicators and specifying associated standards for each zone. The purpose of this step is to identify measurable physical, social, or ecological variables that will indicate whether or not a desired condition is being met. This is a pivotal step that defines the zones, transforming subjective descriptions into objective measurements of conditions in those zones. Monitoring techniques for each zone are also selected and evaluated in this step.

- In **Step 7** the park staff compares desired conditions to existing conditions. Each zone needs to be monitored to determine if there are discrepancies with the desired resource and social conditions.

- **Step 8** consists of identifying the probable causes of discrepancies in each zone. It is important in this step to accurately identify the root causes of the discrepancies.

- In **Step 9** the park staff identifies management strategies to address discrepancies. Visitor use management prescriptions should start with the least restrictive measures that will accomplish the objective and move toward more restrictive measures if needed.

Although Step 9 is the final formal step shown in the figure, the process does not end there. Long-term monitoring is an essential element of the VERP program. Monitoring provides periodic, systematic feedback to park managers to ensure that desired resource and visitor experience conditions continue to be achieved over the long term.

Resource/Visitor Experience Analysis and Management Zoning (Steps 3 and 4)

Basic to the VERP process is a determination of the appropriate range of visitor experiences that can be offered in a park and specific objectives for the condition of park resources. The outer limits that begin to define appropriate park uses and resource conditions are provided by the park purpose and significance determinations. However, most park areas can provide more than a single kind of visitor experience, and some resources are more vulnerable than others to visitor use. Therefore, management zoning is used in the VERP process to prescribe appropriate uses and management strategies for different areas within a park.

The Arches management zones were developed based on an analysis of the park's landscape units, visitor experience opportunity areas, and existing conditions.

Landscape Units. Significant differences usually exist within different areas of a park in terms of resource values and visitor use attributes (see following map). Mapping all the park's important resources is the first task in identifying the relative location and abundance of specific values. The objectives of this analysis are to document those resources upon which the park's

significance and legislated purposes are based and to identify those resources that shape visitors' park experiences.

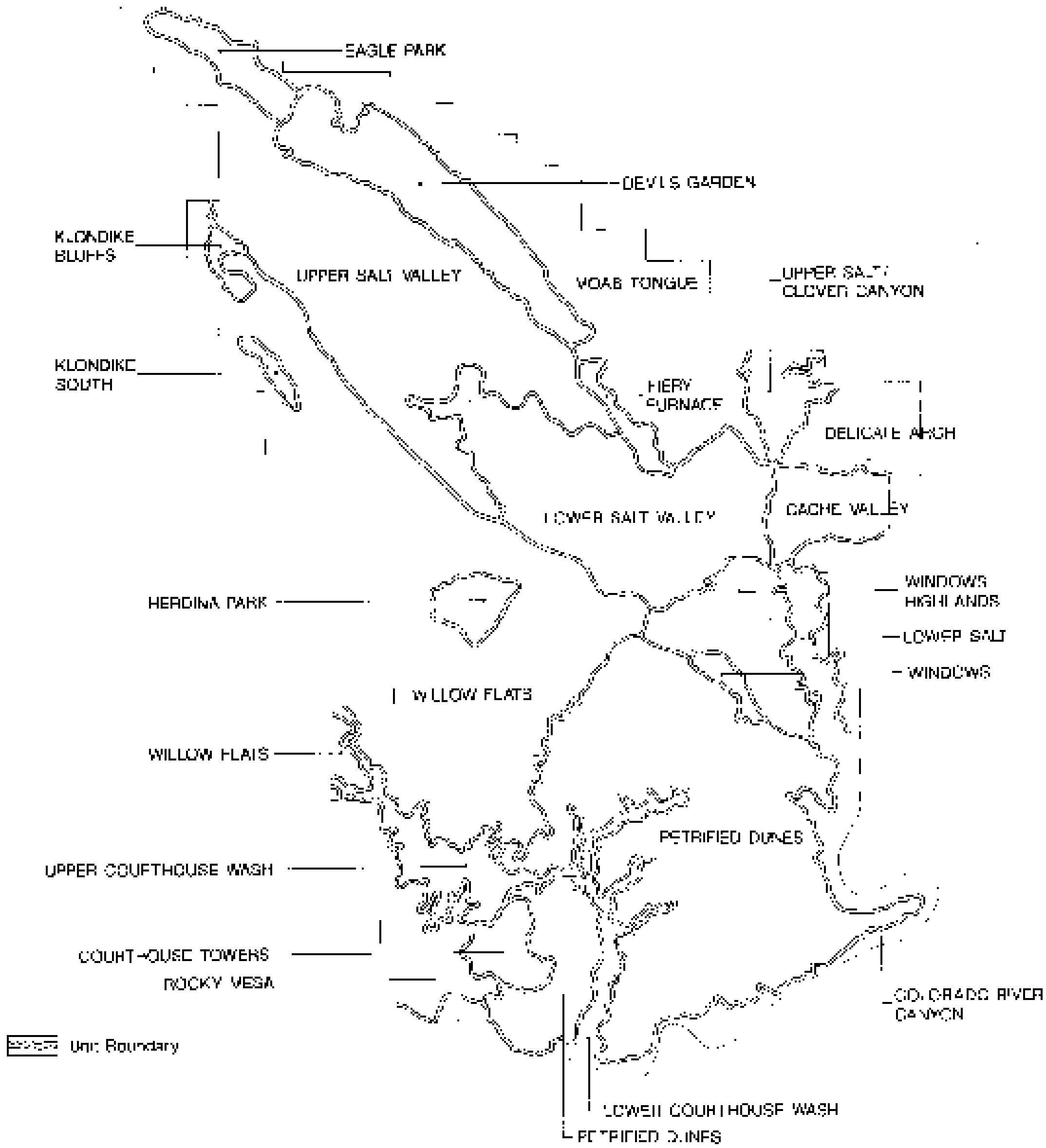
Maps were developed for Arches that show the spatial location and distribution of resources that are important for defining different park landscapes and associated resource-based visitor experiences. These maps included hydrology, vegetation (land cover), topography (landform), and special environments (e.g., riparian areas, sensitive resource areas, and archeological sites). (For other parks these maps might include soils, prehistoric and historic resources, and special environments such as wetlands, critical habitats, and areas that have special designated status such as wilderness areas or cultural districts.)

Using these maps, landform, water, and vegetative boundaries and edges that define spaces in the landscape can be identified. These boundaries and edges form "landscape units" -- areas of the park that are characterized by prominent natural and cultural features, views, view corridors, distinctive surface patterns of vegetation, water, and topography, and special sensory qualities or aesthetic values. The landscape units identified for Arches National Park are shown on the following map.

An important premise of VERP is that the range of diverse visitor opportunities available within a park should be resource related and not depend upon where existing infrastructure is located. Rather, the range of appropriate experience opportunities and the locations of attractions within a park should direct the need for and type and location of infrastructure.

Resource Experience Opportunity Areas. A park's landscape units are distinctive areas, but people may perceive them as having similar qualities and providing similar experiences. To determine which landscape units at Arches could be combined, the sites, areas, features, and corridors distributed throughout each landscape unit were inventoried and a description of the experiential character of each unit was written. This enabled the planning team to combine the landscape units into areas of like or similar character and potential for visitor experiences. These areas of similar character were termed resource experience opportunity areas. Ten such areas were identified for Arches and are shown on the following map. A brief description of each resource experience opportunity area follows:

Fins -- This opportunity area includes the Devils Garden, Fiery Furnace, Klondike Bluffs, and Herdina Park areas. The orange-to-reddish Entrada sandstone fins and spires dominate them. In these areas there are labyrinths of spires, fins, chutes, and arches. The visitor experience in this opportunity area is very much inwardly focused because of the high vertical landforms that limit movement and views along narrow corridors. The immediate foreground and focused corridor views of landforms dominate the experience; in contrast, the importance of color and vegetation cover is minimal.



RESOURCE LANDSCAPE UNITS

ARCHES NATIONAL PARK

- **Monoliths and Walls --** This opportunity area is primarily composed of the park's most striking non-arch landforms: Courthouse Towers, the Great Wall, the Windows section, and the Delicate Arch area. The experience is not one of being within an area but rather that of viewing from the outside the massive to delicate landforms as they appear against the horizon. The opportunity for experiencing them is from the perimeter of the individual landforms. Because of the massiveness, height, and association in clusters, they provide key landmarks and orientation for the visitor. The landforms here also dominate expansive vistas that are afforded in other areas. Vegetation has a relatively minor role in defining the visitor experience.

- **Upland Blackbrush Flats --** This opportunity area covers most of Willow Flats. These areas are generally flat, with some relief, and appear sandy or rocky. They have few distinguishable geologic features. Low, dark, blackbrush dominates the landscape. The vegetation can appear to be an obstacle, and there are no obvious routes through the areas.

- **Slickrock/Petrified Dunes --** Most of the southern part of the park is included in this opportunity area. It appears to be a smooth, rounded, rolling, tan-beige, rugged, barren, rock landscape. Depending on one's location in this area, one can see expansive vistas then move a few steps and feel much more enclosed by the dunes. Vegetation is scarce, with pockets of piñon-juniper vegetation and pothole gardens, and plays a relatively minor role in the visitor experience. There are a lot of opportunities for solitude here, and the landscape appears challenging to explore.

- **Broad Open Grassland Valley --** This opportunity area is found in the northwestern end of Salt Valley. There is a more or less continuous vegetative cover, primarily cheat grass. The valley is very open and flat, with few distinguishing topographic features. There is a moderate sense of enclosure with the valley walls off in the distance. The area appears to be uninteresting and uninviting -- most people pass through this area to get someplace else.

- **Rolling Topography Mixed Shrub Valley --** This arid area is found in the southeastern end of Salt Valley. There are no distinguishable landmarks or routes through it. The landscape appears to be mildly undulating with rounded, eroded hills. Mancos shale and yellow-green-blue soils are present. The area is sparsely vegetated, with saltbush being the most common plant present.

- **Broad Open Shrubland Valley --** This area covers Cache Valley. Similar to the above two opportunity areas, the broad open shrubland valley is perceived as being flat with a vague sense of enclosure. There are no nearby landmarks. A mosaic of substrates (shale soil alternating with sandy soils) and a marbled mix of vegetation are present. Although there is not a continuous vegetative cover, shrubs dominate the landscape and can present a minor obstacle to traversing.

- **Ridge/Highlands --** The ridge/highlands opportunity area includes the southwestern part of the park and the upper flanks of the southwest side of Salt Valley. This is a rocky area with expansive vistas and some moderately distinctive slopes and ridges that break the area into small visual units. There are distinctive landmarks off in the distance and some in the

foreground. Although one is outwardly focused when walking through here, one also is looking down at the vegetation to avoid it. The mix of plant communities found here plays a minor role in the visitor experience, although at times it can appear to be a barrier or obstacle to cross.

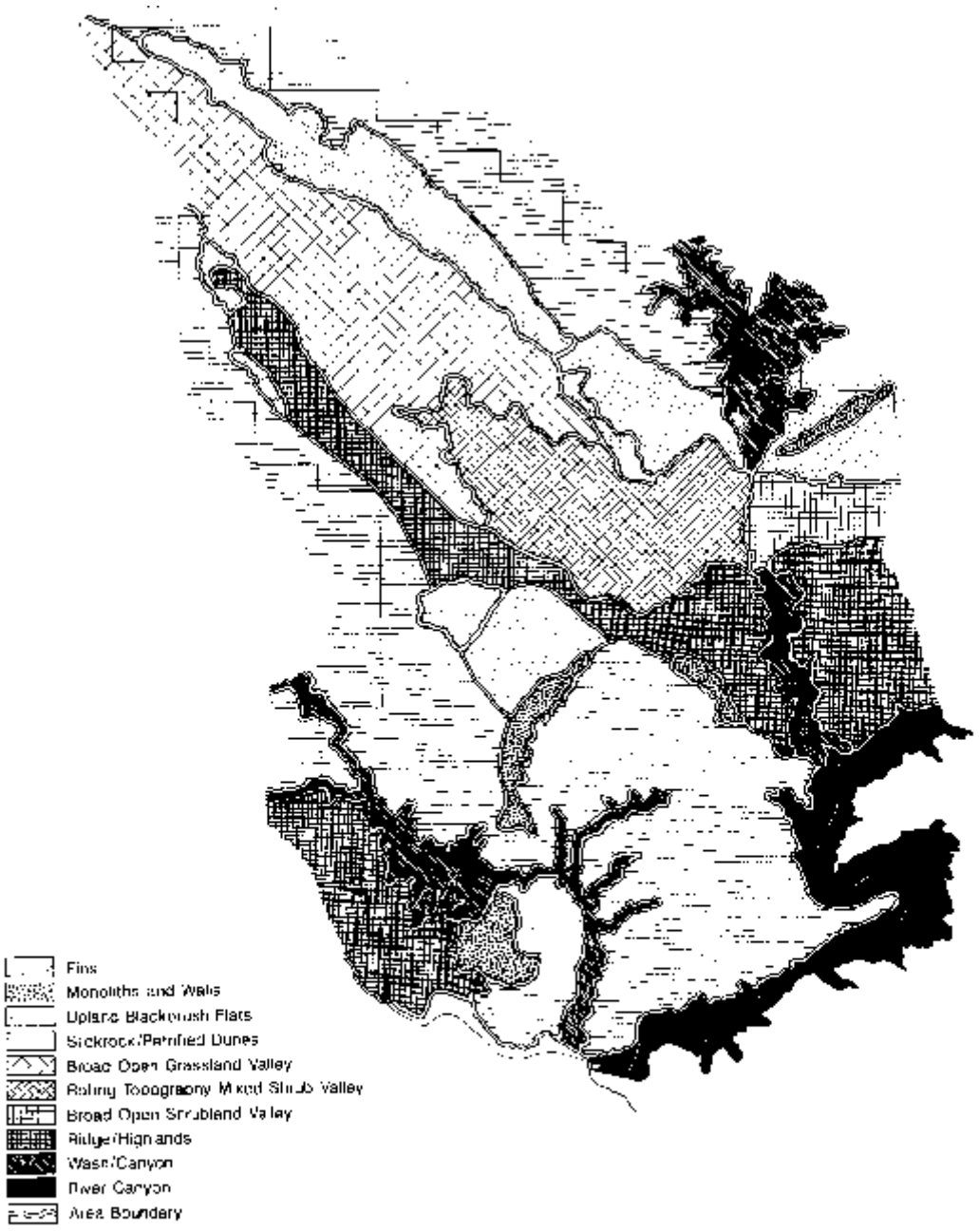
- **Wash/Canyon --** Upper and lower Courthouse Wash and Salt Creek are included in this opportunity area. The experience here can vary from feeling tightly confined to being in a broad valley. Few vistas are evident. The areas generally feel relatively narrow and snakelike with canyon walls. Once one is in this area it is challenging to get out other than to backtrack. There is an obvious route along the wash bottom. The area is interesting to explore because of the presence of (or past signs of) flowing water, seeps, and relatively thick vegetation. There is a sense of wanting to explore what is beyond the next bend in this area. It can be easy to walk in some parts and difficult in other parts because of the presence of mud, quicksand, and impenetrable vegetation.

- **River Canyon --** This is a very scenic, attractive, sinuous landscape. The silty waters of the Colorado River and the towering, dark red sandstone canyon walls dominate the landscape. One feels deeply enclosed in this canyon, with the experience being inwardly focused along the river corridor. The play of light and shadows along the rock faces attracts the eye. Tamarisk growing along the riverbanks is also evident and can affect the experiences of people trying to walk through it or take out their boats. Rugged talus slopes above the river make walking difficult through much of the canyon.

For each of the resource experience opportunity areas, several attributes were evaluated as a means of comparing the areas to determine which can support and/or sustain visitor use, the relative abundance of various resources, and the relative importance of each area to the park's purposes, significance, and primary interpretive themes. This analysis helped to compare the human values inherent in each of the resource experience opportunity areas and the highlighted areas where resource sensitivity may be in conflict with desired visitor experiences; it also assisted in determining the potential range of visitor experiences and management zones for the park.

The following table shows the analysis that was developed for Arches. As shown in the table, six specific attributes were analyzed for each resource experience opportunity area:

- the relative abundance of the resource area, both within and outside the park
- the ability of the resource area to conceal evidence of visitor use or development
- the ability of the resource area to support and or/sustain visitor use
- the potential interest of the resource to visitors
- the relative importance of the area to the park purposes, significance, and primary interpretive themes
- sites or features within the resource area of critical importance to purpose, significance, and interpretive themes



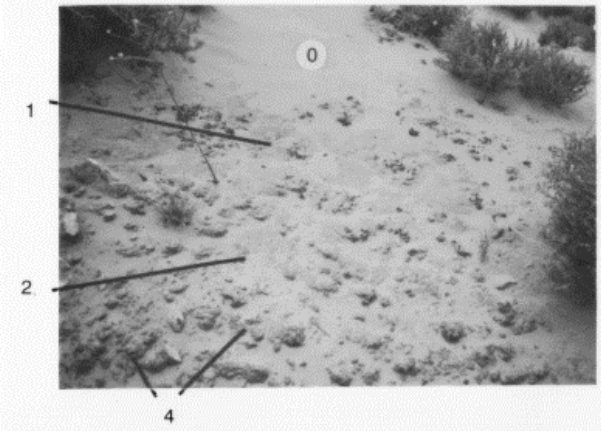
RESOURCE EXPERIENCE OPPORTUNITY AREAS

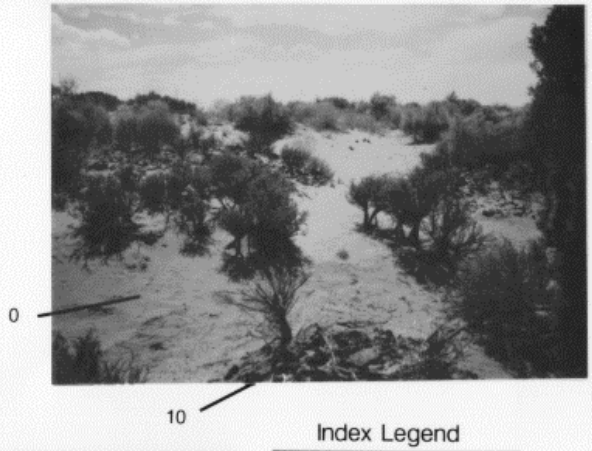
Potential Management Zones. Based on the analysis of resources and experience opportunities described above, and considering existing conditions in the park, nine potential management zones were identified for Arches. These zones cover the range of visitor experiences and resource conditions that are consistent with the park's purposes. The zones are the building blocks for resource protection and visitor management activities -- they identify how different areas in the park could be managed to achieve desirable resource and social conditions. Each zone prescribes different actions with regards to the types and levels of uses and facilities. The potential management zones and desired conditions for Arches are compared in table 1 (page 18).

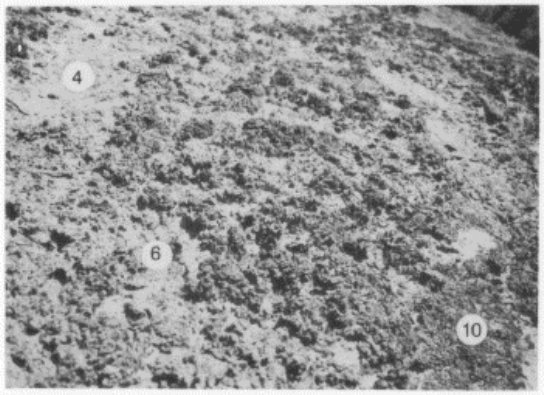
TABLE A-1. RESOURCE ATTRIBUTES FOR VISITOR USE

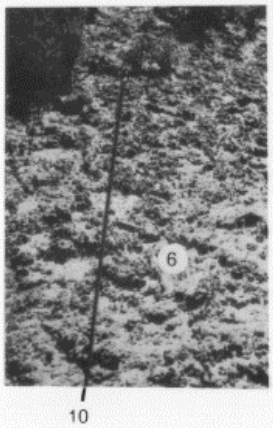
Resource Experience Opportunity Areas	Relative Availability of Resource		Ability of Resource to Conceal Use	Ability of Resource to Withstand Use	Potential Interest of Resource to Visitor	Relative Importance of Area Related to Park Purpose, Significance, and Interpretive Themes	Sites or Features of Critical Importance to Park Purpose, Significance, and Interpretive Themes
	Within Park	Out of Park					
Fins	3	2	5	1	5	5	Landscape Arch, Fiery Furnace
Monoliths and Walls	3	3	3	2	5	5	Delicate Arch, Windows Area, Courthouse Towers, Balanced Rock
Upland Blackbrush Flats	3	5	1	2	1	2	
Slickrock/Petrified Dunes	5	5	4	3	2	4	
Broad Open Grassland Valley	3	3	1	1	1	2	
Rolling Topography Mixed Shrub Valley	3	4	3	2	1	2	Wolfe Ranch
Broad Open Shrubland Valley	3	3	3	1	1	1	
Ridge/Highlands	5	5	4	3	2	1	
Wash/Canyon	3	5	4	2	2	2	
River Canyon	2	2	4	3	5	2	Moab Panel
	1 Unique 2 Rare 3 Uncommon 4 Common 5 Abundant			1 Very Low 2 Low 3 Moderate 4 High 5 Very High			

Soil Crust Index Evaluation Guide Sheet









Index Legend

10	Dark Bumpy Lichens, Mosses
6	Mix Of Light And Dark, Large Bumpy
4	Light, Large Bumpy
2	Light, Slightly Bumpy
1	Smooth, Sealed
0	Sand

APPENDIX C: SUMMARY OF THE TRANSPORTATION RESEARCH BOARD'S TRAFFIC CONGESTION INDEX

This summary is taken from the Transportation Research Board's 1985 Highway Capacity Manual (Special Report 209, page 29).

LEVELS OF SERVICE

Level of Service A: Free-flowing condition with low volumes and high speeds. There are little or no restrictions to traffic and few delays.

Level of Service B: Stable flow with operating speeds and passing beginning to show some restriction. Reductions in speeds may occur, with a low probability of traffic being restricted.

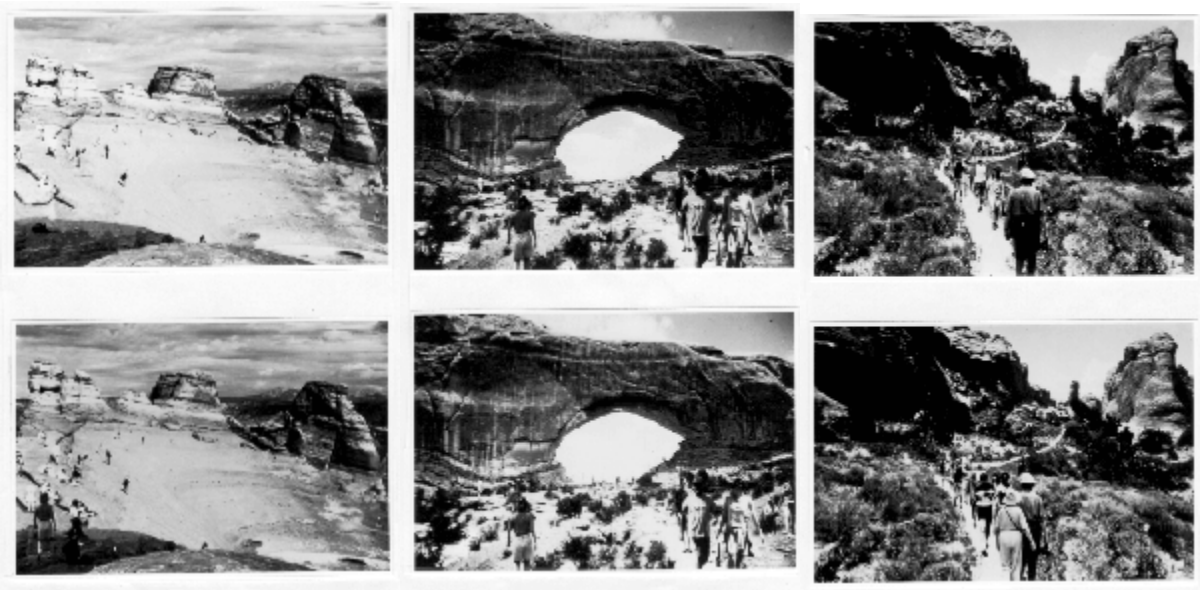
Level of Service C: The higher volumes more closely control relatively stable flow and maneuverability. Most drivers are restricted in their freedom to select their own speed, change lanes, or pass.

Level of Service D: Approaching unstable flow with tolerable operating speeds although considerably affected by changes in operating conditions. Drivers have little freedom to maneuver and pass other vehicles; comfort and convenience are low.

Level of Service E: Represents operations at even lower speeds than LOS D. Volumes are at or near the capacity of the roadway. The highest volume attainable under LOS E defines the capacity of the roadway. Flows are unstable, and there may be stoppages of momentary duration.

Level of Service F: Forced or breakdown flow operation at low speeds where volumes exceed capacity. Speeds are substantially reduced, and stoppages may occur for short or long periods of time due to downstream congestion.

APPENDIX D: SELECTED EXAMPLES OF COMPUTER GENERATED PHOTOGRAPHS USED TO DETERMINE SOCIAL CROWDING STANDARDS AT ARCHES



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