

I 29.2:C 85/8

General Management Plan, Craters of...

PUBLIC DOCUMENTS
DEPOSITORY ITEM

general management plan

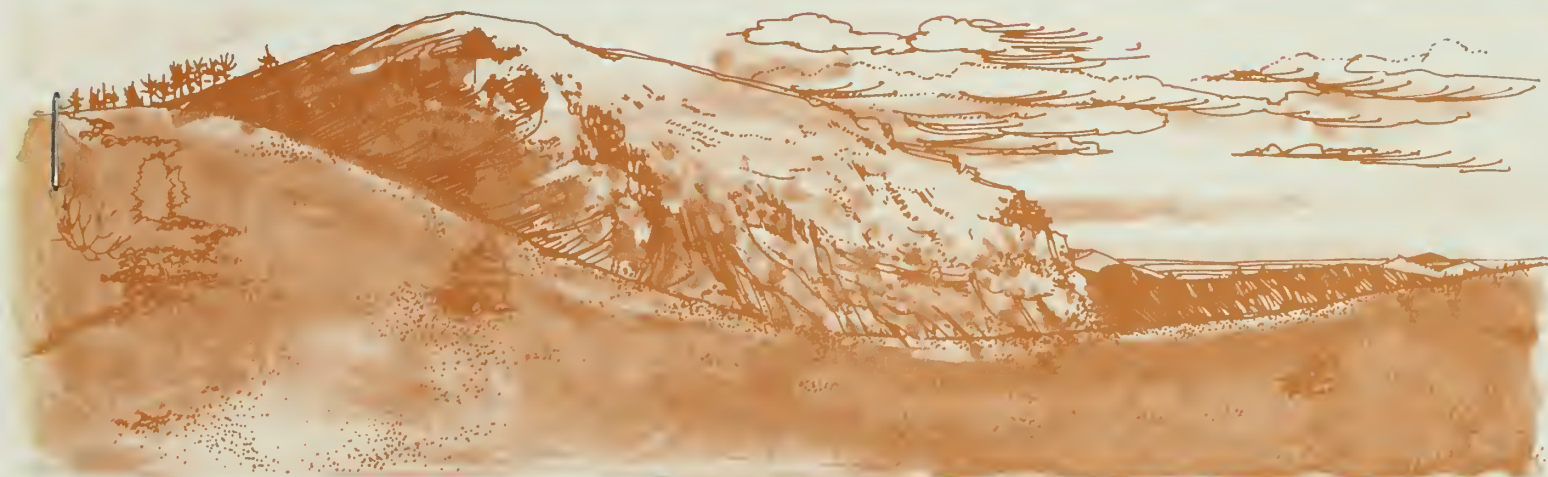
OCT 2 1982

CLEMSON
LIBRARY

Clemson University



3 1604 016 837 652



CRATERS OF THE MOON NATIONAL MONUMENT • IDAHO

Recommended:

Robert Budz
Manager, Western Team, Denver Service Center

December 17, 1991

Jonathan Jarvis
Superintendent, Craters of the Moon National Monument

April 23, 1992

Approved:

Michael Tollefson
Acting Regional Director, Pacific Northwest Region

April 29, 1992

U.S. Department of the Interior / National Park Service




Printed on Recycled Paper

general management plan

june 1992

CRATERS OF THE MOON NATIONAL MONUMENT • IDAHO

UNITED STATES DEPARTMENT OF THE INTERIOR / NATIONAL PARK SERVICE
DENVER SERVICE CENTER



Digitized by the Internet Archive
in 2012 with funding from
LYRASIS Members and Sloan Foundation

<http://archive.org/details/generalmanagemen00nat12>

SUMMARY

A general management plan is needed to guide the management, development, and use of Craters of the Moon National Monument for the next 10 to 15 years. Since major redevelopment of management and visitor facilities in the monument as part of the Mission 66 program in the late 1950s and early 1960s, use of the monument has increased and visitation patterns have changed. These changes have led to traffic congestion, insufficient parking, and conflicts between visitor and staff activities. The transition from the high-speed main highway to the park road and resources is through a congested developed area. Many facilities are outdated and do not provide adequate space to support current levels of use or management. Actions are proposed in this plan to correct these deficiencies.

Few changes will be made in the way the monument is managed. Management policies and concerns are adequately addressed in resource management plans and in management plans for backcountry and wilderness. In the general management plan, emphasis is placed on major actions needed to enhance management of natural and cultural resources and to correct deficiencies in facilities for management and visitor use.

Several actions are proposed: a boundary modification in the north unit to protect the monument's water supply and place the boundary along readily identifiable topographic features, major improvements to the scenic loop road and waysides to bring them up to current standards, development of an interpretive wayside in the Big Sink area, designation of a bike and ski trail in the north unit, and campground improvements such as additional tent sites and leveling of some campsites for use by recreational vehicles.

The major proposal is the development of a new entry road that will bypass the existing developed area. A new visitor center, an entrance station, a group gathering area, and parking areas will be developed along this

new alignment. The existing visitor center will be converted to management facilities; the maintenance facilities will be expanded; and the existing boneyard will be eliminated. Existing seasonal employee housing will be evaluated for rehabilitation or removal and reconstruction to meet National Park Service housing standards.

Several alternatives to the proposed plan were considered but rejected, and three alternatives were considered in detail. Under alternative 1 (no action), operations would have continued essentially unchanged, with improvements to facilities and programs made gradually as funding became available. Many of the proposed actions for resource management, land management, and interpretation would have been implemented. There would have been no major redevelopment of existing facilities.

Alternative 2 would have involved retaining most existing facilities in their present locations. Expansion and redesign would have been carried out as necessary to meet minimum requirements for visitor services and administration. Congestion on the entrance road and in visitor center parking areas would have been relieved somewhat through redesign but probably would not have been eliminated.

Alternative 3 was a seasonal variation on the proposal. The proposed new visitor center would have operated only in summer; during winter, visitor services would have returned to the remodeled headquarters. Winter staff requirements and operating costs would have been reduced slightly under this alternative.

The effects of the proposal and alternatives on the natural, cultural, and human environment were analyzed in the environmental assessment that accompanied the draft *General Management Plan*. Analysis of the effects of the proposed action revealed that there would be no significant impacts from implementation of this plan. The finding of no significant impact is reproduced in appendix A of this document.

CONTENTS

INTRODUCTION	1
BACKGROUND	3
BRIEF OVERVIEW OF MONUMENT	3
LEGISLATED AUTHORITY	6
PLANNING ISSUES AND CONCERNS	9
RESOURCE MANAGEMENT	9
EXTERNAL INFLUENCES ON MONUMENT RESOURCES	10
Air Quality	10
Activities on Adjacent Lands	11
Potential Future Activities	12
ACCESS AND TRAFFIC CIRCULATION	12
INFORMATION AND INTERPRETATION	13
FACILITIES	14
Visual Intrusions	14
Visitors	14
Monument Operations	14
ISSUES AND CONCERNS NOT CONSIDERED FURTHER	15
INTERRELATIONSHIPS WITH OTHER STUDIES, PLANS, AND PROPOSALS	16
PARK EXPANSION	16
ADJACENT WILDERNESS PROPOSALS	16
PROJECTS WITH IDAHO NATIONAL ENGINEERING LABORATORY	16
POTENTIAL SPECIAL DESIGNATIONS	16
MAN AND THE BIOSPHERE	17
THE PLAN	18
MANAGEMENT ZONING	18
Natural Zone	18
Wilderness Subzone	19
Natural Environment Subzone	19
Outstanding Natural Features Subzone	20
Watershed Protection Subzone	20
Development Zone	20
Park Development Subzone	20
Interpretive Development Subzone	23
Special Use Zone	23
RESOURCE MANAGEMENT	23
Boundary Modification	23
Other Resource Management Actions	24
Carrying Capacity	26
Backcountry/Wilderness Management	26
SERVICES AND FACILITIES FOR VISITORS	26
Access and Circulation	26
Interpretation	29
Location and Development of Facilities	31
ADMINISTRATION AND OPERATIONS	32
Management Facilities	32
Employee Housing	33
Staff	33

Contents

IMPLEMENTATION OF THE PLAN 33

Sequence 33

Project Packages 34

PUBLIC INVOLVEMENT 35

APPENDIXES

A: FINDING OF NO SIGNIFICANT IMPACT 39

B: DESCRIPTION OF MONUMENT 41

C: VOLCANIC FEATURES 60

D: OBJECTIVES 61

E: LEGISLATION 62

F: REMODELING AND NEW CONSTRUCTION 69

G: COMPLIANCE WITH NATIONAL HISTORIC PRESERVATION ACT 73

H: VEGETATION, INCLUDING SENSITIVE PLANTS 74

I: ANIMALS, INCLUDING SENSITIVE SPECIES 82

REFERENCES 85

PREPARERS AND CONSULTANTS 87

Illustrations

Location	5
Physical Resources	7
Management Zoning	21
Boundary Modifications	25
Development Concept	27
Lava Features	45
Vegetation	47
Existing Conditions, Headquarters Area	57
Existing Conditions, Entrance Station	59

Tables

1: Management Zoning	19
B-1: Pollutants and Their Effects	42
B-2: Visitor Statistics 1979 – 1990	55
B-3: Monthly Visitation, 1984 - 1990	55
H-1: Area Occupied By Each Vegetation Type	79

INTRODUCTION

A general management plan is needed to guide the management, development, and use of Craters of the Moon National Monument for the next 10 to 15 years. Since major redevelopment of management and visitor facilities in the monument as part of the Mission 66 program in the late 1950s and early 1960s, use has continued to increase, and visitation patterns have changed. These changes have led to traffic congestion, insufficient parking, and conflicts between visitor and staff activities (such as maintenance vehicles traveling through congested areas at the visitor center and campground and employees being disturbed in their residences by visitors).

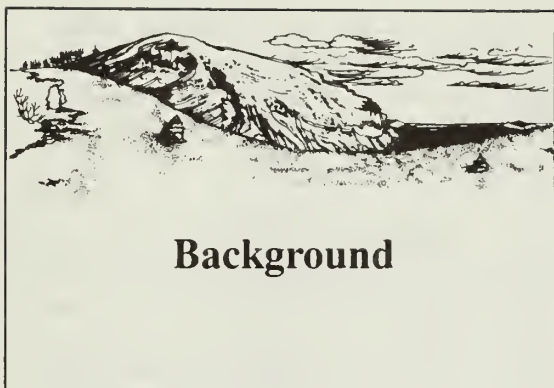
Employee housing is highly visible, providing little privacy. The transition from the high-speed main highway to the park road and resources is through a congested developed area. The main park road goes through the campground, and the fee collection station also is in the campground. This diminishes the camping experience in that area. Many facilities in Craters of the Moon National Monument are outdated and do not provide enough space to support current levels of use or management. Actions to correct these deficiencies are proposed in this general management plan.

The approved resource management plan for the monument (NPS 1987) focuses on man-

agement concerns, prescribes ways to correct deficiencies in baseline information, and includes recommendations for actions to solve specific resource management problems. In the general management plan, the major actions needed to enhance management of natural resources are emphasized. Since the resource management plan is subject to frequent revisions, the current plan should always be referred to when the general management plan is used.

The *Craters of the Moon National Monument Backcountry/Wilderness Management Plan* (NPS 1989a) guides the use of remote areas and establishes the framework for implementing the "limits of acceptable change" system to monitor and correct adverse effects on the monument's resources.

The draft *Craters of the Moon General Management Plan/Environmental Assessment* contained a proposed plan, along with an environmental assessment of the plan and three alternatives. Analysis of the effects of the proposed action revealed that there would be no significant impacts from implementation of this plan. The finding of no significant impact is reproduced in appendix A of this document.



Background

The following section contains a brief summary of the important features of Craters of the Moon National Monument. For a detailed description of the monument, see appendix B.

BRIEF OVERVIEW OF MONUMENT

Natural Setting

Craters of the Moon National Monument was established by presidential proclamation in 1924. The monument occupies approximately 54,000 acres in the eastern Snake River Plain, which crosses southern Idaho as a broad arc of low topographic relief, contrasting with the mountainous terrain of the rest of the state (see Location map). The monument's location may seem remote, but it is within a two-hour drive of major population centers in southeastern Idaho and on a well-traveled tourist route between Yellowstone National Park and the region of Sun Valley and the Sawtooth National Recreation Area. U.S. Highway 20-26-93, the main highway passing through the northwest corner of the monument, provides excellent year-round access.

The significance of the monument is the relatively young age of the lava flows and the diversity of volcanic features in a small geographic area. The monument contains part of one of the four rift sets that make up the Great Rift, a volcanic rift zone that extends for 60 miles from the Pioneer Mountains south nearly to the Snake River. Visitors to the monument can see some of the most spectacular and diverse features along the Great Rift, including vast basaltic lava flows and associated volcanic products from eruptions that occurred

between 15,000 and 2,100 years ago. Features include two types of lava flow (pahoehoe and aa), cinder cones, rafted blocks, fissure cracks, vents, spatter cones, lava tubes, and tree molds (some volcanic terms are defined in appendix C). A visitor can learn about the monument's interesting and fragile resources in a few hours; those seeking to learn more may stay longer, enjoying cool mornings and evenings and exploring related features in the region (see Physical Resources map).

The monument's fauna and particularly its flora reflect the influence of the geologic setting. Plant succession is well illustrated among different aged lava flows. Three subspecies of small mammals were first described from this area and are found only in the vicinity of lava flows of the Great Rift.

The northern end of the monument includes a small portion of the foothills of the Pioneer Mountains. The north unit (4,125 acres) is a different environment from the volcanic area to the south: it is a sagebrush-grassland shrub steppe with stands of Douglas-fir and quaking aspen. Riparian areas surround the small watercourses that arise from springs in the foothills.

Approximately 81% of the monument (43,243 acres) was designated wilderness on October 23, 1970. The remaining acres surround and include the monument's most dramatic volcanic features and encompass the foothills and flanks of the Pioneer Mountains. Nearly all visitation occurs adjacent to the scenic park road corridor; backcountry and wilderness areas are used little because of harsh terrain, extreme temperatures, and lack of water.

Available Facilities and Services

The developments at Craters of the Moon have been designed to support the primary objectives of protecting the volcanic features and interpreting them to the public. The following facilities and services are available.

A combination visitor center and administration building near the entrance from U.S. 20-26-93 offers exhibits and a five-

BACKGROUND

minute videotape about lava phenomena and the geologic processes that created them. Publications, maps, and the monument brochure are available at the center.

A 5.6-mile loop drive leads to scenic areas and some of the most spectacular volcanic features, including cinder cones, lava fragments, and several caves. There are interpretive wayside exhibits throughout the monument at major features. When the road is blocked by snow, vehicles can be driven only to the developed area, but the wayside exhibits can be seen by skiers in winter, when the loop drive is converted to a crosscountry ski trail.

Trails from the loop drive lead to many significant features. Some trails lead to specific points of interest; others are loop trails or connect to other points. Self-guiding trails lead to the North Crater flow, Devils Orchard, and the caves area. Interpretation along these fairly short trails ($\frac{1}{2}$ mile to 2 miles) is available through a combination of trail leaflets and wayside exhibits.

Picnic tables have been placed at several locations along the loop drive, and there are toilet facilities at two trailheads. Water is available only at the visitor center and the campground. A lack of shade discourages picnicking, but visitors move tables under a tree if one is available.

The interpretive staff leads guided walks daily to features such as Buffalo Caves and the lava tubes. The variety of programs available varies with available funding and staff. Nightly programs are offered at an amphitheater that was constructed in the campground in 1987.

On-site teachers' workshops and environmental education programs for school groups are conducted in May and Septem-

ber. Thirty-six elementary to high school groups participated in these programs in fiscal year 1990—a total of 1,697 students. Twelve college groups also visited the monument during that time.

A 52-site campground that has been carved out of the lava formations presents an extraordinary setting and some unusual campsites. The campground appears to meet the demand: campers must be turned away on some days, but commercial campsites with complete facilities for recreational vehicles generally are available in Arco, about 18 miles north.

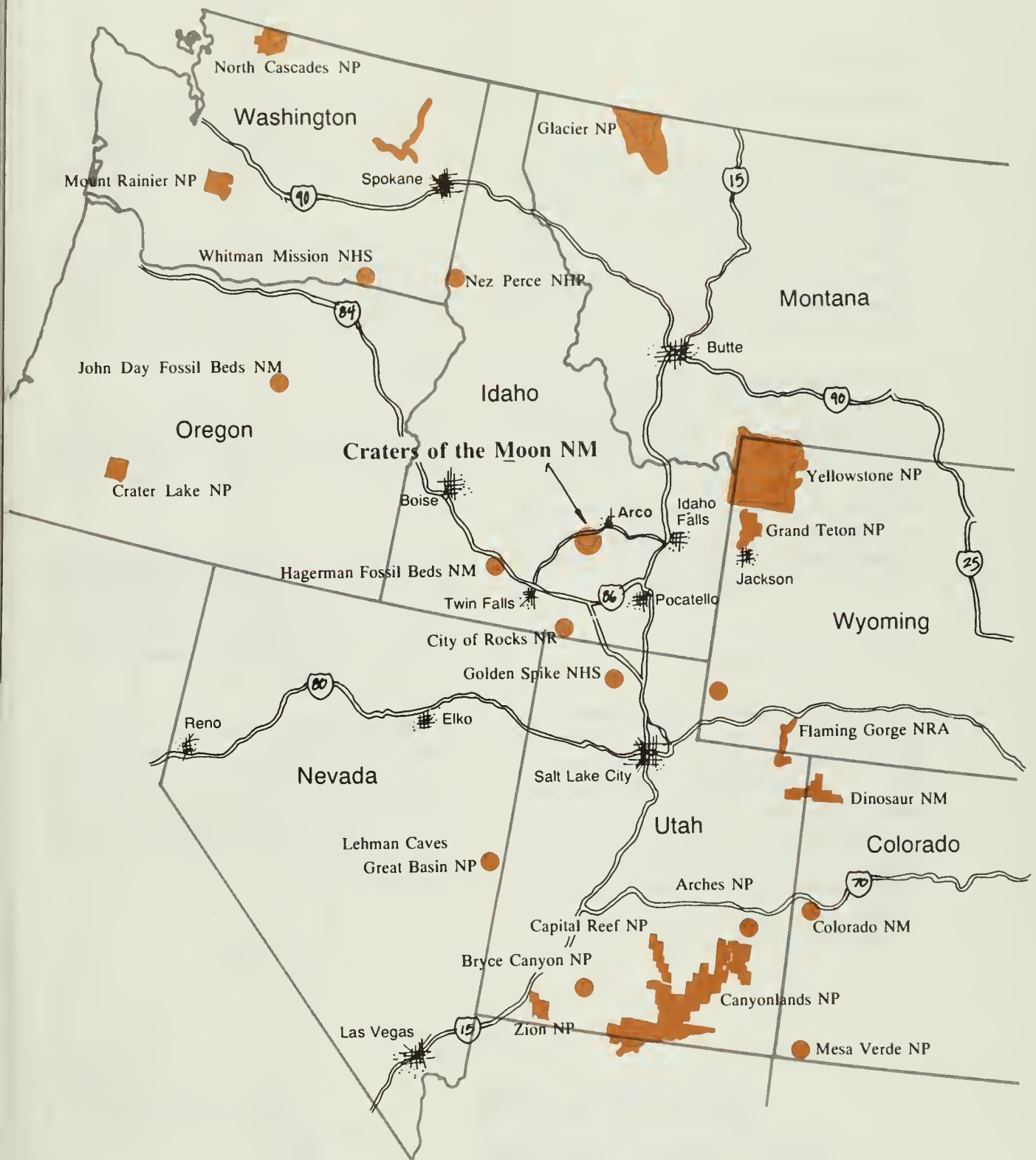
A primitive campground for groups is available across the highway a short distance northwest of the main developed area. The site offers privacy but is remote from such monument services as evening programs.

Winter camping is permitted, but campsites are not cleared of snow, and water and restroom facilities are not available. Portable toilets are provided near the winter parking area. Visitors crosscountry skiing in the monument may camp by permit at the caves parking area.

A permit is required for backcountry camping, which is allowed only in the wilderness area and at the group campground in the north unit.

There are no concessioner-operated services in the monument. Soft drinks are available at the visitor center. Food and other concession services do not seem necessary, as Arco is nearby.

Major redevelopment of management and visitor facilities was accomplished during the Mission 66 program in the late 1950s and early 1960s. As technology and management emphasis have changed since then, some of the facilities no longer function adequately.



Location Craters of the Moon National Monument

United States Department of the Interior - National Park Service
DSC/June'92/131/20011A

Management Philosophy

Craters of the Moon National Monument is managed to protect volcanic features of the Great Rift for their scientific and educational value and to inform the public about the significance and fragility of these resources. Recreational experiences such as camping, hiking, skiing, and biking are secondary to these primary objectives.

To ensure understanding and protection of the resources, there is major emphasis on research in the monument. The management objectives (quoted in appendix D) include preservation of volcanic features, wilderness, and cultural resources; perpetuation of natural ecosystems and regional resources; encouragement of camping, hiking, and other outdoor activities; and promotion of scientific research.

LEGISLATED AUTHORITY

In 1924 an area of public lands in Idaho was "reserved from all forms of appropriation under the public land laws" and set apart as Craters of the Moon National Monument (see appendix E). The presidential proclamation that established the monument recognized the lands as an area of unusual scientific value, general interest, and educational value

which contains a remarkable fissure eruption together with its associated volcanic cones, craters,

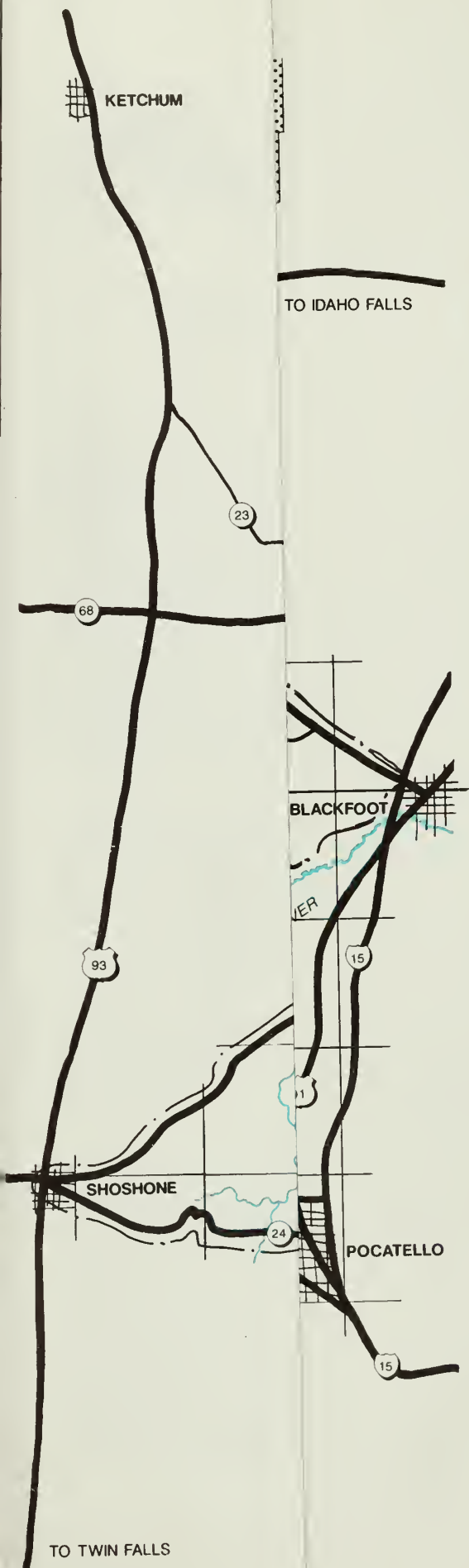
riffs, lava flows, caves, natural bridges, and other phenomena characteristic of volcanic action; . . . and . . . contains many curious and unusual phenomena of great educational value and has a weird and scenic landscape peculiar to itself.

In the proclamation, President Coolidge said, "it appears that the public interest would be promoted by reserving these volcanic features as a National Monument, together with as much land as may be needed for the protection thereof."

Other lands were added in 1928 and 1930 to provide a water source and to include "additional features of scientific interest located thereon."

In 1941 lands "not necessary for the proper care and management of the objects of scientific interest situated within the said monument" were excluded from the monument to allow construction of Idaho Highway 22 (since renumbered to U.S. 20-26-93).

A 1962 presidential proclamation added Carey Kipuka (180 acres) and intervening lands between the kipuka and the then existing monument, a total of 5,346.41 acres (see appendix C for a definition of a kipuka). Craters of the Moon Wilderness (43,243 acres) was designated in 1970.



LAVA FIELDS



STUDY AREA BOUNDARY



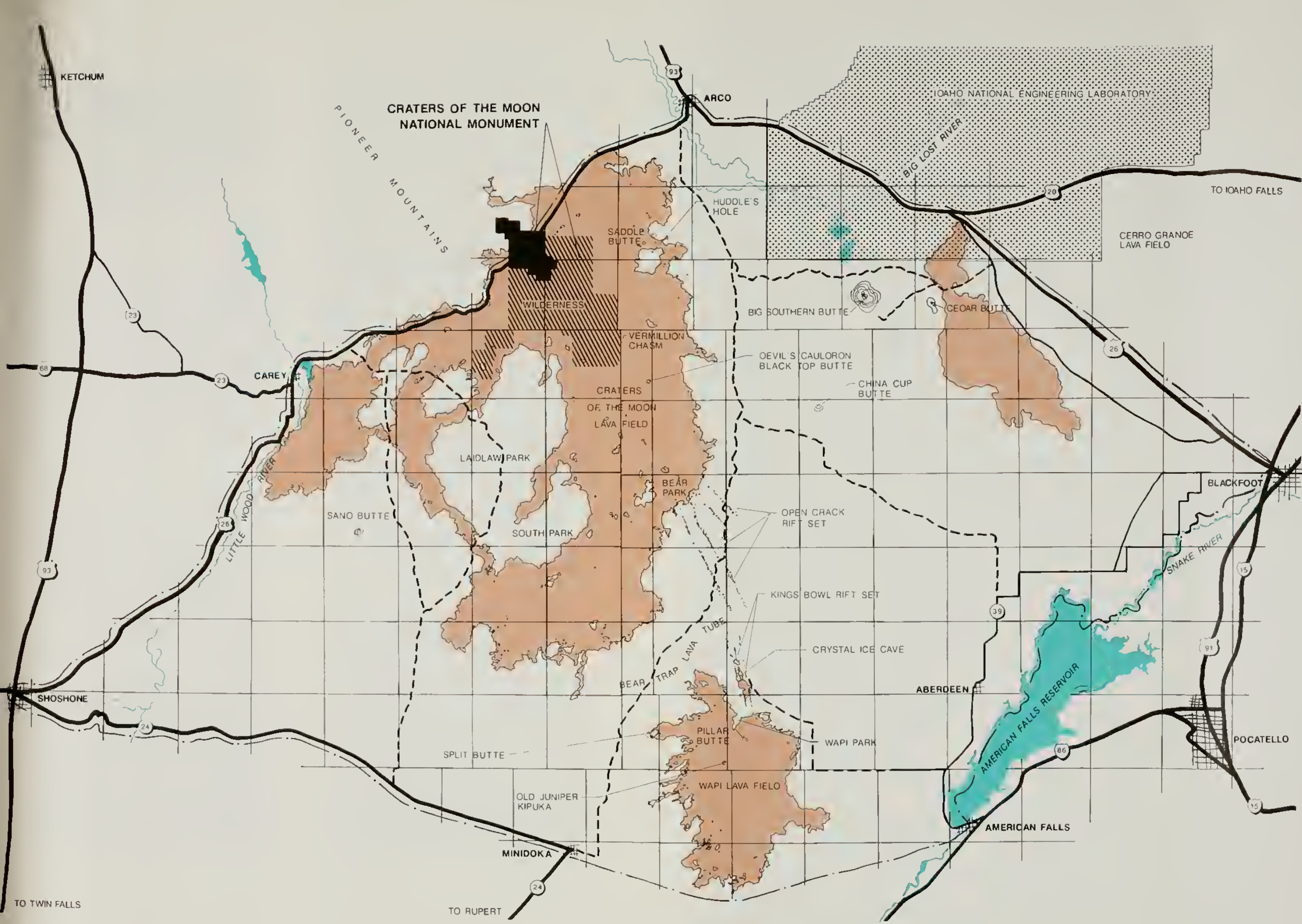
DIRT ROAD



PHYSICAL RESOURCES

CRATERS OF THE MOON NATIONAL MONUMENT
UNITED STATES DEPARTMENT OF THE INTERIOR / NATIONAL PARK SERVICE

131 | 20.010 A
DSC | FEB 89



- LAVA FIELDS
- STUDY AREA BOUNDARY
- DIRT ROAD

0 1 2 3 4 5 6 MILES



PHYSICAL RESOURCES

CRATERS OF THE MOON NATIONAL MONUMENT
UNITED STATES DEPARTMENT OF THE INTERIOR / NATIONAL PARK SERVICE

131 20,010A
OSC FEB 89



Planning Issues and Concerns

Considering the age and design of facilities, the small staff at Craters of the Moon National Monument does a remarkable job of providing visitors with a rewarding experience in a well-maintained setting. The permanent staff of 11 is supplemented by approximately 6 to 14 seasonal employees; the number fluctuates with funding. Help also is obtained from a small but supportive corps of volunteers and from university groups, support groups, the Craters of the Moon Natural History Association, and various youth programs.

Even with this support, fluctuating funding hinders interpretive, resource management, and maintenance programs; such functions are particularly critical in a monument with a small staff. In reduced budget years, the first costs to be eliminated are visitor services such as guided walks. Off-site educational programs and on-site programs for school groups have suffered in years of reduced funding. The general management plan reinforces the need for these programs but cannot ensure adequate funding for them.

There is no transition from the main highway to park roads and resources; visitor center parking areas are a short distance off the highway. For visitors, congestion and lack of parking space at the visitor center/headquarters are significant problems. When a visitor's introductory experience to the monument is poor, the quality of the overall experience is diminished. Existing facilities will not accommodate interpretation for school groups or other large groups, and parking is inadequate for large recreational vehicles (RVs) and buses. For

management, the major problem is inadequate functional work spaces and inadequate storage.

The following issues and concerns have been considered in planning for the management of Craters of the Moon National Monument.

RESOURCE MANAGEMENT

The most significant problem in managing the resources of the monument is a lack of baseline information. The amount of geological information is substantial, but biological research has been limited. Transects have been established for long-term ecological monitoring of vegetation. The following resource management issues and concerns have been addressed in the resource management plan and are being implemented. They are mentioned here to emphasize their importance.

Some air quality indicators such as visibility and radionuclides are being monitored now, and a site for monitoring nitrous oxides is planned for 1992. Modifications of what is monitored and where within the monument will be required as new information is made available. Key viewsheds or integral vistas have been identified and are documented in the *Craters of the Moon National Monument Resource Management Plan* (NPS 1987).

Some baseline information has been acquired already, but detailed surveys of rare plants are needed. Species inventories for birds and most mammals are adequate, but inventories need to be updated on reptiles, amphibians, bats, and especially invertebrates. Some monitoring of plant and animal components is being done, but it also will be necessary to monitor populations not now being monitored.

Information is needed on the monument's water resources, especially the perennial ice in caves and deep crevices. It appears that many waterholes in the lava have dried up since they were reported in the 1920s.

The Federal Cave Resources Act of 1987 requires that cave resources be studied and significant caves be identified.

The U.S. Geological Survey predicts that volcanic activity will occur in the monument in the future. That agency has recommended installation of a seismic monitoring system to warn of impending eruptions.

A survey of cultural resources in the monument is needed. A brief archeological reconnaissance done in 1965 located 26 prehistoric sites in the monument, but a more detailed survey is necessary to plan for protection of these resources. No comprehensive study has ever been done of the historical resources in Craters of the Moon National Monument.

Protection of geological resources is important because geology is the primary theme of Craters of the Moon. The fragile geological resources may appear to be sturdy, but they are affected by visitors; increased erosion of the spatter cones causes irreversible damage. Heavy use by visitors is contributing to erosion of the Inferno Cone trail. Illegal collection of specimens is another major problem.

The present practice of suppressing all wildland fires in the monument presents problems because much of the monument is inaccessible. Fire suppression costs are high relative to the benefit, since there is very little to burn in most places, and the policy of total suppression does not conform to the modified suppression policy of the Bureau of Land Management (BLM), which manages adjacent lands. Research by the cooperative park studies unit from the University of Idaho is being used as the basis of a new fire management plan.

An inventory of abandoned mineral lands completed in 1991 revealed adits and tailings piles that pose threats to water quality and safety and are in need of reclamation.

All known abandoned mineral lands are in the northwest corner of the monument, in the foothills of the Pioneer Mountains. Topographic maps indicate the presence of 11 old prospect pits along the divide at the head of Little Cottonwood Creek. A plan is needed for closure and reclamation of these sites, as appropriate. Some method of coordination with the BLM is needed to ensure that the National Park Service will be included in the review of mining plans of operations or exploration permits for mining activity adjacent to the monument boundary.

EXTERNAL INFLUENCES ON MONUMENT RESOURCES

Air Quality

The air quality at Craters of the Moon is the resource most likely to be significantly affected by external influences. An air quality management plan is needed to address gaseous pollution and visibility impairment due to particulates. Visibility monitoring at the monument indicates relatively pristine air quality, but analysis of data from the fine particulate sampler and teleradiometer at the monument indicates there is a trend toward deterioration.

There is concern that gaseous pollutants may be present in sufficient amounts to damage vegetation. The source or sources of this kind of pollution are not known at this time. Additional air quality monitoring capabilities are needed to determine if adverse effects are being caused by gaseous pollution from sulfur dioxide, nitrous oxides, sulfates, and photochemical oxidants such as ozone.

The regional population density is low, but pollutants may increase as the population increases. Air pollution from outside sources occasionally can be seen when winds blow from the east or southwest. Mining activities and agricultural field burning also are sources of air pollution.

A proposal to build a 2,000-megawatt coal-fired power plant 140 miles southeast of the monument was withdrawn during preparation of this plan. Prevailing winds could have carried emissions from the plant over the monument. Although that proposal is no longer active, it is mentioned to indicate how Craters of the Moon could be affected by distant development.

The Idaho National Engineering Laboratory (INEL), about 25 miles northeast of the monument, maintains a coal-fired power plant for on-site power production. INEL has applied for a permit to expand the plant and increase emissions. The present air quality monitoring program at the monument needs to be expanded to determine if the laboratory is affecting the monument's air quality. There is concern about radionuclides released from INEL activities, including the processing and storing of nuclear waste. This is being monitored at Craters of the Moon by the U.S. Department of Energy and Idaho State University.

Activities on Adjacent Lands

Nearly all lands adjacent to Craters of the Moon are under BLM management; there are only a few adjoining or nearby parcels of private land. Monument roads in the north unit, which connect to BLM-managed public land, are closed to visitor vehicle use except for access to the group campground. Closure of these roads limits access from BLM lands by recreational users, particularly hunters. For visitor safety and to reduce illegal hunting in the monument, the north unit of the monument is closed to visitors during the hunting season.

Hunting pressure is heavy along the north boundary of the monument, and illegal hunting of mule deer in the monument is a continuing problem. People associated with this problem range from hunters who are unaware that they are in the monument to poachers.

Trespass grazing of sheep and cattle from BLM grazing allotments outside the monument historically has been a problem in the north end of the monument. Under a proposed revision, boundary lines would be changed to follow topographic features rather than section lines. The boundary modification also would simplify fencing of that area to exclude livestock. (Fences following section lines on steep slopes are difficult to keep in place because of pressure from creeping snow.) A readily identifiable boundary also would be helpful for fire management and as guidance for prospectors if mineral exploration should take place in the area. In addition, the adjustment of the north boundary would protect the monument's potable water supply, which consists of four springs and two wells. The boundary at the north end has been surveyed and marked, but this has not been done in the entire south section of the park, where much of the boundary is on lava flows.

BLM-administered public land adjacent to the monument is open to mineral exploration. Exploration is being carried out on active mineral claims on some of the lands adjacent to the north boundary of the monument. Interest in mineral development, which is high at present, varies with prices, causing surges in activity. Recently, interest has increased in disseminated, low-grade gold deposits amenable to leaching, so exploration and mining activity in the Pioneer Mountains north of the monument is likely to continue and probably will increase. Mining can affect water resources, wildlife, and vegetation and cause visual impacts, erosion, and increased local traffic. As of February 1991, there were 184 current unpatented mining claims within 1 mile of the Craters of the Moon boundary, with 100 more claims within 2 miles.

There are several borrow pits adjacent to the monument boundary and within a mile of the boundary to the north. It is not known whether these pits are active. Should they become ac-

tive, there could be impacts on the monument similar to those described for mining.

During the mid-1980s, extensive oil and gas exploration was conducted on the Snake River Plain basalt flows and bordering regions. While some oil and gas was found, the quantities proved to be uneconomical because of the expense of drilling through basalt. Surface samples collected from the Pioneer Mountains just north of the monument suggest that there is some oil and gas potential. Chevron conducted exploratory drilling for oil and gas in 1988 in Big Cottonwood Canyon, which is very close to the monument boundary. There is no current exploration activity or interest in hydrocarbon extraction near the monument.

The aquifer that underlies Craters of the Moon National Monument could be affected by well-drilling or pollution on adjacent lands. The aquifer could be diminished or depleted if large amounts of groundwater were removed. Wells drilled recently at Arco are deeper than previous wells; however, it is not known positively if the Arco wells are tapping an aquifer shared with the monument.

Contamination of a part of the Snake River aquifer by activities of the Idaho National Engineering Laboratory is well documented within the site and is currently the subject of a cleanup effort. Contamination of the perched aquifer and the springs that provide potable water to the monument is highly unlikely.

The National Park Service and the BLM work together to manage these adjoining lands in a manner that is compatible with the mission of each agency. Cooperation between the agencies is implemented both by informal agreements and by formal memorandums of understanding. There also is a memorandum of understanding between the Idaho Department of Fish and Game and the National Park Service regarding intergovernmental cooperation in the preservation, use, and management of wildlife resources in the monument and on adjacent federal and state lands.

Potential Future Activities

There is a potential for recreational development on private land west of the monument. The development is only in the conceptual stage now, but interest could increase if Idaho tourism grows. A large development would bring significantly more visitors to the monument, with associated impacts.

Idaho National Engineering Laboratory, about 25 miles northeast of the monument, is involved in energy research and development, including nuclear power development and nuclear waste storage. There is a remote possibility of an accident involving nuclear material; if this should occur it could affect the monument.

ACCESS AND TRAFFIC CIRCULATION

Access problems begin at the turnoff into the headquarters area from U.S. 20-26-93. A profusion of signs confuses visitors as they turn east from the highway to enter the visitor center area. The short distance between the highway intersection and the visitor center parking areas causes a number of traffic problems. From the entrance just after the turnoff, drivers must make a left turn to the north to enter one of the two parking areas for the visitor center. There are no turn lanes; this sometimes causes traffic to be lined up back to the highway intersection. The first turn leading into the first parking area may be blocked by vehicles leaving that area. Currently that access is designated an exit only, but new visitors may not see that there is another entrance to the parking area, and they may not see the second parking area farther along the access road. To add to the congestion, maintenance and staff vehicles also enter the road in this area.

Buses and large RVs will not fit the spaces in the parking areas, which were designed for automobiles. Each such vehicle generally must occupy two or more spaces.

After stopping at the visitor center, visitors must make a left turn across traffic if they want to reenter the access road and drive farther southeast to the campground or to the loop drive that leads to the scenic areas of the monument.

Another area of congestion is an entrance station in the campground a short distance east of the visitor center. Adjacent to the entrance station are eight sites for camping and picnicking, the main exit from the campground, an intersection with a service road to a maintenance storage yard, and a pullout with an information exhibit where visitors can self-register when the entrance station is closed. Two more campsites and the main entrance to the campground are a short distance farther along the same road. Congestion in this small area can be severe. The campsites near this location are less than desirable until traffic abates in the evening.

Curbs have been placed on both sides of almost the entire 5.6 miles of the scenic loop drive to reduce resource damage that can be caused by people stopping randomly and driving off the pavement. However, visitors have problems with this road: tight-radius curves and the curbing make the road seem narrow (although it meets park road standards); an 18% downgrade at one point unnerves some visitors; there is little room for bicycles; and transverse cracks across most of the road at fairly regular intervals make for a bumpy ride. There are relatively few passing points on the one-way road section, and visitors who stop to take photographs can block traffic in some areas.

INFORMATION AND INTERPRETATION

Several waysides along the U.S. highway near Craters of the Moon offer limited information about the monument, but they do not properly introduce the experience ahead. Information and orientation are available at the visitor

center and, to a lesser extent, at an exhibit adjacent to the entrance station.

Exhibits in the visitor center (which was built as a part of the Mission 66 program) are about 30 years old. The content of the exhibits is acceptable; however, current research is providing additional knowledge about volcanism and other monument resources that is not reflected in the exhibits.

The visitor center does not have adequate facilities for audiovisual programs. An excellent five-minute videotape offered at the monument illustrates more current information than that shown in the exhibits. Visitors can push a button to start the program, but because it is shown on a television screen set into a wall, it is difficult for more than five or six people to see the video. There is no seating, and the arrangement of the screen is such that access to other exhibits is blocked by people watching the tape.

Since the small visitor center does not have space for the orientation of groups to the monument, school or tour bus groups generally gather outside on the lawn. This can be unsatisfactory in stormy weather or when there are several groups.

The fact that visitors can borrow descriptive brochures for self-guiding trails is not publicized, so most visitors seem to think they must purchase one to use it. (Since borrowed brochures are often crumpled, their utility for reuse or sale is limited.)

No interpretation of Big Sink is offered. This striking volcanic feature is an important element of the Craters of the Moon story: the perched pond set above the surrounding area was once a lava lake.

Many schools have requested the environmental education programs that are offered in May and September, but a shortage of personnel to conduct the programs has necessitated drastic reductions in the length of time an interpreter

can spend with each group. Attention has been shifted to providing advance teacher training and printed materials so that teachers can conduct their own classes in the monument with just a short introductory talk from an interpreter.

Services such as guided walks in the monument also suffer when funding is low. For example, in 1990 the usual seasonal staff of 14 was reduced to 5. These limitations also curtail off-site school programs and community outreach programs, which are effective and important ways to present critical issues such as resource management concerns.

FACILITIES

Visual Intrusions

The monument lacks an architectural theme for its signs, restrooms, buildings, and other facilities. There are numerous visual intrusions in the landscape, starting with the profusion of signs at the entrance and the clutter of kiosks, campsites, and traffic cones at the entrance station in the campground. Maintained and manicured lawns are inappropriate in this setting. At waysides, the clutter of signs, trash cans, and exhibits intrudes on the natural scene, as do highly visible structures in the developed area and various structures and utility lines on ridges. Some paved trails have become excessively high and/or wide through repaving. Loose chips that spread from asphalt-base trails are another visual problem.

Visitors

Many sites in the campground are not large enough to accommodate large RVs; others are large enough but not suitably level. The campground is highly visible from the highway, the visitor center, and the employee housing area.

Neither of the two restrooms at the campground is truly accessible for visitors with

physical disabilities, although both have been modified to make them reasonably accessible. A designated campsite for disabled persons adjoins one restroom. The restrooms are adequate for the size of the campground, but some campsites are some distance from one. Water faucets and trash receptacles are available throughout the campground. Curb cuts are lacking at many of the roadside pullouts.

Tables in the campground may be used for picnicking, and there are some tables on the lawn next to the visitor center, but their presence encourages longer parking during the peak congestion period.

Relatively minor damage has been caused in some areas by visitors going off trails. Erosion of volcanic features along established trails is a problem; to some extent, this is a necessary sacrifice to permit visitors to enjoy the monument. The spatter cones and north crater flow are closed by signing to off-trail use; however, impacts continue to occur. The path up Inferno Cone is continually eroding because travel to this popular and important feature is heavy.

Monument facilities are ill-suited to bicycle use, which is increasing. The curbs along most of the loop drive and the perceived narrowness of the road make bicycling hazardous. No designated trails are available for mountain bikes, but with permits bicycles may use the dirt roads in the north end of the monument except during the hunting season. These roads are closed to visitor vehicle traffic except for access to the group campground.

Monument Operations

The visitor center contains several offices and work space for the staff, but space is at a premium. The staff has had to convert maintenance workshop space and, at times, an apartment for office use. With portions of the maintenance building converted to temporary offices, the remaining space is inadequate for maintenance functions. No space is available

for meetings, and on at least one occasion a vacant residence has been used for that purpose. Storage space with security and proper environmental conditions is needed for the museum collection. Reference library space is limited, and more room is needed for storage of criminal evidence. Office space in existing buildings is very limited; this has become a critical problem with the addition of new positions in the fields of resource management and maintenance. There is also a serious lack of storage for supplies and materials in the existing facilities.

The visitor center and maintenance building were built when energy costs were not considered important. Thermal blanket window coverings have helped conserve the use of energy in the offices, and enclosing the entry porch also has reduced energy consumption. Other insulation has been added as maintenance space was converted to offices, but the structures still are not energy-efficient.

Excessive heating in the visitor center has been a problem, with summertime indoor temperatures exceeding 89°F. The existing furnace is being modified to provide cool night air, and the use of air-conditioning may be necessary.

Poorly insulated workshops make winter work difficult. There is little or no vehicle storage space; this can be critical in winter. Storage space for equipment also is inadequate, and the storage of flammable materials does not meet code. Proper storage is also needed for pesticides, paint, and other hazardous materials. Because the vehicle storage bays are unheated, the monument's structural/wildland fire truck must be drained of water to prevent freezing; therefore, it cannot be maintained in a state of readiness.

Recent renovation of the duplexes and single-family housing has greatly increased the energy efficiency of those units—additional

insulation and more efficient windows were installed. Like the visitor center, the essentially uninsulated apartments are expensive to heat. The apartment building cannot be used in winter since the plumbing is uninsulated and all units must be heated if one is to be used. Rehabilitation of the existing seasonal housing apartments is being considered to allow for extending the season of use.

The use of housing at Craters of the Moon fluctuates with the preferences of individual employees and families. Some prefer to live in Arco; others prefer to live at the monument. Some occupancy at the monument is essential for protection of resources, facilities, and visitors. Availability of housing in Arco fluctuates with the local economy, driven by mining, agriculture, and INEL. It is difficult to predict the supply of housing and the fluctuations in the market value of a home purchase from one season to the next in Arco. Opportunities for seasonal rentals in Arco are generally very limited.

Existing housing in the monument is small but adequate; no new permanent housing is needed at present. However, with increased visitation and new responsibilities, new housing may be necessary in the future. If so, a housing location study will be initiated at that time. Outside storage units for each permanent quarters are needed.

ISSUES AND CONCERNS NOT CONSIDERED FURTHER

Some visitors have requested an RV waste disposal station within the monument, but it does not seem feasible for the Park Service to provide this because of the complexity of treatment in the crowded developed area. Disposal stations are available at commercial facilities in Arco and at state facilities in the region.



Interrelationships with Other Studies, Plans, and Proposals

PARK EXPANSION

Legislation has been introduced in Congress for the creation of a large national park consisting of the present Craters of the Moon National Monument plus extensive lands adjacent to the monument that are administered by the BLM. The National Park Service prepared the *Reconnaissance Survey: Expansion of Craters of the Moon National Monument* (NPS 1989b) to evaluate the expansion proposals. This *General Management Plan* deals only with management of the existing monument. Should any significant expansion occur by Congressional act, an amendment to this plan would be required.

ADJACENT WILDERNESS PROPOSALS

The National Park Service is not seeking any additional wilderness designation for areas in the existing monument, but the BLM has recommended several nearby areas for wilderness designation: the Great Rift Wilderness Study Area, which is adjacent to the Craters of the Moon Wilderness on the west, south, east, and northeast, and the Raven's Eye and Sand Butte wilderness study areas, both southwest of but not adjacent to Craters of the Moon National Monument. Congress has taken no action to date on any of these recommendations.

A designated wilderness in the BLM Great Rift area would be a logical extension of the designated wilderness in the monument, and such designation would enhance the wilderness values of the entire area. In the 1970 Act

creating the Craters of the Moon Wilderness, a strip of land along the boundary was excluded from wilderness designation as a buffer zone next to the adjacent nonwilderness area. If the BLM Great Rift area is designated wilderness, that strip of nonwilderness land along the boundary should be eliminated.

PROJECTS WITH IDAHO NATIONAL ENGINEERING LABORATORY

Idaho National Engineering Laboratory, which is east of Arco, operates a radionuclide monitor within Craters of the Moon National Monument. A contract with Idaho State University in Pocatello allows the university to duplicate the laboratory's efforts as a check. In conjunction with the monument and the National Oceanographic and Atmospheric Administration, INEL also operates a meteorological station that monitors wind speed and direction.

In cooperation with the monument, INEL has installed a seismic monitor on the northwestern boundary of the monument and installed a recording seismograph in the visitor center for interpretation. The monitor is tied into a larger seismic network operated by the laboratory. Craters of the Moon and INEL have entered into an agreement to monitor nitrous oxides at a facility within the monument to be constructed by the Department of Energy. Craters of the Moon also assists in collection of thyroid glands from road-killed deer to be tested for radioactive contamination.

POTENTIAL SPECIAL DESIGNATIONS

The low sagebrush/Idaho fescue habitat of the north unit and the early low sagebrush/Idaho fescue habitat in Carey Kipuka have been evaluated and found to meet the criteria for national natural landmark (NNL) status because they are outstanding representatives of the "Low Sagebrush/Idaho Fescue" subtheme in the "Low Sagebrush" theme within the Columbia Plateau natural region. These areas have been recommended for designation as national natural landmarks. The proposed NNL in the north unit encompasses lands proposed for exchange with the BLM (see "Boundary

Modifications," page 23). Park Service personnel from the monument and the Pacific Northwest regional office will meet with the BLM to discuss the proposal and to consider whether the NNL could include lands managed by both agencies.

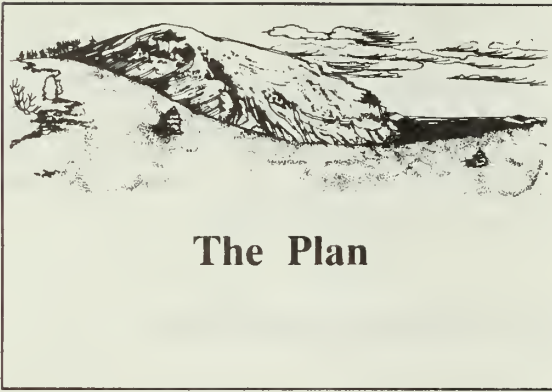
The general vegetation type in the proposed national natural landmarks is called shrub steppe. This combination of low shrubs and grasses once was the common vegetation over southern Idaho, but grazing, fire, and agriculture have reduced incidence and altered species composition in the area. Some regional biologists are concerned that all native Idaho sagebrush grasslands are being reduced and altered from the native condition.

Carey Kipuka meets the criteria for a research natural area and will be so designated in cooperation with the state of Idaho.

The National Park Service has recommended that a study of Craters of the Moon National Monument be prepared to determine its potential for designation as a national historic landmark illustrating the theme of history of the geological sciences (specifically, physical geology) in the United States.

MAN AND THE BIOSPHERE

The Park Service is exploring the possibility of seeking biosphere reserve status for Craters of the Moon National Monument and some of the surrounding area under the Man and the Biosphere program of the United Nations. The cooperative park studies unit at the University of Idaho, the BLM, and Idaho National Engineering Laboratory will be included in the discussions.



The Plan

In this general management plan, the resource management program is emphasized as the primary means of preserving the significant resources of Craters of the Moon while permitting acceptable levels of use by visitors. Management zoning would be used to classify lands as to types of use. The concept of "limits of acceptable change" could be used for further land classification; this would help managers to monitor and manage the resources and establish carrying capacities.

This plan primarily addresses redevelopment to improve the quality of monument visitors' experience by enhancing the entrance experience with a transition from the main highway to park resources and roads, reducing traffic congestion at the visitor center and campground, relieving crowded parking at the visitor center, eliminating visual intrusions, and remodeling or replacing outdated visitor facilities. Redevelopment also will improve operations by providing better maintenance facilities, expanding work space in management offices, and reducing the intrusion of visitor traffic into the employee residential area. Most of these objectives will be accomplished by separating management and employee housing areas from the visitor circulation pattern through development of a new visitor center and an associated road/parking system that will bypass the existing developed area.

MANAGEMENT ZONING

Craters of the Moon National Monument consists of 53,545 acres in fee simple title. Of this area, 43,243 acres have been designated wilderness. The remaining 10,302 acres surround

and include the most dramatic volcanic features along the Great Rift and encompass the foothills and flanks of the Pioneer Mountains to the northwest. Park development, visitor services and facilities, and the major interpretive motor route are in this area.

About 4 miles of U.S. Highway 20-26-93 crosses the northwest corner of the monument. The 94.2 acres in the highway's 200-foot corridor were removed from the monument by presidential proclamation and are under the jurisdiction of the state of Idaho. The area is managed as a special use zone because it is within the exterior boundaries of the monument. Park visitors assume the area is within the jurisdiction of the Park Service; therefore, Craters of the Moon works cooperatively with the state to ensure that the corridor is maintained to NPS standards.

Management zones reflect authorizing legislation, NPS policies, the nature of the monument's resources, desired visitor experiences, and established uses. The monument has three general zones: natural and development zones and the special use zone already described. Within the natural zone are four subzones: wilderness, natural environment, outstanding natural features, and watershed protection. There are two subzones in the development zone: park development and interpretive development (see Management Zoning map). Zone acreages are shown in table 1.

If boundaries in the northwest corner of the monument are redrawn as described on page 23, the change will result in a net removal of 105 acres and exclusion of approximately 220 acres proposed for national natural landmark status. Lands that will be affected by this proposed change are in the watershed protection subzone of the natural zone.

Natural Zone

The natural zone comprises a total of 53,309 acres. Natural zones are dominated by landscapes and resources that are not disturbed by development or facilities. Preservation of resources is the guiding philosophy behind all zoning in this category. The subzones account

TABLE 1: MANAGEMENT ZONING

Management Zone	Subtotal	Subzone Total
Natural Zone (53,309 A.) = 98.9%		
Wilderness Subzone		43,243
Natural Environment Subzone		6,907
Natural Environment ¹	5,198	
Wilderness Buffer ¹	1,709	
Outstanding Natural Features Subzone		779
Devils Orchard ¹	202	
Caves area ¹	275	
Inferno Cone ¹	54	
Big Sink ¹	69	
Big Crater/spatter cones ¹	179	
Watershed Protection Subzone ¹		2,380
Development Zone (142 A.) = 1%		
Park Development Subzone ¹		91
Interpretive Development Subzone		51
Special Use Zone (94.2 A.) = 0.1%		94.2
Total acreage		53,545.2

1. Acreage was determined by planimeter, not survey, and is subject to approximately a 1% margin of error.

for important resources and processes identified by special legislation and through staff analysis. Uses allowed in the natural zone are those that will maintain the integrity of the ecosystems.

Wilderness Subzone. The Craters of the Moon Wilderness Area makes up the 43,243-acre wilderness subzone. The purpose of this subzone is to protect lands set aside in 1970 by P.L. 91-504.

The resource values in the wilderness subzone are primarily pristine and roadless areas. The subzone contains scientifically significant features and offers outstanding opportunities for solitude or a primitive and unconfined type of recreation. It contains approximately 9

miles of the Great Rift system, including special features such as lava trees, tree molds, the highest cinder cone, and various fissure systems (see appendix C).

Wilderness lands are subject to the strictest preservation management possible; uses allowed must comply with those specified in the 1964 Wilderness Act. Typical activities in wilderness areas are nonmotorized, nonwheeled, dispersed camping and hiking.

The Great Rift is the most heavily used backcountry area in the monument. An abandoned fire road that extends approximately 5 miles south of the Tree Molds parking area is the main access route into the wilderness. Overnight use of the wilderness area is minimal. Camping is prohibited within 1 mile of the

Tree Molds trailhead. The wilderness area contains no developed campsites; instead, random, low-impact camping is encouraged. Most camping occurs at four places in the Echo Crater that have been established as campsites through use rather than through formal designation.

Natural Environment Subzone. The natural environment subzone encompasses 6,907 acres. Its purposes are to provide a definable, visually comprehensible buffer between the wilderness and the development zones and to protect lands where resources are in nearly pristine condition.

Features and lava flows in the natural environment subzone are mostly undisturbed, but they

are not unique, nor are they as sensitive to impacts as those in the other subzones of the natural zone. However, developments on nearly level parts of lava flows are visually intrusive because they are difficult to screen and not harmonious in design, color, and texture.

Uses that would not visually degrade the area are allowed in the natural environment subzone, as are environmentally compatible recreation and interpretive activities. Examples of allowable uses are trails, unpaved roads for administrative use, low-profile interpretive displays, primitive camping in designated areas, and buried utilities.

Outstanding Natural Features Subzone. Included in the 779-acre outstanding natural features subzone are Devils Orchard, Inferno Cone, several spatter cones, the caves area, Big Sink, and Big Crater. The purpose of this subzone is to preserve areas that have unusual intrinsic value or uniqueness or to protect features having the inherently "weird and scenic" characteristics mentioned in the authorizing legislation; it is from these characteristics that the area derives its character.

Although visitors apparently perceive the volcanic features mentioned above as the most significant resource values, those features may or may not be as ecologically significant or as sensitive to impacts as other areas of the monument. Inferno Cone is the youngest and one of the tallest cinder cones along the Great Rift. Its composition of ball-bearing sized cinders has been altered and compacted by continued use of the trail. Devils Orchard is a flow area made up of horizontal plains of cinders with "rafted" pieces of crater throughout (see appendix C). Big Crater is not as vulnerable as Inferno Cone or as unique as Devils Orchard, but it is the largest and most dramatic crater in the area, and its fragile qualities require sensitive design solutions.

Allowable uses in the outstanding natural features subzone are those that make use of

such facilities as trails, interpretive displays, and photo turnouts. These types of activities enhance visitors' experience and help them to appreciate the area.

Watershed Protection Subzone. The 2,380 acres in the watershed protection subzone encompass the foothills of the Pioneer Mountains at the north end of the monument. The purpose of this subzone is to protect rare and sensitive water resources in the north end, adjoining arid lava fields to the south. The importance of this area's resource values was first detailed in the expansion proclamation of 1928, when lands containing springs and surface water were added to provide for development needs.

Uses allowed in the watershed protection subzone are those that are unlikely to disrupt the balance of riparian ecosystems or threaten the purity and safety of water sources. Facilities for such uses include trails, temporary research stations, and administrative access roads. The current boundary does not protect this subzone adequately; a proposed boundary modification (discussed on page 23) would offer full protection even though the acreage in this zone would be reduced.

Development Zone

The 142-acre development zone contains lands and facilities that serve the functional needs of visitors and monument staff. In areas where development predominates, resources sometimes have been disturbed to meet these needs. Managing to minimize this loss requires thorough consideration in the form of development concept plans.

Park Development Subzone. The park development subzone encompasses 91 acres. The purpose of this subzone is to provide areas where visitor facilities may be placed, where monument operations can be conducted, and where recreational activities may take place.

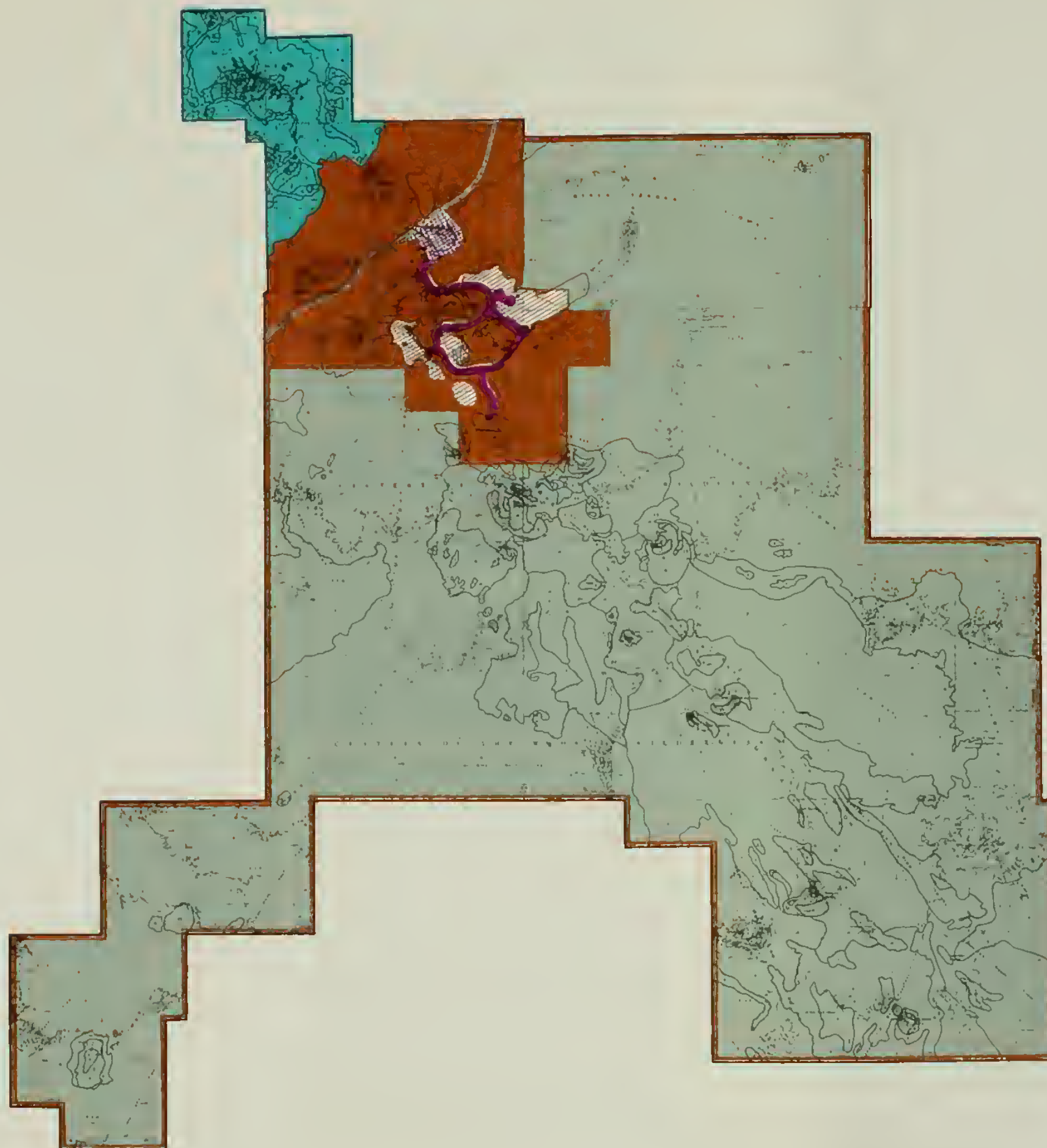


- Wilderness
- Natural environment
- Outstanding natural features
- Watershed protection
- Park development
- Interpretive development
- Special use

Management Zoning

Craters of the Moon National Monument

United States Department of the Interior - National Park Service
DSC/June'92/131/20012A

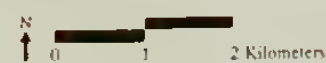


- Wilderness
- Natural environment
- Outstanding natural features
- Watershed protection
- Park development
- Interpretive development
- Special use

Management Zoning

Craters of the Moon National Monument

United States Department of the Interior • National Park Service
DSC/June'92/131/20012A



Sunset Ridge, an arm of an old cinder cone where secondary vegetative succession is taking place, is one feature in the park development subzone. The ridge is a mixture of cinder gardens and sagebrush hillsides with occasional limber pine, surrounded by both young aa and pahoehoe flows. The ridge is neither one of a kind nor rare; it has been included in the development subzone because of its proximity to U.S. Highway 20-26-93 and existing developed areas.

Allowable uses in this subzone are the activities and facilities needed to support visitor experiences and monument administration. The subzone contains a visitor center/administrative headquarters building, a campground/picnic area, and an entrance station, as well as maintenance facilities, a boneyard (storage area for miscellaneous maintenance materials), storage buildings, and employee housing and recreation areas. Also included are areas for proposed expansion of visitor facilities.

Interpretive Development Subzone. The purposes of the 51-acre interpretive development subzone are to provide for needed development and to set criteria for development along the main route through the monument. The 5.6-mile loop road, which is in a well-designed 24-foot corridor, passes many outstanding natural features and crosses fairly sensitive lava flows. Resource values adjacent to this corridor are correspondingly high.

Allowable uses in this subzone are those related to interpretation of the monument for visitors: waysides, self-guiding trails, media displays, trailheads and picnic areas. Because of the large number of travelers drawn to these areas, restrooms and trash receptacles also are included.

Special Use Zone

The purpose of the 94.2-acre special use zone is to set off the area in the monument that is affected by regular activity on U.S. Highway

20-26-93. Concerns about resource values in a special use zone are secondary to the goals of an outside managing agency, in this case the Idaho highway department. Allowable uses in this zone are those deemed necessary to carry out the goals of the managing entity. The necessary action here is the movement of large volumes of traffic across southern Idaho.

RESOURCE MANAGEMENT

The existing approved resource management plan for the monument (February 1992) adequately addresses resource management issues. That plan, which is continually being updated, provides ways to resolve deficiencies in knowledge and contains recommendations for actions to solve resource management problems. Major components of the resource management plan are discussed below.

Boundary Modification

A proposal was prepared in 1987 in cooperation with the BLM and a private landowner to exchange lands so that the border of the north unit of the monument would follow the hydrographic divide of the Little Cottonwood Creek drainage basin (see Boundary Modification map). This change would protect the monument water supply. It also would simplify enforcement of hunting and grazing regulations because the boundary would follow topographic features and therefore be more readily identifiable. This proposal would involve transfer of 315 acres now in the monument to the BLM and transfer to the National Park Service of 170 acres now managed by the BLM. The privately owned 40-acre parcel would be added to the monument either through purchase or through exchange for BLM lands. These adjustments would reduce the monument's area by 105 acres.

The proposed boundary modification would affect one private landowner, two grazing allotments, and potentially 8 to 10 mineral

leases. Exchange of grazing privileges and/or mining leases would be negotiated with the permittees.

Other Resource Management Actions

Projects included in the approved resource management plan for the monument are being implemented as funds become available. The following actions are especially important.

Develop an air quality management plan that will allow the monument to protect its air quality related values.

Continue baseline resource inventories that have been started, and begin inventories of natural resources that have not been surveyed (caves, rare plants, water resources). Develop a monitoring program for these resources after they have been inventoried. Installation of a seismic monitoring network for the Great Rift is recommended.

Increase emphasis on awareness, management, and protection of cultural resources. Initiate a detailed survey of archeological resources and a comprehensive study of historic resources. Maintain existing and expanding museum collection to NPS standards. Evaluate and interpret Goodale's Cutoff for the Oregon Trail Celebration in 1993. Compile oral histories from local pioneer families. Establish communication with the Shoshone-Bannock tribal communities to assist in interpretation of Native American use of the lava areas and the Snake River Plain.

Develop a cave management plan to identify significant cave resources, a monitoring program, and a process for evaluation of cave exploration permits.

Continue negotiations toward securing the federal reserve water right for the monument in the state of Idaho Snake River adjudication.

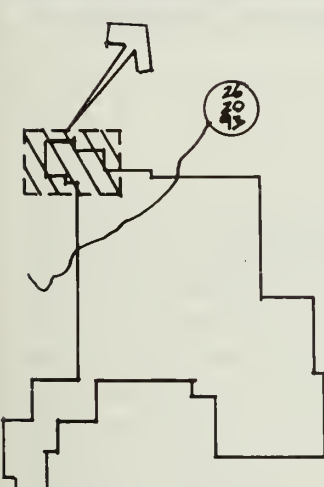
Continue to cooperate with the BLM for compatible management on adjacent lands to ensure continued preservation of monument resources and significant related resources on lands administered by the BLM. Grazing and mining are the most significant practices on adjacent land that require cooperation and coordination in management. A coordinated fire management plan also is needed. Information from the rare plant survey can be used to identify rare plant locations that should be protected from fire, and fire management planning can be carried out accordingly.

Until the recommended boundary changes can be made, try to control trespass grazing through continued coordination with the BLM and through law enforcement action.






Continued research is needed to determine methods of permitting visitors to use the monument with minimal damage to resources. Inferno Cone is probably the major problem area, with continual erosion of the trail. The visitor experience is so significant that it should be continued as long as the damage can be mitigated.

Continue to manage the north unit under the existing backcountry/wilderness management plan. Current use is so low that the existing permit system offers adequate resource protection. The most critical resource is the riparian area, which should be monitored to ensure that visitor use is not creating any adverse impacts.

Craters of the Moon National Monument will continue to accommodate researchers by providing housing (when available) or allowing use of the primitive camping area at Cottonwood Canyon. Use of this area should be kept to a minimum, however. Larger groups should use the group campground.



Craters of the Moon
National Monument

-  Proposed Modification
-  Private Land
-  Bureau of Land Management
-  Pioneer Mts. (toe of slope)
-  Lava

NOTE: Modifications follow ridgelines
 NET CHANGE: Proposed -105



Boundary Modifications

Craters of the Moon National Monument

Carrying Capacity

Visitation at Craters of the Moon National Monument has not reached the point where unacceptable levels of resource damage are caused by visitors; the monument could accommodate more visitors. Although some facilities become congested, it is not because the monument is overcrowded; rather, the congestion results from obsolete design. Wilderness and backcountry areas are used relatively little because the harsh terrain causes most visitors to stay on established roads and trails. Visitation is not expected to increase during the life of this plan to a point where restrictions on visitation would be necessitated by unacceptable levels of impacts.

Carrying capacity for the Craters of the Moon Wilderness is based on "limits of acceptable change," but at current levels of use and resource condition, it is impractical to fully implement the limits-of-acceptable-change system. The park resource management staff continually monitors effects on use areas and when necessary executes measures to reduce resource impacts. Monitoring also will alert the staff to the need to implement a complete limits-of-acceptable-change program.

Backcountry/Wilderness Management

With the exception of the main visitor use areas, the monument is managed as backcountry and wilderness in accordance with the approved backcountry/wilderness management plan (NPS 1989a). Most of the wilderness is virtually pristine; signs of human impact are almost nonexistent. Management objectives are intended to ensure that the area will retain a primeval character while allowing maximum freedom for visitors. Restrictions on use of the wilderness area are the minimum necessary to protect and preserve the wilderness resource and wilderness experience for all visitors.

A backcountry permit is required for any party planning to backpack into the wilderness over-

night or to camp at the caves area during winter. A limit of 12 people per party has been established, and low-impact camping is emphasized to limit the amount of resource damage. Backcountry areas not designated wilderness or development zones are considered primarily day-use areas, except that camping with permit is allowed in the group campground and the research camp.

A permit is required for day use in the north unit and for day use by horse parties in any area. Hiking and biking are not permitted in the north unit during the hunting season. In winter, the interpretive development subzone is managed as backcountry, and camping is permitted at the caves parking area.

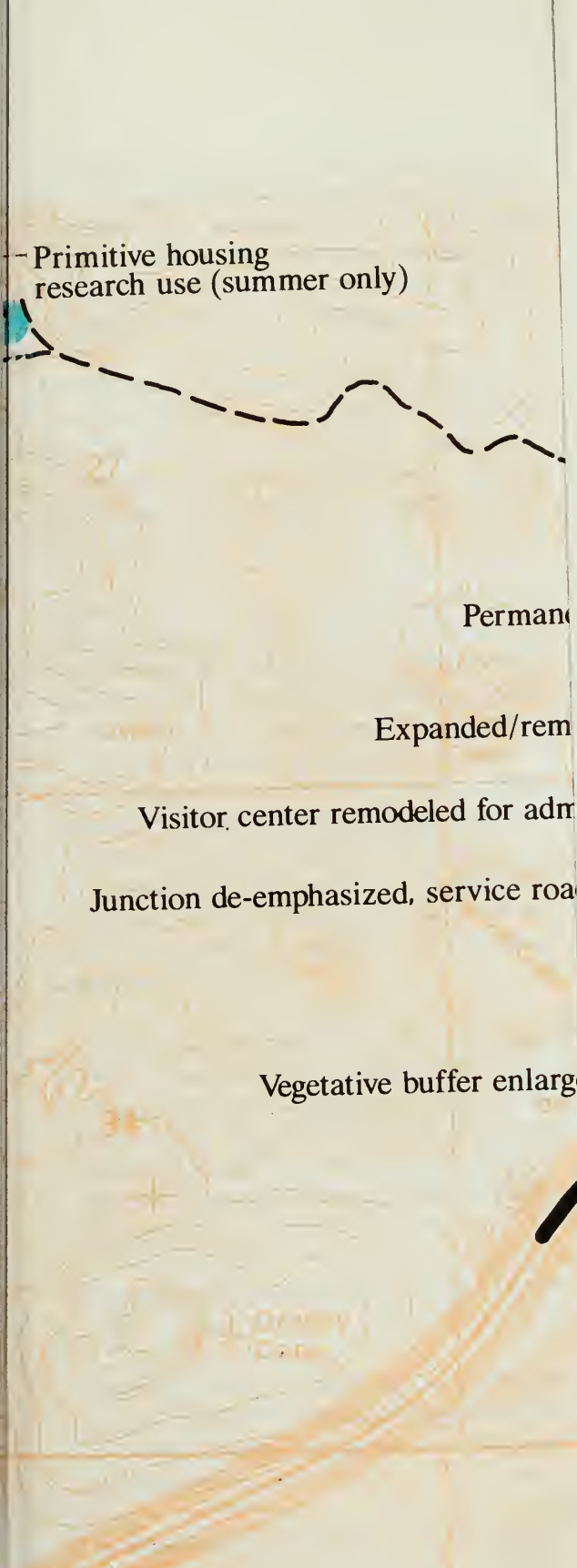
SERVICES AND FACILITIES FOR VISITORS

Appendix F contains detailed information on planned developments and remodeling of existing facilities.

Access and Circulation

Entrance Road. A new entrance road will be developed on the north side of Sunset Ridge, roughly following the alignment of a much earlier road that is now obliterated. The road will skirt lava flows, pass through the present boneyard (to be removed), and connect with the loop road east of the campground. The new intersection will be designed for through traffic on the main road with campground access on a side road (see Development Concept map). Additional studies are needed to determine the precise alignment. Road improvements will be limited to the minimum corridor necessary for a safe driving experience. Any base course or fill material required for the roads will be obtained from sources outside the monument.

Aboveground telephone and power lines at the monument pass through the vicinity of the



Primitive housing
research use (summer only)

Permanent

Expanded/reman

Visitor center remodeled for adm

Junction de-emphasized, service roa

Vegetative buffer enlarge

Development Concept

Craters of the Moon National Monument

United States Department of the Interior - National Park Service
DSC/June'92/131/20013A

Primitive housing
research use (summer only)

Group camping

(new) Primary entrance

Permanent housing rehabilitated;
seasonal built as needed

Expanded/remodeled maintenance

Visitor center remodeled for administrative use

(new) Year-round visitor center
with group orientation

Junction de-emphasized, service road only

(new) Entrance station

Vegetative buffer enlarged

(new) Winter parking

Tent sites added;
RV sites leveled,
limited camping in
winter parking area

(new) Trail

Boneyard removed;
alternate location for
entrance station and
winter parking

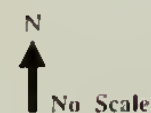
(new) T-junction (alignment)

Scenic loop drive rehabilitated;
parking improved, pullouts added
(new) waysides at Big Sink

Development Concept

Craters of the Moon National Monument

United States Department of the Interior • National Park Service
DSC/June'92/131/20013A



planned entrance road and visitor center en route to the existing developed area. Lines to new structures will be placed underground along the alignment of the new entrance road. (A long-range goal is placement of all the monument's utility lines underground.)

The existing entrance road will be retained for administrative use after redesign of the highway intersection to reduce its prominence. Visitor parking at the old visitor center can be significantly reduced after completion of the new visitor center facilities.

Loop Drive. The new approach to the loop drive will bypass the congested administrative, employee housing, and campground areas. The loop drive, which was carefully designed to fit the land, provides access to major features of the monument with minimal intrusion. The design encourages a leisurely pace, and the road becomes an important part of a visitor's experience. A way to eliminate cracking in the road system is being sought to improve the driving experience. Then the road will be rebuilt as necessary within the following guidelines:

Improve the loop drive and parking areas so that they will accommodate larger RVs and buses while retaining the low-speed, land-conforming character of the loop drive. Continue the use of curbs to discourage visitors from driving vehicles off the road.

Limit fill slopes through the use of lava rock retaining walls.

Provide additional turnouts for photography or wildflower viewing. These turnouts also will permit passing on one-way sections of road.

If feasible with minimal expansion of the road into the resource, include a bicycle lane along the entire length of monument road as part of the road improvements.

Through redesign, increase the capacity of the parking area at the caves with minimal expansion into the resource.

Provide parking for the Big Sink interpretive wayside through either expansion of the existing pullout or development of a new parking area. (Location of the access point for a trail to Big Sink requires further study.)

The two-way sections of the scenic loop drive generally will need to be widened by 3 to 4 feet to accommodate projected traffic levels. The one-way road sections generally are sufficiently wide, but some widening of curves may be necessary to accommodate larger vehicles.

Access for Visitors With Disabilities. Although facilities at the monument were not originally designed to be accessible for the disabled, the monument staff has tried to make many of the facilities accessible. The visitor center and amphitheater are accessible, and the campground has accessible campsites and partially accessible restrooms, although the restrooms do not totally comply with accessibility standards. Many of the waysides are accessible, and some visitors with disabilities can use some of the trails with caution.

It is recognized that extremely rugged terrain makes it impracticable to make all the monument's features fully accessible to all visitors with disabilities. New facilities will be designed to be accessible to the extent feasible. The park staff is working on plans to make the trail to Devil's Orchard accessible through minor modifications with minimal resource impacts.

Interpretation

Craters of the Moon National Monument is primarily significant for its relatively young lava flows and for the great diversity of volcanic features in a small geographic area. The

THE PLAN

present interpretive program is effective in communicating the significance of the monument. The formidable, hostile, seemingly barren land may appear unsuitable for recreational activities, but by spending some time in the monument visitors can learn about and understand its features. Through an understanding of the landforms in the monument, visitors can come away with a greater awareness of how the land was shaped and apply that awareness to what they see elsewhere.

The following actions are part of the monument's current plans or are already in progress.

Rehabilitate existing visitor center exhibits and lobby. Rehabilitation of the visitor center exhibits will correct exhibit-related deficiencies in museum environment, security, and fire protection that were identified in a checklist completed in 1990. Even though a new visitor center is planned, this action is needed because the new facility cannot be completed for some time.

Develop additional interpretive opportunities for special populations.

Provide environmental education to schools in the southern Idaho area on the management of resources at Craters of the Moon. Provide material to teachers and conduct teacher workshops in cooperation with local universities.

Work with the natural history association to provide additional interpretive publications, media, and programs that meet visitor needs.

Weave interpretation of resource management and research concerns into the entire interpretive program.

Complete installation of wayside exhibits with careful attention to reducing visual clutter.

Planned Actions. In addition to continuation of ongoing interpretation programs detailed in the 1990 *Statement for Interpretation*, the following new actions are planned.

Redesign the Devils Orchard self-guided trail to include interpretation of resource management concerns and to be free of barriers, including steep grades.

Develop the Big Sink area for interpretation. Additional study is needed to determine appropriate facilities and media. There are several approaches to the Big Sink area; more study is needed to determine the location of parking and trails. An archeological survey will be required early in the design phase to ensure avoidance of any cultural resources.

Develop interpretation of area history. Consideration will be given to developing interpretation in conjunction with a mountain bike/ski trail that is proposed for Goodale's Cutoff.

Because the interpretive story of the Snake River Plain is not confined within artificial boundaries such as those created by management of adjacent lands by different agencies, cooperate with the BLM to develop interpretive messages on adjacent lands.

Prepare an interpretive prospectus. Topics to be covered include planning for the proposed visitor center and reviewing the need for additional trails and wayside exhibits.

Recent fluctuations in funding and staffing levels have resulted in a cutback of important programs, particularly off-site and outreach programs, personal services, environmental education programs, and the number of hours that the visitor center can remain open. These programs are essential; every effort will be made to ensure sufficient funding and staffing to continue them.

Themes. The following themes are listed in the 1990 *Statement for Interpretation* and remain valid for this plan.

The geological processes represented at Craters of the Moon and the Snake River Plain.

The biological and ecological processes represented within this volcanic landscape.

The roles of visitors and the National Park Service in the continued preservation and management of the monument and related natural communities.

The significance of the Shoshone Indians, early explorers, pioneers, settlers, and researchers associated with the monument and adjacent areas.

State, national, and worldwide concerns related to the goals and objectives of Craters of the Moon National Monument.

Safety awareness.

Location and Development of Facilities

Roads, Trails, and Structures. Visitor information, orientation, and fee collection functions will be relocated to facilities along the new entrance route. Facilities for administration, maintenance, and employee housing will remain in their present locations, but the re-routing of traffic will remove them from the visitor circulation pattern. The campground will be on a spur off the main road.

New facilities planned are a visitor center, an entrance station, a winter parking area, and group gathering spaces and shelters. There are several possible locations along the proposed entrance road for these facilities; the location and combination of facilities will be determined during the comprehensive design phase. Observations by park staff indicate that drifting snow will cause fewer problems in the

new location than at the existing facilities, which are exposed to prevailing winds.

A new year-round visitor center will be built on the north side of Sunset Ridge, adjoining the new entrance road. It will contain exhibits, an area for sale of items by the Craters of the Moon Natural History Association, restrooms, and a separate multipurpose room with audiovisual facilities, as well as offices and storage areas for use by the interpretive staff and the cooperating association.

With the multipurpose room and audiovisual facilities in the new visitor center, organized groups such as school groups will be accommodated more easily. In addition, some shelters will be needed for groups to gather under during inclement weather. These shelters will serve two purposes, sheltering winter visitors as well as summer groups. They may be designed as a part of the new visitor center or in conjunction with the winter parking area.

The visitor center will be located ahead of the entrance station to allow visitors to stop for information before paying to enter the park road system. The new entrance station could be placed along the entrance road in the vicinity of the new visitor center or in the area of the present boneyard.

Winter parking spaces for crosscountry skiers will be made available in conjunction with the new visitor center or the new entrance station. A shelter near the parking area will offer some protection from the elements.

A trail will be developed from the new visitor center to the top of Sunset Ridge and from there to the campground. This will provide an overview of the monument and connect the visitor center and the campground. Campers already use existing informal trails on the ridge.

Xeriscaping with native desert plants will be used around all facilities and houses to conserve water and reduce visual intrusion. Small

lawns in the back of housing units will be retained with minimum water use.

In cooperation with the BLM, a designated trail for mountain biking and skiing will be developed along existing dirt roads. The trail will approximately follow the route of Goodale's Cutoff. Directional signs and wayside exhibits may be added, but there will be no other development.

Camping and Picnicking. Camping in the monument offers an expanded experience that many visitors miss. The evening interpretive programs enhance understanding of the monument's resources, as does the opportunity to explore the monument in the morning and evening, when temperatures are cooler, wildlife is more abundant, and light is more favorable for photography.

The present campground will be retained with minor improvements. Existing RV sites will be leveled, and more tent sites may be added. These changes will eliminate major congestion due to the presence of the entrance station and the information wayside. Some administrative traffic still will travel through the north loop, but in the new arrangement, the campground will be on a side road. The group campsite will be retained in its present location. Primitive winter camping will be allowed either at its present location in the campground or in the vicinity of the relocated winter parking area. Restrooms may have to be added, depending on the location chosen. Crosscountry skiers can continue to camp by permit in the caves parking area.

Picnic tables will continue to be available at several locations along the loop road. Since most sites in the campground are usually empty during the day, those sites also are available for picnicking. When not being used by groups, the planned group gathering area can serve as a picnic area.

ADMINISTRATION AND OPERATIONS

Management Facilities

After construction of the new visitor center, the existing administration building/visitor center will be remodeled and probably expanded. Improvements will include a conference room; offices for administrative, resource management, and protection employees; work space for seasonal employees; and storage space for evidence. (Work space for most interpretive personnel and storage space for collections will be in the new visitor center.) The new storage space will correct deficiencies in storage for museum collections, museum environment, security, and fire protection identified in a checklist completed by the monument staff in 1990.

New and remodeled facilities will be designed for energy efficiency and water conservation, and they will meet all applicable codes and regulations, including federal accessibility codes. The new and remodeled facilities will be linked by a computer network.

The existing maintenance building will be remodeled to be more suitable for winter use. It also will be expanded: two more bays will be added for larger vehicles, and a storage area for flammable materials will be added to comply with codes. Nonmaintenance functions now housed in that building will be relocated to the expanded administration building.

Building colors will be chosen to reduce visual impact. Additional plantings will be planned to screen the remodeled facilities from the highway, the campground, and the North Crater flow trail. Placement of facilities on ridgelines will be avoided so as not to detract from natural aesthetics.

All new utilities will be placed underground; a long-range objective will be undergrounding of all utilities in the monument.

The boneyard will be eliminated; instead, there will be limited outdoor storage in the maintenance area. Additional warehouse space will be available after expansion and remodeling of the existing structures.

The telephone system is outdated. Computer communications to NPS networks are limited by this voice-only system. An upgrade to a data-capable system is recommended.

Employee Housing

The monument staff has been rehabilitating the permanent employee housing to bring it up to standards specified in the NPS "Design and Rehabilitation Guideline." Reroofing materials will be chosen to reduce the visibility of housing from the loop drive and to improve snow control.

The four efficiency apartments do not meet NPS housing standards because of their size and because there is no separation between living, dining, and sleeping areas. The double bunks in the single-room units are unsuitable for singles or for married couples. However, the units do fill a need for temporary housing. Their design is being evaluated for improvements such as addition of a bedroom and insulation for winter occupancy. Additional permanent housing is not needed now. If more seasonal or permanent housing is needed in the future, a location study will be initiated to determine the best location.

Employees' privacy will be improved by the planting of trees or other plants to screen the residential area from view and by changes in the entrance road. However, employee housing will still be visible from the campground, so some intrusions can be expected.

Historically, lawns have been maintained around employee housing areas, ostensibly to reduce the entry of cinders into the buildings. However, lawns are incongruous with the surrounding desert landscape, require extensive

watering, attract deer, and require fertilizers and pesticides to maintain the monoculture of grass. Because of the high visibility of the housing area to visitors and campers, work will begin to reduce the lawns to only the backyards. Vegetation in front of the houses will be converted to blend with the surrounding landscape. The use of native plantings, walkways, patios and paved paths will be considered to reduce cinders while still providing a compatible landscape and a comfortable living area for employees. Irrigation will be reduced to the absolute minimum necessary.

Staff

The monument now has a permanent staff of 11. The optimal staff would be 16 or 17 full-time employees. This includes an increase of two full-time positions to operate the new visitor center and maintain the added facilities. Other actions will not directly require more personnel, but some resource management actions may require short-term increases in seasonal staff to accomplish specific objectives.

IMPLEMENTATION OF THE PLAN

Sequence

Until major redevelopment proposals are funded, loop road improvements and interim improvements to visitor center parking areas will have priority. Improvements to exhibits and waysides are ongoing projects. A comprehensive design program will include preliminary site plans and architectural concepts, specific needs for proposed and remodeled facilities, and cost estimates.

Maintenance facilities could be remodeled and expanded separately from the other projects, but the design of these facilities must be coordinated with other planned improvements. Projects such as housing improvements and development of the Big Sink wayside also

could be done separately when funding becomes available.

The major development proposals cannot conveniently be implemented in phases; to function in the best interest of visitors, the new entrance road, visitor center, and entrance station should become operational at the same time. The existing administration building could be remodeled later.

Cultural resource inventories will be conducted at the monument in fiscal years 1992–1993 to meet responsibilities under section 110 of the National Historic Preservation Act. Consultations required by section 106 of that act will be pursued for any actions that could affect resources identified by those inventories. Section 106 compliance is required for all projects, including archeological surveys of any area that could be directly or indirectly affected by a proposed action. Should it be determined that there is potential for adverse effects on cultural resources, mitigating measures will be determined in consultation with the state historic preservation officer (see appendix G).

Project Packages

There are several ways in which construction projects can be packaged; all are subject to the appropriations process. In the packages described below, projects are grouped together in a logical sequence: infrastructure for the new development, followed by construction of major new facilities, then remodeling of existing facilities. However, some components of the packages could be switched to earlier or later phases.

Package 1: Roads/utilities for new development (approximate cost, \$1,400,000). New north side entrance road; visitor center parking; winter parking; removal of boneyard and old access road scars;¹ extend utilities and place existing utilities underground.

Package 2: Major building phase (approximate cost, \$3,800,000). New year-round visitor center and group orientation facility; new entrance station; restrooms at winter parking area (if needed).

Package 3: Road/parking changes in existing developed area following completion of new facilities—coordinate with package 4 (approximate cost, \$89,000). Remodel existing highway intersection, removing turn lanes; remodel existing headquarters parking areas; rehabilitate old entrance station area.

Package 4: Major remodeling phase (approximate cost, \$1,100,000). Remodel/expand headquarters for administration and operations; expand maintenance building and outside storage;¹ remodel apartments for offices or tear down, depending on final design concept.²

Independent projects (can be started any time funding is available): Rehabilitate campground: level RV sites and add tent sites; construct Sunset Ridge trail and overlook; develop Big Sink interpretive wayside; plant vegetative buffers at housing and headquarters areas; improve main park road, turnouts, and parking areas.³

1. Removal of the existing boneyard will require construction of outside storage space in the maintenance area. Maintenance facilities can be remodeled independently of other actions, but an overall plan for remodeling of the headquarters facilities will be required.

2. Apartment remodeling or removal depends on the final concept for the headquarters and maintenance area. Apartments will not be removed unless replacement housing is provided elsewhere.

3. Rehabilitation of the main park road is a critical need; it should not be delayed by the planned new entrance road or the remodeling of the existing entrance road and parking. This could mean that some work accomplished under this project will be removed at some time in the future.



Public Involvement

A visitor study was conducted at the monument by the University of Idaho Cooperative Park Studies Unit during the summer of 1988. The study confirmed general impressions about visitors, their points of origin, and activities while at Craters of the Moon. Those surveyed were asked "If you were planning for the future management of Craters of the Moon National Monument, what would you propose?" The suggestions were quite wide-ranging; however, it would be inaccurate to say that visitors identified major problem areas since many of the comments were made by one or two persons. All comments were considered when the alternatives were developed.

As part of the scoping process, a public meeting was held in Burley, Idaho, in July 1988 to discuss the park expansion proposal and receive input from the public for the general management plan. Virtually all comments addressed park expansion. It was agreed that further attempts at public meetings in the region would prove futile as long as the expanded park issue remained.

The draft *General Management Plan/Environmental Assessment* for Craters of the Moon National Monument was open for public review and comment from December 23, 1991, until February 7, 1992. Draft copies were mailed to 100 individuals and organizations. A press release was sent to all area media, and two television stations and three local newspapers reported on the plan. Written comments were accepted until February 17 to allow for delay of mail.

To offer the public an opportunity for informal discussion of the alternatives and the draft plan, open houses were conducted in Arco, Burley, Idaho Falls, and Ketchum in January 1992. A total of 20 persons attended the four meetings, at which comments were generally favorable. Participants were encouraged to send written comments to the superintendent.

Special briefings on the draft plan were conducted for the Bureau of Land Management, the Idaho Conservation League, the Sierra Club, the Butte County commissioners, the Lost River Joint Chamber of Commerce, and the staffs of Senators Steve Symms and Larry Craig. Congressman Richard Stallings and his staff were briefed directly.

Nine comment letters were received, of which seven supported the proposed plan and two opposed it on the grounds of cost. The letters are on file at monument headquarters. Where appropriate, the plan has been modified in response to comments received in letters and at open houses.

APPENDIXES/REFERENCES

APPENDIX A: FINDING OF NO SIGNIFICANT IMPACT

FINDING OF NO SIGNIFICANT IMPACT GENERAL MANAGEMENT PLAN CRATERS OF THE MOON NATIONAL MONUMENT, IDAHO

ACTION - The National Park Service has prepared a General Management Plan to guide the management, development, and use of Craters of the Moon National Monument over the next 10-15 years. The major actions proposed in the plan include construction of a new visitor center, group orientation facility, and entrance road approximately three-quarters of a mile north of the existing visitor center; remodeling and expansion of the headquarters for administration and operations, and expansion of maintenance facilities; changes in the roads and parking in the existing developed area to accommodate the proposed changes to the building functions; and rehabilitation of the main park road and associated turnouts and parking areas.

No major change in the direction of resource management for the monument is proposed. Inventory and monitoring of natural and cultural resources will continue, with an increased emphasis on awareness, management, and protection of cultural resources. Continuing cooperation and coordination with the Bureau of Land Management concerning management of grazing, mining, and wildland fires was recommended to ensure preservation of monument resources and significant related resources on lands adjacent to the monument. It is important that an air quality management plan be developed for the monument to protect the Class I air quality of the Craters of the Moon Wilderness. A proposal to modify the northern boundary of the monument to ensure greater protection of the monument's wildlife, vegetation, and watershed is under proposed. No other boundary changes are proposed.

The interpretive program will continue to serve visitors of all abilities. Redesign of the Devil's Orchard trail to be barrier-free is proposed. The program will be expanded to include area history with consideration given to developing interpretation for the Big Sink area and in conjunction with a mountain bike/ski trail proposed for Goodale's Cutoff. Cooperation with the BLM in interpreting the land adjacent to the monument is proposed.

SUMMARY OF ALTERNATIVES AND MAJOR IMPACTS - The Environmental Assessment accompanying the General Management Plan indicated that approximately 4.4 acres of mountain big sagebrush/bluebunch wheatgrass vegetation will be affected by construction under the proposal. The proposal will have no effects on floodplains, wetlands, threatened, endangered, or rare species, significant cultural resources, or the Craters of the Moon Wilderness. The proposed redevelopment will improve the quality of monument visitors' experience by relieving crowding and reducing congestion in and around the visitor center and campground, and remodeling or replacing outdated visitor facilities. Park operations will be improved by providing better maintenance facilities, expanding work space, and reducing the intrusion of visitor traffic into the housing area.

The Environmental Assessment evaluated the proposal and three alternatives. The no action alternative (alternative 1) was evaluated, but was rejected because it would perpetuate crowding and congestion for both visitors and park staff.

The minimum requirements alternative (alternative 2: remodel) was evaluated and found to offer some relief of the crowding in park offices and the visitor center. However, the alternative would not eliminate the congestion on the entrance road and visitor center parking, nor the congestion created by having administration, maintenance, and employee housing share the main visitor circulation pattern.

The seasonal variations alternative (alternative 3: summer visitor center) was also evaluated. It was rejected because of the increase in present operating costs from having two visitor facilities, including one that would require winterization, and the loss of a full range of interpretive opportunities for winter visitors. Additionally, the placement of maintenance facilities across the highway would increase cross-traffic, result in the loss of an additional 1.35 acres of vegetation, and increase the snow-removal operations required to function.

PUBLIC REVIEW - The service contacted the Idaho State Historical Preservation Officer (SHPO) and

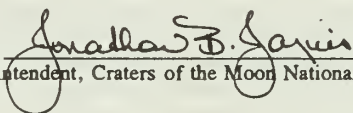
Advisory Council on Historic Preservation under Section 106 of the National Historic Preservation Act (NHPA), amended. No comment was received from the Advisory Council. The SHPO's response was one of support for additional cultural surveys to meet responsibilities under Section 110 of the NHPA. The SHPO also requested review of any proposed modification to structures older than 50 years and noted that continued use of previously impacted segments of Goodale's Cutoff would not cause additional damage to the trail. The National Park Service will work closely with the SHPO to coordinate future consultations and inventory activities under Sections 106 and 110. The service will consult on future projects as outlined in Appendix F of the final plan.

A public comment period lasted 30 days following the distribution of the draft General Management Plan/Environmental Assessment on December 23, 1991. Nine written responses were received. Open houses to discuss the proposals were held in Arco, Burley, Ketchum, and Idaho Falls between January 20 and 23, 1992. Twenty individuals attended these meetings. Of the nine letters, seven supported the proposal and two opposed on the ground of cost. Comments at the open houses were generally favorable. No comments were received that required revisions to the proposal. Other comments have been noted and incorporated into the final plan.

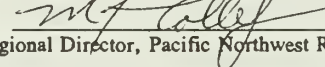
Special briefings on the draft plan were also conducted for the Bureau of Land Management, Idaho Conservation League, Sierra Club, Butte County Commissioners, Lost River Joint Chamber of Commerce, and the staff of Senator Steve Symms, Senator Larry Craig and Congressman Richard Stallings.

DETERMINATION - Based on public and agency comments on the proposal and environmental assessment and on analyses of issues and alternatives, together with the ability of mitigation measures to alleviate impacts, the National Park Service believes that no substantial controversies exist.

It is the determination of the National Park Service that the proposed actions do not constitute a major federal action significantly affecting the quality of the human environment. Nor is the proposed action without precedence or similar to one that normally requires the preparation of an environmental impact statement. Individual construction projects in the proposal will be further evaluated prior to implementation. Therefore, an environmental impact statement will not be prepared.

Recommended 
Superintendent, Craters of the Moon National Monument

4-23-92
date

Approved 
Acting Regional Director, Pacific Northwest Region

4/29/92
date

APPENDIX B: DESCRIPTION OF MONUMENT

CLIMATE

Craters of the Moon has a semiarid climate with hot, dry summers and cold winters. The annual precipitation from 1959 to 1982 averaged 42.6 cm (16.77 in), with greatest amounts in December or January of each year, mostly from snow. There were minor peaks in May or June of each year from rain. July and August are the driest months. Snow first falls in November, and except in dry winters it remains on the ground until at least April. Wind causes the snow to drift; drifts as high as 15 feet can persist well into May. Temperatures vary widely, both seasonally and diurnally. Average maximum monthly temperatures range from -1.7°C (28.9°F) to 28.7°C (83.7°F). Freezing temperatures can occur in any month. The prevailing southwesterly winds are most intense in spring.

The northern part of the monument is in the foothills of the Pioneer Mountains; its higher elevation puts it in a different climatic regime. Snow remains longer in this area, and the total amount of precipitation is greater than that on the lava flows in the southern part of the monument.

AIR QUALITY

The air quality in Craters of the Moon Wilderness, which occupies 81% of the monument's total area, has been designated class I as defined in the Clean Air Act, as amended in 1977. Class I designation indicates the most stringent requirements for protection of air quality related values from adverse impacts. The air quality in the rest of the monument is class II. The dual designation resulted from the 1977 amendments to the Clean Air Act, in which class I designation was given to all national wilderness areas and memorial parks larger than 5,000 acres, national parks larger than 6,000 acres, and international parks in existence at that time. All other areas in the United States that did not exceed national air quality standards were designated class II. Because the wilderness adjoins the rest of Craters of the Moon National Monument, the entire monument is managed as a class I area; thus, the class II area benefits from actions taken to protect the air quality of the wilderness.

Air quality is of critical importance to visitor enjoyment, human health, scenic vistas, and preservation of natural systems and cultural resources. Most elements of a park environment are sensitive to air pollution. These elements, including vegetation, visibility, water quality, wildlife, historic and prehistoric objects, and structures, are referred to as "air quality related values." Notable air quality related values at Craters of the Moon are the visibility and the scenery. The health of visitors also is an air quality related value, as is vegetation. There is some evidence that gaseous air pollution may be adversely affecting some species of plants. Pollutants and their effects in Craters of the Moon National Monument are listed in table B-1.

Visibility is of primary importance at the monument, which has more pristine visual air quality than any other NPS monitoring site in the continental United States. The Environmental Protection Agency uses Craters of the Moon National Monument as a baseline reference for visual quality. Even so, monitoring data indicate a trend toward deterioration. In the early 1980s it was assumed that a pristine airshed existed at Craters of the Moon until an initial analysis of visibility data for the monument demonstrated a significant decrease in visibility between 1982 and 1986.

To comprehend the geological phenomena that led to establishment of a national monument at Craters of the Moon, visitors must be able to see the Great Rift and the vast lava fields clearly. The average visual range at the monument varies from 93 to 125 miles in fall and winter and from 78 to 109 miles in spring and summer. Visibility is 174 miles or more about 10% of the time and less than 65 miles about 10% of the time. Integral vistas have been identified to the south and east of the monument, indicating that the visibility has a high value.

Smog can sometimes be seen entering the monument when prevailing winds are from the east and southeast. The probable source of the smog is the population centers at Idaho Falls and Pocatello.

Radioactivity is monitored because of the proximity of the Idaho National Engineering Laboratory. Radionuclide monitoring indicates that radioactivity is normal, with no carryover from the laboratory

TABLE B-1: POLLUTANTS AND THEIR EFFECTS

Pollutant	Values Affected
Ozone	Limber pine (<i>Pinus flexilis</i>) Quaking aspen (<i>Populus tremula tremuloides</i>) Balsam poplar (<i>Populus balsamifera trichocarpa</i>) Common chokecherry (<i>Prunus virginiana</i>)
Hydrogen sulfide	Limber pine
Sulfur dioxide	Quaking aspen Balsam poplar Bluebunch wheatgrass (<i>Agropyron spicatum</i>) Rocky Mountain maple (<i>Acer glabrum</i>) Lichens Mosses
Heavy metals	Lichens Mosses Mule deer (<i>Odocoileus hemionus</i>)
Other	Visibility Visitor and employee health

facilities. A chemical processing plant and a coal-fired steam generator at the laboratory also threaten the air quality at Craters of the Moon. Radionuclide monitoring indicates that radioactivity is normal most of the time, but spikes do occur that INEL officials attribute to their own activities.

Analysis of Craters of the Moon precipitation data during the 1982–1987 period revealed a mean annual average pH of 5.6 to 5.8. However, in 1989 the mean annual pH was 4.01 to 6.59. The data are inconclusive as to the acidity of precipitation at Craters of the Moon.

The Air Quality Division of the National Park Service has identified eight plant species and one mammal species that could serve as biological indicators of the monument's air quality; these are listed in the monument's resource management plan. The Air Quality Division also has reported red-banded tipburn damage to limber pines in the monument. This damage may have been caused by hydrogen fluoride. The source of the pollution may be a Pocatello phosphate fertilizer plant.

Symptoms of ozone injury observed on a few plants in the monument are dark stippling on chokecherry and black necrosis on aspen.

GEOLOGY

Topography

Craters of the Moon lies at the north edge of the eastern Snake River Plain, a broad, flat lava arc, concave to the north, which covers nearly 10,000 square miles of southern Idaho. It extends from the Yellowstone Plateau and the Teton Mountains on the east to the Oregon state line on the west. The Snake River borders the southern edge of the plain, which occupies almost a quarter of the surface of Idaho and contrasts markedly with the mountainous terrain that dominates the northern, central, and far southern parts of the state. The east-

ern Snake River Plain is essentially flat in this vicinity: vertical relief is a few hundred feet at Craters of the Moon and less than that elsewhere.

There are two distinct landforms in the monument: the foothills of the Pioneer Mountains in the north give way to the low relief of the lava flows in the rest of the monument. The monument's highest elevation, 7,729 feet above sea level, is in the Pioneer Mountains. Elevations gradually decrease from north to south; the lowest elevation is about 5,330 feet in southeast corner. Within the lava flows, cinder cones provide the greatest vertical relief. The highest cinder cone is Big Cinder Butte, which stands more than 700 feet above the surrounding plain. Nineteen other cinder cones are at least 100 feet high. The Great Rift is apparent from the linear alignment of the cinder cones.

Volcanic Features

The primary resource value of Craters of the Moon is the great diversity of basaltic features in a small area. Almost all the features of basaltic volcanism are visible at the monument.

Much of the volcanism of the Snake River Plain was confined to volcanic rift zones. A volcanic rift zone is a concentration of volcanic landforms and structures along a linear zone of cracks in the earth's crust. The Great Rift volcanic rift zone is a zone of cracks running approximately northwest to southeast across almost the entire eastern part of the Snake River Plain. The entire Great Rift is 62 miles long. The Craters of the Moon rift set is 34 miles long; 13 miles of this are in the monument (see the Lava Features map). The other rift sets that make up the Great Rift are, from north to south, the Open Crack rift set, 13 miles long; Kings Bowl, 6.8 miles; and Wapi, 11 miles.

The Great Rift is an example of basaltic fissure eruption. This type of volcanic activity is characterized by extrusion of lavas from fissures or vents that is relatively quiet in comparison with highly explosive eruptions such as the 1980 Mount Saint Helens eruption.

Where the Great Rift intersects the earth's surface, there is an array of cinder cones, lava cones, eruptive fissures, fresh-appearing lava flows, noneruptive fissures, and shield volcanoes. The Craters of the Moon, Kings Bowl, and Wapi rift sets have predominantly eruptive fissures (those from which volcanic products issued). The Open Crack rift set is a set of noneruptive fissures from which no lavas flowed. Craters of the Moon contains non-eruptive fissures as well as eruptive ones.

Of the more than 60 lava flows of the Craters of the Moon lava field, 20 have been dated; their ages were found to range from about 15,000 years before present (B.P.) to about 2,100 years B.P. The flows were laid down in eight distinct eruptive periods that recurred on an average of every 2,000 years. The Kings Bowl is the youngest of the Great Rift lava flows, slightly younger than the youngest Craters of the Moon lava flow. On the basis of recent eruptive history, the Craters rift set is due for another eruption within the next thousand years, perhaps as soon as within 200 years. Eruption is preceded by seismic activity. The resource management plan for the monument recommends establishment of a seismic monitoring system to predict impending volcanic activity.

Craters of the Moon lava flows are classified as aa, pahoehoe, or blocky pahoehoe. Aa lava has rough, jagged surfaces with sharp points. Pahoehoe, which

is more fluid before hardening, spreads into sheets with smooth, glistening surfaces that are often twisted into ropelike wrinkles, pleats, and folds. A continued flow of pahoehoe lava may break the twisted surface into jagged blocks that resemble aa but do not have the sharp surface projections and spines characteristic of aa.

New basaltic lava generally has a dark brown surface. As lavas age and weather, the surface color may change. Disturbance to lava that alters the normal dark surface is evident because it exposes the underlying oxidized area. Pahoehoe lava may take on a glossy, iridescent veneer due to chemical composition. The Blue Dragon and Green Dragon pahoehoe flows and the Vermilion Chasm are named for the striking lava colors in those areas. One area in the southeastern corner of the monument has been described as a "vast amphitheater whose towering walls are a riot of yellow, green, orange, brown, and black, with brick red and vermilion predominating."

Other volcanic features in the monument are cinder cones, spatter cones, vents, fissure cracks, collapse depressions, squeezeups, pressure ridges, bombs, tree molds, and lava tubes (see appendix C).

WATER RESOURCES

Surface water is extremely scarce at the monument. The single surface source is Little Cottonwood Creek, which flows from springs in the foothills of the Pioneer Mountains in the north unit. The flow of Little Cottonwood Creek disappears beneath the ground surface before reaching the highway.

Four springs in the Little Cottonwood drainage provide drinking water for the monument; this source is supplemented by two wells in the same drainage. The wells, each approximately 100 feet deep, tap a perched aquifer of unknown origin and size. There are only isolated occurrences of water on the lava flows.

The occasional existence of ice in the lavas is a seemingly strange phenomenon in the desert environment of Craters of the Moon, yet ice is often found in the holes and caves of lavas in areas that receive winter snow. Runoff water from snowmelt freezes in the depressions in cold weather and remains frozen because of the excellent insulating

properties of the lava and because cold air moves downward, maintaining low temperatures.

The availability of water in water holes varies with seasonal precipitation, particularly snow. Some water holes in Craters of the Moon lava have gone dry since their occurrence was first noted. The water holes are important for wildlife living in the area of the lava flows.

Craters of the Moon is underlain by the Snake River Plain aquifer, one of the most productive in the western United States. The production from the aquifer and its depth beneath the surface of the monument are unknown, but wells drilled outside monument boundaries but near the monument have encountered water about 1,000 feet below the surface.

FLOODPLAINS AND WETLANDS

There are no floodplains in the monument. Areas of riparian vegetation are found along the Little Cottonwood Creek drainage in the north unit, and there are small areas around some of the springs in the north unit that could be considered seasonal wetlands under the definitions in the *Federal Manual for Identifying and Delineating Jurisdictional Wetlands*.

SOILS

Soil surveys have not been completed for most of the monument, but one was done for Carey Kipuka. Soils there are primarily windblown loess or soils that have developed from the area's basalt.

Soils in the north unit differ from those in the rest of the monument in origin and deposition, but lack of a soil survey prevents detailed analysis. In general, soils in the north unit and the kipukas are better developed than those in the rest of the monument. Little time has been available for soil development in parts of the monument that are covered by more recent lava flows. Soil accumulation depends primarily on accumulation of loess; this occurs most rapidly in crevices and cracks.

Soils in adjacent agricultural areas from which the vegetative cover has been removed are subject to wind erosion.

VEGETATION

Although much of the monument surface consists of barren lava flows, plant communities are surprisingly diverse (see the Vegetation map). The varied microhabitats within the lavas, variations in elevation from the lavas up to the foothills, the different aspects created by topography, and the riparian areas in the north end all contribute to habitat diversity. This has resulted in greater plant diversity than might be expected from a first glance at the seemingly barren lava.

The region is a part of the Great Basin floristic province. Day and Wright (1985) listed a total of 26 separate vegetation types in the monument (see appendix H). More than 300 vascular plant species are distributed among those 26 vegetation types.

Importance of Shrub Steppe Vegetation Type

Slightly more than 22% of the monument's total area is covered by shrubs (mostly sagebrush and antelope bitterbrush), grasses, or a combination of the two; the general vegetation type is called shrub steppe. This once was the common vegetation in southern Idaho, but grazing, fire, and agriculture have reduced incidence and altered the species composition of most areas. There is some concern that all native Idaho sagebrush grasslands are being reduced and altered from native condition. The national significance of low sagebrush/Idaho fescue and early low sagebrush/Idaho fescue vegetation types would be recognized officially if those biotic communities were designated national natural landmarks, as has been recommended (see "Potential Special Designations" in the section on interrelationships with other proposals).

Stresses on Arid-Land Vegetation

On arid lands like those in the monument, vegetation is subject to heat, wind, salinity, floods, drought, infertile soils, and animal pressure. Human-induced stresses that can be added to the natural stresses are activities such as scraping, bulldozing, agriculture, water diversion, mining, overgrazing, differential shrub removal, and the use of off-road vehicles. Such stresses are minimal in the monument, but they are present on the boundaries



Map condensed from: *Geologic Map of Craters of the Moon National Monument and the Great Rift Volcanic Field*

Pahoehoe (smooth lava)



Aa (jagged lava)

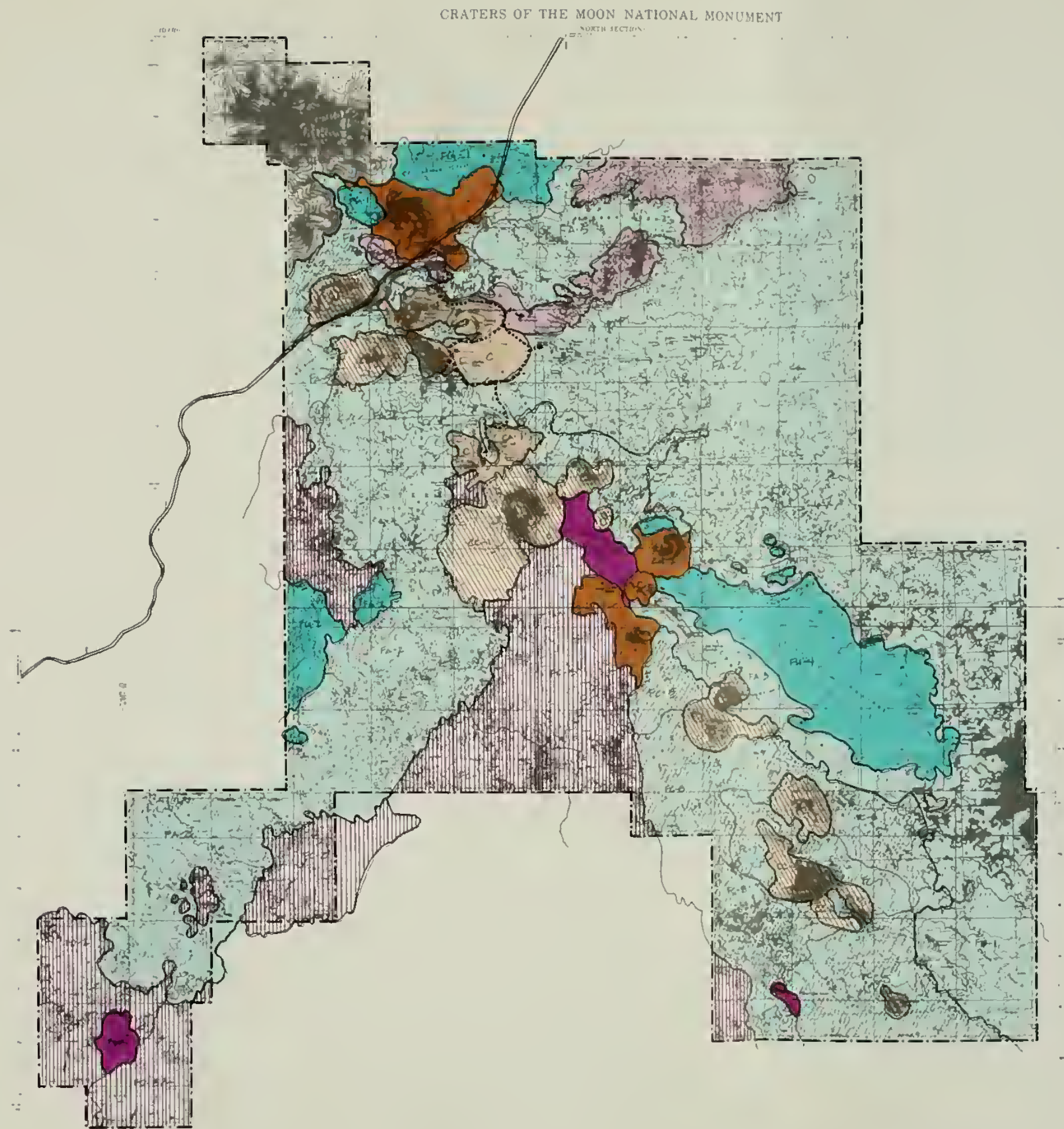


Cone formations



Lava Features Craters of the Moon National Monument

United States Department of the Interior - National Park Service
DSC/June'92/131/20017A



Pahoehoe (smooth lava)

Youngest
↓
Oldest

Aa (jagged lava)

Youngest
↓
Oldest

Cone formations

Youngest
↓
Oldest

Map condensed from: *Geologic Map of Craters of the Moon, King's Bast and Wapi Lava Fields and the Great Rift Volcanic Rift Zone, South Central* By Mel Kuntz

N
0 1 2 Kilometers

Lava Features Craters of the Moon National Monument

United States Department of the Interior - National Park Service
DSC/June'92/131/20017A



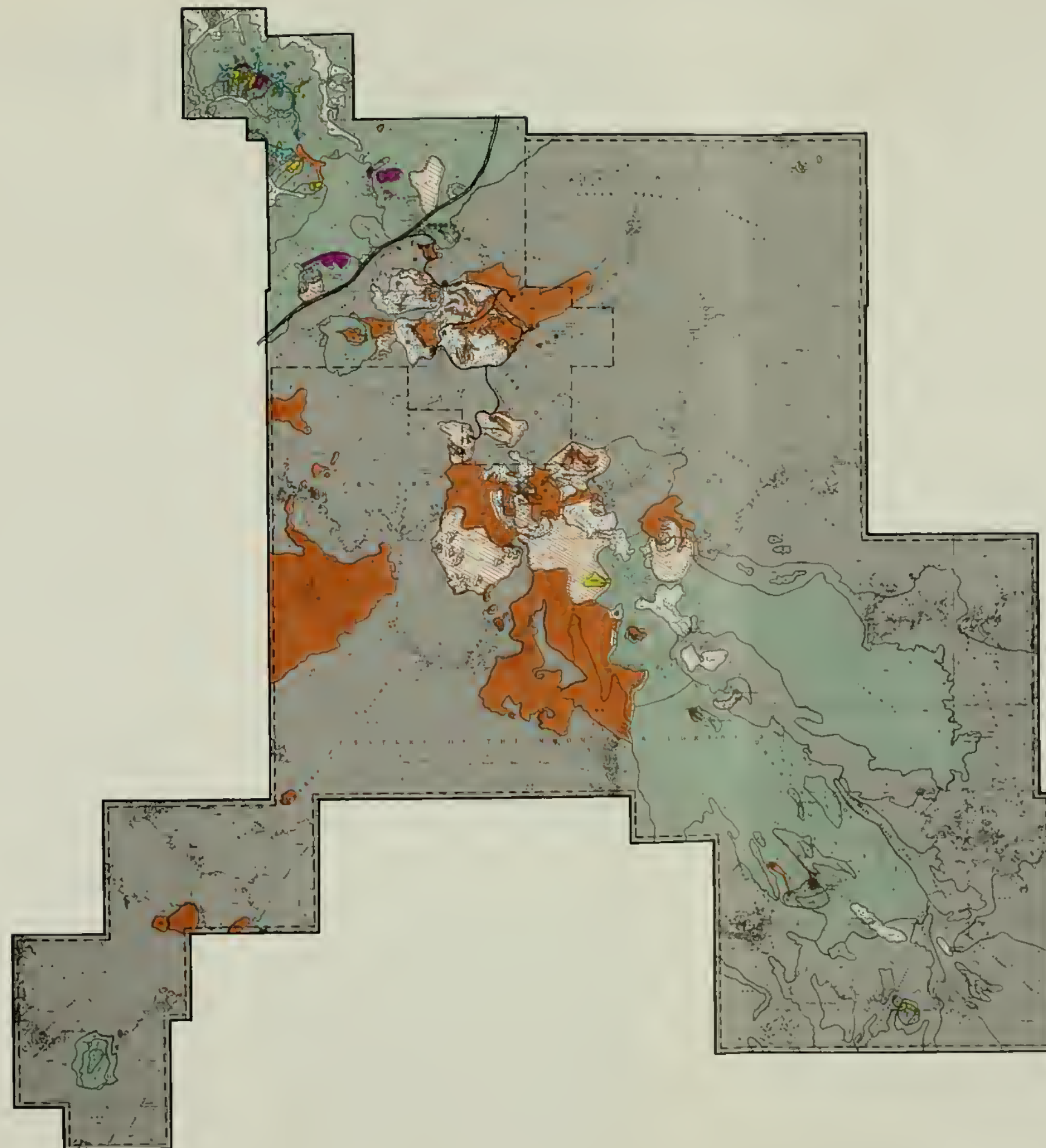
-  Cinder gardens
-  Lava flows
-  Sagebrush
-  'Rare' sagebrush
-  Bitterbrush
-  Wheatgrass
-  Rare grass - wildrye
-  Limber pine
-  Douglas fir
-  Aspen
-  Riparian
-  Wilderness boundary



Map condensed from: *The Vegetation Types of Craters of the Moon*
By R. Gerald Wright and

Vegetation Craters of the Moon National Monument

United States Department of the Interior - National Park Service
DSC/May'90/131/2001



- Cinder gardens
- Lava flows
- Sagebrush
- 'Rare' sagebrush
- Bitterbrush
- Wheatgrass
- Rare grass - wildrye
- Limber pine
- Douglas fir
- Aspen
- Riparian
- Wilderness boundary

Vegetation Craters of the Moon National Monument

United States Department of the Interior - National Park Service
DSC/May'90/131/200

Map condensed from: *The Vegetation Types of Craters of the Moon*
By R. Gerald Wright and Thomas Day

0 1 2 Kilometers

and beyond. The combination of human-caused and natural stresses can be devastating to arid-land vegetation, which is slow to recover from disturbance.

Vegetation in Specific Locations

The density of vegetation depends on the availability of soil. Where basalt rock is very young, the only soil available is what blows into cracks and fractures. As soil develops or is blown into crevices, vegetation takes hold. The depth of crevices, cracks, and depressions and the availability of favored microsites also determines what vegetation is present.

Lava Flows. The surfaces of the newest lava flows in the monument are devoid of vegetation except for lichens. Two of the vegetation types in the monument, low-density and medium-density lava flows, have low total plant cover relative to the rest of the monument. Low-density lava flows are found in about 58% of the total area of the monument, almost six times more than medium-density lava flows, which are in slightly more than 10% of the monument. The density of plant cover varies between types, depending on the age of the flow, but all types have similar species composition.

Kipukas. Kipukas are islands of vegetation developed on old lava flows and surrounded by newer flows. The native vegetation of some kipukas may have been altered by fire or livestock grazing before the monument was established. However, other kipukas in the monument were protected by rough lavas and may offer examples of the native Idaho shrub steppe habitat. Some exotic species have encroached into Carey Kipuka, but it is a relatively pristine remnant of native vegetation. Dominant kipuka vegetation includes three-tip sagebrush, big sagebrush, bluebunch wheatgrass, and needlegrasses (see appendix H for scientific names). The importance of these species varies broadly between and even within kipukas.

Cinder Areas. Cinder cones support three different plant communities, depending on aspect and successional stage. About 2% of the monument is cinder gardens, a distinct vegetation type. In the early successional stages, cinder gardens are colonized by species that produce spectacular spring wildflower displays. As soils develop on the

cinders, antelope bitterbrush dominates shrub communities. Disturbances on cinder areas that cause depressions in the surface (such as vehicle tracks or footprints) may enhance plant establishment, but this often leads to unnatural plant patterns.

Limber pine are present on north-facing slopes where sufficient moisture is available. Limber pine occurs as a codominant species with antelope bitterbrush in three vegetation types, which together cover 7.1% of the monument. The limber pine stands appear to be favored mule deer fawning habitat in the southern part of the monument. Attempts were made in the 1950s to eradicate native dwarf mistletoe from the limber pine population. Numerous trees were pruned and poisoned, and 6,000 limber pine trees were killed. The program was stopped when managers finally realized that limber pine and dwarf mistletoe had coexisted here for thousands of years. The effects of this action have not been studied and are not understood; however, there was a change in the population and age structure of the limber pine forest.

North Unit. The north unit contains three vegetation types that are notable for the diversity they contribute to the monument: Douglas-fir/mountain snowberry, upland quaking aspen, and riparian. The three types cover only 0.3% of the monument, but they provide important wildlife habitat. The Douglas-fir/mountain snowberry type is found on relatively steep, north-facing slopes of older cinder cones and along Little Cottonwood Canyon. The upland quaking aspen type is in upland sites away from permanent stream courses. The riparian type is characterized by dense woody vegetation, proximity to a permanent watercourse, and a dense layer of tall forbs.

Noxious and Exotic Species

Nine species of noxious and exotic (alien) plants have been identified in the monument, including cheatgrass, common mullein, and Canadian thistle. Disturbed areas are particularly susceptible to invasion by exotics; consequently, most of the exotics are found in the developed north end of the monument. Cheatgrass, a common and widespread invader throughout the West, was introduced in the early 1900s when domestic sheep grazed the surrounding area. Common mullein has gained a stronghold along the dirt road and at the site of the

old Martin Mine. Canadian thistle grows along Little Cottonwood Creek. The grass lawns of the monument's developed area are exotics that have been intentionally cultivated.

Leafy spurge is not known to be present in the monument, but it is present in Laidlaw Park and the Appendicitis Hills, both wintering areas for deer from the Craters of the Moon herd. This has caused concern that the deer may introduce the plant into the monument. Spray programs to control leafy spurge in areas north and south of monument boundaries are in effect at the Butte County agricultural extension office and the BLM's Idaho Falls and Shoshone districts.

Spotted and diffuse knapweeds are present in the monument along the highway corridor, and they are known to be in areas close to the boundaries. The state sprays the highway corridor annually.

Threatened or Endangered Plant Species

Idaho laws afford legal protection to state-listed threatened and endangered plant species.

No known federally or state listed, proposed, or candidate species of threatened or endangered plants are known to be in the monument. Near the boundaries of the monument are several species considered sensitive because of their rarity; these species may also be in the monument. To locate rare plant taxa, extremely detailed surveys of likely habitat are necessary, but the inaccessibility of much of the monument makes surveys difficult. Weather and moisture regime determine whether or not a plant will appear in a given year, so timing of surveys is critical. Appendix H contains a list of sensitive plant species found near the monument, with scientific names.

The meadow pussytoes grows in wet meadows along U.S. 20-26-93 between Carey and the western part of the monument. Obscure phacelia, a desert annual that had not been seen since 1969, was recently found again near the eastern boundary of the monument. It appears only at times when there is enough moisture. Both species are listed as endangered by the state and are category 2 candidates for the federal threatened and endangered list. (Category 2 candidate species are those that appear appropriate for listing as threatened or endangered

but for which conclusive data on biological vulnerability and threat are not available to support a proposed rule.) No formal legal protection is attached to candidate species; however, NPS policy is to treat federal candidate species and state-listed sensitive species as if they were fully protected. (Also see appendix H.)

The Picabo milkvetch is known to grow near the southern boundary of the monument and from Picabo east to the Laidlaw Park area. It grows on sandy soils in association with three-tip and basin big sagebrush. This plant is on the Idaho Native Plant Society's list of species to be monitored for changes that could indicate that the populations or habitat are in jeopardy. It was formerly a federal category 2 candidate but is now listed as category 3 (see appendix H).

WILDLIFE

A total of 142 bird and 49 mammal species have been reported in Craters of the Moon. Five of the mammal species—grizzly bear, gray wolf, bison, porcupine, and bighorn sheep—are known to have been extirpated from the monument. However, a bighorn sheep was seen in the monument in the summer of 1990.

The most common animal species in the monument are horned lizards, mourning doves, sage grouse, killdeer, magpies, ravens, Clark's nutcrackers, common nighthawks, mountain bluebirds, great horned owls, golden eagles, bats, rabbits, chipmunks, ground squirrels, pocket gophers, packrats, badgers, coyotes, mule deer, and pronghorn antelope.

Mule Deer

The Craters of the Moon mule deer herd, which has been studied intensively, is known to be very productive in comparison with other mule deer herds that have been studied. In addition to high productivity, the monument herd apparently is unique in having dual summer and winter ranges. Deer that are in the monument from April to November are known to winter on at least two separate ranges on private lands and BLM-managed land. Records of marked deer show that part of the herd migrates to winter range about 56 miles north-

east of the monument near Moore, Idaho. Others apparently move about 45 to 65 miles south-southwest across the Snake River Plain to an area north of Burley and east of Jerome.

The deer move back to the north end of the monument in April. Their summer movements are related to water requirements. Some remain in the north end in summer; the rest disperse among vegetated areas or make a loop into the southern part of the monument, returning to the north end in late July or early August, the hottest and driest time.

Hunting and winter mortality are the major sources of loss to the herd. The fall deer hunting season is an important event for the local community. Poaching on monument lands has been a problem, but this has been relieved somewhat through a vigorous and visually obvious enforcement program, an intense education program, better marking of monument boundaries, and cooperation with the local magistrate. Besides hunting mortality and poaching, important considerations in management of the herd are range condition and livestock trespass (which can affect range condition).

About 3% of the deer herd is killed annually by vehicles. Seventy percent of those kills occur in August and September, when deer summering in the north end of the monument cross the highway to forage on visitor center and employee residence lawns and drink from the sprinkler overflows.

Unusual Mammals

Three subspecies of small mammals endemic to the Snake River Plain were first identified in Craters of the Moon. A subspecies of the Great Basin pocket mouse was first taken from Echo Crater, as was the first specimen of a race of the pika (also see appendix I). As might be expected for mammals that live on lava flows, both races are characterized by darker fur than other races of the species. The first specimen of a subspecies of the yellow-pine chipmunk came from Grassy Cone.

Invertebrates

Of all invertebrates, only insects have been surveyed at Craters of the Moon. A comprehensive inventory of insects was completed in 1964–1967,

when more than 2,000 species and subspecies were recorded from twelve stations. Of the 20 orders represented, most abundant were Hymenoptera (bees, wasps, and ants, 705 species), Diptera (flies, 521 species), and Coleoptera (beetles, 324 species). The type and age of the geological substrate and the variety and abundance of plants influenced the abundance of insects collected at a station. Little Cottonwood Creek station supported the greatest number of insect species. In lava habitats, old cinder cones yielded the most insect species; young aa flows supported the fewest. An inventory specific to the caves is needed.

Fish, Reptiles, and Amphibians

There are no fish in the monument. Two amphibian species, the western toad and the boreal chorus frog, have been reported in Craters of the Moon. Eight reptile species also have been reported: sagebrush lizard, short-horned lizard, western skink, rubber boa, racer, Great Basin gopher snake, western garter snake, and western rattlesnake.

Threatened or Endangered Animal Species

Idaho laws afford legal protection to state-listed threatened and endangered animal species. The Idaho Department of Fish and Game also recognizes species that merit attention because of their present or future potential status. Species with restricted range, specific habitat requirements, and/or low numbers (which make them vulnerable to elimination from the state) may be classified as "species of special concern" to inform land managers and the public about the vulnerability of these species. Without special consideration, such species could become threatened or endangered. This classification does not provide any statutory protection.

Data on some species indicate that populations are declining or are less common than once reported, yet the species have not been classified by any agency into a category that affords special protection or consideration. These species are identified here as sensitive species; their populations should be monitored for changes until their status can be determined (also see appendix I).

Bald eagles, a federally listed endangered species, occasionally fly over Craters of the Moon, but they

do not breed there or permanently inhabit the monument. Bald eagles winter in the vicinity of American Falls, south of Craters of the Moon on the Snake River.

The blind cave leiodid beetle, which is known to occupy lava caves in the monument, is a federal category 2 candidate species (see appendix I). Other category 2 federal candidate species that have been reported in the monument are the ferruginous hawk and the lynx. Swainson's hawk was formerly a category 2 candidate species but is now a category 3 species:

Ferruginous hawk, merlin, kit fox, and lynx are Idaho species of special concern. All have been observed in the monument except the lynx, which has not been reported in the monument since 1936.

Townsend's big-eared bats are known to inhabit Craters of the Moon. The eastern subspecies is listed as endangered; the western subspecies is a category 2 candidate species; and it is possible that the entire species will be proposed for listing, including the subspecies found in the monument. The bats inhabit caves, lava tubes, and abandoned mines throughout the monument; these habitats should be monitored.

The spotted bat has not been recorded from Craters of the Moon, but it may occur in the north end. This bat, a federal category 2 species, is very rare and is captured only when specific techniques are used. These methods were not used in the baseline vertebrate survey.

All birds except house sparrows, feral pigeons, starlings, and upland and migratory gamebirds are protected nongame bird species in Idaho. Nongame mammals protected in Idaho that are found in Craters of the Moon National Monument are pika, least chipmunk, yellow-pine chipmunk, golden-mantled ground squirrel, red squirrel, and kit fox.

CULTURAL RESOURCES

Prehistory

Evidence of human occupation in the vicinity of the monument dates from at least 10,000 years before present. The earliest recorded inhabitants were big game hunters. They were replaced by

people who utilized a wider variety of plant and animal resources, but available resources could not support more than a few small bands of hunters and gatherers. During the late prehistoric and protohistoric periods, small bands of hunters and gatherers known as Northern Shoshoni occupied the area.

The most significant archeological sites for understanding the prehistoric inhabitants of the Snake River Plain are year-round living sites outside the monument; the monument area was occupied primarily in spring and summer. The nearest great density of cultural sites is in an area roughly a mile on either side of the Little Wood River, southwest of the monument. Much of the archeological material has been removed; few of the known sites now contain any archeological material.

Starting with a cluster of large archeological sites in the northwest part of the monument, the sites become smaller, fewer, and more thinly scattered as one proceeds south. The mass of lava prevented prehistoric peoples from moving north or south and inhibited east-west movement through the central and southeast parts of the monument. Except for sites near Little Cottonwood Creek and at the base of the Pioneer Mountains, known sites represent short periods of occupation. The presence of larger sites in the northwest part of the monument can be explained by easier travel at the base of the mountains than through the lava flows and more plentiful game and water in the mountains. The presence of only one site in the southeast corner, in the Vermilion Chasm-Fissure Butte area, suggests that this section was little used. The distribution of sites supports the theory that native hunters and gatherers came into the central and southeastern sections of the monument from the northwest, then moved south along the Great Rift, where travel was relatively easy.

The relatively small size of most sites in the monument reflects low population density. Five types of sites have been recorded in the monument: open sites, cave sites, rock structures, hunting blinds, and quarry sites. Open sites are the most common. Smaller open sites contained chipping material, implying that they were work stations used for short periods. Artifact assemblages indicate that the larger open sites were used as campsites. These larger sites are situated on the northwestern sides of prominent geological features such as spatter

cones, cinder cones, and mountain slopes and thus were sheltered from weather and the prevailing southwesterly winds. All the larger sites are near intermittent streams or lava sinks containing water.

History

Southern Idaho was the domain of the Northern Shoshone and Bannock Indians until about 1800. The Shoshone had been driven west from Montana and the Dakotas by the Blackfoot. The Bannock from southern Oregon were a relatively small tribe who joined the Shoshone when larger groups were required, as for buffalo hunts.

Fur trappers were the only Euro-Americans inhabiting the Snake River area in the early 1800s. The Fort Hall trading post, which overlooked the Snake River (southeast of the present monument), was the only outpost for hundreds of miles. As the fur trading industry declined, Fort Hall became a welcome stop on the Oregon Trail for an estimated 200,000 emigrants bound for Oregon and California in the 1840s and 1850s. Big Southern Butte, east of the present monument, was a major landmark for Oregon Trail emigrants.

Aboriginal lifestyles remained relatively intact until gold and silver were discovered in Idaho in 1860, with an ensuing gold rush. Most mining in Idaho took place in the north part of the state, but placer and hydraulic gold mining were extensive along the Snake River. Euro-Americans came to dominate the area after the discovery of gold and establishment of permanent American settlements.

The Bannock were more warlike than the Shoshone; they were willing to fight for their homeland when settlers moved in. Native Americans were forced to give up most of their traditional lifeways when the Fort Hall Indian Reservation was established by treaty in 1868. Through intermarriage on the reservation, the Bannock and Shoshone cultures intermingled.

Indian raids in 1862 diverted Oregon Trail emigrants to the northwest. This route, known as Goodale's Cutoff after trapper Tim Goodale, follows the base of the Pioneer Mountains from Big Southern Butte through the north part of the existing monument. The cutoff was used as a stage route until 1906; some of it is now a dirt road.

None of the historic fabric of the cutoff remains within the monument, and very little of the original cutoff is left outside the monument. The BLM has found the Goodale's Cutoff route eligible for nomination to the National Register of Historic Places. The portion of the cutoff route that is in the monument is listed on the National Register.

The volcanic regions appeared barren and useless until it was discovered that cattle and sheep could graze there. The livestock industries supplied meat and wool for mining communities and travelers along the Oregon Trail. The first irrigation ditches in southern Idaho were dug in the 1880s. With water, the land was fertile and productive, and farms and ranches sprang up. Idaho became a state in 1890. Huge federally funded irrigation projects resulted in settlement of most of the arable land in southeastern Idaho under the Carey Act, the Reclamation Homestead Act, the Desert Land Act, and the Stock Raising Homestead Act.

Historically, very few people, including Native Americans, ventured into lava flows. Robert Limbert entered the lava north of Minidoka in 1921, accompanied by W. L. Cole and a dog. The going was difficult, especially in aa lava. The explorers were unable to sleep on the rough surface. Cole's feet became blistered, and the dog's feet were so badly cut that the men carried it. The going was easier when they got to smoother pahoehoe flows, but the new problem was finding water. By following dove flights, they located snowmelt waterholes in the Great Rift. Limbert's photographs and reports were instrumental in obtaining protection of the area as a national monument in 1924.

VISUAL RESOURCES

To a casual observer, the landscape at Craters of the Moon may appear harsh and barren, but closer inspection reveals an astonishing variety of shapes, colors, and textures of the lava formations. In spring and summer, wildflowers display bright colors that contrast with the dark lavas. In winter a mantle of snow softens the harsh edges and brings new shapes and textures to light. The clarity of the air in the monument contributes to the visual quality of the vistas of the Great Rift to the south and the mountains to the northwest. Because there are few tall trees in most of the monument to block views, the volcanic features stand out in relief. The

greatest diversity of visual resources is found in the spatter cones area, where the vertical relief of the Pioneer Mountains and the cinder and spatter cones gives way to the vast lava flows in the southern part of the monument.

VISITATION

University of Idaho Survey

The cooperative park studies unit of the University of Idaho conducted a visitor study at Craters of the Moon in the summer of 1988. The information in the following paragraphs was extracted from the complete report prepared by the cooperative park studies unit (Machlis, Dolsen, and Madison 1989).

Of the visitors contacted, 77% were visiting the monument for the first time, and 4% had visited more than five times.

Family groups made up 83% of the total; 44% of the groups consisted of two people (predominantly couples); 18% were groups of more than four people. The number of persons in a group ranged as high as 35.

Visitors aged 1 to 10 made up 13% of the total number; 17% were aged 62 or older. The number of visitors aged 26 to 61 were divided fairly evenly across those ages.

Visitors from foreign countries made up 19% of the persons contacted; 24% of the foreign visitors were from Canada. Most visitors from the United States were from Idaho and five other nearby states: California, Colorado, Oregon, Washington, and Wyoming.

Fifteen percent of the visitors were overnight visitors; of those, 79% stayed only one night; 18% stayed two nights. Visitors who stayed two hours made up 39% of the total; 28% stayed three hours; 12%, four hours; and 5%, more than four hours.

Most visitors who had stopped at the visitor center said they thought the exhibits and film offered were very useful to extremely useful. Those who went to the visitor center made up 79% of the total number contacted. The most popular other activities were stopping at overlooks and other turnouts to see the view or photograph the scene.

Visitors who hiked for less than one hour made up 46% of the total; 42% hiked for more than one hour. The most popular place to go for a walk or hike was the area of Big Crater and the spatter cones (81%), followed by the caves area (64%), the North Crater flow area (58%), Inferno Cone (56%), Devils Orchard (55%), North Crater cinder cone (54%), and tree molds (27%).

Visitation Statistics from Monument Records

Records kept by Craters of the Moon personnel over the past eleven years indicate substantial year-to-year variation in the number of visits, the number of tents and RVs using the campground, and the number of backcountry visitors (see table B-2). Some variation can be accounted for by a change in 1984 in the way vehicles were counted. Snowfall also is a major factor in annual fluctuations, since the time when snow begins determines when the scenic park road will be closed.

Visitation has averaged around 215,000 per year over the past decade. The number of visitors increases gradually from spring to mid-July and remains at peak until mid-August. Peak visitation occurs between 10 a.m. and 4 p.m. each day; there is little variation with the day of the week. The campground often is full at night, and it is nearly empty by 10 a.m.

Since the staff has maintained a trail for cross-country skiing, winter use has increased in deep snow years. The increase in winter use is relatively insignificant in terms of total visitation.

Table B-3 contains monthly visitation statistics from 1984 through 1990.

Visitation Projections

Annual visitation has increased an average of 7% over the past decade, but the statistical division of the NPS Denver Service Center indicates that the erratic nature of annual visitation makes long-term forecasting difficult. A modest increase in visitation should be expected over the life of the general management plan. The statistical office has recommended that facilities be designed to accommodate from 285,000 to 300,000 visitors per year, or a peak of 63,000 to 67,000 during July and August.

TABLE B-2: VISITOR STATISTICS 1979 – 1990

Year	Visits	Percentage of Change	Tents	RVs	Backcountry
1979	220,698	—	3,909	9,177	252
1980	162,454	- 26	6,533	10,504	342
1981	236,525	+ 46	6,673	10,973	283
1982	294,387	+ 24	5,852	10,168	426
1983	273,693	- 7	4,214	10,696	227
1984	220,801	- 19	4,509	9,926	119
1985	172,503	- 22	3,711	8,210	118
1986	178,332	+ 3	3,438	9,292	130
1987	202,800	+ 14	3,601	15,026	112
1988	217,022	+ 7	1,957	14,796	42
1989	189,317	- 13	1,727	14,665	56
1990	207,766	+ 10	1,973	16,890	42

approximately 4 miles of state-maintained highway. The scenic loop road and 12 pullouts and parking areas constitute the major part of the paved road system. Secondary paved roads serving the campground and management facilities total 0.45 mile. There are 3.55 miles of graded and 2.45 miles of ungraded roads, primarily in the north unit of the monument. These roads lead to the group campground and the water system and provide access for patrol. Sections of Goodale's Cutoff, a historic wagon trail, coincide with unpaved roads in the north unit.

The monument contains 2.37 miles of paved trails and 9.58 miles of unpaved trails. The paved trails are generally associated with the various waysides along the loop road.

EXISTING DEVELOPMENT

Most of the existing development at Craters of the Moon dates from the late 1950s and early 1960s, when extensive redevelopment was undertaken. Most of the management and visitor facilities are in a small developed area adjacent to U.S. 20-26-93. Other facilities are along the scenic loop road and across the highway in the north unit. The main developed area is constrained by the highway corridor, Sunset Ridge, and the North Crater lava flow to the south. There is virtually no room for expansion of the developed area; any new facilities would have to be fitted into the existing area.

Roads and Trails

The monument contains 6.65 miles of paved primary roads besides the

Buildings and Facilities

The visitor center, which is combined with monument headquarters in a fairly small building of nondescript 1950s design, contains a lobby with an information desk and publication sales, a small

TABLE B-3: MONTHLY VISITATION, 1984 - 1990

Month	1984	1985	1986	1987	1988	1989	1990
January	819	1,123	1,519	3,293	3,906	3,095	2,790
February	2,293	2,386	2,401	3,108	3,240	1,060	2,110
March	3,929	3,792	3,962	4,561	8,135	2,072	3,322
April	4,935	4,596	5,172	8,885	9,660	2,540	10,304
May	17,942	10,503	12,044	24,209	14,270	16,782	18,119
June	31,742	31,990	32,632	30,345	37,885	37,390	37,051
July	58,590	44,679	48,119	45,105	46,329	45,920	48,706
August	56,528	39,711	35,656	43,942	42,315	37,729	40,362
September	28,378	21,320	22,160	24,041	28,472	28,875	29,015
October	10,006	8,470	9,005	9,982	11,627	9,284	10,483
November	4,410	2,849	2,478	2,877	3,380	3,112	3,389
December	1,289	1,084	3,184	2,452	7,803	1,458	2,115

exhibit room, and large public restrooms (see the Existing Conditions: Headquarters Area illustration). These facilities are all accessible to visitors with disabilities. In the management section are a small coffee room, a library, a restroom, and four office spaces, one of which is adjacent to the information desk in the lobby. In the era when this building was constructed, energy conservation was not a consideration. Since then there has been extensive renovation to improve energy efficiency, including enclosure of the entrance porch. Two parking areas with 50 spaces provide visitor parking; parking for the monument staff is available behind the building in the maintenance yard.

The 52-site campground contains a 130-seat amphitheater. There are two restrooms, each of which will accommodate one male and one female. An entrance station kiosk is located along the loop road where it passes through the campground (see the Existing Conditions: Entrance Station illustration). Vault toilets are located at the Tree Molds and caves parking areas and near the entrance station (the latter is primarily for winter use.) There are pit toilets in the group camping area.

Immediately behind the visitor center/headquarters building is a six-bay maintenance building. Parts of that building have been converted to offices. Fuel tanks and pumps are at the east end of the building. Vehicles are stored in the maintenance yard between the two buildings. A chlorinator building near the campground and a small storage building near the service road to the boneyard complete the management facilities.

The employee housing area east of the maintenance building consists of four one-room apartments, a duplex residence, and three single-family residences. If necessary, eight seasonal employees can be housed in the apartments, but this practice would violate current NPS housing policy.

Wood-burning stoves have been added to reduce heating costs in the family housing, and residences are being rehabilitated as funds become available. The major improvements being added are insulation and thermal windows. As appliances, storage cabinets, and flooring material are replaced and some spaces are remodeled, the family units are becoming more livable. It is questionable whether the apartments could be rehabilitated in a cost-effective manner to meet NPS housing standards.

Minor facilities in the monument are a weather station, a radio base station and repeater, air quality monitoring equipment, and temporary facilities (tents, solar shower, toilets) in the research camp in Little Cottonwood Canyon. A boneyard for the storage of materials is at the end of a short service road on the north side of Sunset Ridge.

Utility Systems

The local Rural Electrification Administration cooperative association furnishes power to several distribution points in the developed area. The monument maintains the distribution system beyond the meter. Telephone lines come into the monument from Arco. Power and telephone lines enter the monument overhead from the highway. Utilities are underground in the administrative area but overhead in the campground.

Water, which is supplied by four springs and two wells (15 gallons per minute) in the northern part of the monument, is gravity-fed through a chlorinator and then stored in two concrete tanks (50,000 and 100,000 gallons) across the highway on the slope of Sunset Cone. From there the water is distributed to the visitor center, the campground, the group campground, and the housing areas.

Sprinkler systems are in place throughout the headquarters and residential sections to maintain the extensive lawn areas. At peak times, when lawns are being irrigated and visitor use is high, water consumption exceeds the supply from spring and well sources. There is a possibility that the supply of water could be exhausted in case of structural fires. Additional wells are being tested as a possible replacement for the spring sources.

Sewage for the utility area and the visitor center is handled by a 2,000-gallon single-compartment septic tank and leaching well. Approximately 150 feet of leach field extends through a section of the visitor center lawn. The residential area is served by a single-compartment septic tank and leaching well located in a fairly large cinder field away from the buildings. The campground restrooms are served by separate systems, each consisting of a septic tank and a concrete block open-joint leaching well. The vault toilets mentioned earlier are pumped by a contractor.

Deer crossing
from paths t

Visitor center

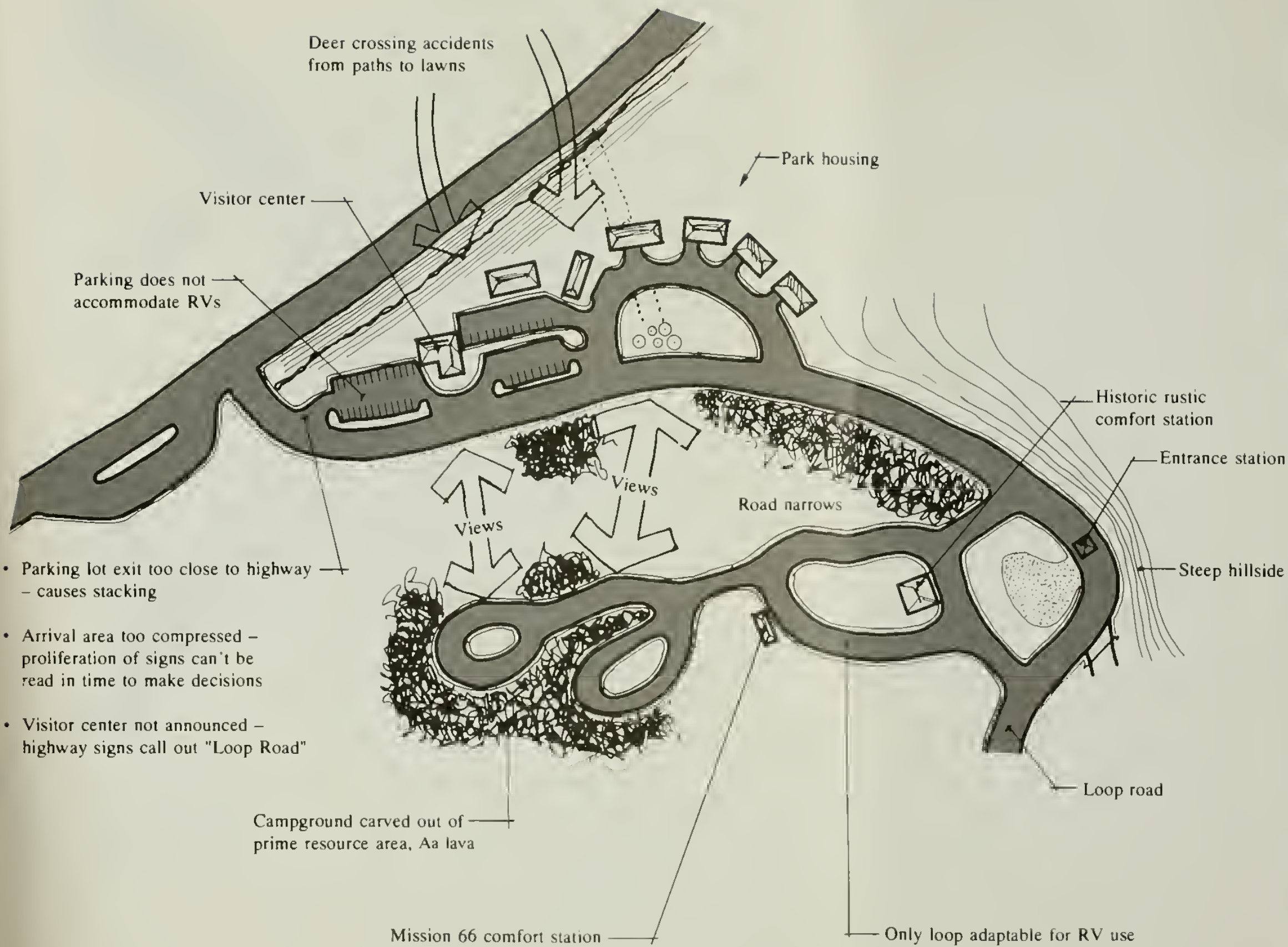
Parking does not
accommodate RVs

- Parking lot exit too close to highway – causes stacking
- Arrival area too compressed – proliferation of signs can't be read in time to make decisions
- Visitor center not announced – highway signs call out "Loop Road"

Campground curve
prime resource are

Existing Conditions *Headquarters Area* Craters of the Moon National Monument

United States Department of the Interior - National Park Service
DSC/Feb'91/131/20019



Existing Conditions

Headquarters Area

Craters of the Moon

National Monument

United States Department of the Interior - National Park Service
DSC/Feb'91/131/20019

No Scale ↑ N

Campground exit road (one way)
conflicts with traffic coming to
entrance station and with vehicles
backing out of campsites

Entrance to self-registration
and pull-out area precedes
kiosk and sign that
explains process

Entrance station

Pedestrians cross traffic to
use temporary restrooms

Trail to Sunset Ridge

Information
registration

Gated service road is highly
visible from entrance station

Difficult angle to negotiate for
maintenance vehicles headed into park

Two way traffic on road
designed for one way
Angles difficult to negotiate

Existing Conditions

Entrance Station Area Craters of the Moon National Monument

United States Department of the Interior - National Park Service
DSC/Feb'91/131/20020

No Scale ↑ N

APPENDIX C: VOLCANIC FEATURES

- aa lava flow:** A lava flow that has a rough, jagged surface with many sharp points. Literal meaning of this Hawaiian word is "hard on the feet."
- cinder cone:** A relatively steep-sided cone built of small fragments of volcanic material that spewed from a vent and fell back into a pile. Because the loosely packed fragments are rather permeable, water runs through the cinders rather than eroding away the cones.
- collapse depression:** A basin-shaped volcanic depression caused by the collapse of the roof of a lava tube. Some depressions may be more than a hundred feet in diameter.
- eruption:** The emission or ejection of volcanic materials. In **central** eruptions, volcanic materials are emitted from a central vent or pipe and ordinarily form a volcanic cone; in **fissure** eruptions, lava or pyroclastic materials emanate from a relatively narrow fissure, generally building lava plains and plateaus. Craters of the Moon's features resulted from fissure eruptions.
- fissure:** An extensive crack, break, or fracture in the earth's crust. An eruptive fissure is one from which volcanic products issued.
- kipuka:** An island of vegetation that has developed on the top of an old lava flow that is surrounded by newer flows but has not been covered by a more recent lava flow.
- lava bomb:** A fragmentary piece of volcanic material that was liquid at the time of ejection. The soft lava bomb tumbles and spins as it flies, acquiring a characteristic twisted tear shape. Most lava bombs have surface markings acquired during flight through the air or after landing. Also called "volcanic bomb."
- lava tube:** A flow channel through which liquid lava moved while the upper surface hardened. When fluid molten lava flowed out of the ground, it behaved like a stream of water working its way downhill. Soon the surface cooled and hardened, forming a crust that insulated the molten lava inside, enabling it to remain liquid. The molten inside lava eventually flowed out, leaving the crust as the walls of a lava tube. A tube may have collapsed sections or skylights where only the ceiling has collapsed. The inside diameter of lava tubes found in Craters of the Moon varies from a few feet to 50 feet.
- pahoehoe lava flow:** A smooth, billowy, or ropy appearing lava flow that resulted from a more fluid flow than that which caused aa lavas (*pahoehoe* means "ropy" in Hawaiian). Its formation process can be described as "hardening like fudge poured from a pan." A continued flow of pahoehoe lava may break the twisted surface into blocks. The rough, jagged blocks resemble aa lava but do not have the sharp surface projections and spines characteristic of aa.
- pressure ridge:** An elongated ridge formed by viscous lava pushing upward.
- rafted block:** Large fragment of crater broken off and carried to another location by flowing lava.
- spatter cone:** A low, steep-sided hill or mound that formed when clots of pasty lava stuck together as they fell, forming a cone around the volcanic vent. The spatter cones in Craters of the Moon are generally less than 100 feet tall.
- squeezeup:** A lava ridge that results from lava pushing up through existing cracks.
- tree mold:** A hollow cast of a tree formed when molten lava encased a tree and then hardened.
- volcanic bomb:** See *lava bomb*.
- volcanic rift zone:** A concentration of volcanic landforms and structures along a linear zone of cracks in the earth's crust.
- volcanic vent:** An opening in the earth's crust through which volcanic materials are erupted.

APPENDIX D: OBJECTIVES

MANAGEMENT OBJECTIVES

Management objectives are taken from the 1988 *Statement for Management*, which was approved by the regional director on October 11, 1988.

To preserve to the greatest extent possible the basaltic volcanism features of the monument through effective interpretation and protection programs.

To perpetuate the natural ecosystems of the monument through active and effective resource management programs.

To preserve visibility and associated vistas and to prevent deterioration of the airshed and all air quality related values.

To identify, evaluate, protect, and preserve the park's archeological and historic resources in a manner consistent with historic preservation law and National Park Service policies.

To emphasize water conservation in the development of management and visitor facilities as well as in the park's operating programs.

To provide, in the most environmentally suitable locations possible, only those developments necessary to serve the needs of park visitors and park management.

To foster an understanding and appreciation of the environmental forces that formed the present day landscape of the Snake River Plain as well as an understanding of the plants and animals that have adapted to this harsh habitat.

To encourage camping, picnicking, hiking, and other compatible recreational uses by providing quality facilities for a more meaningful experience for the visitor.

To promote perpetuation and compatible use of monument and regional resources through cooperation in planning and management activities with other governmental agencies as well as private interests.

To promote a continuing program of scientific research and study to gather information that will allow for long-term wildlife management programs.

To work on a cooperative basis with other government agencies, primarily the Bureau of

Land Management, in matters of mutual concern such as the effect of stock grazing in the vicinity of the monument.

To establish objective policy and guidelines (backcountry management plan) that will ensure a strong and definite commitment by park management to the preservation of the monument's wilderness.

To continue management of the Lava Flow campground to ensure a safe and pleasant experience for the monument visitor and to provide maximum feasible access to the handicapped.

To increase the Park Service's ability to accomplish its mission in the most cost effective manner, creating more park self-sufficiency and thus helping to offset the national deficit.

To increase visitor use and enjoyment of the monument during the winter.

INTERPRETIVE OBJECTIVES

The following objectives are listed in the 1990 *Statement For Interpretation* for Craters of the Moon National Monument.

To encourage visitors' understanding and appreciation of the geological, biological, and ecological aspects of Craters of the Moon.

To stimulate in visitors an increasing awareness of and interest in all natural processes occurring at the monument and elsewhere.

To encourage in visitors an understanding of what preservation is and the role it plays in the management and maintenance of natural areas.

To present to visitors the concerns of the National Park Service on various issues that affect the natural world.

To give visitors a better understanding of monument regulations and policies.

To instill in visitors a sense of caution when confronted with unfamiliar safety hazards.

To create an interest in and foster understanding of the way in which past human activities have influenced the monument and our culture.

APPENDIX E: LEGISLATION

Some of the presidential proclamations and legislation pertaining to Craters of the Moon National Monument are reproduced in this appendix.

BY THE PRESIDENT OF THE UNITED STATES OF AMERICA

A PROCLAMATION

[No. 1694—May 2, 1924—43 Stat. 1947]

WHEREAS, there is located in townships one south, one and two north, ranges twenty-four and twenty-five east of the Boise Meridian, in Butte and Blaine Counties, Idaho, an area which contains a remarkable fissure eruption together with its associated volcanic cones, craters, rifts, lava flows, caves, natural bridges, and other phenomena characteristic of volcanic action which are of unusual scientific value and general interest; and

WHEREAS, this area contains many curious and unusual phenomena of great educational value and has a weird and scenic landscape peculiar to itself; and

WHEREAS, it appears that the public interest would be promoted by reserving these volcanic features as a National Monument, together with as much land as may be needed for the protection thereof.

NOW, THEREFORE, I, Calvin Coolidge, President of the United States of America, by authority of the power in me vested by section two of the act of Congress entitled, "An Act for the preservation of American antiquities," approved June eighth, nineteen hundred and six (34 Stat., 225) do proclaim that there is hereby reserved from all forms of appropriation under the public land laws, subject to all valid existing claims, and set apart as a National Monument all that piece or parcel of land in the Counties of Butte and Blaine, State of Idaho, shown as the Craters of the Moon National Monument upon the diagram hereto annexed and made a part hereof.

Warning is hereby expressly given to all unauthorized persons not to appropriate, injure, destroy or remove any feature of this Monument and not to locate or settle upon any of the lands thereof.

The Director of the National Park Service, under the direction of the Secretary of the Interior, shall have the supervision, management, and control of this Monument as provided in the act of Congress entitled, "An Act to establish a National Park Service and for other purposes," approved August twenty-fifth, nineteen hundred and sixteen (39 Stat., 535) and Acts additional thereto or amendatory thereof.

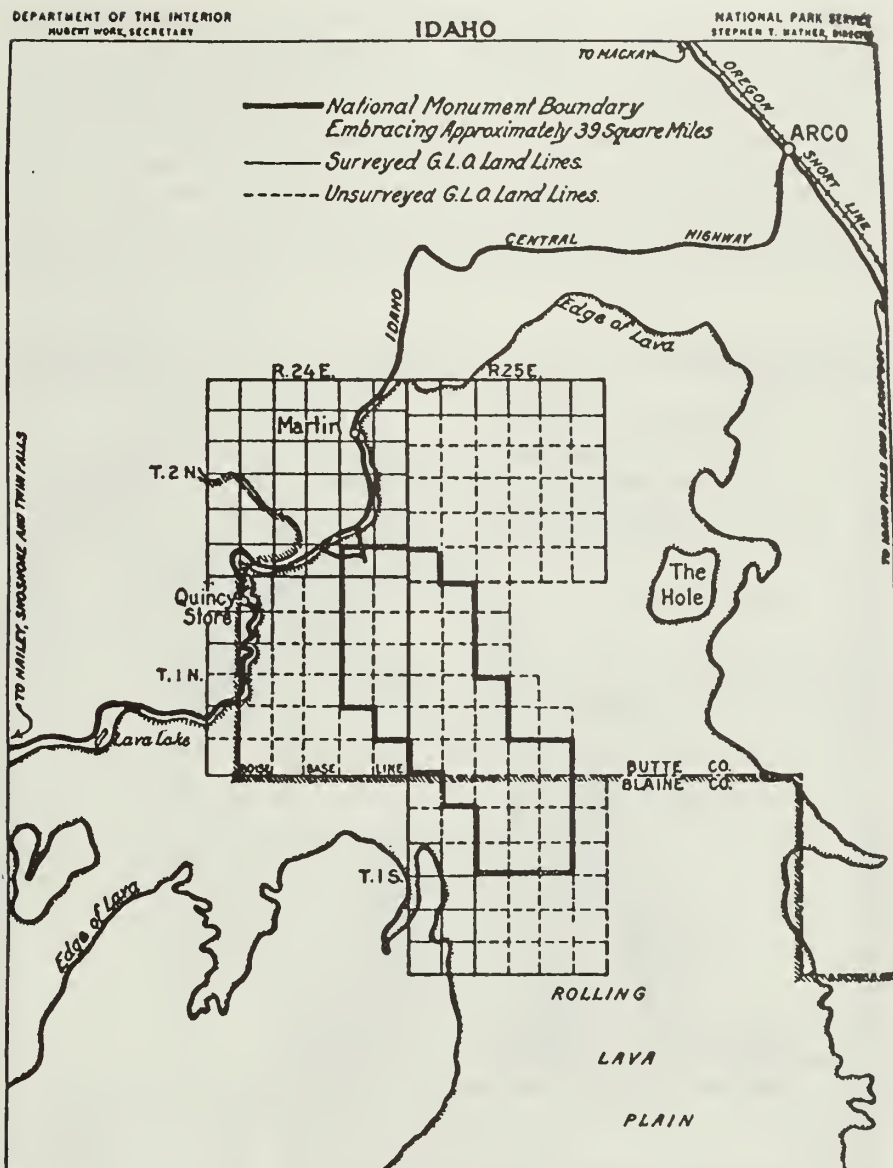
IN WITNESS WHEREOF, I have hereunto set my hand and caused the seal of the United States to be affixed.

DONE in the City of Washington this 2d day of May in the year of our Lord one thousand nine hundred and twenty-four and of the [SEAL] Independence of the United States of America the one hundred and forty-eighth.

CALVIN COOLIDGE.

By the President:
CHARLES E. HUGHES,
Secretary of State.

VIII. NATIONAL MONUMENTS—CRATERS OF THE MOON



CRATERS OF THE MOON NATIONAL MONUMENT

BY THE PRESIDENT OF THE UNITED STATES OF AMERICA

A PROCLAMATION

[No. 1843—July 23, 1928—45 Stat. 2959]

WHEREAS, it appears that the public interest would be promoted by adding to the Craters of the Moon National Monument in the State of Idaho, certain adjoining lands for the purpose of including within said monument certain springs for water supply and additional features of scientific interest located thereon.

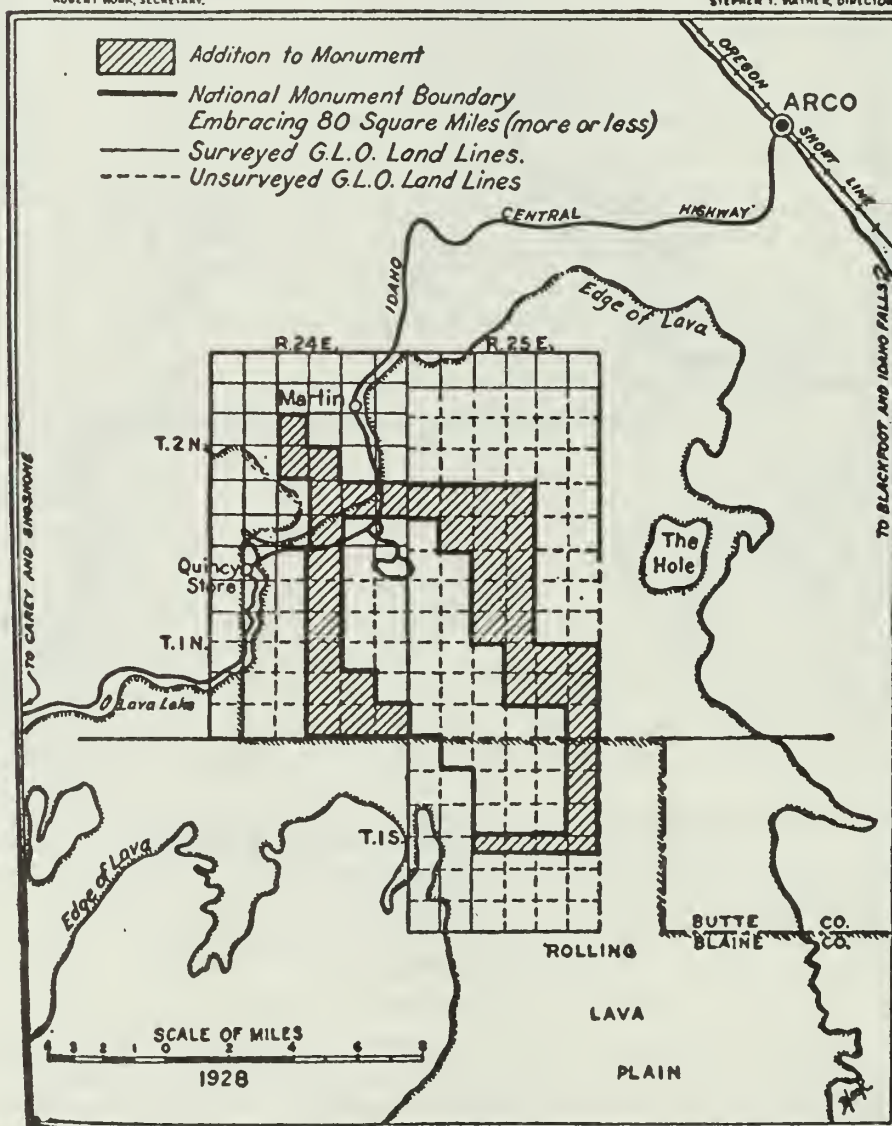
VIII. NATIONAL MONUMENTS—CRATERS OF THE MOON

NOW, THEREFORE, I, Calvin Coolidge, President of the United States of America, by authority of the power in me vested by section two of the act of Congress entitled, "An Act for the Preservation of American antiquities", approved June eighth, nineteen hundred and six (34 Stat., 225), do proclaim that Sections sixteen, twenty-one, twenty-two, twenty-five, twenty-six, twenty-seven, and thirty-four in Township two North, Range twenty-four East; Unserved Sections twenty-seven, twenty-eight, twenty-nine, thirty, thirty-two, thirty-three and thirty-four in Township two North, Range twenty-five East; Unserved Sections three, ten, fifteen, twenty-two, twenty-six, twenty-seven, thirty-four, thirty-five and thirty-six in Township

DEPARTMENT OF THE INTERIOR
HUBERT WORK, SECRETARY.

IDAHO

NATIONAL PARK SERVICE
STEPHEN T. MATHER, DIRECTOR.



CRATERS OF THE MOON NATIONAL MONUMENT

U. S. GOVERNMENT PRINTING OFFICE: 1928

VIII. NATIONAL MONUMENTS—CRATERS OF THE MOON

one North, Range twenty-four East; Unsurveyed Sections three, four, nine, ten, fifteen, sixteen, twenty-two, twenty-three, twenty-four, twenty-five, twenty-six, twenty-seven and thirty-six in Township one North, Range twenty-five East; Unsurveyed Sections one, twelve, thirteen and the north half of Sections twenty-one, twenty-two, twenty-three and twenty-four in Township one South, Range twenty-five East; all Boise Meridian, Idaho; are hereby reserved from all forms of appropriation under the public land laws, subject to all valid existing claims, and set apart as an addition to the Craters of the Moon National Monument and that the boundaries of the said National Monument are now as shown on the diagram hereto annexed and made a part hereof.

Warning is hereby expressly given to all unauthorized persons not to appropriate, injure, destroy or remove any feature of this Monument and not to locate or settle upon any of the lands thereof.

The Director of the National Park Service, under the direction of the Secretary of the Interior, shall have the supervision, management, and control of this Monument as provided in the Act of Congress entitled "An Act to establish a National Park Service and for other purposes," approved August twenty-fifth, nineteen hundred and sixteen (39 Stat., 535) and Acts additional thereto or amendatory thereof.

IN WITNESS WHEREOF, I have hereunto set my hand and caused the seal of the United States to be affixed.

DONE at the City of Washington this 23 day of July in the year of our Lord one thousand nine hundred and twenty-eight and of the [SEAL]. Independence of the United States of America the one hundred and fifty-third.

CALVIN COOLIDGE.

By the President:

FRANK B. KELLOGG,
Secretary of State.

BY THE PRESIDENT OF THE UNITED STATES OF AMERICA

A PROCLAMATION

[No. 1916—July 9, 1930—46 Stat. 3029]

WHEREAS lot 1, section 28, township 2 north, range 24 east, Boise meridian, Idaho, is bounded on the north and east by the Craters of the Moon National Monument; and

WHEREAS said lot 1, section 28, contains a spring which is needed to furnish the said monument with an adequate water supply; and

WHEREAS said lot 1, section 28, is vacant unappropriated public land of the United States;

NOW, THEREFORE, I, Herbert Hoover, President of the United States of America, do proclaim that the lands hereinafter described shall be, and are hereby, added to and included within the Craters of the Moon National Monument, and as part of said monument shall be, and are hereby, made subject to the provisions of the act of August 25, 1916 (39 Stat. 535), entitled "An act to establish a national park service, and for other purposes" and all acts supplementary thereto and amendatory thereof and all other laws and rules and regulations applicable to, and extending over, the said monument:

VIII. NATIONAL MONUMENTS—CRATERS OF THE MOON

BOISE MERIDIAN

In township 2 north, range 24 east, lot 1, section 28.

Nothing herein shall affect any existing valid claim, location, or entry on said lands made under the land laws of the United States whether for homestead, mineral, right of way, or any other purposes whatsoever, or shall affect the right of any such claimant, locator, or entryman to the full use and enjoyment of his land.

IN WITNESS WHEREOF, I have hereunto set my hand and caused the seal of the United States to be affixed.

DONE at the City of Washington this 9th day of July, in the year of our Lord nineteen hundred and thirty, and of the Independence of [SEAL] the United States of America the one hundred and fifty-fifth.

HERBERT HOOVER.

By the President:

HENRY L. STIMSON,
Secretary of State.

BY THE PRESIDENT OF THE UNITED STATES OF AMERICA

A PROCLAMATION

[No. 2499—July 18, 1941—55 Stat. 1660]

WHEREAS it appears that certain public land which is now a part of the Craters of the Moon National Monument in the State of Idaho, established by proclamation of May 2, 1924, 43 Stat. 1947, and enlarged by proclamations of July 23, 1928, 45 Stat. 2959, and July 9, 1930, 46 Stat. 3029, is not necessary for the proper care and management of the objects of scientific interest situated on the lands within the said monument; and

WHEREAS it appears that such land is needed for the construction of Idaho State Highway No. 22, by the State of Idaho:

NOW, THEREFORE, I, Franklin D. Roosevelt, President of the United States of America, under and by virtue of the authority vested in me by section 2 of the act of June 8, 1906, c. 3060, 34 Stat. 225, U. S. C., title 16, sec. 431, do proclaim that a strip of land situated in section 3, Township 1 North, Range 24 East, and sections 25, 34, 35 and 36, Township 2 North, Range 24 East, Boise Meridian, Butte County, Idaho, as shown on a map prepared by the Department of Public Works, Bureau of Highways, State of Idaho, on file in the General Land Office, Department of the Interior, bearing the title

"FAP 128-E(1)

Map showing right-of-way across

Craters of the Moon National

Monument—Butte County—Idaho

February 1941 — Scale 1"=400'

is hereby excluded from the Craters of the Moon National Monument.

IN WITNESS WHEREOF, I have hereunto set my hand and caused the seal of the United States to be affixed.

DONE at the City of Washington this 18th day of July in the year of our Lord nineteen hundred and forty-one, and of the Independence [SEAL] of the United States the one hundred sixty-sixth.

FRANKLIN D. ROOSEVELT.

By the President:

SUMNER WELLES.

Acting Secretary of State.

Presidential Documents

From Federal Register of Nov. 22, 1962

Title 3—THE PRESIDENT

Proclamation 3506

ADDITION TO THE CRATERS OF THE MOON NATIONAL MONUMENT, IDAHO

By the President of the United States of America
A Proclamation

WHEREAS the Craters of the Moon National Monument, Idaho, established by Proclamation No. 1694 of May 2, 1924, was reserved and set apart as an area that contains a remarkable fissure eruption together with its associated volcanic cones, craters, rifts, lava flows, caves, natural bridges, and other phenomena characteristic of volcanic action that are of unusual scientific value; and

WHEREAS it appears that it would be in the public interest to add to the Craters of the Moon National Monument a 180-acre kipuka, a term of Hawaiian origin for an island of vegetation completely surrounded by lava, that is scientifically valuable for ecological studies because it contains a mature, native sagebrush-grassland association which has been undisturbed by man or domestic livestock; and to add to the monument the intervening lands between the kipuka and the present monument boundaries:

NOW, THEREFORE, I, JOHN F. KENNEDY, President of the United States of America, by virtue of the authority vested in me by Section 2 of the Act of June 8, 1906 (34 Stat. 225; 16 U.S.C. 431), and subject to valid existing rights do proclaim that the following-described lands are hereby added to and reserved as a part of the Craters of the Moon National Monument:

BOISE MERIDIAN, IDAHO

T. 1 S., R. 24 E.

sec. 3, W- $\frac{1}{2}$

All of section 4, 5, 8, 9, 17, 18 and 19

sec. 10, W- $\frac{1}{2}$

sec. 20, W- $\frac{1}{2}$ and W- $\frac{1}{2}$ E- $\frac{1}{2}$

sec. 29, NW- $\frac{1}{4}$ and W- $\frac{1}{2}$ NE- $\frac{1}{4}$

sec. 30, NE- $\frac{1}{4}$;

comprising 5,360 acres, more or less.

Warning is hereby expressly given to all unauthorized persons not to appropriate, injure, destroy or remove any of the features or objects of this monument and not to locate or settle upon any of the lands thereof.

IN WITNESS WHEREOF, I have hereunto set my hand and caused the Seal of the United States of America to be affixed.

DONE at the City of Washington this nineteenth day of November
in the year of our Lord nineteen hundred and sixty-two, and
[SEAL] of the Independence of the United States of America the one
hundred and eighty-seventh.

JOHN F. KENNEDY

By the President :

DEAN RUSK,
Secretary of State.

[F.R. Doc. 62-11655; Filed, Nov. 21, 1962; 9:54 a.m.]

9. Craters of the Moon

An Act to designate certain lands as wilderness. (84 Stat. 1104)

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

* * * * *

DESIGNATION OF WILDERNESS AREAS WITHIN NATIONAL PARKS AND MONUMENTS

SEC. 2. In accordance with section 3(c) of the Wilderness Act (78 Stat. 890; 16 U.S.C. 1132(c)), the following lands are hereby designated as wilderness:

(a) certain lands in the Craters of the Moon National Monument, which comprise about forty-three thousand two hundred and forty-three acres and which are depicted on a map entitled "Wilderness Plan, Craters of the Moon National Monument, Idaho", numbered 131-91,000 and dated March 1970, which shall be known as the "Craters of the Moon National Wilderness Area";

SEC. 4. As soon as practicable after this Act takes effect, a map and a legal description of each wilderness area shall be filed with the Interior and Insular Affairs Committees of the United States Senate and the House of Representatives, and such description shall have the same force and effect as if included in this Act: *Provided, however,* That correction of clerical and typographical errors in such legal description and map may be made.

SEC. 5. Wilderness areas designated by or pursuant to this Act shall be administered in accordance with the provisions of the Wilderness Act governing areas designated by that Act as wilderness areas, except that any reference in such provisions to the effective date of the Wilderness Act shall be deemed to be a reference to the effective date of this Act, and any reference to the Secretary of Agriculture shall be deemed to be a reference to the Secretary who has administrative jurisdiction over the area.

Approved October 23, 1970.

APPENDIX F: REMODELING AND NEW CONSTRUCTION

An appropriate architectural theme does not exist in the monument, and regional architecture does not suggest a theme other than the use of lava

rock, which would not be appropriate in the monument. Space and functional requirements for developments are detailed in the following sections.

VISITOR CENTER

The design of the new visitor center could suggest a theme for the monument or could be a unique statement.

Lobby

- National Park Service information desk
- Natural history association sales desk
- Some exhibits (assume orientation type)
- Book sales area
- Space to accommodate 75–100 people at a time

Exhibit Room

- Exhibits plus capacity for a maximum of 175–200 people at a time

Audiovisual/Multipurpose Room

- Seating for 60–100 in portable chairs
- Permanent projection booth and screen
- Storage for chairs and tables

Visitor Restrooms

- Capacity must be compatible with 200 visitors on site at a time

Outdoor Meeting Area

- Covered area
- Capacity for 50–75 people
- Possibly some picnic tables

Other Facilities Needed for Visitors

- Public pay phone
- Area for refreshment vending machines

Library

Capacity for 1,000 volumes, with room for additions

Room for at least two large desks with chairs

Museum Storage

Must be climate controlled

Storage for a minimum of 12 museum cases

Space for herbarium

Space for computer work station

Sink and work space, equipment storage

Natural History Association Offices

Space for two employees and associated equipment

Storage for merchandise and books, with room to handle and inventory incoming stock

National Park Service Offices

Separate offices for two permanent employees

Work space for at least three seasonal employees

Separate room for mail handling and for copy and fax equipment

Separate room for program preparation with work table, movie screen, cabinets for storage of equipment and slides

Miscellaneous Facilities for Monument Operations

Employee restrooms with changing and shower room, preferably one for each sex

Lunchroom with refrigerator, microwave, and table, and chairs

Utility and maintenance storage rooms for cleaning equipment and supplies

Mechanical room(s) for heating and cooling equipment, telephone and electrical panel, etc.

First aid room with space for bed, supply cabinet, and sink

REMODELING OF OLD VISITOR CENTER/HEADQUARTERS BUILDING

The existing building contains large public restrooms, an exhibit room, a public lobby, and enclosed porches that could be converted to administrative spaces. The existing space probably would not be adequate for the projected needs, so it is

likely that an addition would be needed. The existing building is not energy efficient, although much has been done to improve it. Consideration must be given to energy needs and a more sensitive architectural theme.

Superintendent's Office

Work station with desk, computer, and bookcases

Seating for three visitors

Office for Rangers and Resource Management

- Offices for chief ranger and two permanent rangers, including three computer work stations
- Checking facility with lockers for five seasonal employees
- Room for handling fees
- Storage space for equipment for emergency medical service, search-and-rescue operations, firefighting, and general needs (see "Maintenance" for vehicle storage needs)
- Office for two resource management personnel and two seasonal personnel
- Storage area work lab for resource management division

Administration Area

- Area for two permanent employees, including two computer work stations
- Seating area and counter to handle walk-ins
- File storage

Visitor Restrooms

- Restrooms for general public, smaller than employee restrooms

Other Rooms for Monument Operations

- Conference room with space for 25 people at tables, up to 100 in chairs
- Extra office with work space for researcher or VIP, including computer work space
- Mail and copy room with copy and fax machines, storage for copier and paper supplies, employee mail-boxes
- Security room with safes and evidence lockers (including a freezer)

Miscellaneous Facilities for Monument Operations

- Employee restrooms with changing and shower room, preferably one for each sex
- Lunchroom with refrigerator, microwave, table, and chairs
- Utility room with heating and cooling equipment, sink, cleaning equipment and supplies, and telephone lines—existing may not be adequate

MAINTENANCE AREA REMODELING AND EXPANSION

The existing maintenance facilities are not energy-efficient, and they have insufficient work space. At least two additional bays are needed to store larger vehicles. The ranger and the Resource Management Division would like to see heated storage for an emergency vehicle and a wildland fire truck. There is not much expansion space, but the elimination of

visitor functions from this area would increase flexibility. The site is highly visible from the highway and campground, so aesthetics must be considered. The feasibility of converting the apartment building to maintenance functions also should be considered.

Office for Chief of Maintenance

- Office space for two permanent employees, including computer space
- Space for a 6-foot drafting table, file cabinets, and bookcases
- Space for two clothes lockers
- Checking area and locker room for six seasonal employees
- Employee restroom with shower

Metal Shop & Vehicle Storage

- 30' x 20' heated work area with metal-covered workbenches on outside walls
- Two heated vehicle bays with doors 12' wide by 16' high
- Overhead electric hoist
- Room for storage bins for nuts and bolts
- Heated bay for storage of fire truck, storage area for fire equipment

Heated Area for Dispensing Fuel and Storing Flammable Materials

- Area heated to prevent freezing
- Cabinet for storing lubricating fluids
- Storage shelves for 50 gallons of paint
- Storage area for three 55-gallon drums
- One pump for unleaded gasoline and one for diesel fuel

Covered Cold Storage

- Pipe rack, snow pole storage
- Storage area for small equipment such as lawn mowers, snow machines, and cement mixers
- Rack for hand tools (shovels, rakes, etc.)

Temporary Storage Area

- Aggregate (10 cubic yards)
- Cold mix (30 cubic yards)
- Concrete bins for storage of these materials

Hazardous Materials Storage

- Area to store six 55-gallon drums; must be able to contain spills

Workshop area is adequate. An area is needed for bins and shelves to store electrical and plumbing parts.

APPENDIX G: COMPLIANCE WITH NATIONAL HISTORIC PRESERVATION ACT

The following list shows the status of compliance of actions proposed in the *Craters of the Moon General Management Plan* with section 106 of the National Historic Preservation Act of 1966, as amended. This is in accordance with the program

matic memorandum of agreement dated August 15, 1991, among the Advisory Council on Historic Preservation, the Conference of State Historic Preservation Officers, and the National Park Service.

Action

Compliance Required

General Development

- Scenic Loop Drive improvement projects
- Big Sink interpretive wayside development
- Caves parking area modification
- Devils Orchard interpretive trail modifications
- Development of new visitor center, entrance road, and related facilities
- Campground modifications
- Additional employee housing, when developed in park
- Undergrounding of utilities
- Sunset Ridge Trail

Consultation with state historic preservation officer required in identification and treatment of historic properties; consultation with Advisory Council on Historic Preservation as appropriate.

Determination of eligibility of two log structures for National Register of Historic Places

Consultation with state historic preservation officer required in identification and treatment; consultation with Advisory Council on Historic Preservation as appropriate.

APPENDIX H: VEGETATION, INCLUDING SENSITIVE PLANTS CRATERS OF THE MOON NATIONAL MONUMENT

PLANTS MENTIONED IN TEXT

Plant species mentioned in the text of this document are listed below with their scientific names.

Trees

Limber pine	(<i>Pinus flexilis</i>)
Quaking aspen	(<i>Populus tremuloides</i>)
Douglas-fir	(<i>Pseudotsuga menziesii</i>)

Shrubs

Low sagebrush	(<i>Artemisia arbuscula</i>)
Early low sagebrush	(<i>Artemisia longiloba</i>)
Three-tip sagebrush	(<i>Artemisia tripartita</i>)
Mountain big sagebrush	(<i>Artemisia tridentata</i> ssp. <i>vaseyana</i>)
Antelope bitterbrush	(<i>Purshia tridentata</i>)
Mountain snowberry	(<i>Symphoricarpos oreophilus</i>)

Grasses

Bluebunch wheatgrass	(<i>Agropyron spicatum</i>)
Cheatgrass	(<i>Bromus tectorum</i>)
Idaho Fescue	(<i>Festuca idahoensis</i>)
Needle-and-thread grass	(<i>Stipa comata</i>)
Nelson's needlegrass	(<i>Stipa occidentalis</i> var. <i>nelsonii</i>)
Thurber needlegrass	(<i>Stipa thurberiana</i>)

Forbs

Diffuse knapweed	(<i>Centaurea diffusa</i>)
Spotted knapweed	(<i>Centaurea maculosa</i>)
Canadian thistle	(<i>Cirsium vulgare</i>)
Leafy spurge	(<i>Euphorbia esula</i>)
Common mullein	(<i>Verbascum thapsus</i>)

VEGETATION TYPES

Day and Wright (1985) described twenty-six distinct vegetation types found in Craters of the Moon National Monument. The following descriptions of the types are taken from their report. Only some of the more common species are listed for each type.

1: Cinder Gardens

The cinder gardens community is characterized by a cinder surface and a low total plant cover. Common species are dwarf buckwheat (*Eriogonum ovalifolium* var. *depressum*), silverleaf phacelia (*Phacelia hastata*), Douglas chaenactis (*Chaenactis douglasii*), two species of monkeyflower (*Mimulus* spp.), dwarf onion (*Allium simillimum*), and bitter-root Lewisia (*Lewisia rediviva*).

2: Low Density Lava Flows

Low density lava flows are generally the youngest in the monument and have relatively low plant cover. Shrubs, which provide less than 5% of total cover, include tansybush (*Chamaebatiaria millefolium*), ocean spray (*Holodiscus* spp.), mock orange (*Philadelphus lewisii*), dwarf goldenweed (*Happlopappus nanus*), and, in favorable microsites, antelope bitterbrush (*Purshia tridentata*) and lava phlox (*Leptodactylon pungens*). Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) is common in this vegetation type in the southern parts of the monument. Common forbs are scabland penstemon (*Penstemon deustus*) and desert parsley (*Cymopterus terebinthinus*). Sandberg bluegrass (*Poa sandbergii*) and squirreltail (*Sitanion hystrix*) are the most common grasses.

3: Medium Density Lava Flows

Medium density lava flows have more vegetational cover (up to 15%) than the low density lava flows, but species composition is very similar. Additional grasses are Thurber needlegrass (*Stipa thurberiana*) and Indian ricegrass (*Oryzopsis hymenoides*).

4: Mountain Big Sagebrush/Bluebunch Wheatgrass

The mountain big sagebrush/bluebunch wheatgrass type is widespread in the monument and diverse in

composition. Mountain big sagebrush is the dominant shrub. Bluebunch wheatgrass (*Agropyron spicatum*) is the common grass. Antelope bitterbrush is common throughout this type. North of the highway, mountain snowberry (*Symphoricarpos oreophilus*) and saskatoon serviceberry (*Amelanchier alnifolia*) are common, especially in more mesic sites such as ravines and north-facing slopes.

5: Mountain Big Sagebrush/Sandberg Bluegrass

The mountain big sagebrush/Sandberg bluegrass type occurs on less mesic sites or those with shallower soil than type 4, and there is generally more bare ground. Besides the two dominant species for which the type is named, rabbitbrush (*Chrysothamnus* spp.), antelope bitterbrush, lava phlox, and several species of buckwheat (*Eriogonum* spp.) are common. Squirreltail and bluebunch wheatgrass are common grasses on favorable microsites.

6: Mountain Big Sagebrush/Needlegrass

The mountain big sagebrush/needlegrass type is found on sandy, often shallow soils in the southern portions of the monument. Mountain big sagebrush dominates; antelope bitterbrush also is common. Wyeth eriogonum (*Eriogonum heracleoides*) and sulfur buckwheat (*E. umbellatum*) are common understory species. Needle-and-thread (*Stipa comata*), squirreltail, and Indian ricegrass are common grasses.

7: Mountain Big Sagebrush/Needle-and-thread/Cheatgrass

The mountain big sagebrush/needle-and-thread/cheatgrass type is confined to a south-facing slope at the mouth of Little Cottonwood Canyon. Mountain big sagebrush dominates, and antelope bitterbrush is common. The dominant grasses are needle-and-thread grass and cheatgrass (*Bromus tectorum*).

8: Mountain Big Sagebrush/Idaho Fescue

The mountain big sagebrush/Idaho fescue type is found on the north- and northeast-facing slopes in Little Cottonwood Canyon and on Carey Kipuka. Mountain big sagebrush occurs in sporadic clumps and at lower densities than in the mountain big sagebrush/bluebunch wheatgrass type. Herbaceous vegetation, which is relatively dense between shrubs, is dominated by Idaho fescue (*Festuca idahoensis*) and prairie junegrass (*Koeleria nitida*). Scarlet painted-cup (*Castilleja miniata*) and silvery lupine (*Lupinus argenteus*) are common forbs. In Carey Kipuka, the dominant sagebrush is basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*), but it was included in this type for simplicity.

9: Big Sagebrush/Cheatgrass

The big sagebrush/cheatgrass type, which occurs on Carey Kipuka, appears to be a relatively stable successional stage of the big sagebrush/Idaho fescue type.

10: Complex of Types 4 and 8

Type 10, a complex of types 4 and 8, which is found in Little Cottonwood canyon, contains all species common in both the mountain big sagebrush/bluebunch wheatgrass and the mountain big sagebrush/Idaho fescue types.

11: Three-tip Sagebrush/Idaho Fescue

The three-tip sagebrush/Idaho fescue type occurs on the relatively steep north-facing slopes in upper Little Cottonwood Canyon. Three-tip sagebrush (*Artemisia tripartita*) is the dominant shrub, but it occurs in low densities. Forbs in this vegetation type include silvery lupine, pussytoes (*Antennaria* spp.), stonecrop (*Sedum stenopetalum*), and Hood's phlox (*Phlox hoodii*). Idaho fescue, prairie junegrass, and Sandberg bluegrass are common grasses.

12: Early Low Sagebrush/Idaho Fescue

The early low sagebrush/Idaho fescue type is restricted to a small but distinct area on Carey Kipuka. Early low sagebrush (*Artemisia longiloba*) is

the dominant shrub. Narrowleaf pussytoes (*Antennaria stenophyllus*), mat eriogonum (*Eriogonum caespitosum*), and Hood's phlox are common forbs. Idaho fescue is the dominant grass, with squirreltail common. In a natural landmark theme study, this vegetation type was judged to be an outstanding example of the low sagebrush/Idaho fescue subtheme of the low sagebrush theme.

13: Low Sagebrush/Sandberg Bluegrass

The low sagebrush/Sandberg bluegrass type occurs on exposed, windswept ridges along Little Cottonwood Canyon. The total plant cover is less than 40%. Low sagebrush (*Artemisia arbuscula*) is the only shrub present in most areas. Stemless goldenweed (*Happlopappus acaulis*), Hood's phlox, rabbit-foot crazyweed (*Oxytropis lagopus*), mat eriogonum, and paintbrush (*Castilleja* spp.) are common forbs. Sandberg bluegrass is the dominant grass, with spikegrass (*Leucopoa kingii*) common at higher elevations. The sagebrush present at the lowest elevation where this type occurs in the monument is apparently a hybrid between three-tip and low sagebrush. In the national natural landmark theme study, this vegetation type was judged to be an outstanding example of the low sagebrush/Idaho fescue subtheme of the low sagebrush theme.

14: Low Sagebrush/Idaho Fescue

The low sagebrush/Idaho fescue type is found on sites similar to those containing type 13, but on finer textured and/or deeper soils. Idaho fescue replaces Sandberg bluegrass in this type. The total cover is higher in this type than in type 13. In the national natural landmark theme study, this vegetation type was judged to be an outstanding example of the low sagebrush/Idaho fescue subtheme of the low sagebrush theme.

15: Complex of Types 13 and 14

Type 15, is found on exposed ridges. It is composed of mosaics of the low sagebrush/Sandberg bluegrass and low sagebrush/Idaho fescue types. In the national natural landmark theme study, this vegetation type was judged to be an outstanding example of the low sagebrush/Idaho fescue subtheme of the low sagebrush theme.

16: Antelope Bitterbrush

The antelope bitterbrush type covers large areas of the larger cones. Plant cover is generally more than 50%. Antelope bitterbrush is the dominant shrub. Rubber rabbitbrush (*Chrysothamnus nauseosus*) and wax currant (*Ribes cereum*) are common shrubs. Limber pine (*Pinus flexilis*) and mountain big sagebrush are scattered in this type. Common forbs are Anderson larkspur (*Delphinium andersonii*), sulfur buckwheat, dwarf buckwheat, dwarf monkeyflower (*Mimulus nanus*), and silverleaf phacelia. Squirreltail, Thurber needlegrass, and Sandberg bluegrass are the common grasses.

17: Antelope Bitterbrush/Great Basin Wildrye

The antelope bitterbrush/Great Basin wildrye type is found on the slopes of medium-aged and older cinder cones. The dominant shrub is antelope bitterbrush, with rubber rabbitbrush, mountain snowberry, and Wyeth eriogonum common. Arrowleaf balsamroot (*Balsamorhiza sagittata*), Holboell rockcress (*Arabis holboelli*), sulfur buckwheat, and stoneseed (*Lithospermum ruderales*) are common forbs. Desert parsley forms the relatively dense understory where grass density is low. Great Basin wildrye (*Elymus cinereus*) is the most conspicuous grass, but bluebunch wheatgrass occurs in greater density in some areas.

18: Bluebunch Wheatgrass/Idaho Fescue

The bluebunch wheatgrass/Idaho fescue type occurs in limited areas on north-facing slopes at upper elevations in Little Cottonwood Canyon. These areas are apparently more mesic because of snow accumulation than areas that contain shrubs. Forbs present are those from both the mountain big sagebrush/bluebunch wheatgrass and the three-tip sagebrush/Idaho fescue types.

19: Bluebunch Wheatgrass/Sandberg Bluegrass

The bluebunch wheatgrass/Sandberg bluegrass type occurs on three older cones in Craters of the Moon Wilderness: Round Knoll, Two-Point Butte, and Coyote Butte. Inconspicuous shrubs are dominated by low-growing forms such as lava phlox and slenderbrush eriogonum (*Eriogonum microthecum*).

Forbs include Douglas chaenactis and taper-tip hawksbeard (*Crepis acuminata*). Bluebunch wheatgrass and Sandberg bluegrass are common grasses.

20: Great Basin Wildrye

The Great Basin wildrye type, which is dominated by relatively dense stands of Great Basin wildrye, is found on alluvial fans where the drainages of the Pioneer Mountains enter the lava plains. There is occasional mountain big sagebrush and rubber rabbitbrush. Several weedy forbs are present among the wildrye, including whitestem mentzelia (*Mentzelia albicaulis*) and shepherd's purse (*Cap-sella bursa-pastoris*).

21: Limber Pine/Antelope Bitterbrush (Low Total Cover)

Areas containing limber pine/antelope bitterbrush (low total cover) are composed of large, block type lava remnants interspersed with cinder gardens; for example, Devil's Orchard. Limber pine is common at favorable microsites such as around the edges of lava blocks where moisture accumulates. The dominant shrub is antelope bitterbrush; rubber rabbitbrush, tansybush, mountain big sagebrush, lava phlox, and wax currant also are common. Common forbs are dwarf monkeyflower, deceptive ground-smoke (*Gayophytum decipiens*), rosy calyptidium (*Calyptidium roseum*), sulfur buckwheat, and dwarf buckwheat. Thurber needlegrass, squirreltail, Indian ricegrass, and Sandberg bluegrass are common grasses. Cinder patches are dominated by species typical of the cinder garden vegetation type.

22: Limber Pine/Antelope Bitterbrush (High Total Cover)

The limber pine/antelope bitterbrush (high total cover) type is found on medium-aged cinder cones. Because lava blocks are absent, the total vegetative cover is higher than in type 21. The dominant antelope bitterbrush is a relatively low form. Rubber rabbitbrush and wax currant are common. Mountain big sagebrush is common on favorable soil sites. Forbs and grasses common in type 21 are also common in this type, except for Indian ricegrass.

23: Limber Pine/Antelope Bitterbrush (High Density Limber Pine)

In the limber pine/antelope bitterbrush (high density limber pine) vegetation type, limber pine occurs in relatively high density on favorable north to east-facing slopes of cinder cones. The number of species is similar to type 22, but Douglas-fir (*Pseudotsuga menziesii*) is present on older or more mesic sites such as Silent Cone. Mountain snowberry and common chokecherry (*Prunus virginiana*) are present with Douglas-fir.

24: Douglas-fir/Mountain Snowberry

The Douglas-fir/mountain snowberry type occurs on relatively steep north-facing slopes of older cinder cones and along Little Cottonwood Canyon. Douglas-fir dominates, with occasional individuals of limber pine. More than half of the soil surface is devoid of vegetation but is covered with a layer of litter. Mountain snowberry dominates the understory. Common chokecherry is common, especially where light intensity is higher. Willow (*Salix* spp.) is present. Common forbs are broadleaf bluebells (*Mertensia ciliata*), sharp-leaf valerian (*Valeriana acutiloba*), and sticky cinquefoil (*Potentilla glandulosa*). Common grasses are Sandberg bluegrass, Idaho fescue, and slender wheatgrass (*Agropyron trachycaulum*).

25: Upland Quaking Aspen

The upland quaking aspen type occurs on upland sites away from permanent stream courses. Quaking aspen (*Populus tremuloides*) is the dominant

tree. A dense layer of forbs and grasses makes up the understory, with occasional mountain snowberry and willows. Forbs include sticky purple geranium (*Geranium viscosissimum*), scarlet painted-cup, silvery lupine, and Sitka columbine (*Aquilegia formosa*). Common grasses are Kentucky bluegrass (*Poa pratensis*), slender wheatgrass, Nelson's needlegrass (*Stipa occidentalis* var. *nelsonii*), and Idaho fescue.

26: Riparian

The riparian type differs from the quaking aspen type by the presence of dense woody vegetation, proximity to a permanent watercourse, and the presence of a dense layer of tall forbs. The dominant trees form a mosaic consisting of patches of aspen, black cottonwood (*Populus trichocarpa*), common chokecherry, willow, mountain alder (*Alnus incana*), and bog birch (*Betula glandulosa*). The last three species are more common at higher elevations. A dense tall forb component is conspicuous in mesic areas; this is dominated by cow parsnip (*Heracleum lanatum*), bigsting nettle (*Urtica dioica*), and small-leaf angelica (*Angelica pinnata*). Blackhead coneflower (*Rudbeckia occidentalis*), nettle-leaf horsemint (*Agastache urticifolia*), and Sitka columbine are also common.

AREA OCCUPIED BY EACH VEGETATION TYPE

The acreage occupied by each vegetation type is shown in table H-1.

TABLE H-1: AREA OCCUPIED BY EACH VEGETATION TYPE

Vegetation Type	Acreage	Percentage	Vegetation Type	Acreage	Percentage
1	1,195	2.2	14	63	0.1
2	30,948	57.8	15	38	0.07
3	5,430	10.1	16	1,178	2.2
4	2,772	5.2	17	211	0.4
5	6,245	11.7	18	38	0.07
6	778	1.5	19	24	0.04
7	5	<0.01	20	21	0.03
8	242	0.5	21	558	1.1
9	18	<0.01	22	2,995	5.6
10	13	<0.01	23	214	0.4
11	101	0.2	24	72	0.1
12	1	<0.01	25	38	0.07
13	311	0.6	26	73	0.13

SENSITIVE PLANT SPECIES

The following sensitive plant species are known to occur near Craters of the Moon National Monument.

SENSITIVE PLANTS FOUND NEAR CRATERS OF THE MOON NATIONAL MONUMENT

[NOTE: Codes are those used by the Idaho Fish and Game Natural Heritage Program, the Idaho Native Plant Society (INPS), and the U.S. Fish and Wildlife Service (USFWS). An explanation of codes follows the list.]

Plant Name	Status	Habitat/Probable Location
<i>Antennaria arcuata</i> — meadow pussytoes	G2/S1; F2C	Wet meadows on lava edges.
<i>Astragalus oniciformis</i> — Picabo milkvetch	F3C; INPS-M	Three-tip and big sagebrush communities. Near southern boundary of monument.
<i>Camissonia pterosperma</i> — winged-seed evening primrose	G4/S2; INPS-S	Gravelly sagebrush and juniper slopes in foothills.
<i>Gymnosteris nudicalis</i> — large-flowered gymnosteris	G4/S3; INPS-M	Sandy or gravelly sites in Wyoming sagebrush communities and on recent lava (Cerro Grande) flow.

Plant Name	Status	Habitat/Probable Location
<i>Lesquerella kingii</i> var. <i>cobrensis</i> — King's bladderpod	G4T2/S3; INPS-S	Cerro Grande lava flow southwest of the monument; raw lava.
<i>Oxytheca dendroica</i> — treelike oxytheca	G4/S2; INPS-S	Sandy loess in sagebrush zone
<i>Phacelia inconspicua</i> — obscure phacelia	G1/S1; F2C	Near east boundary of monument, in mixed mountain shrub communities on volcanic buttes and in foothills.
<i>Silene scaposa</i> var. <i>lobata</i> — scapose silene	G4T4/S3; F3C; INPS-M	Mesic sagebrush/grass to Douglas-fir habitats in foothills.
<i>Stipa webberi</i> — Webber's needlegrass	G4/S2?; INPS-S	Shallow soils over lava on eastern Snake River Plain, generally in depressions.

Explanation of Status Codes

Heritage Program. Codes indicating classifications used by the Idaho Fish and Game Natural Heritage Program are as follows.

G = Global rank indicator. Denotes rank based on rangewide status.

T = Trinomial rank indicator. Denotes rangewide status of subspecific taxa.

S = State rank indicator. Denotes rank based on status in Idaho.

Numbers, letters, or other symbols following G, T, or S indicate the following:

1. Critically imperiled because of extreme rarity or because some factor of its biology makes it especially vulnerable to extinction.
 2. Imperiled because of rarity or because of other factors making it vulnerable to extinction.
 3. Either very rare and local throughout its range or found locally in a restricted range, or made vulnerable to extinction by other factors.
 4. Apparently secure, though it may be quite rare in parts of its range, especially at the periphery.
- ? Indicates reservations about assigned rank.

Idaho Native Plant Society. Letters following "INPS" indicate the following classifications:

S = Sensitive. A taxon with small populations or localized distribution within Idaho that currently does not meet the criteria for classification as priority 1 or priority 2, but whose populations and habitats may be jeopardized if current land use practices continue. (Priority 1 refers to a taxon in danger of becoming extinct or extirpated from Idaho in the foreseeable future if identifiable factors contributing to its de-

cline continue to operate; priority 2 refers to a taxon likely to be classified as priority 1 within the foreseeable future in Idaho, if factors contributing to its population decline or habitat degradation or loss continue.)

M = Monitor. Taxa that are common within a limited range as well as taxa that are uncommon but have no identifiable threats.

U.S. Fish and Wildlife Service. Categories used by the USFWS are indicated in this table by the codes shown below.

F2C = Category 2 candidate species. Listing as endangered or threatened is possibly appropriate, but USFWS lacks sufficient data to support such action.

F3C = Former candidate taxa. Taxon is more widespread or abundant than previously believed or is not subject to identifiable threats.

APPENDIX I: ANIMALS, INCLUDING SENSITIVE SPECIES CRATERS OF THE MOON NATIONAL MONUMENT

ANIMALS MENTIONED IN TEXT

Animal species mentioned in the text of this document are listed below with their scientific names.

Unusual Mammals

Great Basin pocket mouse	<i>(Perognathus parvus idahoensis)</i>
Pika	<i>(Ochotona princeps goldmani)</i>
Yellow-pine chipmunk	<i>(Eutamias amoenus craterieus)</i>

Amphibians

Western toad	<i>(Pseudacris triseriata)</i>
Boreal chorus frog	<i>(Bufo boreas)</i>

Reptiles

Sagebrush lizard	<i>(Sceloporus graciosus)</i>
Short-horned lizard	<i>(Phrynosoma douglassii)</i>
Western skink	<i>(Eumeces skiltonianus)</i>
Rubber boa	<i>(Charina bottae)</i>
Racer	<i>(Coluber constrictor)</i>
Great Basin gopher snake	<i>(Pituophis melanoleucus)</i>
Western garter snake	<i>(Thamnophis elegans)</i>
Western rattlesnake	<i>(Crotalus viridis)</i>

Species Protected in Idaho

Pika	<i>(Ochotona princeps)</i>
Least chipmunk	<i>(Eutamias = Tamias minimus)</i>
Yellow-pine chipmunk	<i>(Eutamias = Tamias amoenus)</i>
Golden-mantled ground squirrel	<i>(Spermophilus lateralis)</i>
Red squirrel	<i>(Tamiasciurus hudsonicus)</i>
Kit fox	<i>(Vulpes macrotis)</i>

SENSITIVE ANIMAL SPECIES

Sensitive animal species known to occur in or near Craters of the Moon National Monument are listed on the next page.

SENSITIVE ANIMAL SPECIES IN OR NEAR CRATERS OF THE MOON NATIONAL MONUMENT

[NOTE: Codes are those used by the Idaho Fish and Game Natural Heritage Program and the U.S. Fish and Wildlife Service (USFWS). An explanation of codes follows the list.]

Species Name	Status	Likely Occurrence
Birds		
<i>Haliaeetus leucocephalus</i> — bald eagle	G3/S3; FE	Flyover.
<i>Buteo regalis</i> — ferruginous hawk	G4/S3; SSC; F2C	Shrub steppe; possible nesting in north end.
<i>Buteo swainsoni</i> — Swainson's hawk	was F2C; now F3C	Riparian zone in north end.
<i>Falco columbarius</i> — merlin	G4/S1	Observed in north end.
<i>Melanerpes lewis</i> — Lewis' woodpecker	G4/S4	Confirmed nesting where tree cavities available.
<i>Empidonax traillii</i> — willow flycatcher	G5Q/S5	Riparian vegetation.
<i>Passerella iliaca</i> — fox sparrow	G5/S5	Riparian zone in north end.

Mammals

<i>Euderma maculatum</i> — spotted bat	G4/SH; SSC; F2C	Possibly north end but no recorded sightings.
<i>Plecotus townsendii</i> — Townsend's big-eared bat	G4/S2; SSC; F2C	Lava tubes throughout the monument.

[NOTE: Townsend's big-eared bats are known to occur at Craters of the Moon. The eastern subspecies (*P.t. virginianus*) is listed as endangered, the western subspecies (*P.t. townsendii*) is a federal category 2 candidate, and there is information indicating that the entire species, including the subspecies that occurs at the Craters of the Moon (*P.t. pallescens*), will be proposed for listing.]

<i>Lepus townsendii</i> — white-tailed jackrabbit	G4/S5	Shrub steppe.
<i>Vulpes macrotis</i> — kit fox	G5/SH	Shrub steppe.
<i>Felis lynx</i> — lynx	F2C	Has been reported in the monument.

Insects

<i>Glacivicola bathyscioides</i> — blind cave leiodid beetle	F2C	Known to occupy lava caves.
--	-----	-----------------------------

[NOTE: Most sightings of animals occur near the headquarters, where there are likely to be people to see them. Animals may also be in other places in the park where there is less likely to be anyone to record their presence.]

Explanation of Status Codes

Heritage Program. Codes indicating classifications used by the Idaho Fish and Game Natural Heritage Program are as follows.

G = Global rank indicator. Denotes rank based on rangewide status.

T = Trinomial rank indicator. Denotes rangewide status of subspecific taxa.

S = State rank indicator. Denotes rank based on status in Idaho.

Numbers, letters, or other symbols following G, T, or S indicate the following:

1. Critically imperiled because of extreme rarity or because some factor of its biology makes it especially vulnerable to extinction.
2. Imperiled because of rarity or because of other factors making it vulnerable to extinction.
3. Either very rare and local throughout its range or found locally in a restricted range, or made vulnerable to extinction by other factors.
4. Apparently secure, though it may be quite rare in parts of its range, especially at the periphery.
5. Demonstrably secure, though it may be quite rare in parts of its range, especially at the periphery.
- H. Of historical occurrence (i.e., formerly part of the native biota with the implied expectation that it may be rediscovered).
- Q. Indicates uncertainty about taxonomic status.

U.S. Fish and Wildlife Service. Categories used by the USFWS are indicated in this table by the codes shown below.

FE = Federally listed as endangered

F2C = Category 2 candidate species. Listing as endangered or threatened is possibly appropriate, but USFWS lacks sufficient data to support such action.

F3C = Former candidate taxa. Taxon is more widespread or abundant than previously believed or is not subject to identifiable threats.

Idaho Department of Fish and Game

SSC = Species of special concern. A species listed by the Idaho Department of Fish and Game as meriting attention because of its present or potential future status. This classification alerts professionals and the general public to the vulnerability of these species.

REFERENCES

Blakesley, Jennifer A., and R. G. Wright

- 1988 *A Review of Scientific Research at Craters of the Moon National Monument*. Station bulletin 50. Moscow, Idaho: University of Idaho, College of Forestry, Wildlife and Range Sciences.

Day, Thomas A., and R. Gerald Wright

- 1985 *The Vegetation Types of Craters of the Moon National Monument*. Bulletin 38. Moscow, Idaho: University of Idaho, Forest, Wildlife and Range Experiment Station.

Gleason, H. A., and A. Cronquist

- 1964 *The Natural Geography of Plants*. New York: Columbia University Press.

Greeley, Cynthia R.

- 1977 "Idaho: Indian Country to Statehood." In *Volcanism of the Eastern Snake River Plain, Idaho: A Comparative Planetary Geology Guidebook*, edited by Ronald Greeley and John S. King, 113. Washington: Office of Planetary Geology, National Aeronautics and Space Administration.

Greeley, Ronald

- 1977 "Basaltic 'Plains' Volcanism." In *Volcanism of the Eastern Snake River Plain, Idaho: A Comparative Planetary Geology Guidebook*, edited by Ronald Greeley and John S. King, 23. Washington: Office of Planetary Geology, National Aeronautics and Space Administration.

King, John S.

- 1977 "Crystal Ice Cave and King's Bowl Crater, Snake River Plain, Idaho." In *Volcanism of the Eastern Snake River Plain, Idaho: A Comparative Planetary Geology Guidebook*, edited by Ronald Greeley and John S. King, 45. Washington: Office of Planetary Geology, National Aeronautics and Space Administration.

Kuntz, Mel A.; Duane E. Champion; Richard H. Lefebvre; and Harry R. Covington

- 1988 *Geologic Map of the Craters of the Moon, Kings Bowl, and Wapi Lava Fields, and the Great Rift Volcanic Rift Zone, South-Central Idaho*. N.p.: Geological Survey, U.S. Department of the Interior.

Kuntz, Mel A.; Duane E. Champion; Elliott C. Spiker; and Richard H. Lefebvre

- 1986 "Contrasting Magma Types and Steady-state, Volume-predictable Volcanism along the Great Rift, Idaho." *Geological Society of America Bulletin* 97 (May 1986): 579 – 594.

Kuntz, Mel A.; Richard H. Lefebvre; Duane E. Champion; John S. King; and Harry R. Covington

- 1983 "Holocene Basaltic Volcanism along the Great Rift, Central and Eastern Snake River Plain, Idaho." In *Guidebook Part 3: GSA Rocky Mountain and Cordilleran Sections Meeting*. Salt Lake City: Utah Geological and Mineral Survey.

Kuntz, Mel A.; Elliott C. Spiker; Meyer Rubin; Duane E. Champion; and Richard H. Lefebvre

- 1986 "Radiocarbon Studies of Latest Pleistocene and Holocene Lava Flows of the Snake River Plain, Idaho: Data, Lessons, Interpretations." *Quaternary Research* 25 (1986): 163 – 176.

Limbert, R. W.

- 1924 "Among the 'Craters of the Moon': An Account of the First Expeditions Through the Remarkable Volcanic Lava Beds of Southern Idaho." *National Geographic* 45: 303.

REFERENCES

Lovejoy, Steven H.

- 1980 "Patterns in the Distribution of Plants and Animals on Lava Flows and Kipukas in Southeastern Idaho." Master's thesis, Idaho State University, Pocatello.

Machlis, Gary E.; Dana E. Dolsen; and Dwight L. Madison

- 1989 *Visitor Services Project: Craters of the Moon National Monument*. 2 vols. VSP report 20. Moscow, Idaho. Prepared for the National Park Service by the Cooperative Park Studies Unit, University of Idaho.

National Park Service, U.S. Department of the Interior

- 1987 *Craters of the Moon National Monument Resources Management Plan and Environmental Assessment*. Arco, Idaho.

1989a *Craters of the Moon National Monument Backcountry/Wilderness Management Plan*. Arco, Idaho.

1989b *Reconnaissance Survey: Expansion of Craters of the Moon National Monument*. Denver.

- 1990 *Management Alternatives and Reconnaissance Survey: Expansion of Craters of the Moon National Monument*. Denver. Incorporates new material under title *Management Alternatives: Expansion of Craters of the Moon National Monument* and 1989 *Reconnaissance Survey*, cited above.

Papson, Ronald P.

- 1977 "Geological Guide to Craters of the Moon National Monument." In *Volcanism of the Eastern Snake River Plain, Idaho: A Comparative Planetary Geology Guidebook*, edited by Ronald Greeley and John S. King, 215. Washington: Office of Planetary Geology, National Aeronautics and Space Administration.

Poldervaart, Arie

- 1971 "Volcanicity and Forms of Extrusive Bodies." In *Volcanic Landforms and Surface Features*, edited by Jack Green and Nicholas M. Short, 1 – 14. New York: Springer-Verlag.

Prinz, Martin

- 1970 "Idaho Rift System, Snake River Plain, Idaho." *Geological Society of America Bulletin* 81 (March 1970): 941 – 948.

Sneed, Paul

- N.d. "A Preliminary Report of the Archeological Reconnaissance of Craters of the Moon National Monument." Report prepared for the National Park Service. On file at Denver Service Center, Technical Information Center.

Spear, Dallas B.

- 1977 "Big Southern, Middle, and East Buttes." In *Volcanism of the Eastern Snake River Plain, Idaho: A Comparative Planetary Geology Guidebook*, edited by Ronald Greeley and John S. King, 113. Washington: Office of Planetary Geology, National Aeronautics and Space Administration.

Wallace, Arthur

- 1986 "Interaction of Stresses in the Behavior of Native Shrub Populations." In *Proceedings: Symposium of Shrub Ecophysiology and Biotechnology*, compiled by Arthur Wallace, E. Durant McArthur, and Marshall R. Haferkamp, 144 – 146. General technical report INT-256. Ogden, Utah: Intermountain Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture.

PREPARERS AND CONSULTANTS

NATIONAL PARK SERVICE STUDY TEAM

Douglas Cornell, Jr., Architect/Planner — Team Captain, Denver Service Center
Jonathan Jarvis, Superintendent, Craters of the Moon National Monument
Roberta McDougall, Interpretive Planner, Denver Service Center
Aida Parkinson, Natural Resource Specialist, Denver Service Center
Laura Rotegard, Landscape Architect, Denver Service Center
Robert Scott, former Superintendent, Craters of the Moon National Monument

CONSULTANTS

Mel Kuntz, U.S. Geological Survey, Denver
Ivan Miller, Chief, Office of Planning, Pacific Northwest Regional Office, National Park Service
R. Gerald Wright, Cooperative Park Studies Unit, University of Idaho
Staff, Idaho Falls, Shoshone, and Burley district offices, Bureau of Land Management
Staff, Idaho Department of Fish and Game
Staff, Craters of the Moon National Monument
Staff, Pacific Northwest Regional Office, National Park Service



As the nation’s principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural and cultural resources. This includes fostering wise use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people. The department also promotes the goals of the Take Pride in America campaign by encouraging stewardship and citizen responsibility for the public lands and promoting citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

Publication services were provided by Glenda Heronema and David Hesker, visual information specialists; Lou Layman, editor; and Janet Stickland, visual information technician, of the Branch of Publications and Graphic Design, Denver Service Center. NPS D-141A June 1992

