

# Final Report: Ecotourism and Trail Design Workshop

Presented by  
The Nature Conservancy  
and  
the Pohnpei State Division of Commerce and Industry

December 3 - 6, 1996

Pacific Island Network/Pacific Program  
University of Hawaii Sea Grant Extension Service  
Honolulu, Hawaii

UNIH- SG-AR-98-01

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The Pacific Island Network (PIN)/Pacific Program, through its extension agents and specialists, works in partnership with the U.S. affiliated Pacific island governments for the long-term benefit of coastal resources. PIN's activities are directed toward those communities that use natural resources and agencies that manage them. In response to island needs, in accordance with their culture and traditions, PIN provides technical assistance through training that builds on-island expertise, development and dissemination of information and materials, sharing and leveraging available resources, and facilitating communication.

For more information about PIN and its programs, please contact:

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# **Final Report for the 'Ecotourism and Trail Design' Workshop**

*Presented by The Nature Conservancy &*

*The Division of Commerce & Industry*

*December 3 - December 6, 1996*

## **Introduction**

Currently on Pohnpei there exists numerous trails open to the public and several private trails off shooting from the public ones. On the majority of the public trails, problems of drainage, signage, maintenance, and repair are clearly seen. Tourists are unhappy with the trails and lack of safety on them. Landowners and a few surrounding communities complain of tourists on their private trails to their sakau or farms. Basically, a need arose to address these issues and educate government employees and the public as tourism is one of the focuses from the 1996 Pohnpei Economic Summit.

Therefore, the objective for this workshop is to inform and facilitate a discussion on trail design and maintenance and its' effect on the Ecotourism sector. In order to achieve this objective, Curt Cottrell, the Program Manager from the Na Ala Hele Program at the Dept. of Forestry in Hawaii was flown over to facilitate the material, such that the participants could then apply it in the field. The four day workshop would entail two days of classroom instruction and discussion, one day spent working at a developed trail site, and the last day spent looking at an undeveloped trail site & coming up with a group plan for the Pohnpei Visitors' Bureau to develop it.

## **Preparations**

The following extensive preparations were made before December, 1996:

- coming up with 30 participants to invite excluding 3 participants from Yap, Chuuk, and Kosrae.
- securing the venue that happen to include refreshments
- coordinating hotel & plane reservations with the participants' needs,
- creating and distributing 2 information flyers about the workshop (See Appendix A & B),
- locating two field sites that would be suitable for the workshop,
- and putting together a workshop packet for each participant (See Appendix C).

## **The Workshop**

### **Day One:**

The first day of the workshop kicked off with welcoming remarks from Bumio Silbanuz, the Chief of the Office of Tourism for Pohnpei State. He discussed the present state of the Tourism industry, how it is now the focal point of the Pohnpei State Government, and what the future can hold. In addition, the problems of funding and government downsizing were mentioned. However, a positive statement was made that if all the agencies and the public can work together then these problems could be easily combated.

Bill Raynor also welcomed the group adding why he saw the need for this workshop and why Curt was chosen to be the facilitator. Curt took over from there giving a background speech on how he came to his present job position but noting that he will be presenting material that they use in Hawaii. He did acknowledge his unfamiliarity with Micronesia but stressed that participants can take from what is presented to be modified for Pohnpei.

After the summary of the Na Ala Hele Trail and Access Program, the class discussed the fundamental roles and functions for a trail. What kinds of trails exist? A trail classification pie chart that is included in the workshop packet was discussed along with the trail guidelines sheet. It would be up to the Tourism Office

with the assistance of Forestry to determine what trails would stay open to the public, its uses (just hiking or also bicycling), how often would these trails be used, and if it affects the watershed of the forest. So both conservation and recreational purposes can be applied to Pohnpei's trails. This led the discussion in to the concepts of planning, layout, and construction.

Planning is an important aspect of a trail because before any trail can be carved out or repaired, its vision should be defined. Do you want tourists to see canyons (historical value), see the ocean view (recreational), understand the cultural significance, or just feel an aesthetic sense (landscaping & design). In addition, community input is crucial because the majority of land on Pohnpei is privately owned and many landowners have private trails to their sakau plants and farms. Communities have protested tourists coming in to their areas since they get nothing out it so why should they care. Therefore, a lot of information must be collected before mapping out the layout and designing it.

An interesting point was brought up too regarding safety and liability issues. In Hawaii, the trail workers are covered by insurance but if a tourist falls they may be able to sue. Safety issues is a big concern on Pohnpei as with drainage and eroding problems, tourists often find themselves in sticky situations on many of the trails. Safety must be the first consideration!

At this point, the group broke for lunch where they heard an informative talk by Howard Rice, the new program developer for the College of Micronesia Pohnpei State. Howard talked about the new certification program he would like to start at COM for trail guides and also maybe a certification class for hoteliers and restaurateurs. He will be the link for Tourism offices in all the states of FSM and can offer assistance to try to create jobs in the FSM. In addition, Howard proved to be resourceful throughout the workshop as one of his former jobs was with the U.S. Forestry service. The talk was enlightening for the participants.

The rest of the day flew by as the discussion finished with design and learning to work with and sometimes around the foliage. What type of materials that would be appropriate for Pohnpei, such as rocks, mangrove wood (in small quantities), dead coral, and sand, was considered. Curt had brought with him several of the Na Ala Hele's signs and Forestry tools for the participants to see as well as two pieces of recycled plastic that look like wood. Although the recycled plastic steps works great in muddy areas and helps create a nice looking trail, the group felt the cost and the shipping of the plastic could cause too much hassle. Therefore, the best idea is working with local materials. Curt took this opportunity to present a great slide show to visually illustrate the concepts of layout, design, and construction that Hawaii incorporates on their trails. He mentioned a little bit about volunteer manpower as most of the slides depicted young teenagers working to repair their favorite trails.

## Day Two:

The focus of this day was on management, maintenance, and restoration. Of course, Hawaii has a more intricate system of maintenance and budget allotment but Pohnpei has the potential to create a better one on such a small island. It was reiterated that safety should be the motivating drive to sustaining maintenance and developing a schedule for all the trails makes it easier. For example, Pohnpei receives enormous amounts of rain each year causing the vegetation to constantly grow out of hand. Curt asked the group to think about how many tourists they want on each public trail and based upon these numbers & the rainfall, they should devise a schedule. In Hawaii, most trails have maintenance crews visit up to 6 times in a month because of the high number of tourists and the different uses on each trail (e.g. hikers, bikers, horseback riders, etc.). Trail restoration may not be such a problem on Pohnpei if a landowner lies on the trail site then they could be contracted to take a weedwacker out once in awhile.

This spurred an open discussion among the group on community involvement, where money should come from for maintenance, and what kind of compensation should be given to the landowner of a trail. Participants felt the tour guides should take financial responsibility and maybe give a percentage of their profits to the landowner for use of the trail. Money for maintenance could come from the office of

Tourism, the municipality office, and private businesses that would benefit from it like hotel operators. Then maybe some jobs could be created during the time of maintenance and people could be contracted for work. Pohnpei has close communities of people who value land and traditional culture above almost everything else. Therefore, the input of a community must be respected and followed. Otherwise, the future of tourism could plummet.

Before going in to manpower, Curt showed a video of the Na Ala Hele Trail and Access Program that focused on the various types of people that volunteer time and effort. The majority of volunteers are youth groups (Boy Scouts, Church groups, and students on vacation) and the elderly. After the 30 minute video, the participants targeted what groups could be asked for assistance. Church and youth groups are popular on Pohnpei and could benefit from this kind of community work. They could feel empowered about the difference they can make and pride in their surroundings. If this happens then maybe the problems of garbage and littering could be stopped.

The lunch break offered a lecture from Hirson Anson on the Watershed Management Team and their efforts to preserve natural habitats for the native species of Pohnpei. Watershed, again, was an issue to be reminded of when it came to starting new trails and deciding which ones may be better not to have tourists be on.

Signage and public information, costs, and Ecotourism was the afternoon's topics. As Curt brought examples of signs used in Hawaii, the reason for public information was reviewed. Interpretative information like the local foliage, the historical value, and any cultural significance would help tourists get a better understanding Pohnpei and be respectful of the trail. Maps and trailhead information would guide them out of private trails.

Curt gave a brief idea of the costs for a trail in Hawaii reaching around \$80,000 with all the work tools, signs, and employees. Obviously, Pohnpei does not have that kind of money designated for trails but with the help of communities, tour operators, and the government the labor could be virtually free and maintenance not a high expense. Team effort would be the only requirement, which brought the last topic for the day on Ecotourism out on the table. Participants did see the financial benefits to tourism and understood what is Ecotourism but found it challenging to convince others.

Community awareness was again discussed through maybe informational announcements on the radio or on the public radio station about keeping Pohnpei clean from littering and also keeping trails clean. Since oral communication is the favored transport of passing around important news then maybe speaking to local leaders, families, and neighbors could be a start. However, the participants didn't really understand these topics until they went out in to the field the following day.

### **Day Three:**

The field site, Pahn Takai Waterfall in Uh Municipality, was chosen to be worked due to several reasons. The popular trail leading to the caves under a waterfall was a tourist attraction, had drainage problems, and the surrounding neighbors were upset that they didn't get any financial benefit to allowing strangers come up their road. It is understood by the foreigners on Pohnpei that if you go to Pahn Takai then be expected to deal with kids and adults approaching your group stating you need to pay a fee. Although this is false, tourists do not know and often get pestered until they pay up. Thus, Pahn Takai proved to be a perfect place to apply classroom discussion in the field.

Each participant that day was given a souvenir, Na Ala Hele baseball hats provided by Curt, and gloves to give them the sense of team work. After a safety talk by Curt, each participant grabbed a tool (a pick, shovel, machete, or pulaski) and headed out on to the trail. They saw that another trail had off shoted the main one and was told that it was a private trail to a sakau patch. A landowner lives right above the head of the trail and kindly participated with his two sons in our attempts of restoration. When we first arrived,

Curt had gone ahead marking areas of the trail in pink spray paint that needed work. As the group disbursed on the trail, participants worked on removing extra foliage, widening the trail to 4 feet, and picking the side slope of the trail at a 90 degree angle.

Out of the four days, the most participants was this day totaling 35 participants. The other days averaged to 20 participants as it turned out many people had other workshops or important meetings to attend. The district chief of Uh, the employees of Tourism, and the employees of Forestry all contributed a great deal to the successful work completed. Participants saw possible drainage areas, the danger to safety at certain points, and the beauty at the end of the trail that tourists should focus on.

In addition, they visibly spotted the interference of sakau growing right on the trail or impeding tourist to go around it. After some discussion, a few participants and the local district chief approached the landowner asking for his input. The landowner gladly helped by transplanting the sakau more upland and out of the way. What a wonderful solution to a cultural problem of moving other people's sakau and the safety factor for tourists. By the end of the day, not only was a new trail carved out of a narrow one but participants were empowered to see what was on the last day!

#### **Day Four:**

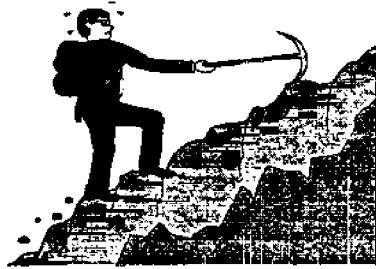
The Pohn Lehr trail was chosen for a field site because money has been allocated by the Pohnpei Visitors' bureau for further development and the trail needed a lot of restoration. Participants spent the morning on the trail noticing its direction, the materials already used on it, the difficulty of the trail, and whatever changes should be made.

The afternoon was spent in group discussion coming up with a plan to give the Visitors' Bureau and the Office of Tourism for development. (See Appendix D) At the end of the day and of the workshop, each participant was given a certificate of accomplishment and some offices received a certificate of appreciation for their assistance. Participants were already excited to see what follow up will be done in the future.

#### **Conclusion**

Overall, the four day workshop proved to be successful because of the hands-on-training and the great classroom discussion facilitated by a knowledgeable resource person. Participants have plenty of enthusiasm for the topic and saw the need there. A follow-up to the workshop was suggested by Curt. It would be similar to the concept of Adopt-A-Trail theme, where the Pahn Takai trail could be maintained with help from the community and the tour operators. A successful Ecotourism hotel that attracts many types of people willing to spend a high rate to live in local style accommodations could offer its guests to donate a dollar or more to save the Pahn Takai trail. The money from the trail could go to maintenance costs and the guests of this hotel could get information on its historical and cultural significance. What is a dollar or two if it helps protect our natural resources?

Then, tour operators could give a percentage of the money they get from bringing their tourists there to the landowners. The maintenance could be overseen by the landowner, who gets something out of it, and the maintenance workers could be contracted creating a few jobs. This proposal is still being fine tuned but will be presented soon. However, none of this awareness couldn't have happened without conducting this workshop.



## **"Ecotourism Site and Trail Design" Workshop**

**presented by The Nature Conservancy  
and the Division of Commerce and Industry  
Kolonia, Pohnpei - December 3-6, 1996**

This workshop is designed to provide participants with the knowledge and tools required for trail design and management at their Ecotourism site. The information will be extremely useful for owners and managers of existing Ecotourism properties and government officials involved in developing Ecotourism. Planned topics to be presented include:

- \* Trail Planning, Layout, Design, and Construction
- \* Trail Maintenance and Management
- \* Trail Restoration
- \* Manpower and Volunteer labor
- \* Signage and Public Information
- \* Commercial use of Trails for Ecotourism
- \* Also Field Exercises!**

Participants will receive 2 days of instruction and discussion time. Then, they will have the opportunity to apply concepts from the workshop in the field for the remaining 2 days. At the conclusion of the workshop, participants will understand the role of trails in providing sustainable and profitable Ecotourism ventures.

If you are interested in attending, please contact:

Falguni Shah at the Div. of Commerce & Industry- 320-3264

APPENDIX B



**"Ecotourism and Trail Design" Workshop**  
**\*Presented by The Nature Conservancy and**  
**the Division of Commerce & Industry**

**Date: December 3 - 6, 1996**

**Times: 9:00am - 4:00pm**

**Place: The Govt. Training Center, Kolonia**

This is the second announcement just to remind you of our exciting, informative workshop. We look forward to seeing you there and the following itinerary for the 4 days will be:

**Tuesday, December 3:** Classroom Discussion at the Training Center.

**Wednesday, December 4:** Classroom Discussion at the Training Center.

**Thursday, December 5:** Field visit and application of classroom discussion.

**Friday, December 6:** Field visit and application of classroom discussion. Final wrap up and discussion.

Please note that lunch and refreshments will be provided for participants throughout the workshop. If there are any questions, please feel free to call Falguni Shah at the Division of Commerce & Industry at 320-3264 or 320-2968.

**\* This is sponsored by the Pacific Program at the University of Hawai'i Sea Grant Extension Service with funds from the U.S. Department of Interior.**

APPENDIX C



Ecotourism Site  
and Trail Design  
Workshop



Presented By

Curt Cottrell,  
Hawaii State Trail &  
Access Program Manager

The Pohnpei Nature Conservancy

The Division of Commerce & Industry

*With Funding and Assistance Provided by the Pacific Program of the  
University of Hawai'i Sea Grant Extension Service with funds from the  
U.S. Department of Interior.*

# ECOTOURISM SITE AND TRAIL DESIGN WORKSHOP

KOLONIA, POHNPEI

December 2 - 6, 1996

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*Monday - Site Visitation*

## *SESSION 1*

9:00 a.m. Tuesday

### 1. INTRODUCTIONS

### 2. OVERVIEW OF THE HAWAII NA ALA HELE TRAIL AND ACCESS PROGRAM

- Summary of Na Ala Hele Directives

- A. Trail and access inventory
- B. Trail and access classification
- C. Proposed, potential and needed trails and accesses
- D. Regulation of trails and accesses
- E. Legal issues associated with trails and access in Hawaii
- F. Trail and access advisory councils
- G. Trail and access related information and issues

- Na Ala Hele Program Plan

Blueprint for implementation of the program

### 3. THE FUNDAMENTAL ROLE AND FUNCTION OF A TRAIL

Description of the trail as management tool, recreational experience and aesthetic feature.

### 4. TRAIL PLANNING, LAYOUT, DESIGN AND CONSTRUCTION

- Planning

A. Issues to consider:

- \* What is the purpose of the specific trail?
- \* Where will the trail go?
- \* What will the user of the trail see?
- \* What is the intended experience?
- \* Who will use the trail?
- \* How much use is acceptable?
- \* Is it desirable to regulate the amount or types of use?
- \* Who will take care of the trail?

- B. Information collection:
  - \* Topographical
  - \* Flora and Fauna
  - \* Historical, archeological or cultural
  - \* Community input and perspectives
- **Layout**  
Selecting and marking an alignment
  - \* Mapping
- **Design**
  - A. Trail specifications
    - \* Management, safety, and aesthetic considerations
  - B. Applications in tropical environments
    - \* Types of materials
- **Construction**
  - A. Clearing of vegetation
    - \* Types of tools
  - B. Excavation
    - \* Types of tools

### SESSION 2

9:00 a.m. Wednesday

## 5. TRAIL MAINTENANCE and MANAGEMENT

Long term stewardship of the trail

### A. The importance and necessity of maintenance

- \* Types of tools

### B. Monitoring types of use and establishing limits to acceptable change

## 6. TRAIL RESTORATION

Repair and improvements to damaged or improperly designed trails

## 7. MANPOWER - VOLUNTEERS

The role and utilization of volunteers

- \* 30 minute video on trail issues in Hawaii and volunteers constructing the Maunawili trail on Oahu.

## 8. SIGNAGE AND PUBLIC INFORMATION

### A. Trailhead information

### B. Interpretive information

### C. Handouts and Maps

9. **WHAT DOES ALL THIS COST?**

Hawaii scenario

10. **COMMERCIAL USE OF TRAILS (ECOTOURISM)**

- A. Types of Ecotourism activities
- B. Reasons to regulate and monitor
- C. Hawaii scenario

**SESSION 3**

**9:00 a.m. Thursday and Friday**

**FIELD EXERCISE**

Modification or improvement of an existing trail segment. Participants will select trails from the site visitations and physically apply some of the concepts presented in the workshop.

# Conceptual View All Trails and Accesses

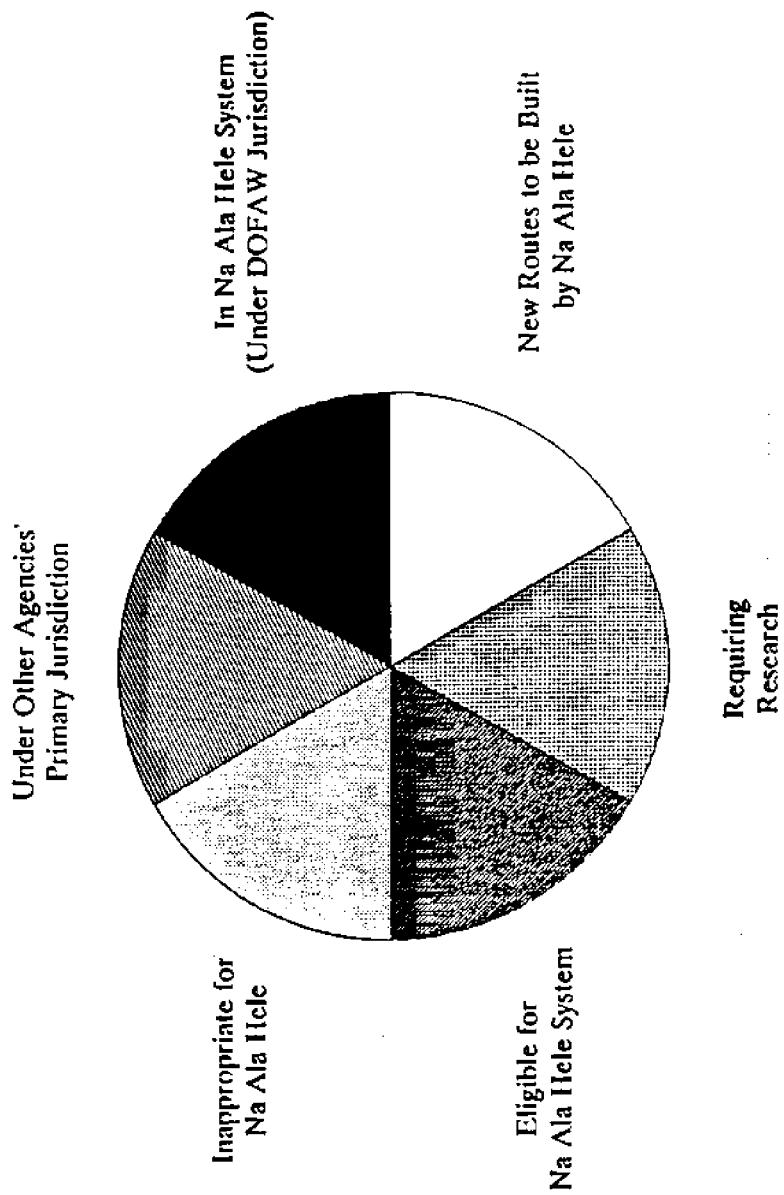
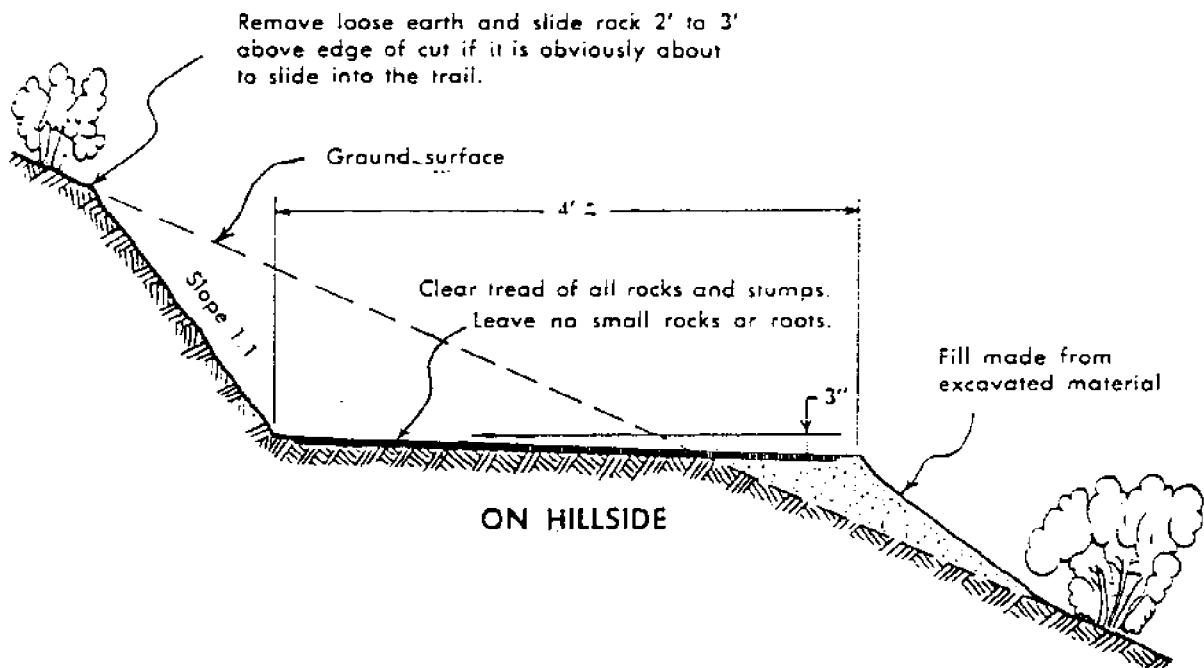
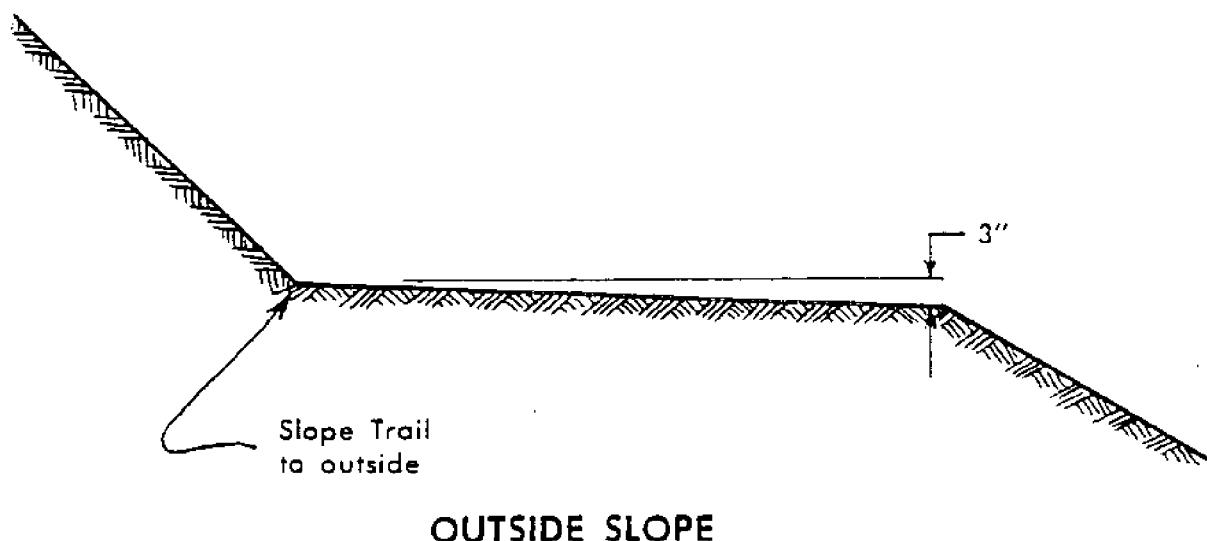


Figure V-4. Trail Guidelines

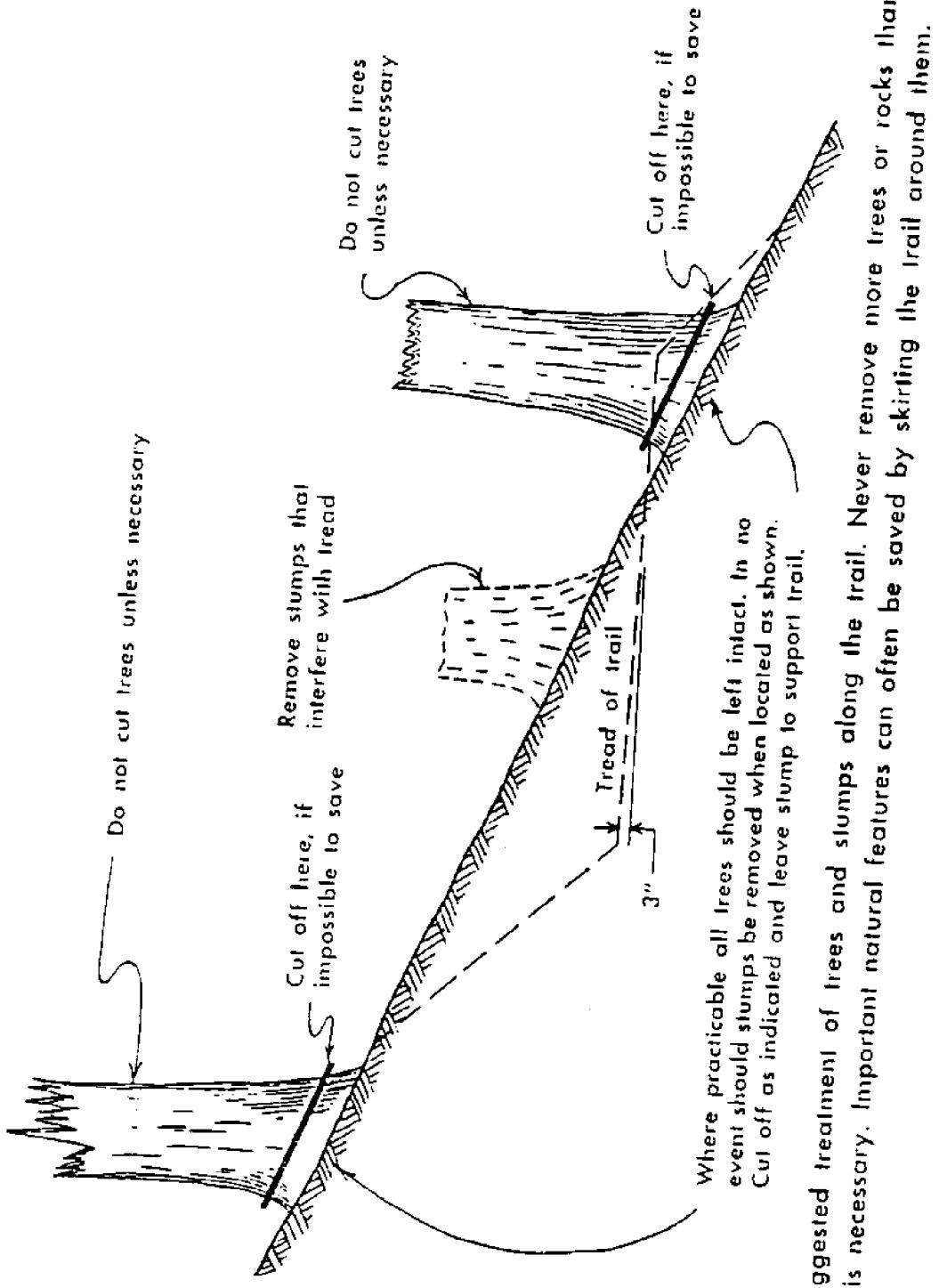
				Clearing Width	Brush/Logs	Vertical Clearing	Maintenance Comments
				Tread Width	Tread Material	Trees/Logs	
	Urban	6 Ft. Min.	Concrete or Asphalt				
	Rural	4 - 6 Ft.	Asphalt or Packed Dirt	1 Ft. to each side of tread		2 Ft. to each side of tread	7 - 8 Ft.
	Wildland	3 - 4 Ft.	Packed Dirt or Woodchips				
	Sensitive	3 - 4 Ft.	Boardwalk				
	Urban	3 - 6 Ft.	Asphalt/Packed Dirt				
	Rural	2 - 4 Ft.	Natural/Woodchips				
	Wildland	2 - 3 Ft.	Natural				
	Sensitive	2 - 3 Ft.	Natural/Woodchips/Boardwalk as nec.				
	Urban	3 - 6 Ft.	Concrete/Asphalt for short dist.				
	Rural	2 - 4 Ft.	Natural				
	Wildland	2 - 3 Ft.	Natural				
	Sensitive	...	....				
	Urban	3 - 6 Ft.	Concrete/Asphalt				
	Rural	3 - 4 Ft.	Packed Dirt				
	Wildland	3 - 4 Ft.	Packed Dirt				
	Sensitive	...	....				
	Urban	10 Ft. Min.	Asphalt				
	Rural	10 Ft. Min.	Natural				
	Wildland	...	....				
	Sensitive	...	....				

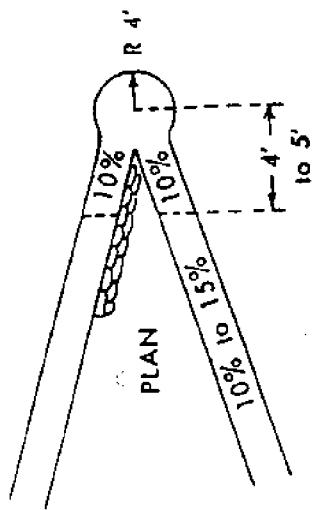
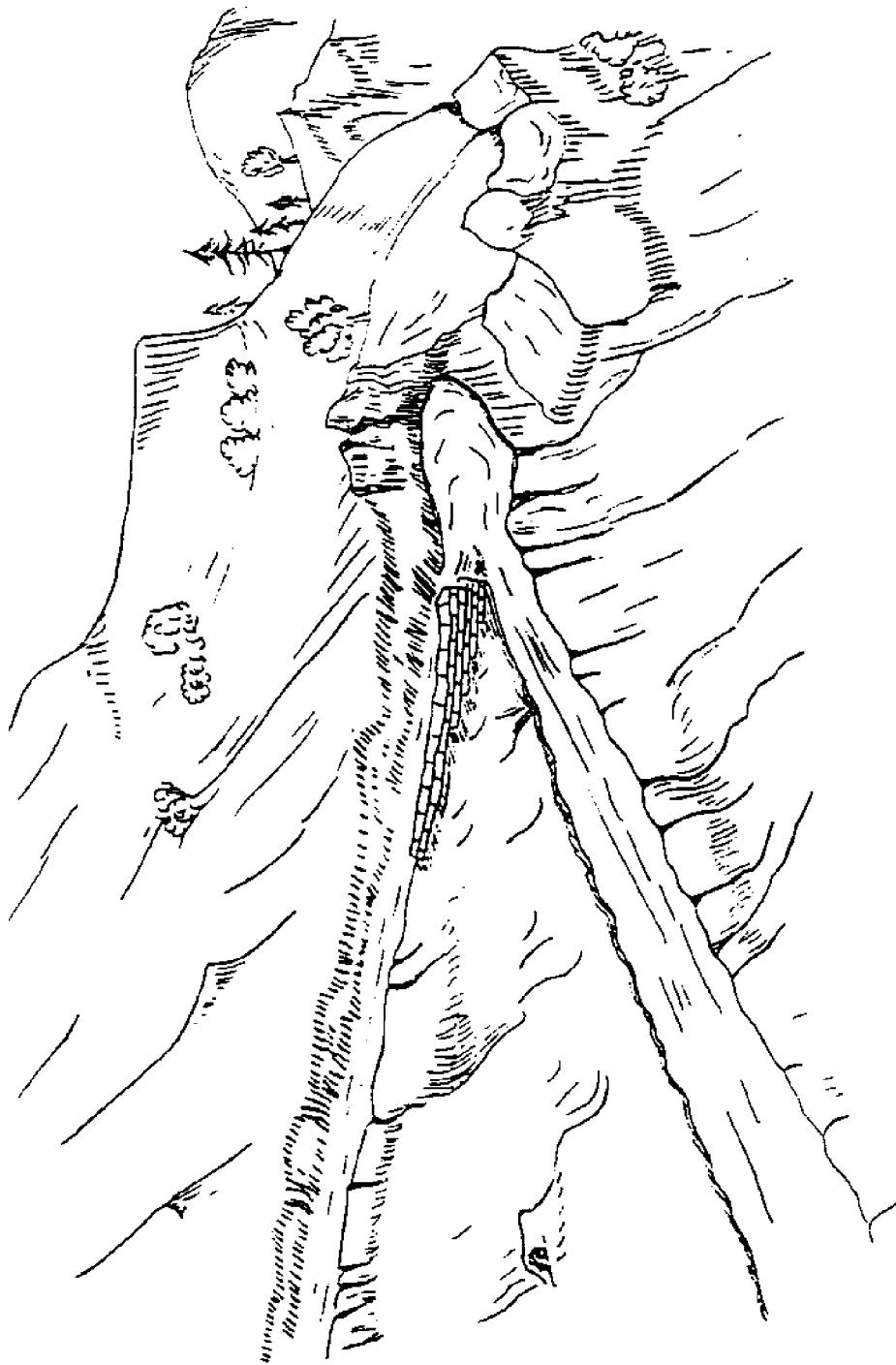


Trail specifications for a trail along a slope. Note absence of curbing. Exposed surfaces on sides should be planted to grass.

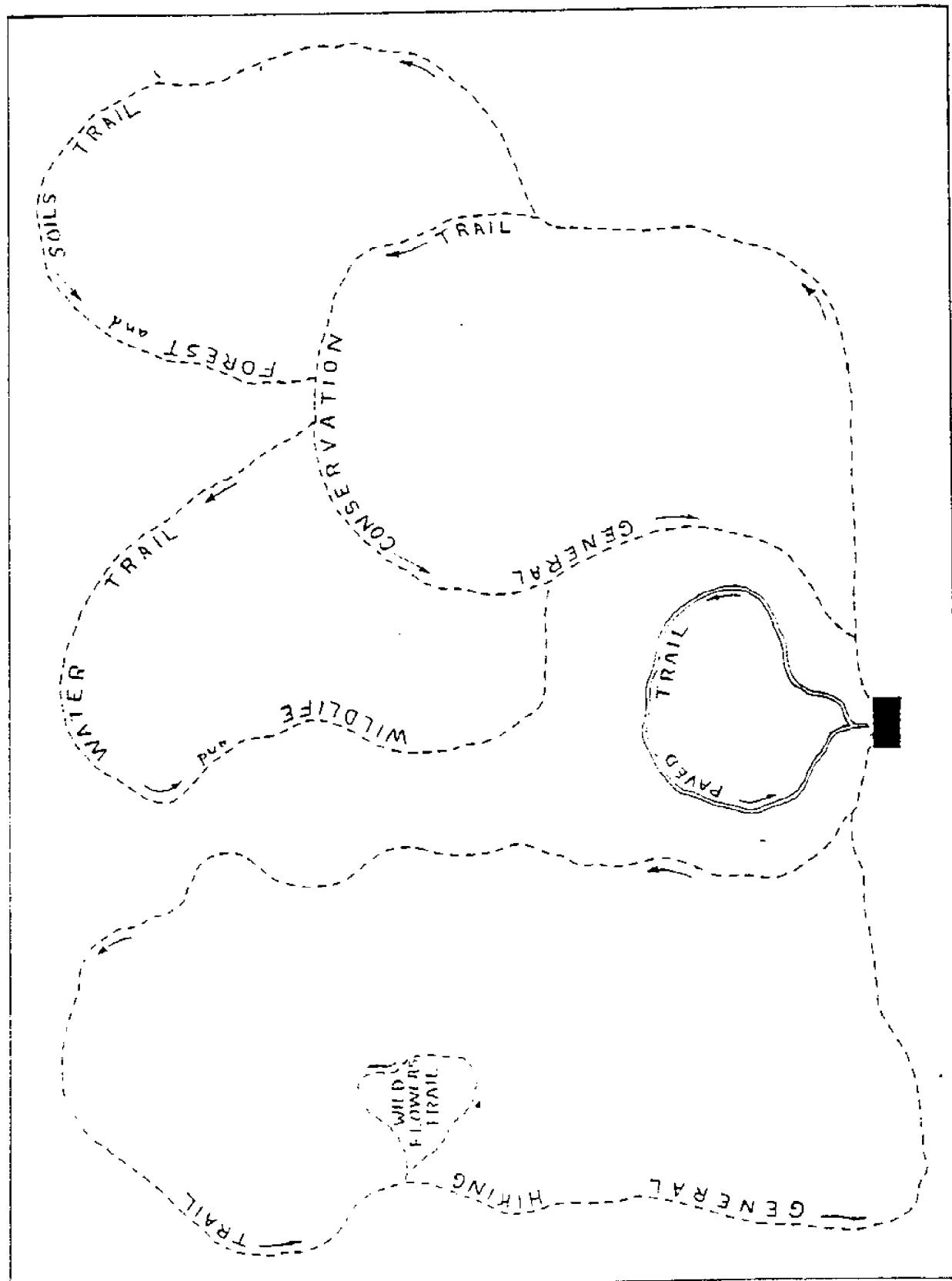


Trails should be sloped to the outside to permit run-off. Do not gutter trails on the inside cut.





Design of trail along steep slope using the "switchback." No trail should have more than a 15% grade.



Another design for a system of trails. The design is simple and yet complete without over-develop-

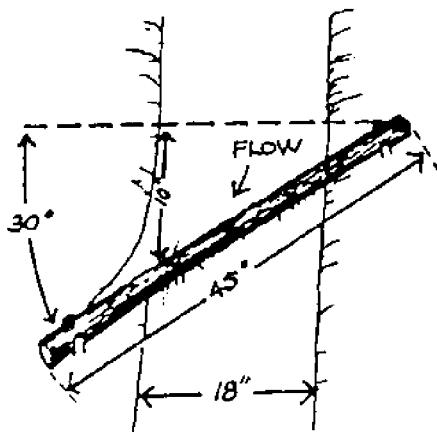
# Drainage and Erosion Control

Providing for adequate drainage and control of erosion is an important step in trail construction. When the vegetative cover on soil is disturbed during construction, the occurrence of erosion becomes probable. Water bars or drainage dips should be provided at regular intervals to divert water off the tread; this will help prevent erosion on new trails as well as help control erosion on older trails.

The use of water bars or dips minimizes disruption of the natural drainage pattern and generally eliminates the need for high cost drainage ditches and culverts. Any type of trail cross-drainage should extend well past the edges of the tread to insure that all water is diverted; rocks should be placed along a drain to slow down water, removing energy so it does not damage the lower side of the trail.

Water bars should be installed at a 30° to 40° angle to promote self-cleaning and to lessen the impact of water along the face of the water bar. Any rot-resistant wood, such as beech, maple, oak, and locust, is good to use for water bars. Logs for water bars should be 6" to 8" in diameter.

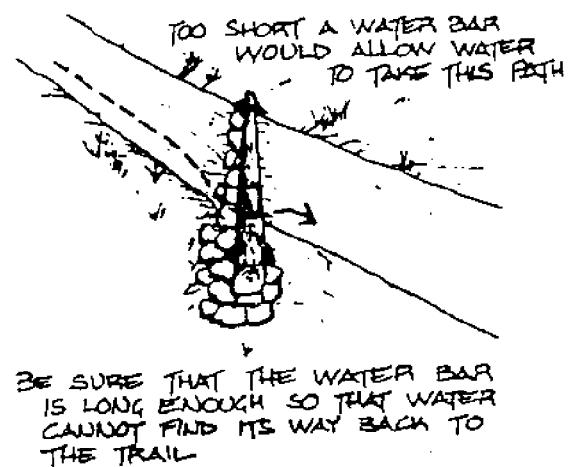
## SLANT AND LENGTH OF WATER BAR



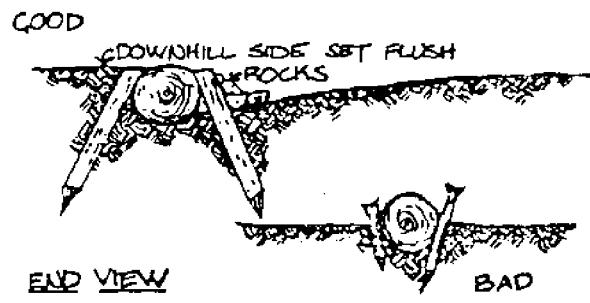
LENGTH OF THE WATER BAR INCLUDES A 12" EXTENSION ON EACH SIDE OF THE TRAIL

Trail Width	Angle		Approx. Length	
	30°	40°	30°	40°
18"	10"	15"	45"	47"
24"	14"	20"	52"	55"
36"	21"	30"	66"	71"

To install a bar, dig a ditch slightly larger than the log to be used. The bar should lie almost flush with the downhill side of the trail and be buried to approximately half its diameter on the uphill side. This will help keep water from undercutting the log. The log should extend at least 12" beyond each side of



the trail to prevent diverted water from returning to the trail below the bar. Stakes, 2" to 3" in diameter and 2½" to 3" long, are used to secure the log after it is in place in the ditch; they should be notched into the log when on the uphill side. Stakes should be driven in to form an inverted "V" over the log, and they must be cut flush with the top of the log to prevent their catching on pant cuffs and boots. Starting approximately 5' before the water bar the trail should be sloped outward until a vertical distance of about 6" is attained at the bar; this will help the bar to function properly and keep it from clogging.



The steepness of the trail grade, the soil type, and the availability of places to divert water influence the intervals at which a water bar should be constructed. Water bars should always be installed above and below trail curves, intersections, steps, ords, and culverts, and below seeps, springs, and general run-off areas. A "Trail Cross-Drain Spacing" chart has been developed by the U.S. Forest Service Intermountain Forest and Range Experiment Station. It has been adapted for reproduction here to give guidelines for the spacing of water bars and drainage dips.

#### TRAIL CROSS-DRAIN SPACING

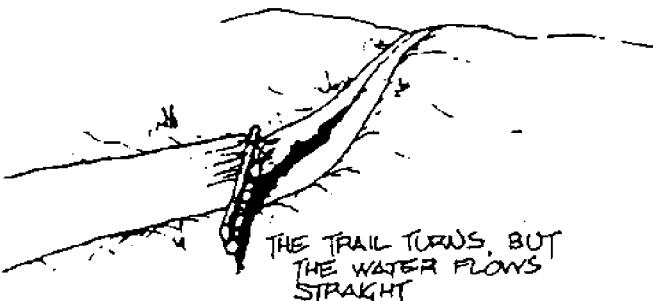
Trail Grade	2	4	6	8	10	12	14	
Deg.	.9	1.8	2.7	3.6	4.5	5.4	6.3	
Hard	Up	167	152	144	137	128	119	108
Sedi- ment	Mid	149	135	126	119	110	101	90
	Low	131	116	108	101	92	83	72
Glo- cial	Up	135	120	112	105	96	87	76
	Mid	117	102	94	87	78	69	58
Silt	Low	99	84	74	69	60	51	40
Loess	Up	95	80	72	65	57	48	37
	Mid	77	62	54	47	39	30	19
	Low	59	44	36	29	21	12	1

NOTE: On south facing slopes, reduce spacing by 15 feet. For each 10% decrease in hillside steepness below 80%, reduce spacing by 5 feet.

Topographic position of trail on hillside is indicated by Up, Mid, and Low (upper, middle, and lower one-third).

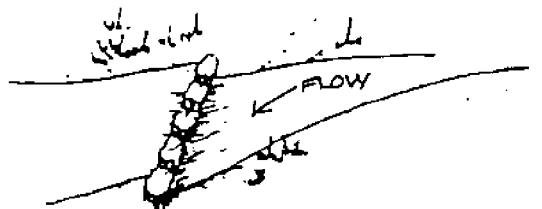
All lengths are given in feet.

Turns in a trail are ideal places to set water bars; water can follow the bar off the trail without the flow being substantially interrupted or causing the bar to become clogged with sediment and debris. Rocks and other natural debris should be placed on the lower side of a trail to slow down the flow of diverted water and help prevent erosion, especially if the slope on the lower side of the trail is steep.



Rock water diversion structures, or water bars, can also be constructed. A narrow trench is dug and then rocks are placed in it; large rocks of approximately 200 pounds are suggested. The angle of a rock water bar should also be 30° to 40°, and the rocks should be placed tightly end-to-end or overlapped. When properly constructed, rock structures will last much longer than wood water bars.

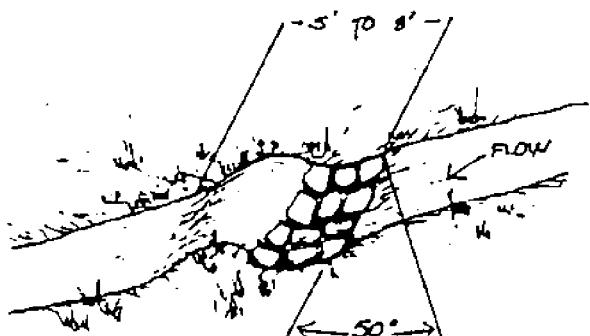
#### ROCK WATER BAR



OVERLAP STONES LIKE SHINGLES

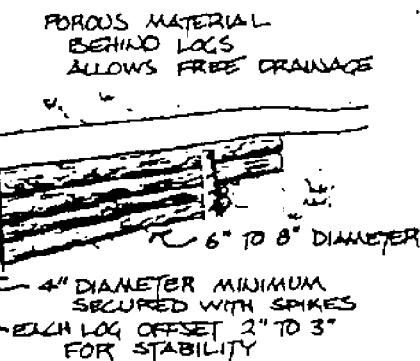
Drainage dips are similar to water bars, but they are more appropriate for use on trails which will be used by the handicapped. To construct a drainage dip, dig a trench across the tread depositing the earth in a mound on the downhill side of the trench to a width and height of 1' to 2'. The dip and mound should take up a 5' to 8' length of tread. The angle of the dip across the trail should be approximately 50°, steeper than the angle used for water bars; the steeper angle lessens the impact of flowing water on the mound. Starting approximately 10' before the dip, the trail should be outsloped gradually until a vertical distance of about 6" is reached at the dip. Drainage dips are most effective on stable soil, but they can be made suitable for use on loose soils by lining them with large flat rocks.

#### DRAINAGE DIP



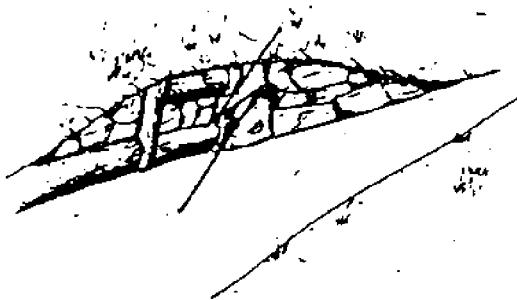
LARGE ROCKS CAN BE USED TO STABILIZE THE DIP

## LOG CRIBBING



Cribbing can also be used to reinforce and stabilize the bank on the uphill side of the trail. It can be constructed in many different ways to offer a suitable solution for each particular site.

## LOG & ROCK CRIBBING AND ROCK CRIBBING



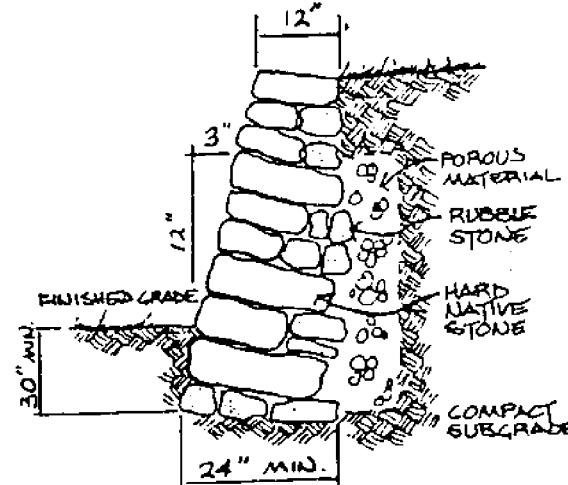
Retaining walls and bulkheads are more elaborate and more expensive structures which serve the same general purpose as cribbing. Retaining walls can be constructed of rock, logs, railroad ties, or dimensional lumber. Retaining walls need a footing for a firm foundation. The footing should go at least to the frost line (30" below ground for most of the state, 36" in the northern part of the state). Placement of a 6" layer of gravel under the footing will add stability to the retaining wall and promote drainage; porous fill may also be needed directly behind the retaining wall to drain water away rather than build up pressure. Drainage tile may be needed at the base of the wall, beneath the gravel, to carry away excess water.

The largest, relatively flat rocks available should be used for constructing a retaining wall. The rocks should fit together solidly with staggered joints; small rocks can be used to fill in holes. Approximately  $\frac{1}{3}$  of all rocks used should be of header dimensions. A header stone has a length greater than  $2\frac{1}{2}$  times the width, and the width is greater than  $2\frac{1}{2}$  times the thickness of the stone. All headers should be placed with the long edge running toward the slope to tie together the retaining wall. If a retaining wall is to be constructed of

wood, tie the exterior of the wall to the interior with timber cross-ties or galvanized cables. Offset retaining walls back from the base 3" for every 12" of wall height; this lowers the center of gravity and makes the wall more stable.

## STONE RETAINING WALL

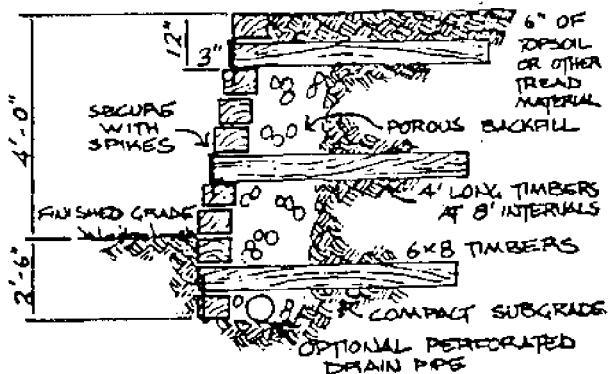
### END VIEW



TOP COURSE OF WALL SHOULD BE MORTARED  
STONES SHOULD BE SET AT RIGHT ANGLES  
TO FACE OF WALL  
A MINIMUM OF 1/3 OF STONES SHOULD  
BE THROUGH STONES  
FACE SHOULD BE CARRIED A MINIMUM  
OF 6" BELOW FINISHED GRADE  
WALL MAY BE USED ON UPHILL OR  
DOWNSHILL SIDE OF TRAIL

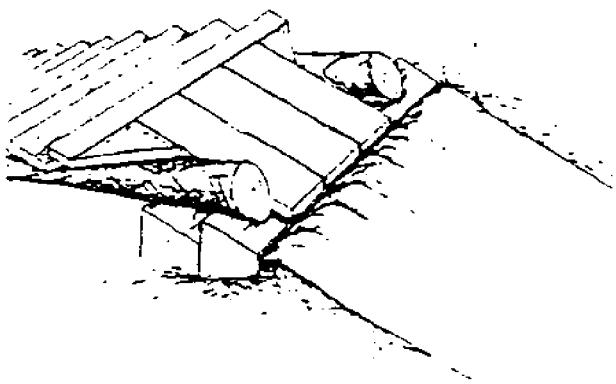
## WOOD RETAINING WALL

### END VIEW

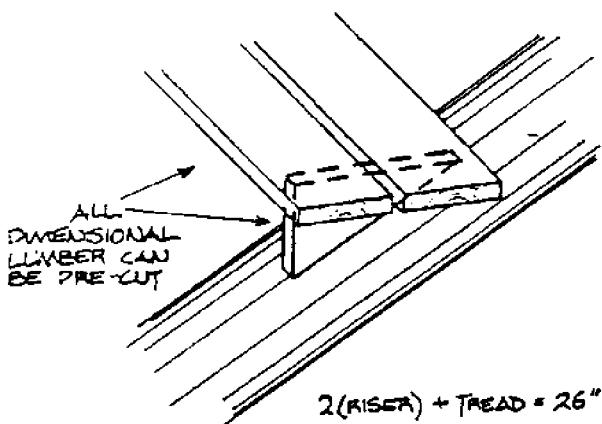


WALL MAY BE USED ON UPHILL OR  
DOWNSHILL SIDE OF TRAIL

## ROCK CRIBBING

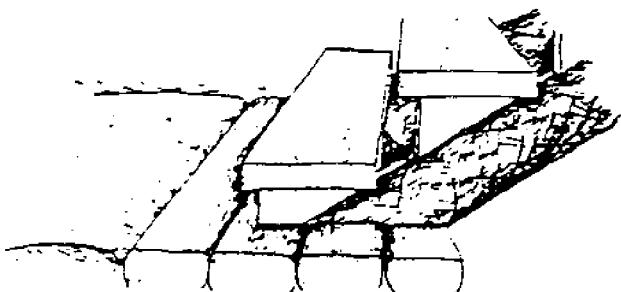
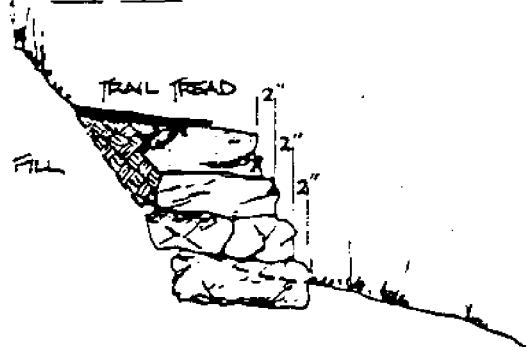


100 LB. MINIMUM WEIGHT



## ROCK WALL CRIB

### END VIEW



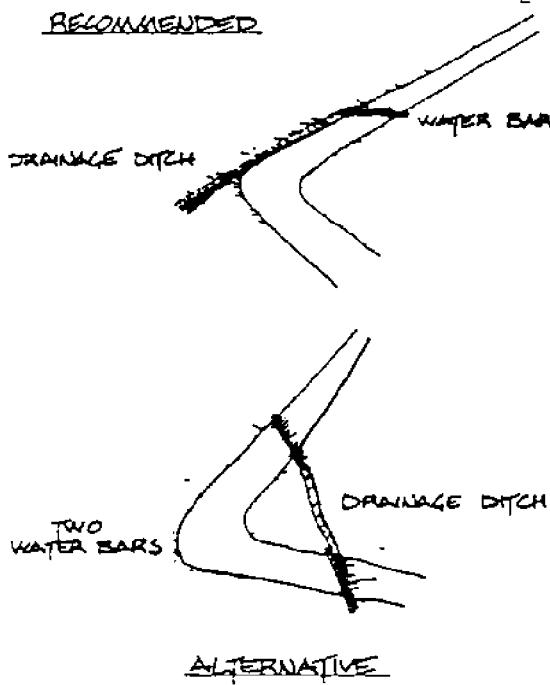
Rock cribbing can be used to stabilize the low side of a trail. To construct a rock crib, dig a uniform trench in which the rocks can be set as though constructing rock steps. If the soil is poorly drained, use a 4" to 6" layer of small rocks under the rocks and behind the face of the cribbing to aid drainage by allowing water to percolate through.

Log cribbing serves the same purpose as rock cribbing. Logs are laid along the edge of a gully and then firmly secured with large stakes; logs can also be secured against rocks and trees that are next to the trail. Logs can also be placed across the tread as combination spacers, steps, and retainers.

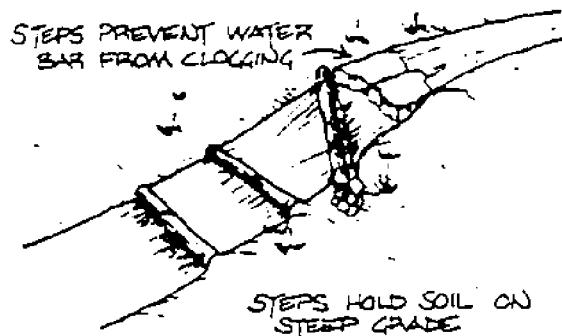
Logs used for cribbing should be 5" to 10" in diameter, reasonably straight, and peeled with the limbs cut flush. Water must be able to drain behind and under all logs; coarse, porous fill, such as small rocks, should be used in conjunction with soil to facilitate drainage. All logs should be treated with a wood preservative. When building a log crib with one log on top of another, offset each successive log back toward the tread by 2" to 3" to add stability to the structure.

On steep slopes where switchbacks are required proper drainage is very important and can be done in two basic ways. In the preferred way, a water bar on the upper switchback leg directs the water off the upper leg to a drainage ditch which carries the water away from the trail. By disposing of runoff before the turn, the lower switchback leg will not have to be drained, aside from normal outsloping of the tread and normal placement of water bars. The second method of switchback drainage diverts water off the upper switchback leg into a drainage ditch and across the lower leg. Where the water crosses the lower leg a water bar is needed to carry the water away from the trail. Natural debris should be placed between the switchback legs to discourage shortcircuiting when the second method is used.

## DRAINAGE OF A SWITCHBACK



When developing a trail on steep slopes where switchbacks cannot be constructed, steps must be used; they can help in the stabilization and retention of soils. In fact, the use of water bars in conjunction with steps is often the most effective way to control erosion on steep slopes—steps hold the soil, and water bars placed above the steps prevent them from washing out.



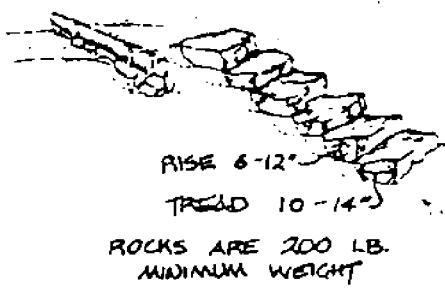
Steps can be constructed of rock or wood. When building steps, the riser/tread ratio should be comfortable for the hiker. Steps should be constructed using the formula:  $(2 \times \text{riser}) + \text{tread} = \text{approximately } 26"$ . The average person's pace is approximately  $2\frac{1}{2}$  feet, and tread lengths between risers should be in multiples of that figure if a hiker will be required to take a pace or more between steps. Steps should also cover the full width of the trail. For one-way travel, steps should be a minimum width of 18"; a width of 42" usually allows two people to pass comfortably, and an extra 24" is generally needed for each additional lane of travel. Width may need to vary with site conditions, and large rocks, trees, and other natural elements should be incorporated into the design of the steps.

When constructing rock steps, start from the bottom of a slope and work upward. Native stone should be used to maintain the natural quality of the trail environment. If stones need to be split, a rock drill or jackhammer may be needed in addition to the basic tools for rock step construction—a crowbar, shovel, and mattock or pick. Any time split stones are used the side with the holes in it should be placed down. Rocks for steps should weigh at least 200 pounds and, ideally, they should be wide enough to extend across the entire tread. Smaller rocks can be placed side-by-side to achieve the desired width, but the steps will be more stable if larger rocks are used. The weight of each rock should keep it in place.

To begin construction, dig a hole in the trail where the bottom step is to be placed. Place the rock in the hole so that the flattest, widest surface is placed up; the surface should be relatively smooth and level. Each step should be long (deep) enough to allow a hiker to place his whole foot on it—10" to 14" is recommended. The rise should generally be between 6" and 12". The top step should be flush with the normal tread. Steps should be sloped

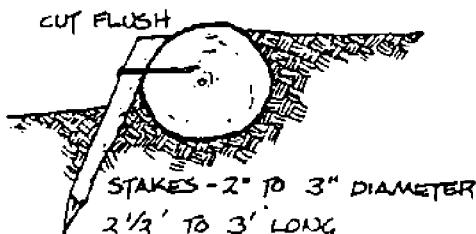
slightly outward from the back of the step and slightly toward the natural drainage flow off the trail. Fit each rock solidly into the soil. It should not shift when stepped on. If it does, fill the hole to make a firmer, more solid foundation for the rock. Do not wedge the rock with smaller rocks because they will work loose. Overlapping rock steps will be more stable than those which have earth backfill: the weight of the upper rock steps helps hold the lower steps in place.

## OVERLAPPING ROCK STEPS

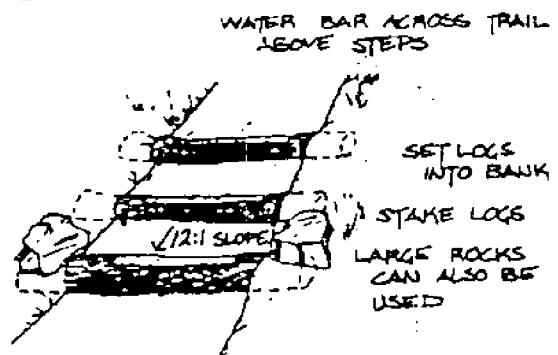


Although rock steps are the most durable type of step and are esthetically pleasing when properly constructed, wood steps can also be constructed using logs, railroad ties, or dimensional lumber. When using logs, remove all limbs, trim knots flush, cut the ends neatly, and peel the bark. All debris should be removed from the trail and each log should be treated with a wood preservative. Logs should be at least  $\frac{1}{3}$  larger in diameter than the finished rise and should be long enough to extend past the edges of the tread.

After preparing a log, dig a trench approximately  $\frac{1}{3}$  of the diameter of the log and set it into the trench. Drive a stake into the ground near each end of the log on the downhill side of the step; stakes should be 2" to 3" in diameter and 2' to 3' long. Drive the stakes at an angle and nail them to the step. Cut the stakes flush with the top of the log to minimize tripping hazards. Backfill behind the log with soil. Repeat the procedure to complete a series of steps. Steps should slope from the back of the step toward the log at approximately 12:1 (for every 12" of horizontal distance the trail should be sloped 1" of vertical distance). Finally, flatten the tops of the logs to make them easier to walk on. Construction procedures are similar for steps when using railroad ties or lumber.

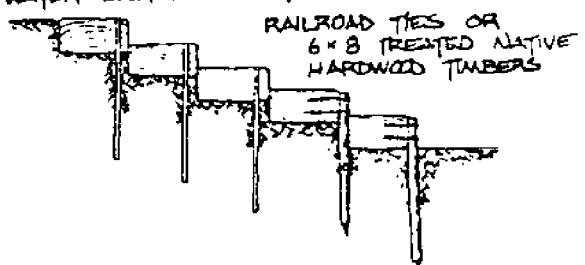


## LOG STEPS



## RAILROAD TIE OR TIMBER STEPS

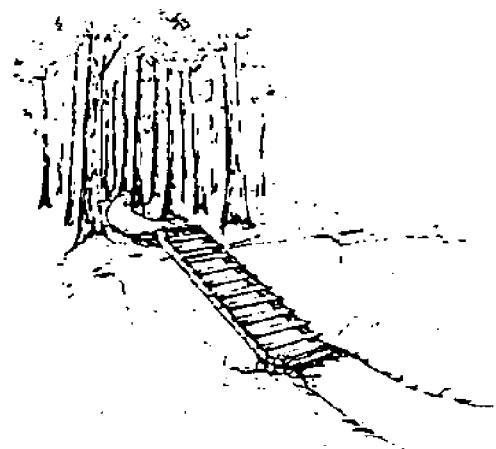
END VIEW  
WATER BAR ACROSS TRAIL ABOVE STEPS



STAKES - 2" TO 3" DIAMETER, 2 1/2' TO 3' LONG -  
TWO PER STEP  
OR STEEL RODS - 3/4" DIAMETER, 3' LONG -  
TWO PER STEP; DRILL HOLES IN STEPS  
FOR RODS

A trail step ladder, rock or log cribbing, or some other special technique, such as a combination or crib ladder, may need to be constructed on top of or next to a gully when steps cannot be built due to severe erosion. Trail ladders can be constructed of logs or dimensional lumber, and the wood should be treated. The bottom of a ladder must be securely anchored into the ground so it does not shift; if the soil is too shallow for a footing or the use of stakes, the placement of large rocks at the bottom of the ladder may help to stabilize it.

## TRAIL STEP LADDER



# GUIDELINES FOR TRAIL RECONSTRUCTION

ALL LAND AREAS HAVE AN INHERENT and variable ability to sustain recreational use without suffering damage to soils, vegetation, and water. This ability can be relatively low, especially in mountain parks and forests with steep slopes and abundant water runoff. To increase the land's ability to withstand hiking use without resource damage, trail construction techniques need to be introduced.

The intensity, and consequently the expense, of construction of a satisfying and undamaged trail environment is controlled basically by two factors. The first is the volume of use an area receives. As use increases there is more wear and tear on a trail, and therefore the need for increased trail stabilization work is present if soils and plant life are to be maintained in a healthy condition. The second factor governing construction is the character of the land itself. Areas that are wet, located on steep slopes, characterized by poor soils, or which support fragile vegetation such as that present in the alpine zone require particularly careful — and sometimes costly — construction. There are construction techniques which allow a certain degree of use in such areas, but the associated costs of labor and materials will be high and an inevitable loss of natural qualities will result. Trails in these more sensitive areas should be avoided if possible or at least minimized.

## When to Relocate

Gullies or wide muddy areas on trails can be tackled in one of two ways: they can be circumnavigated with a relocated section of trail or they can be hardened with techniques described later. When deliberating on this choice, two questions should be answered.

1) *Will the new section of trail have the same environmental conditions and the same design as the damaged section being replaced?*

Often the answer to this question is "yes," which means that the same steep slope or boggy soils have to be traversed by the relocated section of the trail. If this is the case, then more often than not it is best to stick to the old location rather than opening up a new one that will deteriorate in the same fashion. If, however, the same terrain is crossed but in a less direct fashion — i.e., if there is a design change whereby the trail crosses the slope rather than climbs directly up it — then the relocation is probably worth considering. The same environmental conditions may predominate, but the trail design in this case is more topographically sound.

2) *Will the old section of the trail be too difficult to close and rehabilitate?*

If the section of trail being replaced is the most obvious location in a given landscape — for example, on a pond

shore or on a pronounced ridge — then hikers naturally tend to assume its existence and will use the trail even after a relocation is installed and the section in question has been closed. In these cases, again, it is best to stick to the old location. Sometimes in situations like this, a relocation can actually hasten environmental degradation by becoming confused with the old location so that hikers begin using both routes interchangeably. When this happens there can be many problems with both locations, as well as any unplanned crossover trails that may develop because of hikers' confusion.

Generally relocations should only be used when there can be a substantial improvement in the environmental conditions on the new section. This assumes that the relocation will replace a substantial piece of trail. Short relocations around a wet area may be appropriate, but the best long-term solution is usually to either close and replace a long trail section or to reconstruct it. More often than not the hardening alternative is the best one: it will be addressed in the next two chapters.

## Building Materials for Reconstruction

The techniques described here require that the trail maintainer find native materials in the vicinity of the trail and move them to the treadway for use in its reconstruction. This laborious process should be undertaken carefully to minimize damage to the trail environment and to maximize the quality of reconstruction.

The materials, usually wood or rock, are either cut or dug from sites near the trail but preferably out of sight from it. This is a primary criterion in choosing reconstruction materials — that they be unnoticed and subtle in terms of what the trail user senses as he traverses a trail's length.

**Wood Materials** — Usually a stand of trees appropriate in size and length can be found uphill and out of sight of the trail. After the trees are cut down they should be limbed, peeled, and cut to appropriate length on site so that bark, wood chips, and other waste products are not left on the trail itself. Once prepared they can be hand carried to the trail. A peeled log can be slippery, however, so some prepare the log at the trail and remove the debris afterward.

**Rock Materials** — Rock debris should also be removed out of sight of the trail. Dead brush and other forest litter should be placed in any hole left by removal of rock near the trail. So as not to leave a visible scar, do not cut bedrock or ledge within sight of a trail.

**Soil for Fill** — Occasionally a soil pit needs to be dug to provide soil for fill work along the trail. Though such pits can be near the trail, they should be out of direct view, and after being used they should be filled with debris and hidden.

## TRAIL BLAZE

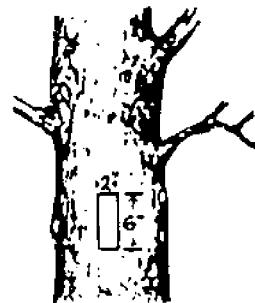
# Marking the Trail

After a trail is constructed it should be marked before it is opened for use. The method for marking should be kept consistent with trail markers appearing regular intervals. In general, a hiker should not have to walk more than 600' without being able to see a marker either ahead of him or behind him. In addition to being marked, trails should be named (not just numbered) to aid in their identification, and a color can be used for marking a trail to further aid in identification.

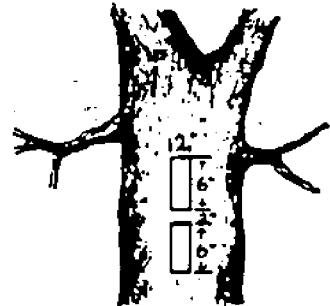
Signs will be needed for trail heads and trail junctions and intersections. Routed wood signs have the advantages of being relatively durable and esthetically pleasing. Letters are routed into the wood using a router and a template; the letters are then filled in with a contrasting paint. The sign will remain legible even if the paint fades. Signboards should be at least 2" thick and letters should be 2" to 4" high.

When signs are mounted on posts, the posts should be at least 4" by 4". If a sign is less than 20" wide one post is all that is needed; two posts should be used for larger signs. To make a sign stable, approximately 40% of the post should be buried in the ground. If vandalism is a problem, set posts in concrete or place steel reinforcing bars in holes drilled through the bottom of the posts. Either of these methods will deter vandals from turning or removing a post. Attach signs to posts with countersunk galvanized lag bolts. All wood for signs should be treated with a preservative.

Paint blazes can be used for trail marking. Paint blazes are most recommended for use on long trails such as backpacking or backcountry trails. Blazes can be placed on trees, posts, or where appropriate, rocks. They should be painted rectangles approximately 6" x 2" placed at eye level. When painting blazes on a tree, a large tree which attracts attention is generally more desirable to use than a small one. Two blazes should be used to alert the hiker of a change in direction. This does not indicate in which direction the trail will be turning, it only warns a hiker he is about to change direction at a trail intersection.



## CHANGE OF DIRECTION



When marking a trail, paint blazes in only one direction at a time. After painting a blaze look down the trail for a tree that strikes your eye. When you reach the tree, if it is not too far off of the trail, paint the next blaze. On your return trip, select trees for blazes in the same manner. If possible, avoid placing blazes from both directions on the same tree. Do not mark a trail to the extent it detracts from the trail setting.

To paint a blaze prepare the bark with a hard-wood floor scraper (a scraper with a 2½" blade and a 6" handle is recommended for use). Two to three downward strokes should be adequate; do not scrape through the bark. When renewing an old blaze (this may need to be done every two years) scrape it lightly to smooth the bark and remove any paint flakes. Paint the remainder of the scraped area which is not covered by the blaze with neutralizing paint (black, brown, or charcoal). When painting on light gray bark, outline the blaze with a narrow line of neutralizing paint to make it stand out, particularly when the blazes are white. If you are painting a blaze on black cherry, cedar, or another tree with bark which cannot be easily



### **The Pohn Lehr Trail**

**Devised by the Participants of the 'Ecotourism and Trail Design' Workshop**  
**December 6, 1996**

**Vision:** To improve and promote the Pohn Lehr Trail.

#### **I. Planning**

- A.** Is the land privately owned then first ask for permission for any work?
- B.** What is the historical value of this trail or site at the top?
- C.** Providing a good map will allow hikers to stay on the path not in someone's sakau patch.
- D.** Need to set aside space for parking as the road next to the trail is extremely narrow.
- E.** A rest stop currently is provided across the street, however, no signs are posted indicating the place and no rest stop is created halfway up the trail. The participants rated the trail as difficult due to the steepness of the incline. There are a couple of tree stumps along the way, so maybe they can be carved in to little stools for people to stop and take in the beauty around them.

#### **II. Trail Work**

- A.** Ocean Trail- Since this trail is across from the ocean and has an incredible view, it is important to trim branches in the path or blocking the view or reroute the trail, remove slippery palm leaves along the path, and continually weedwacking.
- B.** Repair Trail- The trail may need to repaired in terms of the upkeep of signs and if a viewpoint is constructed at the top of the plateau.

#### **I. Management**

- A.** Signage- Maybe 3 or 4 signs would be adequate like one at the bottom showing a map of the trail and suggestions of what not to do like trespass, two along the way indicating the direction and pointing out native foliage or animals, and one at the top displaying information on the historical significance, any cultural significance, and what can you see from the view.

**B. Weedwacking-** The suggested period for this type of maintenance is twice a month or 24 times in a year as opposed to the usual 64 times in a year that Hawaii needs to do since there are more tourists to consider. In fact, the number of tourists promoted to this trail was determined to be small so the management of it should correspond.

### **The Sections of Pohn Lehr and suggestions listed in order of preference**

I. Beginning of the trail starts with walking on large, slippery rocks so suggestions for improvement are

1. Setting the stone rocks by filling in gaps with gravel
2. Turning that section in to concrete
3. Leave it as is
4. Remove the rocks
  - There is a pig pen right next to the trail by the landowner's house that may need to be moved or the landowner needs to be required to keep the area in certain conditions as pieces of aluminum siding was laying across the trail. If this step isn't taken then the safety for the tourists' can be at jeopardy.

II. Narrow- Muddy area that should be rerouted especially the grade is too steep so changing the trail to a switchback kind would be better.

1. Set stone
2. Boardwalk

III. Steep and slippery area that needs to be re-graded maybe making it a switchback trail with carved steps or a cable helping guide people.

IV. The top plateau that has overgrown grass and ferns

1. Clean it out with a weedwacker
2. Maybe plant some trees to keep the watershed intact
3. Build a small platform on stilts so people can see a view and add an informative sign.

### **Promotion of the Pohn Lehr Trail**

1. Maps
2. A pamphlet or brochure
3. Distribute materials to surrounding hotels and big companies
4. Through e-mail and world wide web place travel postings for avid hikers or adventurers.

Topographic Map



View from Paben's Log Cabin



Site 2: Pohn Fehr Trail

Sign on Trailhead to Pohn Fehr



Group 10 members at the trailhead to Pohn Fehr Trail







## Trail Improvement at Pabu Lukar Waterfall

BEFORE



AFTER



## Trail Improvement at Pahn Takai Waterfall

**BEFORE**



**AFTER**



## **Field Exercises of Workshop**

### **Site One: Pahn Takai Waterfall in Uh Municipality**



**Workshop Participants  
from Pohnpei, Yap,  
Chuuk and Kosrae**

**Pahn Takai Waterfall**

