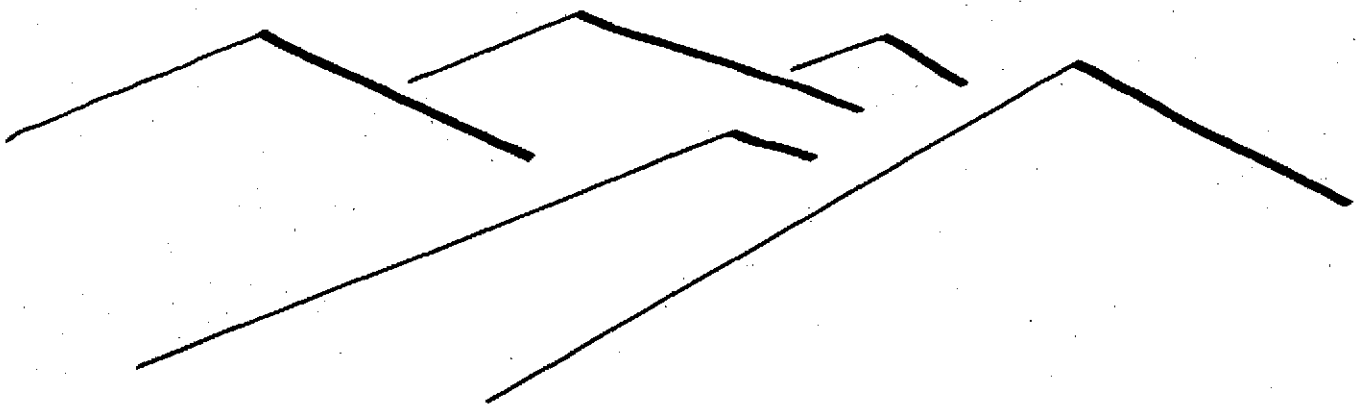

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Appendix **HH** ..... Annotated Bibliography
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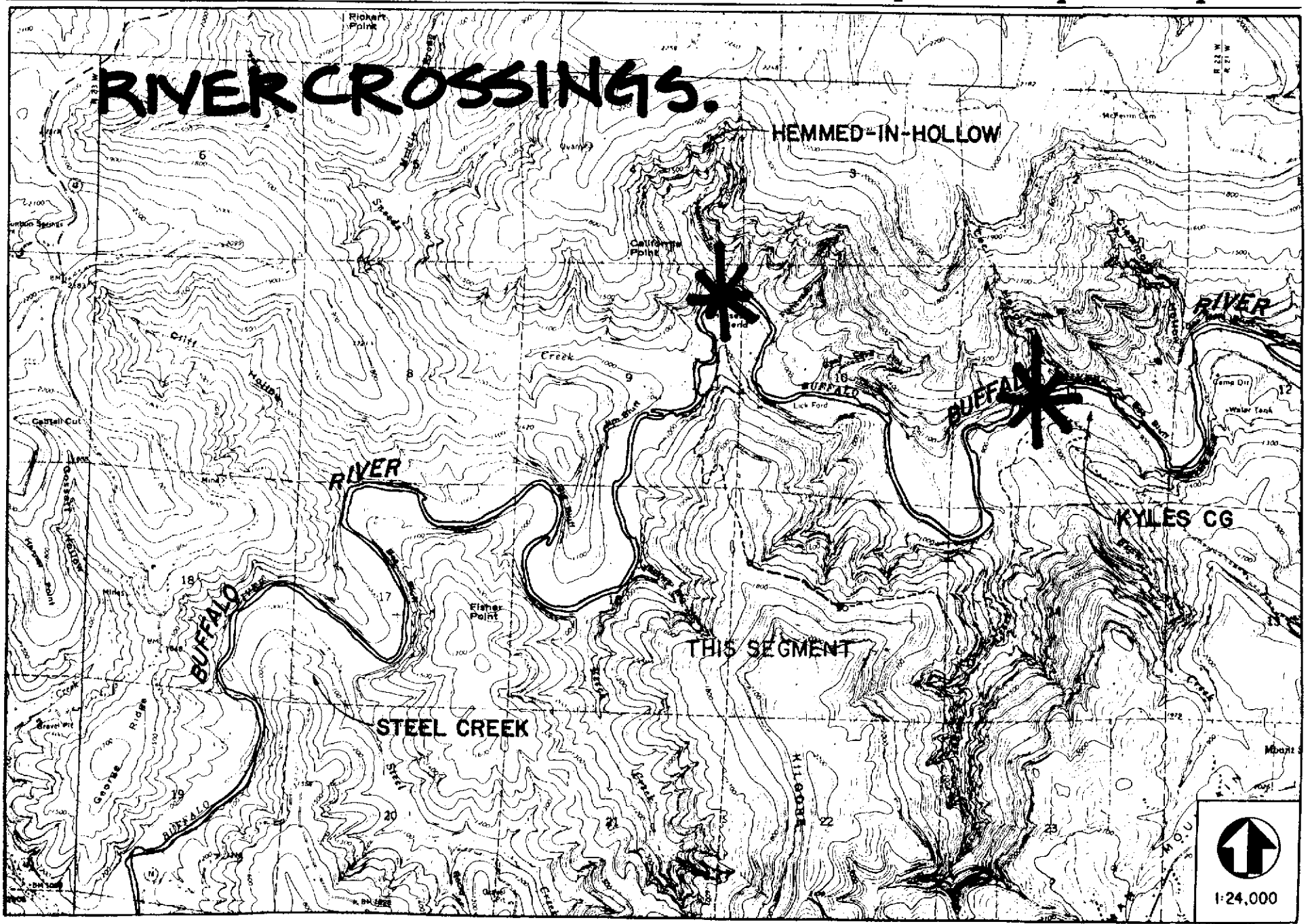
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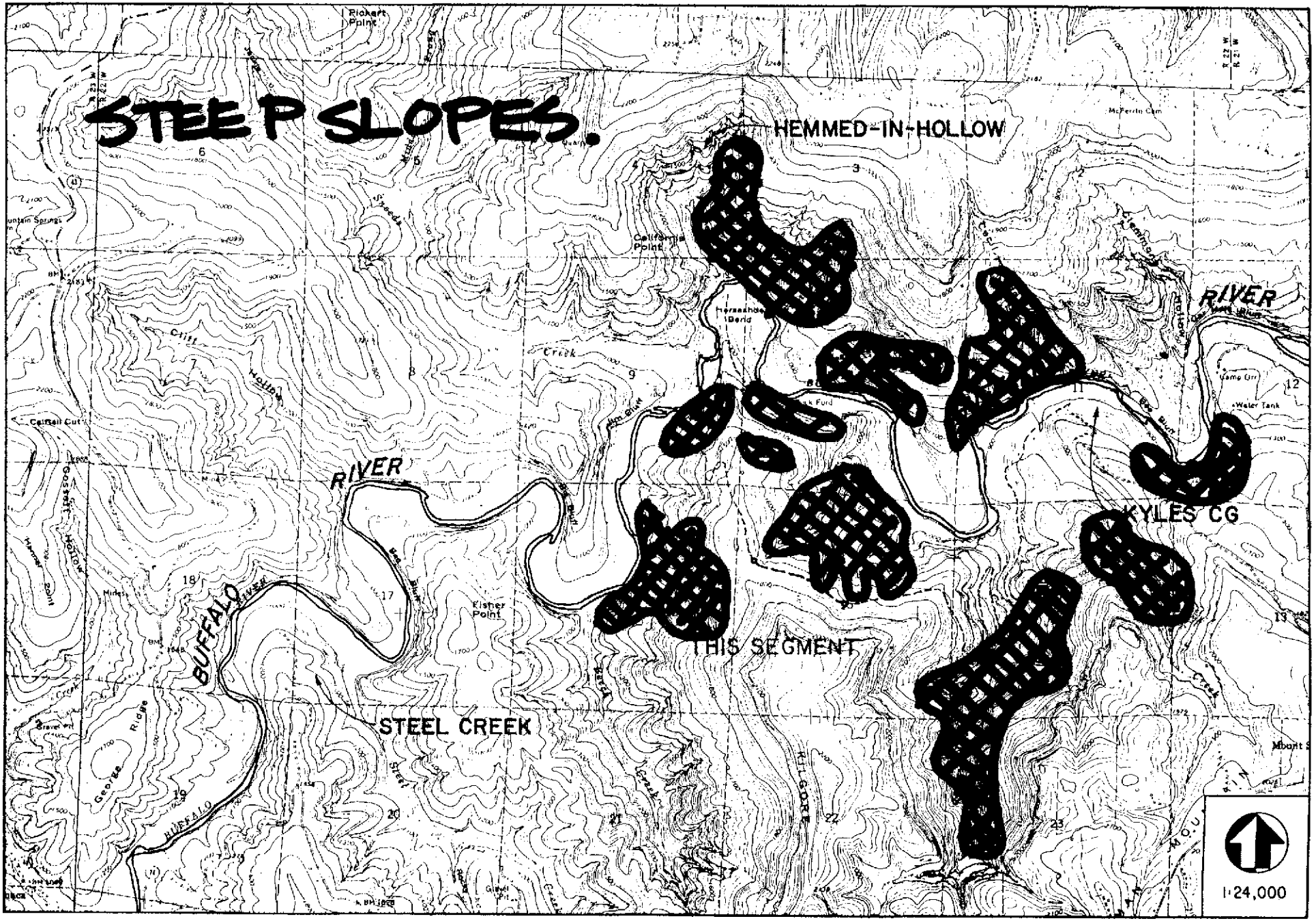
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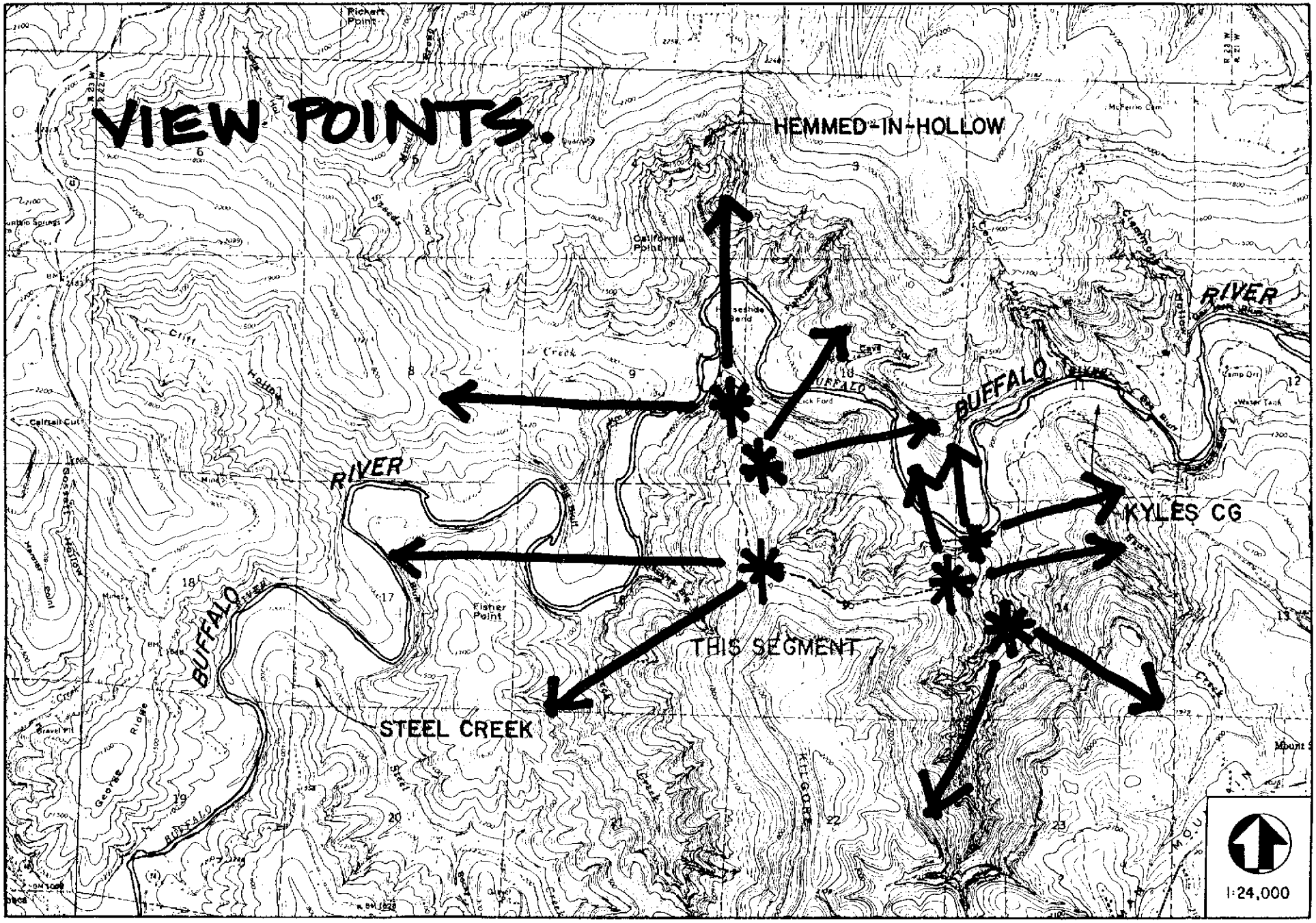
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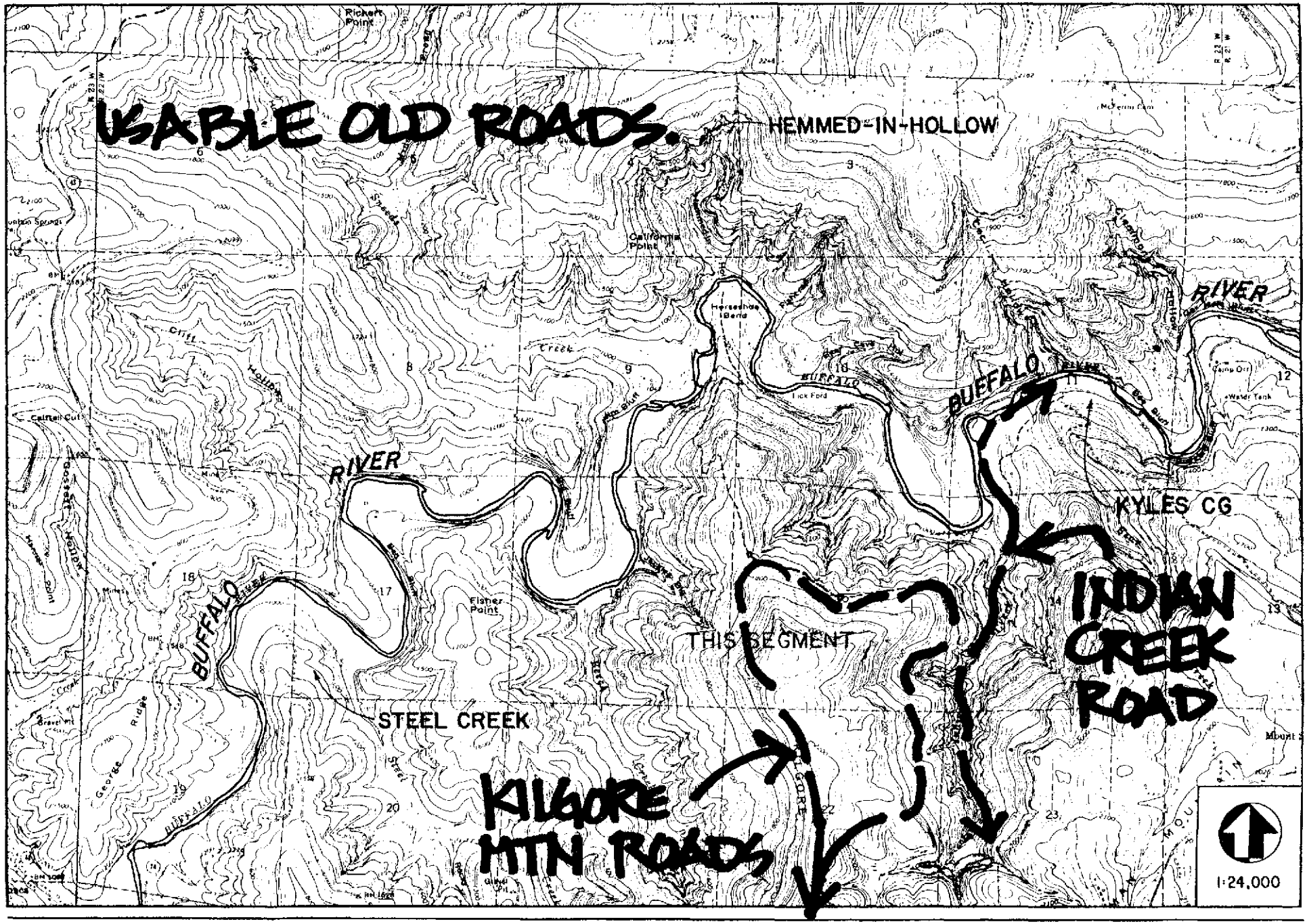
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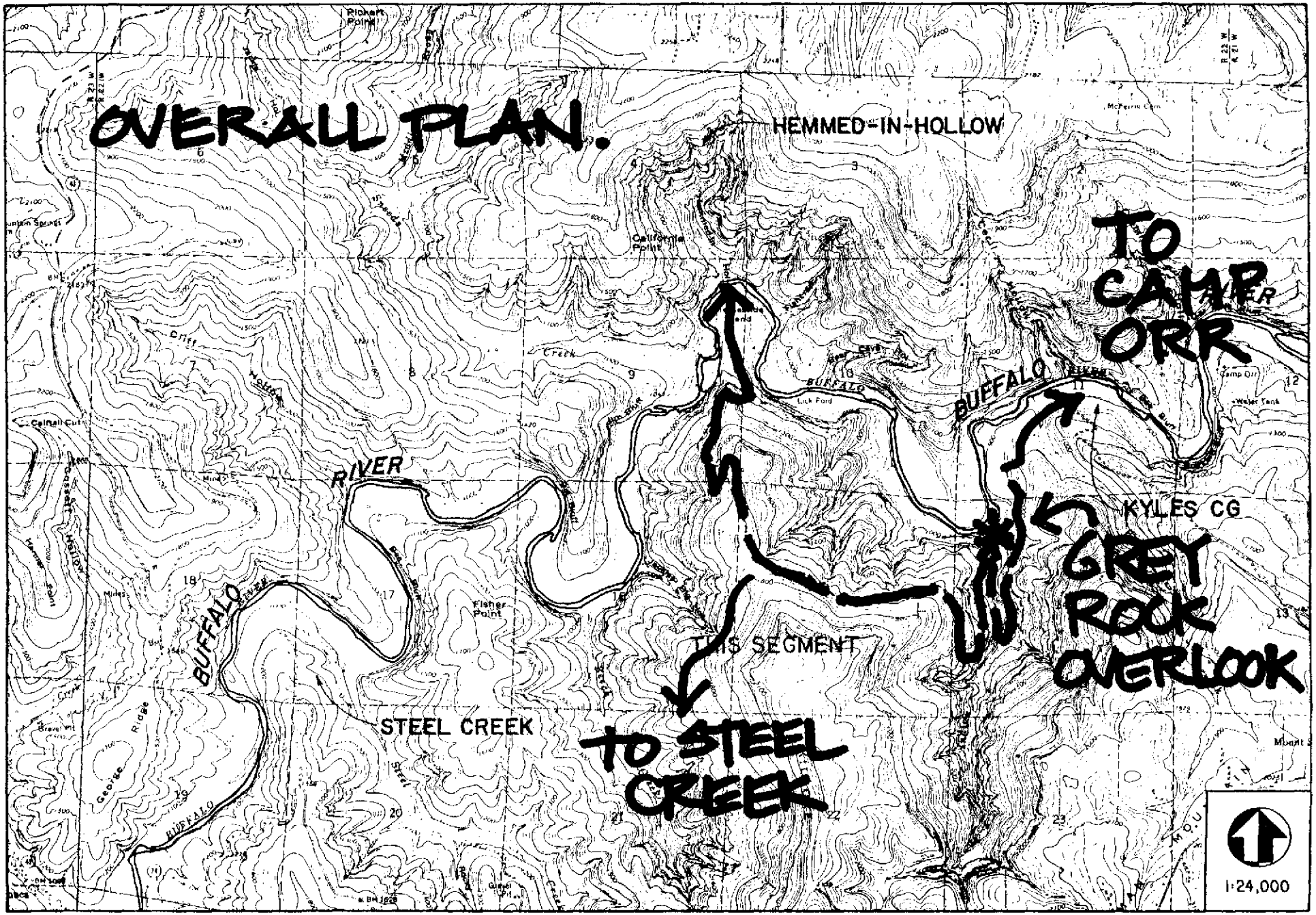
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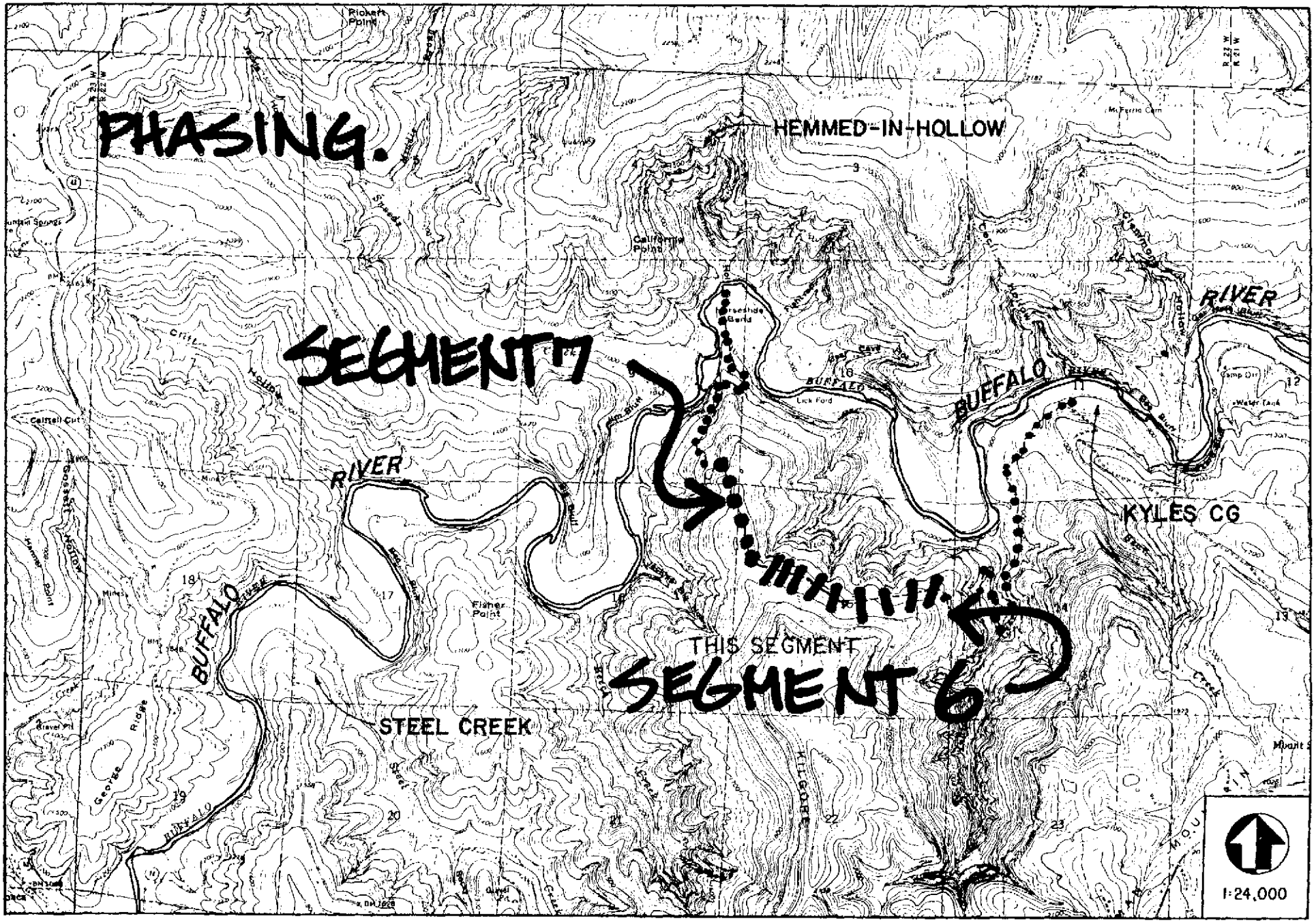
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SEGMENT 6
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RIVER
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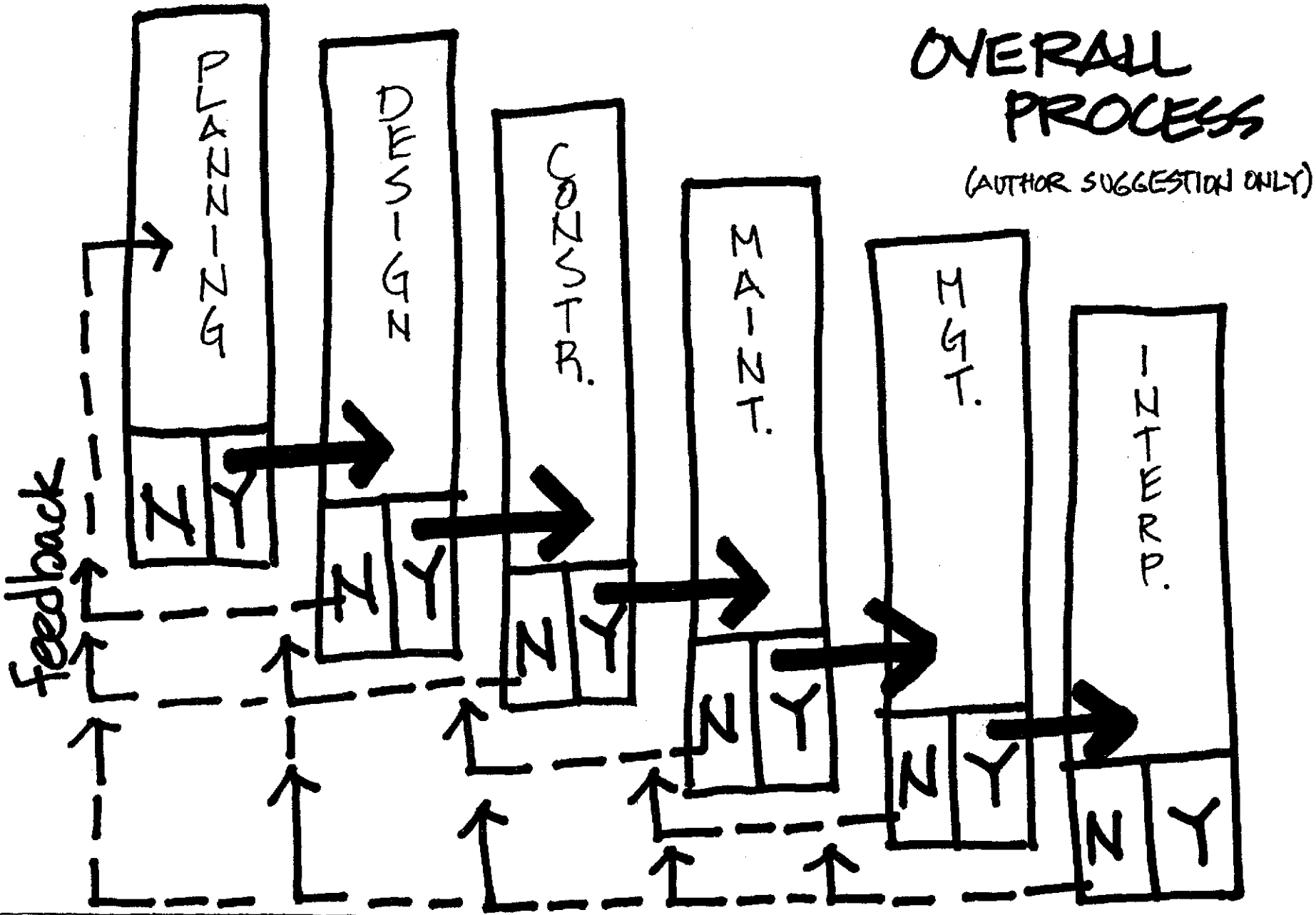
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N
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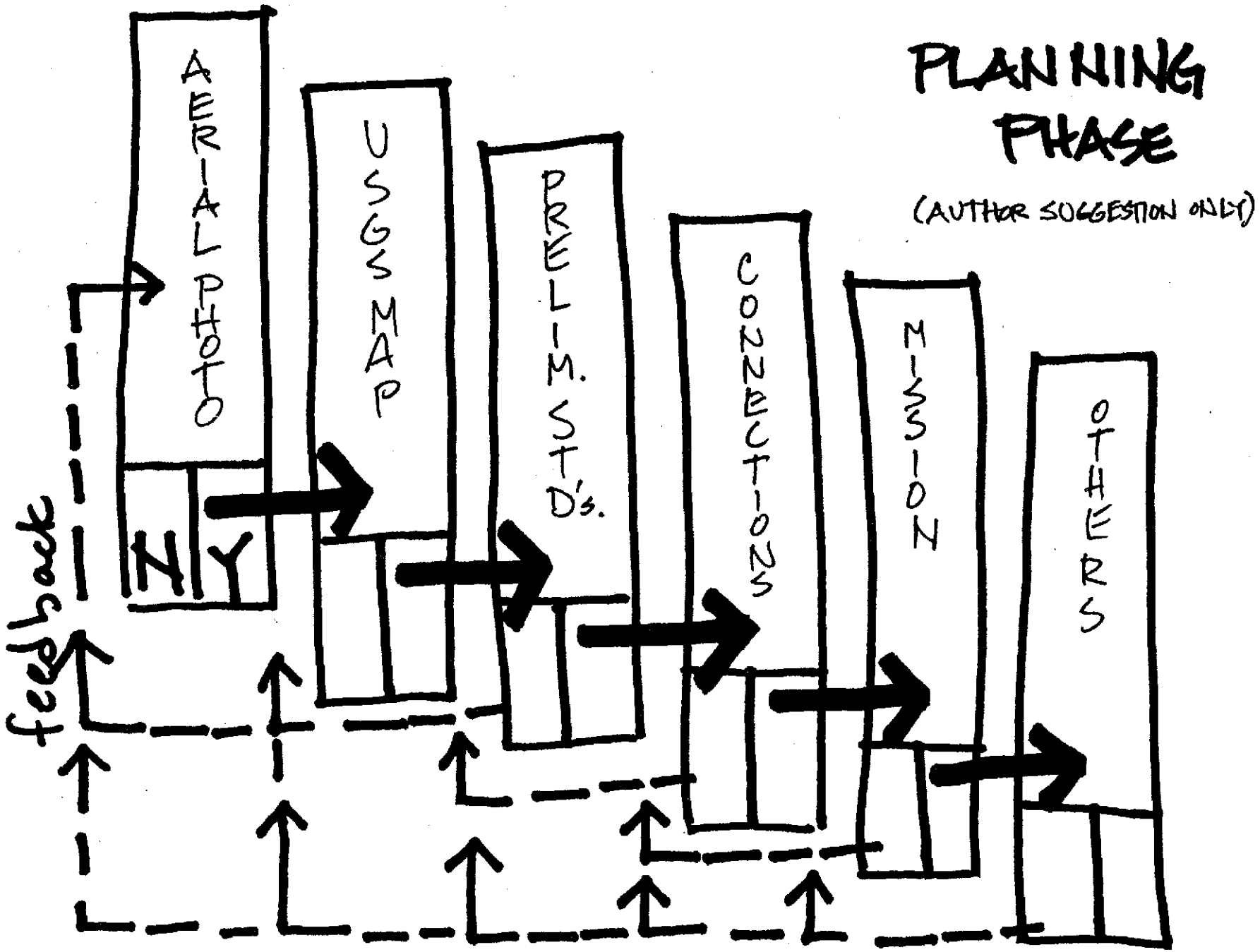
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OTHERS
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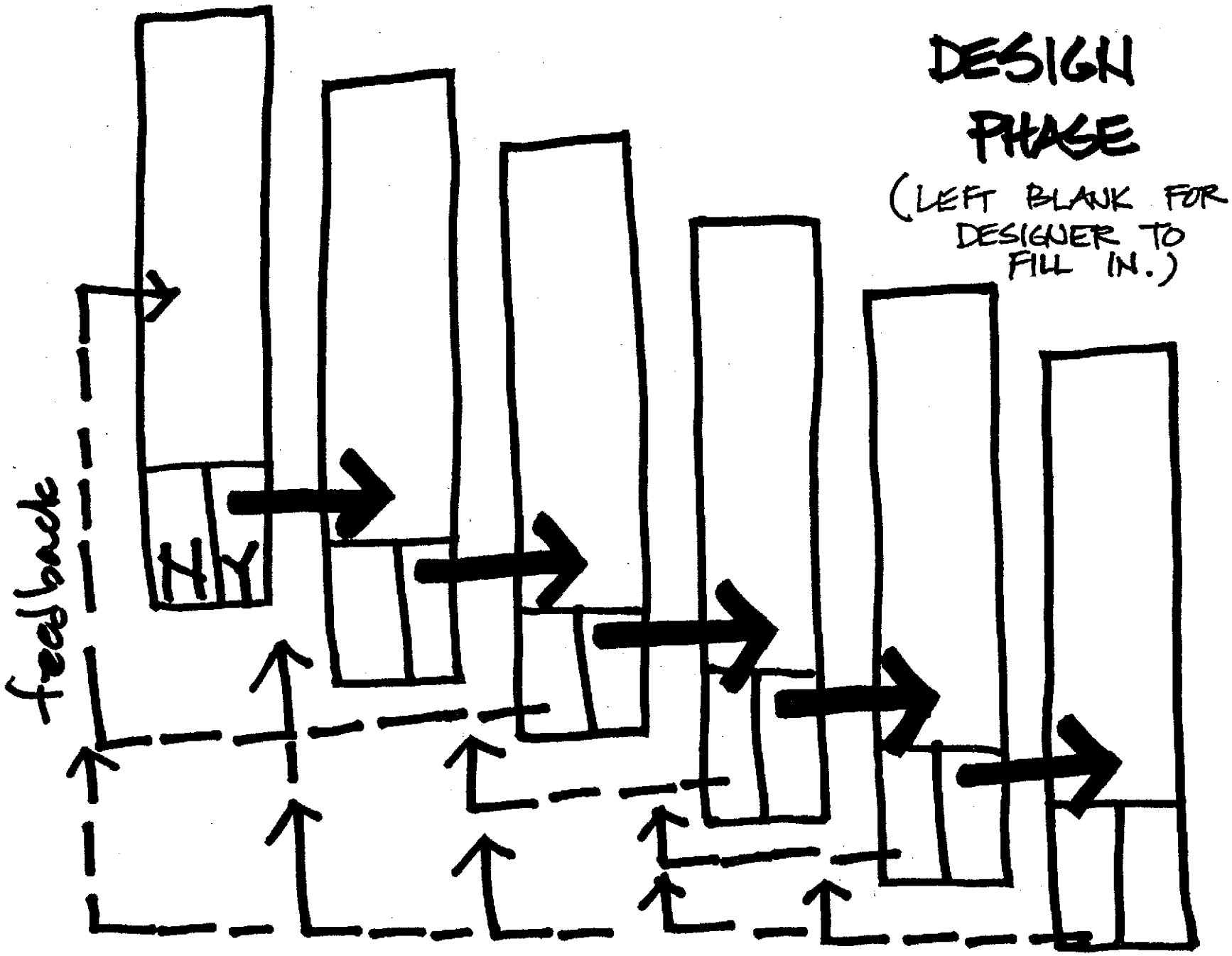
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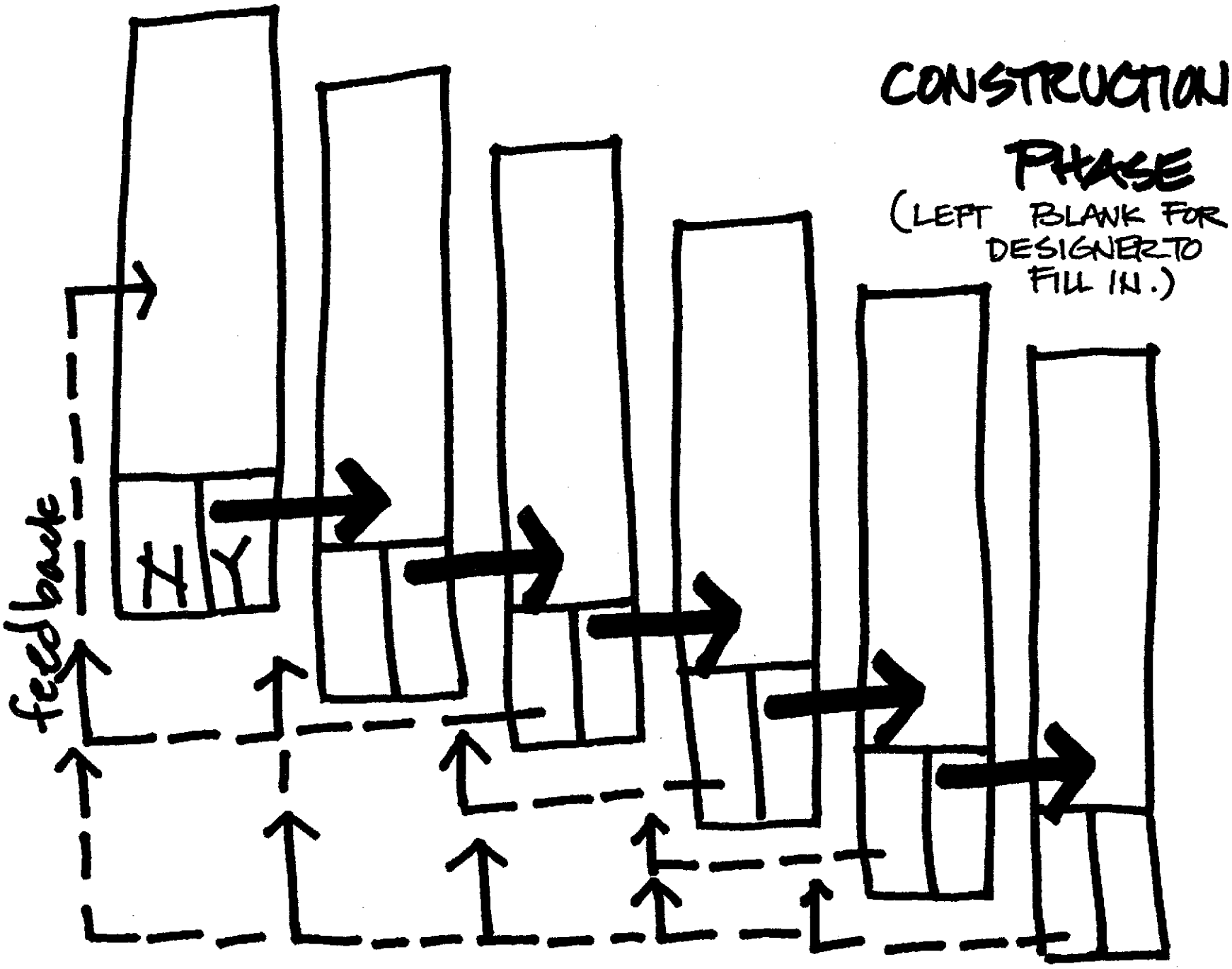
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Developing Sustainable Mountain Trail Corridors

An Overview

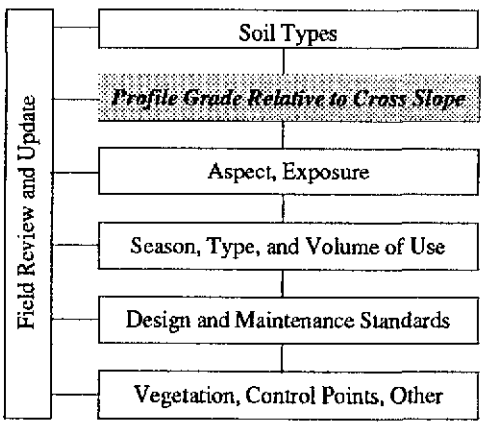
National Park Service, Rocky Mountain Region January 1991

Introduction

This article introduces the criteria of *maximum profile grade relative to existing cross slope (fall line)* as key to the development of natural surface trail projects that are sustainable. Key trail design concepts excerpted from trail documents are presented in this article. Each of the important documents allude to the suggested criteria and to the concept of sustainability, however no document specifically nor fully develops this particular point of view. The criteria presented in this article will assist planning teams in developing natural surface trail projects that are sustainable.

Sustainable Criteria

Natural travel surface sustainability criteria include: soil types, *trail profile grade relative to existing cross slope,* aspect, exposure, season of use, type of use, volume of use, trail design and maintenance standards, ecological implications of vegetation, and functional and aesthetic control points. Imported surfacing materials may improve sustainability of specific areas within the overall corridor.



Evaluating sustainable criteria is a process, with a suggested hierarchy shown. The introduction of the criteria *profile grade relative to cross slope* is the focus of this article.

Corridor Definition

Mountain trails are often treated as a simple linear connection between points of interest, with attention usually given in the literature to just the trail clearing dimensions. Many trail planners realize, however, that there can be influences on the project from beyond the travel surface or clearing limits. The trail corridor is defined as the swath of landscape 10-25 feet on both sides of centerline which contains the travel surface and the aesthetic (viewpoints, wildflower areas, waterfalls) and functional (saddles, switchbacks, stream crossings) control points. Such a definition for the corridor will ensure adequate room for flexibility in the final trail alignment design.

The trail corridor may also include land that must be acquired to protect or buffer the trail from adverse influences, and to protect scenic viewsheds. One purpose of delineating the proposed corridor is to communicate the scope and intent of the project to planning team members and decision makers.

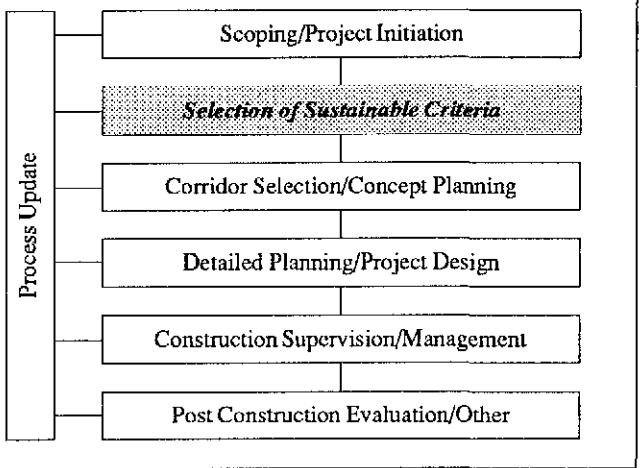
What is sustainability?

Sustainability of natural surface trail corridors is defined as the characteristic of a travel surface to support currently planned and future uses with minimal impact to the natural systems of the area. Sustainable trails have negligible soil loss or movement while allowing the naturally occurring plant systems to inhabit the area, recognizing required pruning and eventual removal of certain plants over time. Sustainable trails will not adversely affect the naturally occurring fauna. Sustainable trail design will accommodate existing and future uses while only allowing appropriate uses. The sustainable trail will require little rerouting and minimal maintenance over extended periods of time.

Interdisciplinary Planning Team

For over 50 years, interdisciplinary planning teams have been assigned to trail projects. The National Park Service Construction of Trails and the Parks Canada Trails Manual documents both describe this need. A landscape architect and an engineer have been traditionally included on the team. Other specialists such as a naturalist, field personnel, or consultant can also be included.

Key to project success is the development of a rational and defensible design process by the planning team. Varying by project, the process will include many steps, including: scoping/project initiation, sustainable criteria selection, corridor selection, concept planning, detailed planning, project design, construction supervision, management, and post construction evaluation. Adhering to the established process will ensure that the team will make well informed decisions that will impact natural travel surface sustainability. Developing a review process for interested parties will also be important to individual project success.



The planning process is project specific. Updating the process as new information is presented and new criteria developed is important to sustainability and project success.

Trailside Vegetation

Understanding the ecological implications of the trailside vegetation within the corridor will assist the planning team in decision making. Response to light and pruning, mature plant size, and invasive or undesirable plants are important factors to consider. The landscape architect can prepare drawings with annotations of anticipated vegetative changes within the corridor for the team.

Environmental Protection

The Trails Manual recognizes the importance of the protection of the environment for the success of corridor projects. The following excerpts are just a few ideas of many that relate to design which must be considered during the planning process:

The protection of the environment is (also) of major importance; if environmental quality is seriously affected the very attributes that have made areas attractive for development in the first place may be lost. Effort should be made to ensure that trails fit their environment as harmoniously as possible so that ecological processes and environmental character are not significantly altered. ...The carrying capacity of an area is the amount of use by man that the area can withstand without undue environmental degradation. Carrying capacity is partially determined by man in that it is man who must define the level of change that constitutes the threshold of unacceptable degradation. The task of the [interdisciplinary] development team is to plan, build and manage the trail so that the carrying capacity of its environment is not exceeded.

...Detrimental impact of trail use upon the environment is directly affected by type of trail activity and how intensively the trail is used. For example, horses will cause more wear to trail surfaces than hikers, and trails used by experienced outdoors people will usually receive less abuse than those used by the general public, since the experienced hiker is less likely to be careless or destructive.

New Uses on Existing Facilities

Realizing that different uses have differing impacts, planning teams must study new uses on existing trails. Addressing pertinent sustainable criteria during the planning process will assist the team in determining the suitability of new uses on existing trails, few of which meet modern standards. Also realizing that design criteria for old roads and railway beds is significantly different than trail criteria, it is necessary to study sustainable criteria when redeveloping these corridors for new uses. Evaluation of projects in the local area can assist the planning team in developing sustainable criteria for the project at hand.

Field Work

Diligent field work is required to ensure that corridor locations have been identified that will support sustainable travel surfaces. More detailed field work is required in complex areas, the extra work being important to sustainability. Also, scouting an important alternative over several seasons, including a winter, may be required to ensure fitness of the corridor for development.

Planning team members are wise to plan boldly, overlooking social and game trails that have evolved haphazardly. Suggesting new alternatives may be the team's responsibility. Suggesting additional management techniques such as signs and short sections of fencing or planted barriers are the team's responsibility and may be necessary to complete a package to gain management support. Well planned, designed, constructed, and managed corridors will not be improperly used as many suggest, but will be respected by users.

Slope Ranges and Sidehill Design

As described in many popular trails documents, acceptable cross slope ranges for typical mountain trail construction (without heavy investment) are between 10 and 70%. The acceptable range suggested for maximum profile grade is commonly between 8 and 12%. Combining local topographic study with varying trail profile grades will reduce the erodibility of, and therefore increase the sustainability of, the natural surface trail during the detailed planning and project design steps.

The concept of sidehill trail design is also described in the popular documents. As excerpted from the Appalachian Trail Conference's Trail Design, Construction and Maintenance: *Using a sidehill trail design is the surest way of preventing erosion. ...The grade of the trail can be far less than the grade of the slope itself.* The Appalachian Mountain Club's Trail Building and Maintenance, 2nd Edition, suggests a way to combine trail gain while preventing gullying: *This happy medium can be found with the sidehill trail location, so that running water will cross the trail but not run down [it].* The Trails Manual develops the concept of *diagonal* trails this way: *Location of trails diagonally across slopes slows run-off and reduces erosion.*

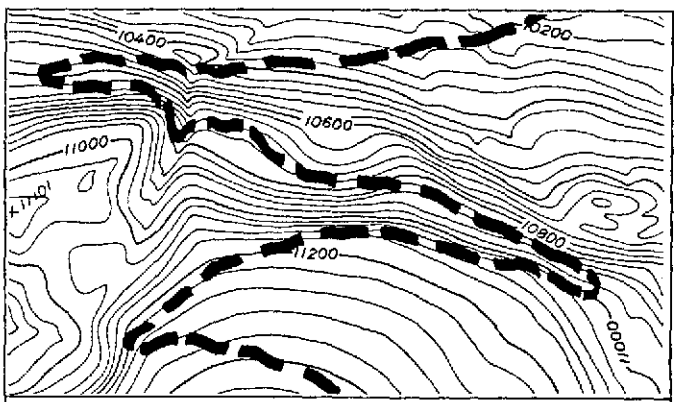
Profile Grade Relative to Cross Slope

Field experience in the front range near Denver, CO suggests that sustainable travel surfaces not only have good maintenance programs in place, but they also have profile grades (along the trail centerline) that are less than 15%, and that are less than 1/4 the prevailing cross slope (direction of drainage) of the immediate section of trail.

Due to topographic variation, the maximum profile grade along a length of trail should also vary with steeper topography being able to sustain a steeper maximum profile grade. This suggests a 2.5% maximum profile grade in 10% cross slope areas, 5% in 20%, 10% in 40%, and 12% maximum profile grade in 48% cross slope areas or greater.

[Reminder: Natural surface trails in cross slope areas of less than 10% usually require surfacing and drainage improvements if they receive even a moderate amount of use; natural surface trails in cross slope areas between 70 and 90% usually require retaining walls in order to ensure the trail does not mass fail; and natural surface trails simply cannot be built in cross slope areas exceeding 90%.]

Trails with profile grades greater than 15% in any cross slope area are usually prone to erosion. Profile grades exceeding 15% also need to consider the effect of moisture (frost, rain, ice and snow), aspect, season of use, and volume of use on user comfort and safety, and on travel surface sustainability. *Diligent efforts in the scoping and corridor selection planning steps can usually avoid using these profile grades!*



Diligent field work searching out trail profile grades that are less than 1/4 the prevailing cross slope grade will have maximum benefit to natural travel surface sustainability and project success.

Design Guidelines

Design guidelines are required for each corridor project. A simple outline with supporting sketches describing trail or segment origin, destination, nodes, natural or cultural resource points of interest, landscape architectural design intentions, design standards, and anticipated investment is suggested.

Estimating/Commitments

Typically, 6 full work days spread out over a year or more are required to prepare each mile of a sustainable trail project for the team leader. This includes project initiation, meetings, scoping, alternative development, preliminary flagging, corridor review with the planning team, design drawings and detailing, supervision of [volunteer or day labor] construction, post construction evaluation, and follow up with the land manager. High quality construction of mountain trails by well organized volunteers usually requires about 175 (6 hour) volunteer days per mile, and contract projects can cost $50,000 per mile for typical construction.

Maintenance

Maintenance activities are required to restore the original design standard to natural travel surfaces and clearing dimensions at opening and closing each year, and when necessary to restore the original standard. On some trails, routine activities may be required each month during the high use season. All maintenance activities must be designed into the project during the planning stages by the planning team. A typical project may require 10% of the original time and dollar investment each year after construction. Projections can be developed with input from maintenance crews. Monitoring and updating the maintenance schedules season to season and year to year will be required to ensure continued sustainability of natural travel surfaces.

Does your agency have the time and resources to undertake design and maintenance commitments? Planners who communicate time and resource needs to managers, and managers willing to commit to those recommendations will further the interest in developing sustainable travel surfaces. This will ensure a wonderful recreation facility legacy not only to future land managers, but also to future generations of users, and all will be grateful.

Management

Management of corridor projects by land managers is required to ensure that individual projects complement each other and that they comply with agency, state or federal initiatives. Maintenance activities such as weed control, encroaching or invasive vegetation removal, and bridge deck replacement may be tasks that are managed in a less than annual frequency. From the natural resource point of view, it is wise to monitor access to trails, use patterns and to upgrade individual trail corridor projects to sustainable status before new projects are undertaken.

Summary

The criteria *maximum profile grade relative to existing cross slope* is key to sustainability for natural surface trails. Trail corridor projects that are developed recognizing this criteria will more effectively meet management goals of exercising a reasonable standard of care for the safety and comfort of users, economy of investment, and will display a commitment to natural resource protection.

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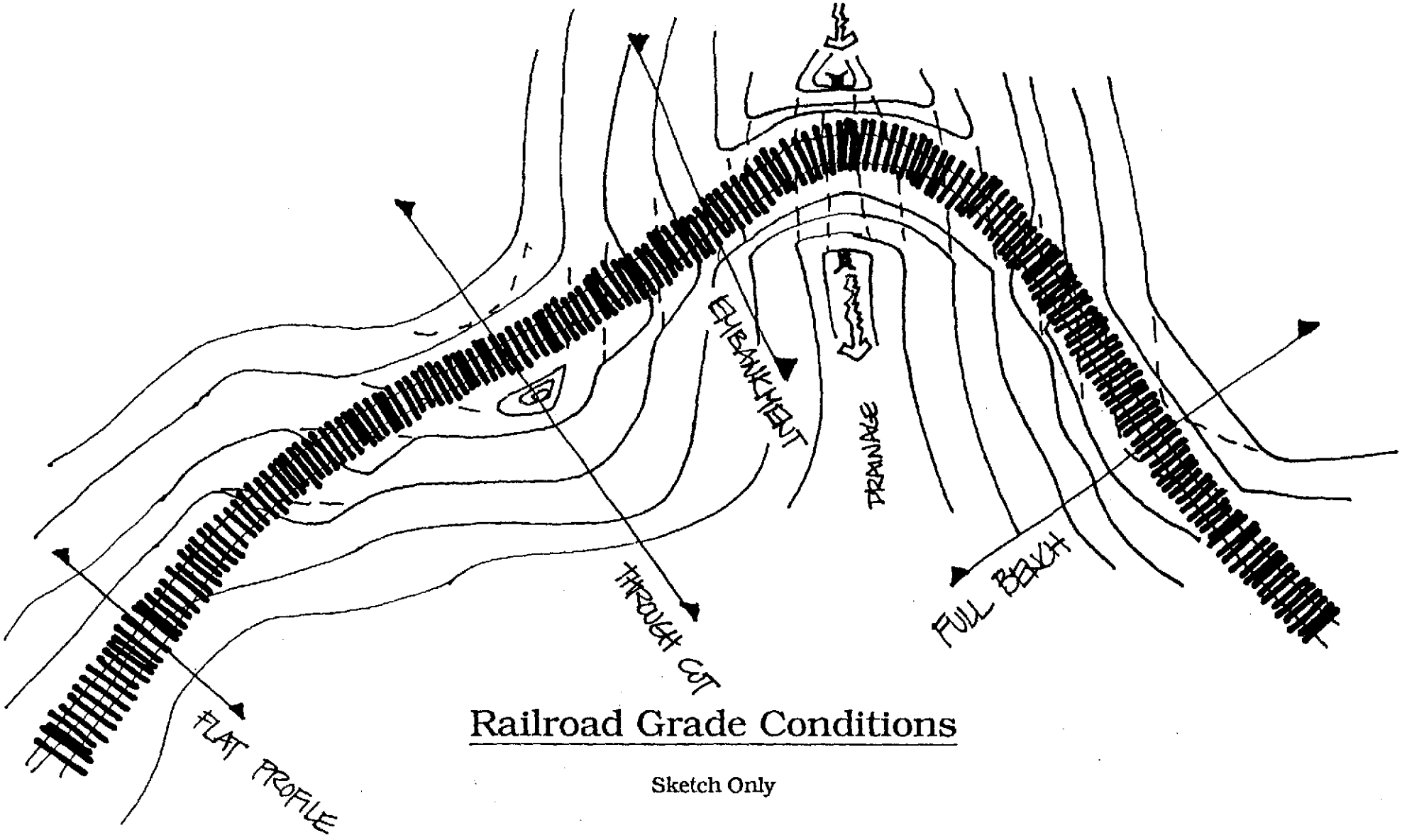
Parks Canada. Trails Manual. Ottawa, Ontario: _____, 1978.

Proudman, Robert D. and Reuben Rajala. AMC Field Guide to Trail Building and Maintenance. Boston, MA: Appalachian Mountain Club, 1981.

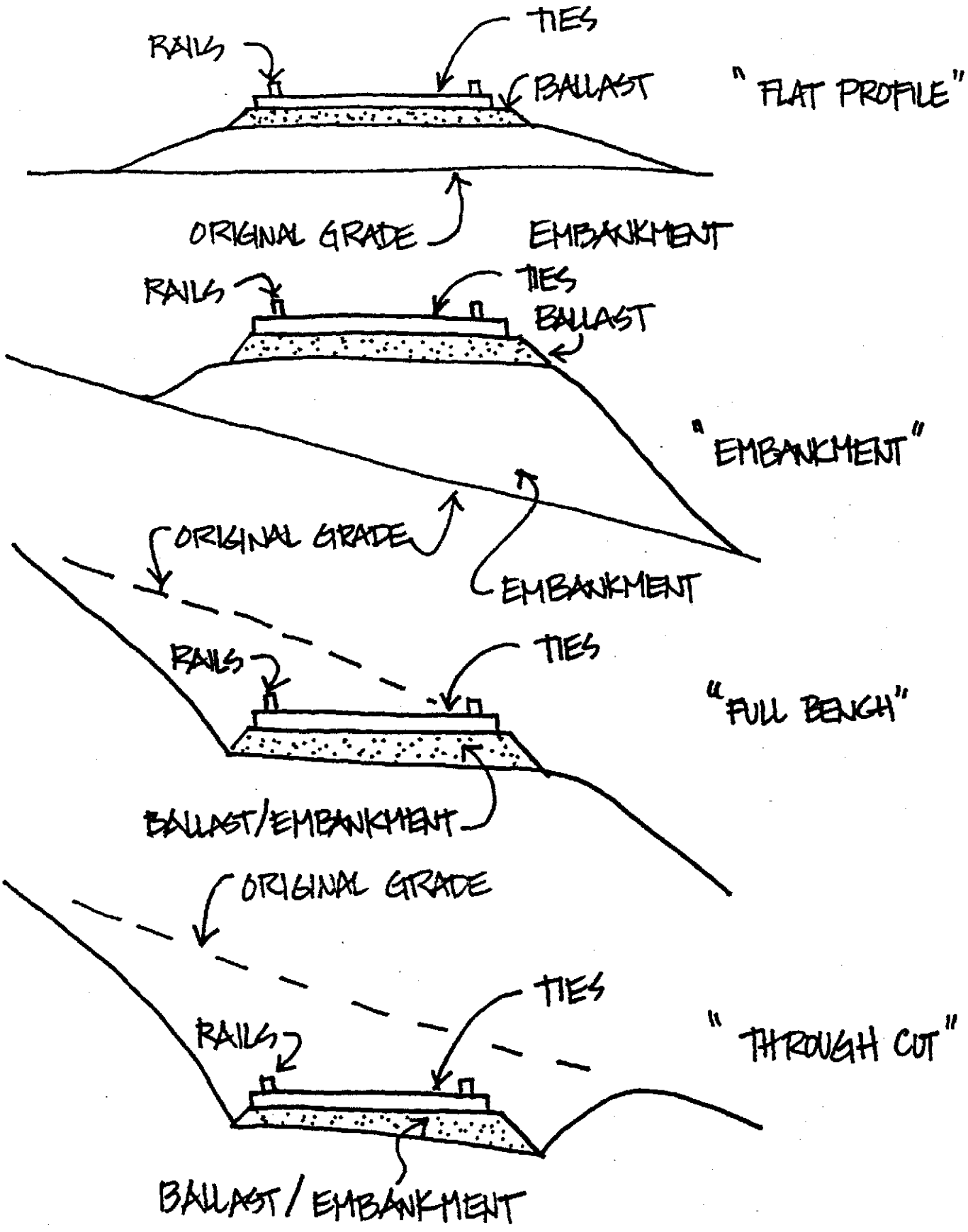
The Appalachian Trail Conference. Trail Design, Construction and Maintenance. Harpers Ferry, WV: _____, 1981.

US Forest Service. Trail Construction on The National Forests. Washington, DC: US Government Printing Office, 1923. [While not specifically referenced in this article, this is an important document in a trail planner's library.]



Railroad Grade Conditions

Sketch Only


RAILS
TIES
BALLAST
"FLAT PROFILE"
ORIGINAL GRADE
EMBANKMENT
RAILS
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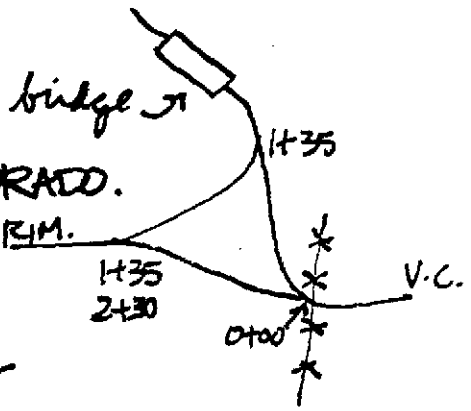
"EMBANKMENT"
ORIGINAL GRADE
EMBANKMENT
RAILS
TIES
"FULL BENCH"
BALLAST/EMBANKMENT
ORIGINAL GRADE
TIES
RAILS
"THROUGH CUT"
BALLAST/EMBANKMENT

Pathway Design Standards Comparison Matrix

		X-Slope Range	Tread Width	Clearing		Surface Materials *					Cross Slope	Maximum Profile	Sw'back Radius
				horiz.	vert.	natural	gravel	asphalt	concrete	other			
H. Access	Fully Accessible	0-10%	7'	11'	10'	No	No	Pref	Pref	-	<2%	5% avg, 8.33% max	-
Hiking	Walking	0-10%	4'	8'	10'	No	No	Pref	Pref	-	4%	5% avg	-
	Standard	10-70%	24-36"	+4'	10'	Pref	Pref	No	No	-	4%	12%	2'
	Backcountry	10-90%	18-24"	+3'	8'	Pref	OK	No	No	-	4%	12%	2'
Mtn. Bike	Mtn. Single Track	10-70%	24-36"	+4'	10'	Pref	Pref	No	No	-	4%	12%	4'
	Rural Double Track	0-30%	48-96"	+4'	10'	Pref	Pref	No	No	-	4%	12%	4'
Equestrian	Mtn. Single Track	10-70%	18-24"	+6'	10'	Pref	Pref	No	No	-	4%	12%	8'
	Rural Double Track	0-30%	48-96"	+6'	10'	Pref	Pref	No	No	-	4%	12%	8'
Nordic Ski	Single Track	0-70%	12"	5'	+6'	Pref	Pref	OK	OK	-	NA	10% desired	NA
	Double Track	0-70%	12"/12"	10'	+6'	Pref	Pref	OK	OK	-	NA	10% desired	NA
	Skate Lane	0-70%	8'	10'	+6'	Pref	Pref	OK	OK	-	NA	10% desired	NA
Road Bike	One Way	0-10%	5'	9'	10'	No	No	Pref	Pref	-	>2%	5% desired	35' @ 15 mph
	Two Way	0-10%	8'	9'	10'	No	No	Pref	Pref	-	>2%	5% desired	
Multi-Use	Urban/Suburban	0-10%	10'	14'	10'	No	No	Pref	Pref	-	>2%	5% avg	-
	Rural	0-30%	24-36"	+6'	10'	Pref	Pref	OK	No	-	4%	12%	8'
	Mountain	10-90%	24-36"	+6'	10'	Pref	Pref	No	No	-	4%	12%	8'

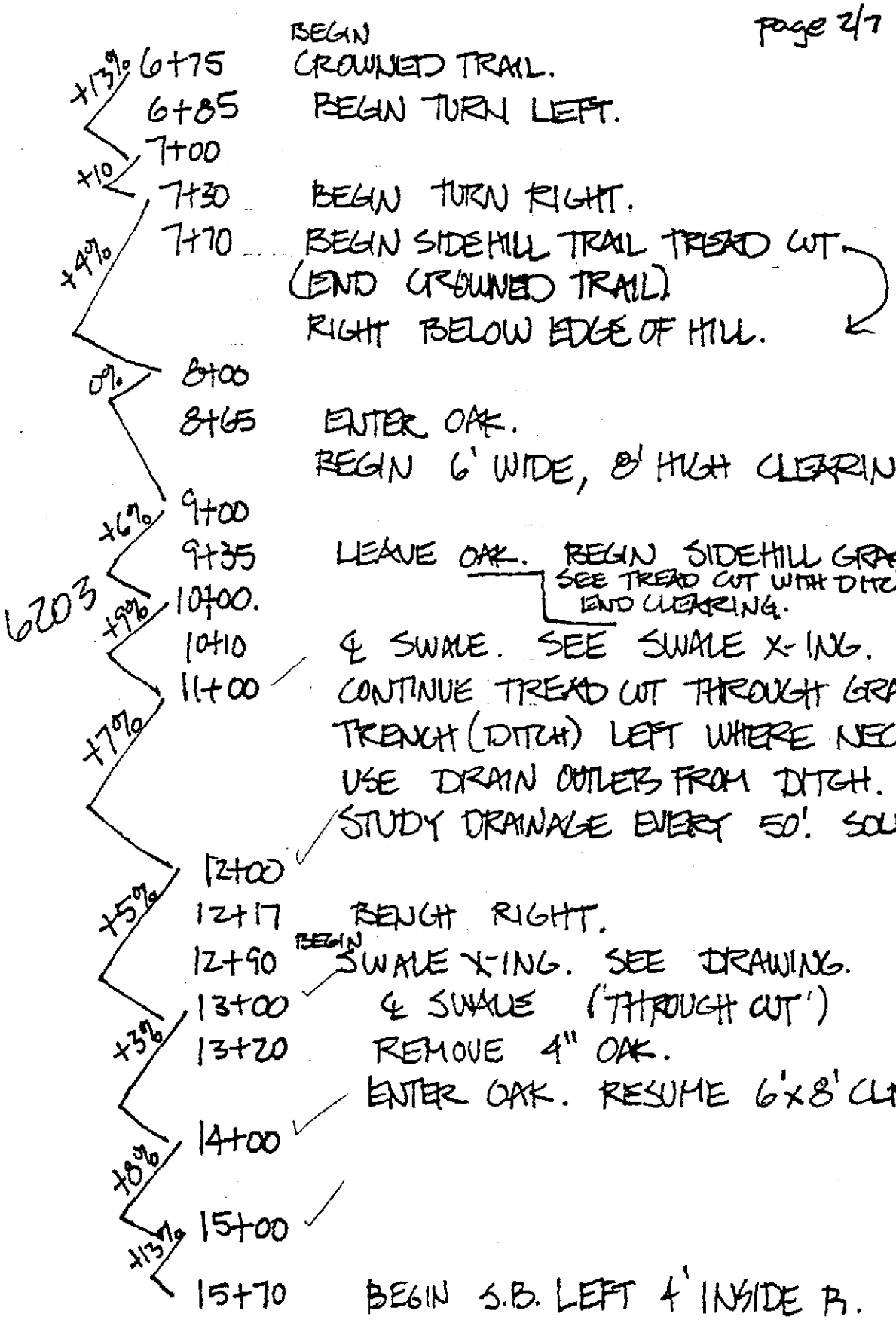
** Pref = Preffered, OK = Acceptable, No = Not Appropriate, NA = Not Applicable*

April, 1988.
PHASE I page V1
SOUTH RIM TRAIL
ROXBOROUGH STATE PARK, COLORADO.



-3% 0+00 FENCE LINE X-ING
CARPENTER PEAK TRAIL
GRASS
1+00

flat. 1+35 "Y" INTERSECTION.
1+35 ALSO 25' FROM BRIDGE.
2+30 INTERSECTION "T"
-2% 2+40 BEGIN CROWNED TRAIL.
2+55 ℄ DRAINAGE SEE DRAWING.
2+70 END CROWNED TRAIL.
3+00 INCORPORATE CURVI-LINEAR ALIGNMENT
AS TRAIL APPROACHES FENCE.
x1. GENTLE 'S' RECOMMENDED.
3+97 CROSS FENCE.
-3 4+00
-11 4+25 BEGIN LEFT TURN.
5+00 BEGIN RIGHT TURN, BEGIN CROWNED TRAIL.
0% 5+35 ENTER WILLOWS/COTTONWOODS.
5+70 REMOVE WILLOWS
-9% 6+00 END CROWNED TRAIL. BEGIN TYP. TRAIL
6+50 BEGIN BRIDGE. 25' SPAN.
6+75 END BRIDGE. CUT THIS END AT
LEAST 1'. SEE 'THROUGH CUT'.


BEGIN
+13% 6+75 CROWNED TRAIL.
6+85 BEGIN TURN LEFT.
+10 7+00
7+30 BEGIN TURN RIGHT.
+4% 7+70 BEGIN SIDEHILL TRAIL TREAD CUT
(END CROWNED TRAIL)
RIGHT BELOW EDGE OF HILL.
0% 8+00
8+65 ENTER OAK.
BEGIN 6' WIDE, 8' HIGH CLEARING.
+6% 9+00
9+35 LEAVE OAK. BEGIN SIDEHILL GRASS CUT
SEE TREAD CUT WITH DITCH.
END CLEARING.
6203
+9% 10+00.
10+10 ℄ SWALE. SEE SWALE X-ING.
+7% 11+00 CONTINUE TREAD CUT THROUGH GRASS-
TRENCH (DITCH) LEFT WHERE NECESSARY
USE DRAIN OUTLETS FROM DITCH.
STUDY DRAINAGE EVERY 50'. SOLVE.
12+00
+5% 12+17 BENCH RIGHT.
BEGIN
12+90 SWALE X-ING. SEE DRAWING.
13+00 ℄ SWALE ('THROUGH CUT')
+3% 13+20 REMOVE 4" OAK.
ENTER OAK. RESUME 6'x8' CLRING.
+8% 14+00
+13% 15+00
15+70 BEGIN S.B. LEFT 4' INSIDE R.

+25% 15+70

+12% 16+00 ✓ END. S.B.

16+50

+13% 16+75 X- OLD ROAD WATCH DRAINAGE.

+4% 17+00 CONTINUE TYPICAL TRAIL

+6% 18+00 ✓

+6% 18+50

+9% 19+00 ✓ — WATCH DRAINAGE.

+9% 19+80

20+00 (622) END TYPICAL TRAIL

20+10 LEAVE OAK.

+10% BEGIN TREADCUT WITH DITCH LEFT. DRAIN AT ≈ 20+40.

20+64 ENTER OAK, BEGIN TYP. TRAIL.

END DITCH LOWERSIDE.

+9% 21+00 ✓ BEGIN "TURN" RIGHT.

21+50 LEAVE OAK. TYPICAL TRAIL, WEAVE THROUGH MOUNTAIN MAHOGANY.

+9% 22+00

+7% 23+00 ENTER OAK. BEGIN WATERBAR, DRAINS EVERY 25'. NEED (4).

+12% 23+50

+3% 24+00 END W.B.

+1% 25+00

+10% 26+00

+4% 26+53 MOLE HOLE. BUILD JUST BELOW. OTHERWISE DISREGARD.

27+00

+4% 27+00
27+13 LEAVE OAK. SWEEP AROUND OAK
27+50
-3
~~28+00~~ 27+63 BEND LEFT.
28+00 ✓
+9% 28+10 ENTER OAK.
28+30 ℄ SWALE } SWALE SEE ▲ X-ING
28+40 ℄ SWALE }
PAVED DIP IS PROBABLY BEST. EXPERIENCED CREW LEADER REQ'D. ENSURE DRAINAGE BELOW.

+9 28+50
+12 29+00
29+50
+11
30+00 (359)
+11
30+50
+13
31+00 ✓
31+50
+16
31+85 BEGIN TURN L. SKY ABOVE LOW POINT.
+12
32+00 ✓
33+00 ✓
+10
33+55 RIP RAP ABOVE TRAIL.
+6
34+00 ✓
+14
34+50
35+00 ✓
+15
+9
35+50
36+00

+0 36+00
+11 36+50
37+00
+9
+8 37+50
38+00 FENCE REMOVAL RIGHT ABOUT 100'.
+12 38+50
+5 38+65 & SWALE PAVED DIP.
+14 39+00
39+45
+12 39+90 WATERBAR
40+00 6058
+12 40+05 "THROUGH CUT" CUT ABOUT 1'.
40+10 & SWALE.
+10 40+50
~~41+00~~
+18 40+90 TURN LEFT.
+14 41+00
41+50
+12 42+00
+12 42+50
BEGIN
42+65 ▲RAMP DOWN TO & SWALE.
+6
42+78 & SWALE. PAVED DIP.
+10 43+00
+26 43+40 TURN RIGHT.
43+50
+12 43+55 RAMP DOWN
44+00
~~44+03~~

+8 44+00

44+03 & SWALE PAVED DIP. ENSURE DOWNSTREAM DRAINAGE

44+05 BEGIN RAMP UP.

+10 44+50

+8 45+00 SB. LEFT.

+13 45+25

+12 46+00 ✓

+12 46+50

+14 ~~47+00~~ 46+75

47+00 ✓

+3 47+40 FOLLOW FLAGS IN TREES. MEANDER ALONG TREE LINE.

BEGIN CROWNED TRAIL. MAYBE DITCHES, OR TYPICAL SECTION OK. DEPENDING ON SITUATION.

-5 47+50

0 48+00 ✓

+5 48+50

+10 49+00 ✓

50+00 LOSS

+2 51+00

+10 52+00

+10 53+00 ✓

+14 54+00 ✓

+10 54+50 ✓

+8 55+00 BEGIN CROWNED TRAIL

page 7/7

+2 / 55+00
55+90 ENTER OAK.
56+00
0 \ 56+50
-4 \ 57+00
0 \ 58+00
-3 / 59+00
-3 / 60+00
-4 / 61+00 E.O.T.

BENCH LOCATIONS.

6 Benches see dwg.

38+50 ✓
48+00 ✓
31+25 ✓ Spur left 50' required.
27+50 Spur right 30' required.
20+25 Spur left 50' required.
12+17 Right.

SOUTH RIM LOOP TRAIL
Roxborough Park
June 17 and 18, 1989

THE TRAIL

This year's VOC project at Roxborough Park will complete the South Rim loop trail that was started last year. The 1989 crew completed about a mile of trail running south from a point of connection with the existing Willow Creek/Carpenter Peak Trails to the encircling ridge perhaps 500 feet in elevation above it. That trail section follows the trend of the valley between the red sandstone Fountain Formation on its west and the Lyons Formation on its east.

This year's trail takes off where last year's ended, near the top of the ridge at roughly 6440', and runs some 6500 feet to close the loop (see diagram next page). In its first 1200 feet, it follows the crest of the ridge formed by the Lyons Formation. The views from here are great in all directions, and some clearings near the trail will make for good lunch spots.

Beyond the shoulder (at about station 7 + 00), the trail leaves the ridgetop and curves southward, then eastward, traversing the north-facing sidewall of a parallel valley formed by the Lyons Formation on its west and the Dakota Hogbacks on its east. This section of the trail will likely be the most difficult to construct, as the scrub oak is thick and the sideslope is fairly steep, necessitating some stone retaining walls in an area where rocks are not abundant.

When the trail curves northward onto west-facing slopes (roughly after station 20 + 00), the soil and vegetation conditions change noticeably: The scrub oak is less dense and is joined by mountain mahogany and prickly pear cactus. Because the soil is drier, less cohesive, and more prone to erosion, a few short, low stone retaining walls and some rip-rap will be needed to stabilize loose slopes along these sections. Fortunately, rock is definitely in good supply here!

Between stations 31 + 00 and 37 + 00, the trail curves through isolated shrub masses following a pair of switchbacks. Then, in the open on grassy slopes, it descends to the valley floor at a fairly steady 10-12% grade. Near station 56 + 00, it enters a wetter, densely wooded area and, at 61 + 00, crosses the creek. Just past station 65 + 00, the trail rejoins the road at a parking lot several hundred yards below the main visitor center parking lots.

Author's Note: Pages F-9 through F-19 were originally prepared for Volunteers for Outdoor Colorado (VOC) and Roxborough State Park by Sherry Dorward, technical advisor for VOC.

GENERAL NOTES FOR CREW LEADERS

On much of the second half of the South Rim trail, conditions call for nothing more complicated than a typical trail section and tread. In addition, there are a few flat trail sections that will require drainage ditches on one side, some paved swale crossings (one of which will need some stepping stones as well), a pair of switchbacks, a landing where the trail meets the entry road, and a number of retaining stone walls (see the trail profile drawings to locate these). For each of these special conditions, please refer to the detail drawings in the crew leader training manual. No waterbars or steps are anticipated.

The park staff will already have built the new bridge and has done much of the shrub clearing, but many sections of the trail will require stump and root removal. If time permits, there could also be a limited amount of fence clearing and some transplanting of shrubs and cactus.

Other general notes:

1. Because much of the trail is on terrain with a considerable sideslope and because there's lots of cactus around, **good boots** are essential for all your crew members, and **work gloves** are strongly recommended.

2. Make sure you have a **good backslope** on the new trail. In Roxborough's unconsolidated soils, if the backslope is too abrupt and steep, it will erode, and its revegetation will take much longer.

3. **Good cross-slope** is the other priority in trail-building. It should be adequate for drainage across the trail but not so noticeable that people will walk on the shoulder.

4. The big surprise on the trails that VOC has already built at Roxborough is the incredible regrowth along the trail of scrub oak that was cut back. The species seems to push up new sprouts with renewed vengeance in response to disturbance. In some areas, it threatens to close the trail completely by mid-summer if not cleared again. Thus, it will be important to **clear scrub oak** not just to the edge of the trail's tread, but at least a foot or two beyond it.

5. Dispose of **cleared vegetation out of sight.**

6. **Store all rocks** 4" or bigger **uphill** from the trail. Disperse them only when the trail is finished and the crews have gone.

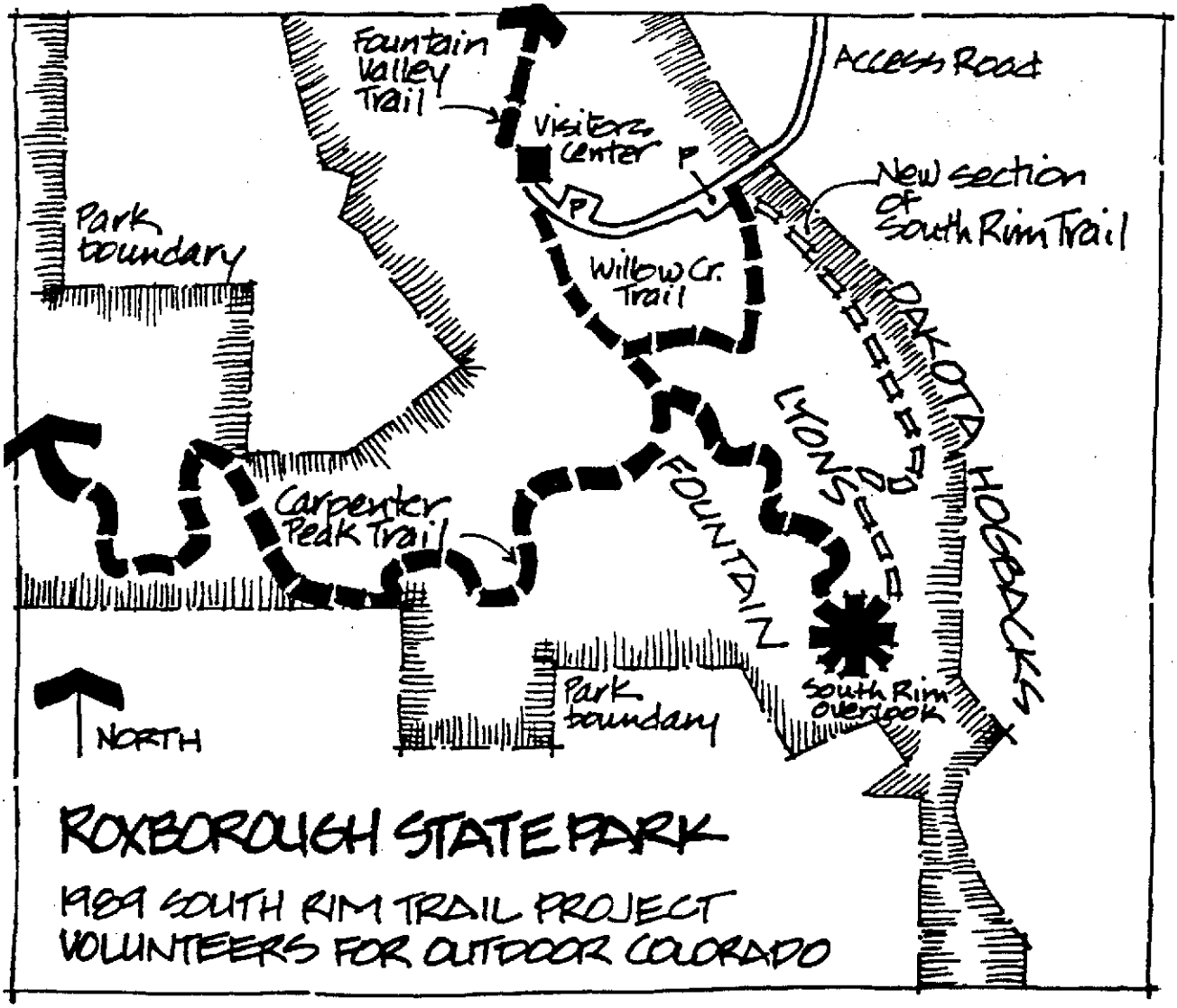
7. In cutting the tread, dispose of **removed soil** a minimum of 5' **downhill** from the new trail so that existing vegetation along the trail can survive.

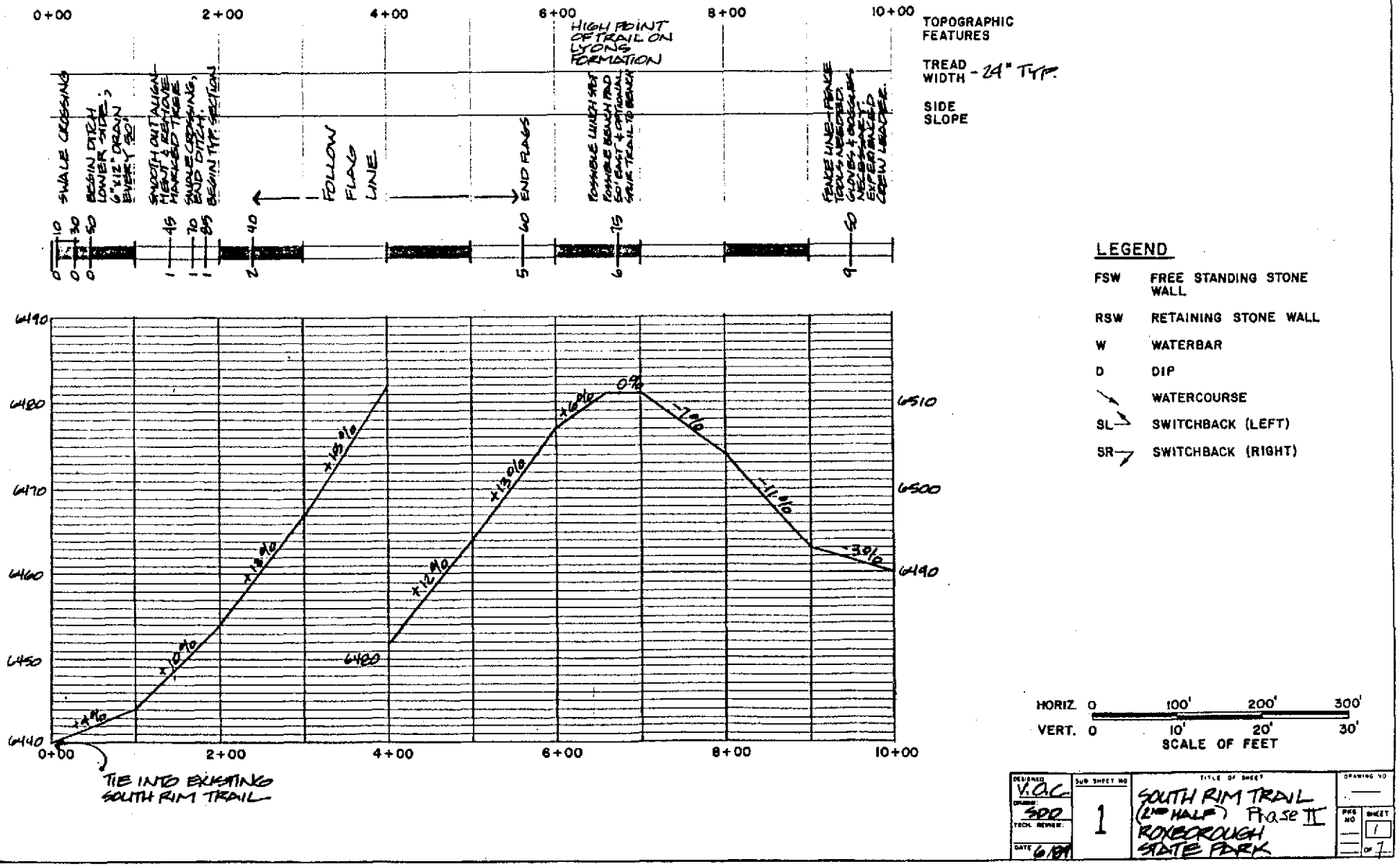
8. **Stockpile excess soils and sod** -- if there is time, carry these materials down to the Willow Creek trail to aid in its eventual revegetation (from approximately **37 + 00** to **60 + 00**).

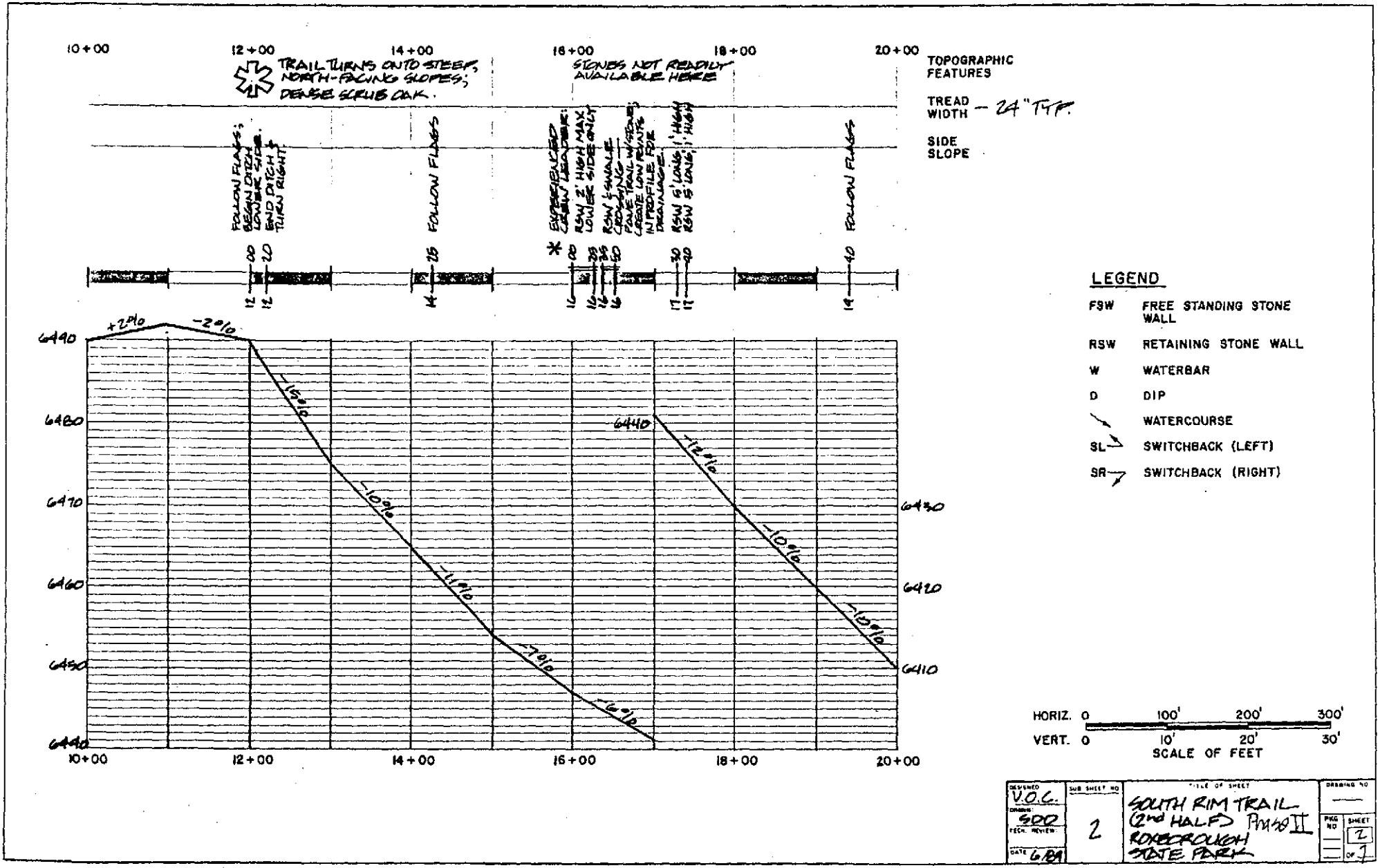
9. **Preserve all numbered stakes.**

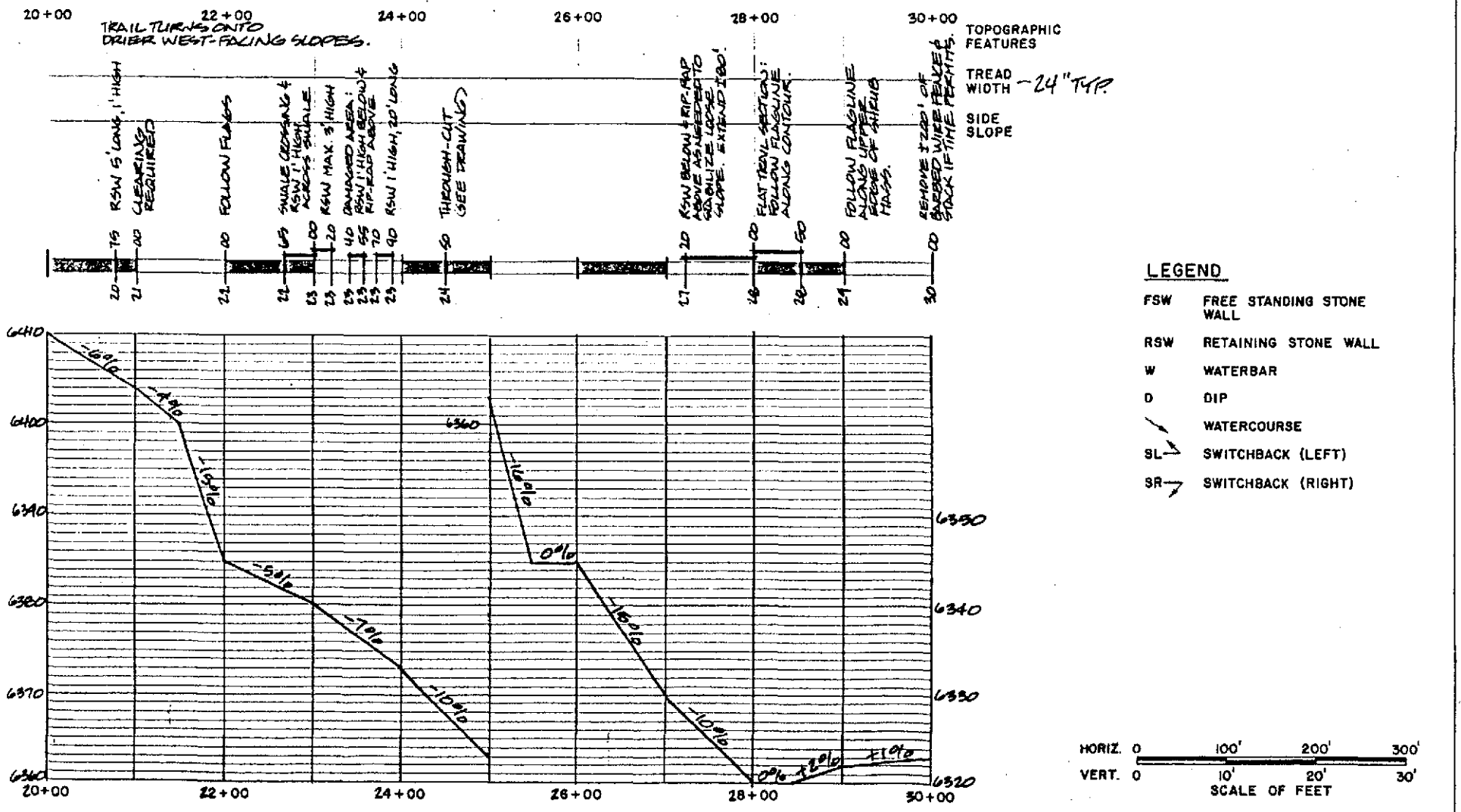
10. Trail alignment in the first 1200 feet or so goes up and down, so you'll need to smooth out the vertical profile between stations. Always **avoid sudden changes in grade.**

Lastly, if you have questions or problems, try them out on your TA's for this project, Hugh Duffy and Sherry Dorward.




0+00
2+00
4+00
6+00
8+00
10+00
HIGH POINT OF TRAIL ON LYONS FORMATION
TOPOGRAPHIC FEATURES
TREAD WIDTH - 24" TYP.
SIDE SLOPE
SWALE CROSSING
BEGIN DITCH LOWER SIDE; 6"x12" DRAIN EVERY 50'
SMOOTH OUTALIGN HEAVY & REMOVE MARKED TREE
SWALE CROSSING, END DITCH, BEGIN TYP. SECTION
FOLLOW FLAG LINE
END FLAGS
POSSIBLE LUNCH SPOT POSSIBLE BENCH AND SCENIC OVERLOOK EAST & OPTIONAL SPUR TRAIL TO BENCH
FENCE LINE - FENCE TO BE REMOVED AND REASSEMBLED. GLOVES & GOGGLES NECESSARY. SUPERVISED CREW LEADER.
10
30
50
45
70
85
40
60
75
50
0
0
0
1
1
2
5
6
9
LEGEND
FSW FREE STANDING STONE WALL
RSW RETAINING STONE WALL
W WATERBAR
D DIP
WATERCOURSE
SL SWITCHBACK (LEFT)
SR SWITCHBACK (RIGHT)
6490
6480
6470
6460
6450
6440
6510
6500
6490
6480
+4%
0%
+12%
+13%
+12%
+6%
0%
-7%
-11%
-3%
0+00
2+00
4+00
6+00
8+00
10+00
TIE INTO EXISTING SOUTH RIM TRAIL
HORIZ. 0 100' 200' 300'
VERT. 0 10' 20' 30'
SCALE OF FEET
DESIGNED V.A.C.
DRAWN SDD
TECH. REVIEW
DATE 6/89
SUB SHEET NO 1
TITLE OF SHEET SOUTH RIM TRAIL (2ND HALF) Phase II ROXBOROUGH STATE PARK
DRAWING NO
PROJ NO
SHEET 1 OF 7


10+00
12+00
14+00
16+00
18+00
20+00
TRAIL TURNS ONTO STEEP, NORTH-FACING SLOPES; DENSE SCRUB OAK.
STONES NOT READILY AVAILABLE HERE
TOPOGRAPHIC FEATURES
TREAD WIDTH — 24" TYP.
SIDE SLOPE
FOLLOW FLAGS; BEGIN DITCH LOWER SIDE. END DITCH & TURN RIGHT
FOLLOW FLAGS
EXPERIENCED CREW LEADER ONLY
RSW 2' HIGH MAX LOWER SIDE ONLY
RSW & SWALE CROSSING — PAVE TRAIL W/GRADE TO PROFILE FOR DRAINAGE.
RSW 6' LONG (1' HIGH) RSW 5' LONG (1' HIGH)
FOLLOW FLAGS
+2%
-2%
-15%
-10%
-11%
-7%
-6%
-12%
-10%
-10%
6490
6480
6470
6460
6450
6440
6440
6430
6420
6410
LEGEND
FSW FREE STANDING STONE WALL
RSW RETAINING STONE WALL
W WATERBAR
D DIP
WATERCOURSE
SL SWITCHBACK (LEFT)
SR SWITCHBACK (RIGHT)
HORIZ. 0 100' 200' 300'
VERT. 0 10' 20' 30'
SCALE OF FEET
DESIGNED V.O.C.
DRAWING 500
TECH. REVIEW
DATE 6/89
SUB SHEET NO 2
TITLE OF SHEET SOUTH RIM TRAIL (2nd HALF) PHASE II ROCKCROUGH STATE PARK
DRAWING NO —
PKG NO —
SHEET 2 OF 7

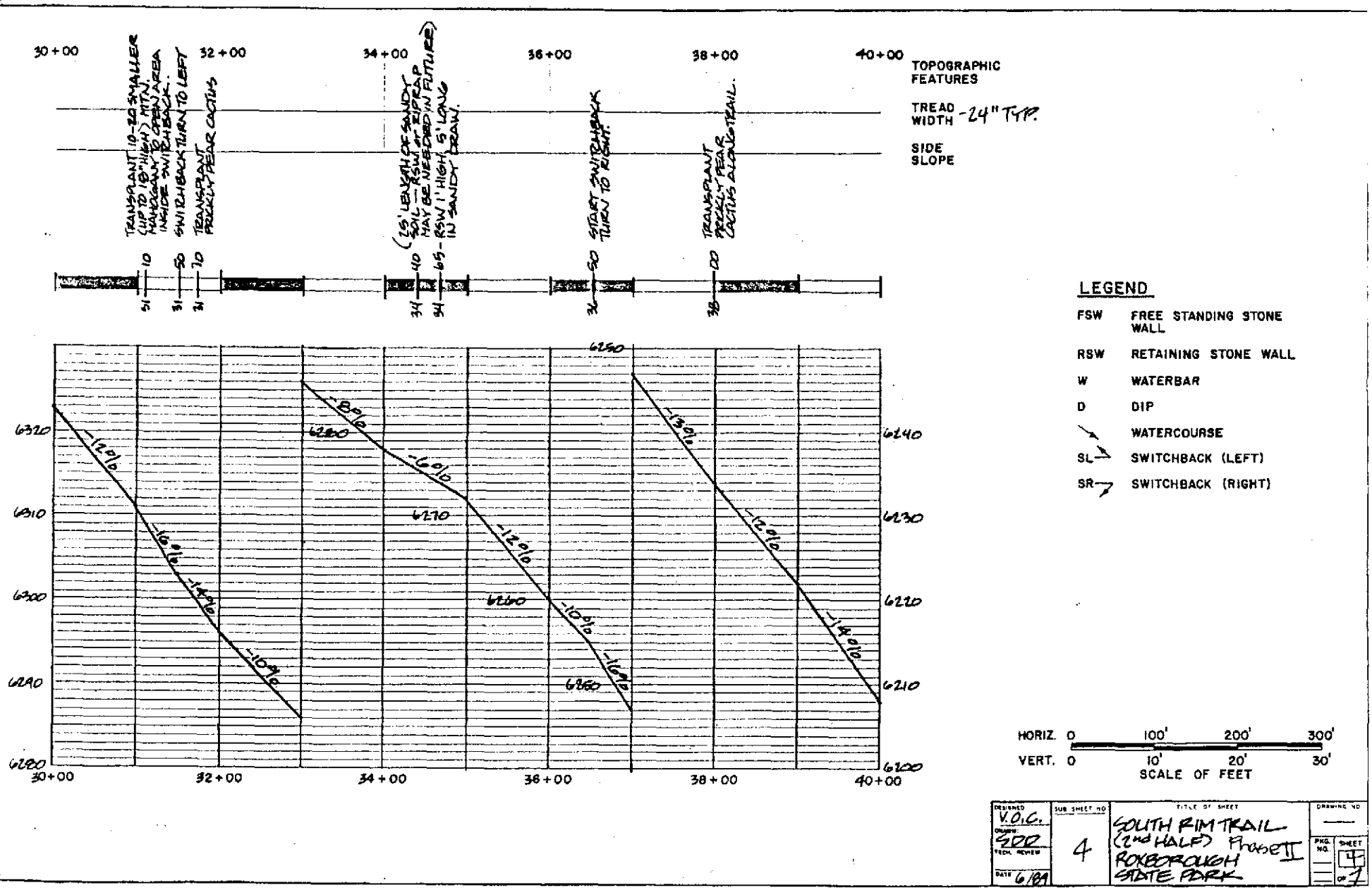


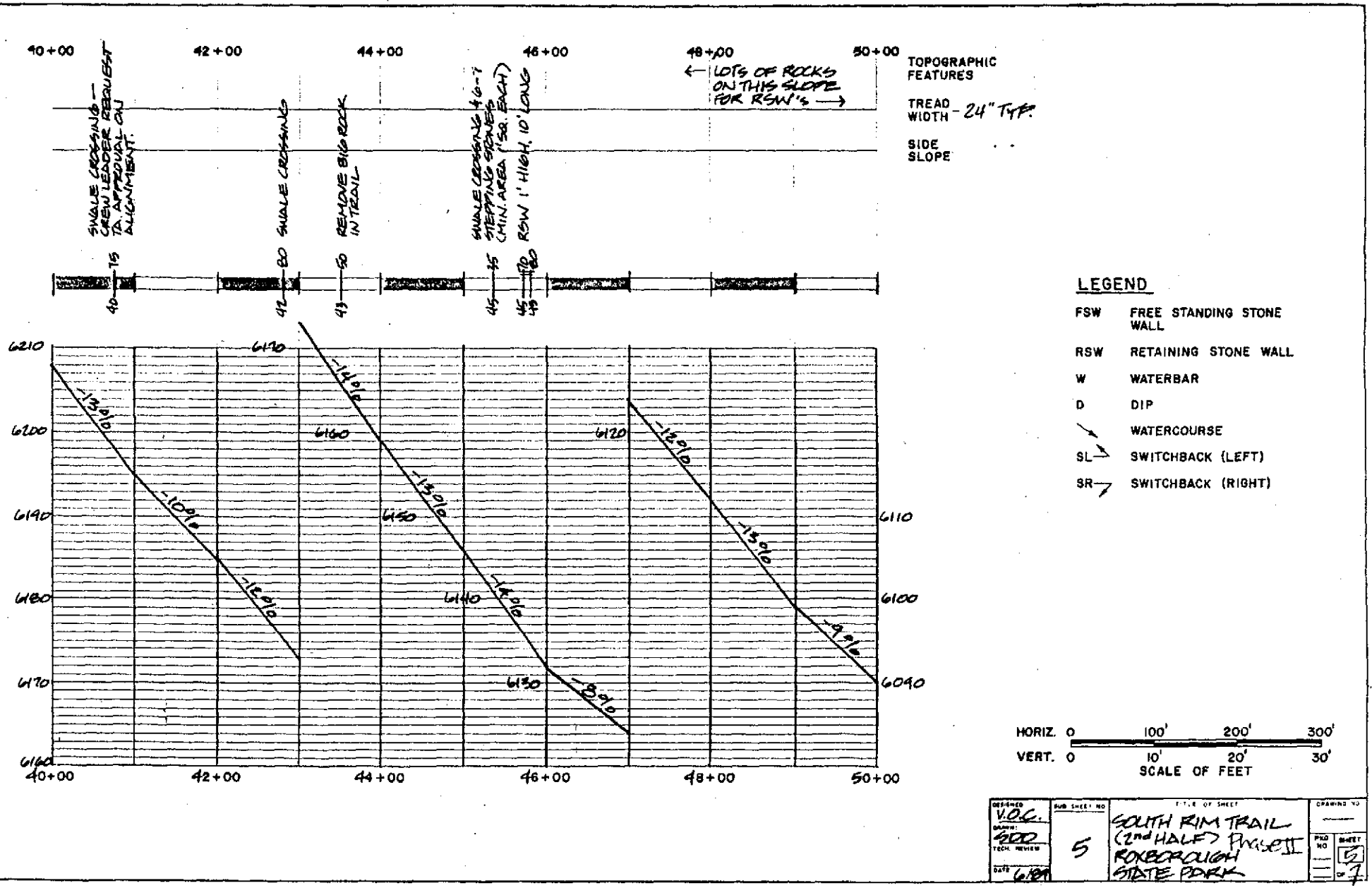
LEGEND

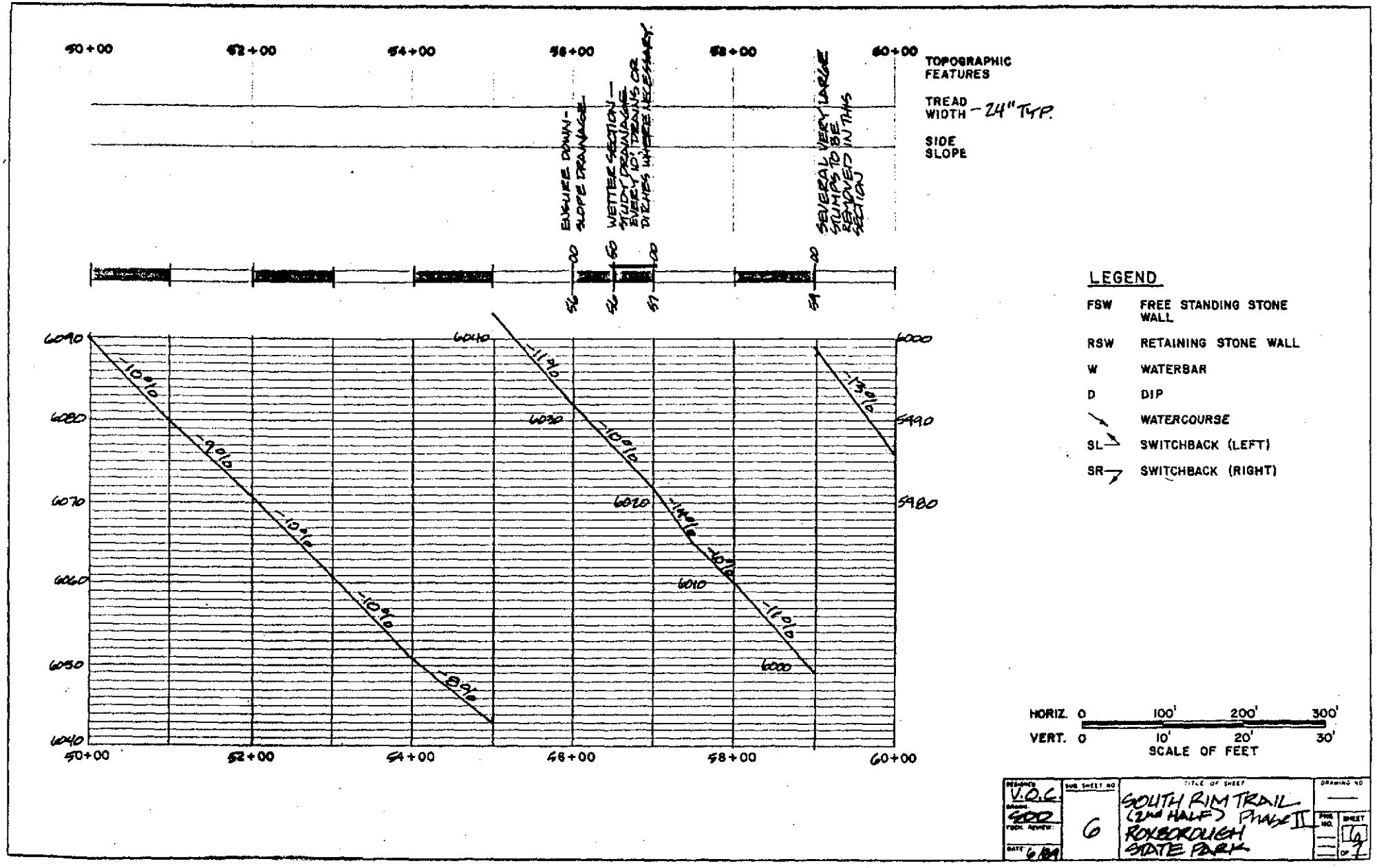
FSW	FREE STANDING STONE WALL
RSW	RETAINING STONE WALL
W	WATERBAR
D	DIP
	WATERCOURSE
SL	SWITCHBACK (LEFT)
SR	SWITCHBACK (RIGHT)

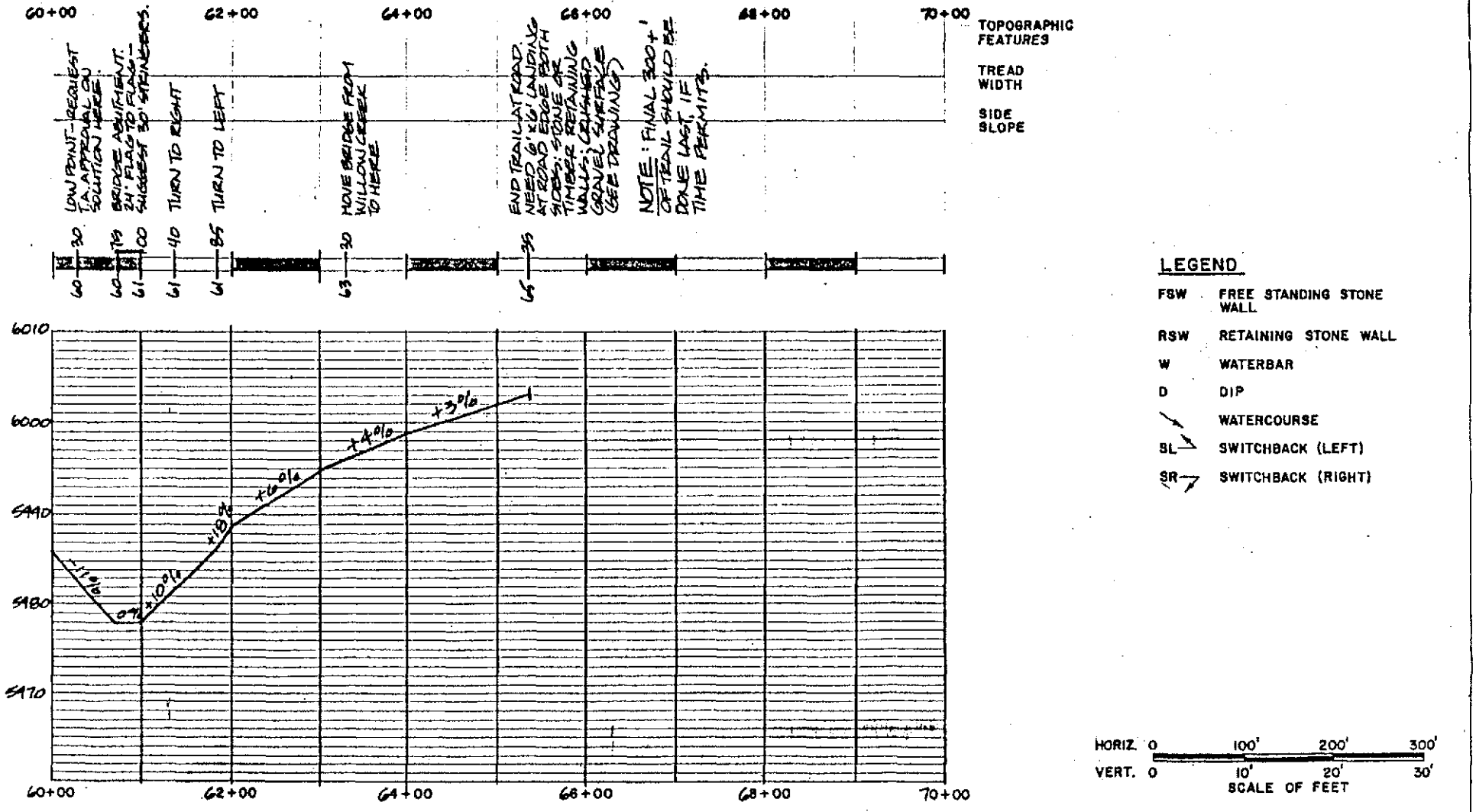
HORIZ. 0 100' 200' 300'
VERT. 0 10' 20' 30'
SCALE OF FEET

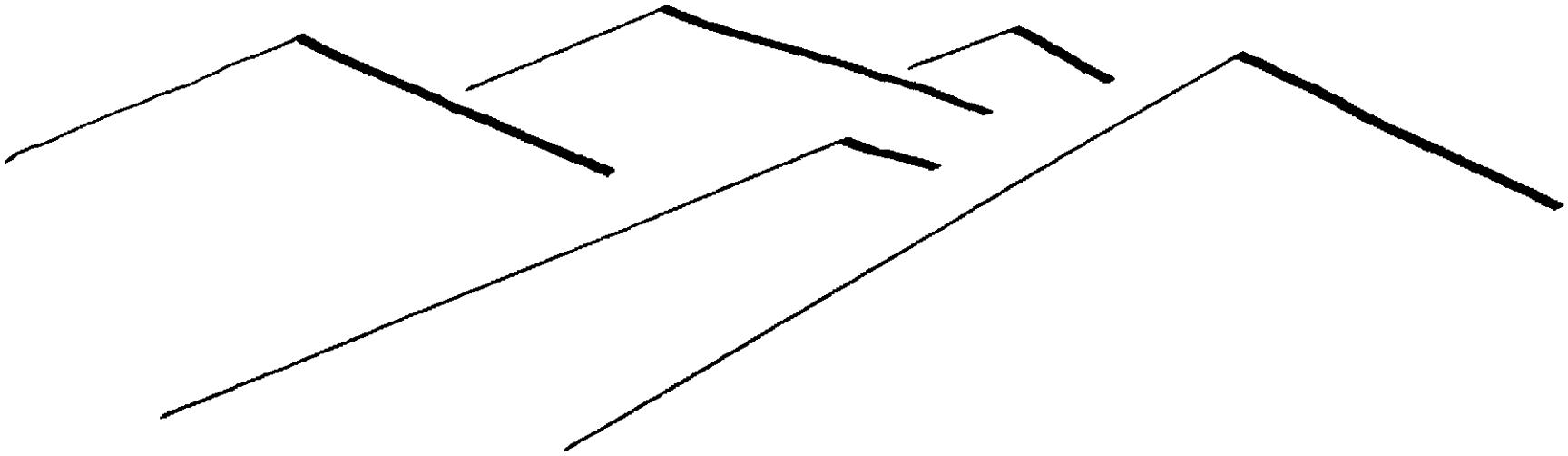
DESIGNED V.O.C.	SUB SHEET NO 3	TITLE OF SHEET SOUTH RIM TRAIL (2nd HALF) Phase II ROCKBOROUGH STATE PARK	DRAWING NO —
DRAWN SDD			PKG NO — SHEET 3 OF 7
TECH. REVIEW			
DATE 6/89			


30+00
32+00
34+00
36+00
38+00
40+00
TOPOGRAPHIC FEATURES
TREAD WIDTH -24" TYP.
SIDE SLOPE
TRANSPLANT (UP TO 18" HIGH) MTN. MAHOGANY TO OPEN AREA INSIDE SWITCHBACK.
SWITCHBACK TURN TO LEFT
TRANSPLANT PRICKLY PEAR CACTUS
(15' LENGTH OF SANDY SOIL — RSW or RIPRAP MAY BE NEEDED IN FUTURE)
65 - RSW 1' HIGH, 5' LONG IN SANDY DRAW.
SHORT SWITCHBACK TURN TO RIGHT.
TRANSPLANT PRICKLY PEAR CACTUS ALONG TRAIL.
6320
6310
6300
6290
6280
6250
6240
6230
6220
6210
6200
6270
6260
6860
LEGEND
FSW FREE STANDING STONE WALL
RSW RETAINING STONE WALL
W WATERBAR
D DIP
WATERCOURSE
SL SWITCHBACK (LEFT)
SR SWITCHBACK (RIGHT)
HORIZ. 0 100' 200' 300'
VERT. 0 10' 20' 30'
SCALE OF FEET
DESIGNED V.O.C.
DRAWN 4DR
TECH. REVIEW
DATE 6/81
SUB SHEET NO 4
TITLE OF SHEET SOUTH RIM TRAIL (2nd HALF) PHASE II ROXBOROUGH STATE PARK
DRAWING NO —
PKG. NO.
SHEET 4 OF 7


40+00
42+00
44+00
46+00
48+00
50+00
TOPOGRAPHIC FEATURES
TREAD WIDTH - 24" TYP.
SIDE SLOPE
← LOTS OF ROCKS ON THIS SLOPE FOR RSW's →
SWALE CROSSING — CREW LEADER REQUEST TA APPROVAL ON ALIGNMENT.
SWALE CROSSING
REMOVE BIG ROCK IN TRAIL
SWALE CROSSING 4 6-7 STEPPING STONES CHIN. AREA (50 EACH)
RSW 1' HIGH, 10' LONG
LEGEND
FSW FREE STANDING STONE WALL
RSW RETAINING STONE WALL
W WATERBAR
D DIP
WATERCOURSE
SL SWITCHBACK (LEFT)
SR SWITCHBACK (RIGHT)
HORIZ. 0 100' 200' 300'
VERT. 0 10' 20' 30'
SCALE OF FEET
V.O.C.
5
SOUTH RIM TRAIL (2nd HALF) PHASE II
ROXBOROUGH STATE PARK


50+00
52+00
54+00
56+00
58+00
60+00
TOPOGRAPHIC FEATURES
TREAD WIDTH - 24" TYP.
SIDE SLOPE
ENSURE DOWN-SLOPE DRAINAGE
WETTER SECTION - STUDY DRAINAGE EVERY 100' DRAINS OR DITCHES WHERE NECESSARY
SEVERAL VERY LARGE STUMPS TO BE REMOVED IN THIS SECTION
6090
6080
6070
6060
6050
6040
6040
6030
6020
6010
6000
6000
5990
5980
-10.0%
-9.0%
-10.0%
-10.0%
-9.0%
-11.0%
-10.0%
-14.0%
-10.0%
-11.0%
-13.0%
LEGEND
FSW FREE STANDING STONE WALL
RSW RETAINING STONE WALL
W WATERBAR
D DIP
WATERCOURSE
SL SWITCHBACK (LEFT)
SR SWITCHBACK (RIGHT)
HORIZ. 0 100' 200' 300'
VERT. 0 10' 20' 30'
SCALE OF FEET
DESIGNED V.Q.C.
DRAWN GDD
TECH. REVIEW:
DATE 6/89
SHT. SHEET NO 6
TITLE OF SHEET SOUTH RIM TRAIL (2ND HALF) PHASE II ROXBOROUGH STATE PARK
DRAWING NO
PROJ. NO.
SHEET 6 OF 7


60+00
62+00
64+00
66+00
68+00
70+00
TOPOGRAPHIC FEATURES
TREAD WIDTH
SIDE SLOPE
LOW POINT - REQUEST T.A. APPROVAL ON SOLUTION HERE
BRIDGE ABUTMENT. 24' FLAG TO FLAG - SUGGEST 30' SPREADERS.
TURN TO RIGHT
TURN TO LEFT
MOVE BRIDGE FROM WILLOW CREEK TO HERE
END TRAIL AT ROAD. NEED 6' x 6' LANDING AT ROAD EDGE BOTH SIDES; STONE OR TIMBER RETAINING WALLS; CRUSHED GRAVEL SURFACE (SEE DRAWING)
NOTE: FINAL 300+' OF TRAIL SHOULD BE DONE LAST, IF TIME PERMITS.
30
30
40
85
30
35
60
60
61
61
61
63
64
6010
6000
5990
5980
5970
-11%
0%
+10%
+18%
+10%
+14%
+30%
60+00
62+00
64+00
66+00
68+00
70+00
LEGEND
FSW FREE STANDING STONE WALL
RSW RETAINING STONE WALL
W WATERBAR
D DIP
WATERCOURSE
SL SWITCHBACK (LEFT)
SR SWITCHBACK (RIGHT)
HORIZ. 0 100' 200' 300'
VERT. 0 10' 20' 30'
SCALE OF FEET
7
SOUTH RIM TRAIL (2nd HALF)
ROOSEVELT STATE PARK



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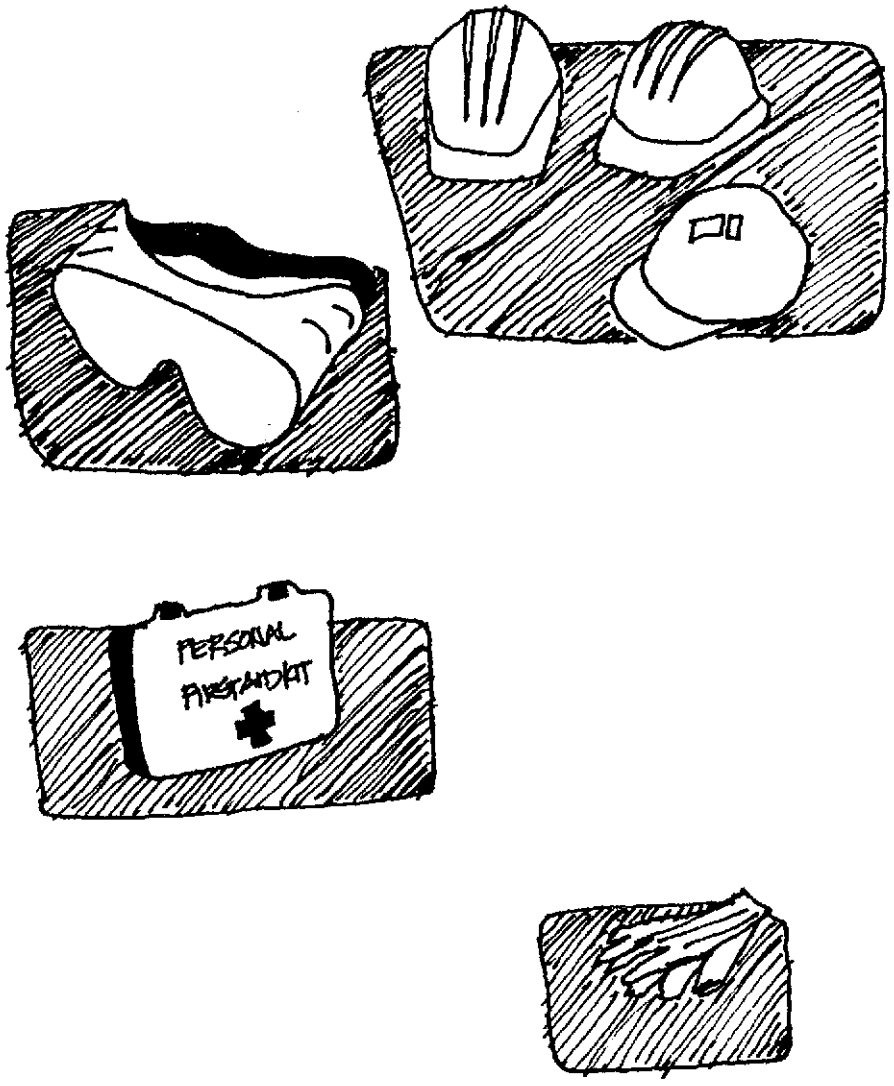
Author's Note: These drawings were originally developed for volunteer trail construction projects by Volunteers for Outdoor Colorado (VOC) at Roxborough State Park, near Denver, Colorado. Early versions of these drawings were included in VOC leader training handbooks in 1986. Over the years, they have been fine tuned to their present state. Additionally, they have been used as detail drawings for Colorado Trail construction projects.



Safety

Safety should be the highest priority on any volunteer conservation project. Only work that can be accomplished safely should be undertaken. There are three main areas of safety concerns on trail projects: personal, group, and organizational safety.

Personal Safety

Regarding personal safety, crew leaders and trail builders should keep in mind the following:

- Prepare and carry your own personal first aid kit.
- Make companions aware of your personal medical needs regarding bee stings or other potential illnesses.
- Know your limits and don't exceed them. Pace yourself. Stay in shape between projects. Use the proper tools for the task at hand, and use them efficiently.
- Counsel co-workers about safe and efficient tool use. Avoid working near dangerous people.
- Carry enough food and water. Don't rely on others. Frequent snacks are beneficial.
- Use sunscreen and wear sunglasses.
- Wear proper clothing. Long sleeve shirts, long pants, and work boots are required. Wear your hardhats! Wear gloves! Use goggles when chipping stone or sawing limbs!

Group Safety

- Regarding group safety, keep these in mind:
- Act smart. If you get hurt badly, several people might have to carry you out. Think about the group.
- Inquire about special medical requirements of your co-workers.
- Remain calm if an accident occurs. The person with the most experience should take charge. Think before you react to an emergency. Do not get emotional.

Organization Safety

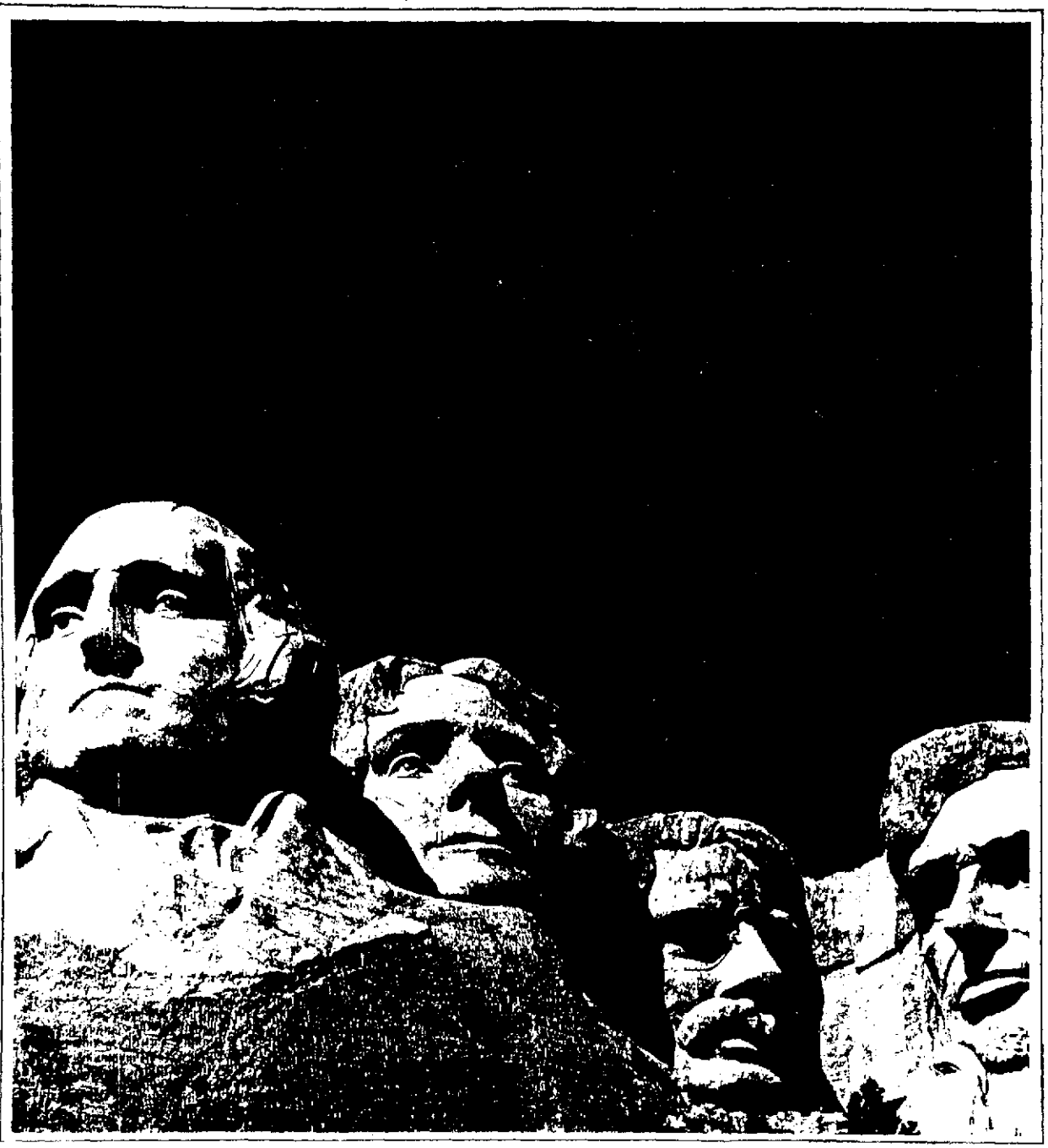
If you have the opportunity, it would greatly benefit your organization to enroll in a first aid or CPR course or refresher. These courses are available at your local Red Cross office or fire department.

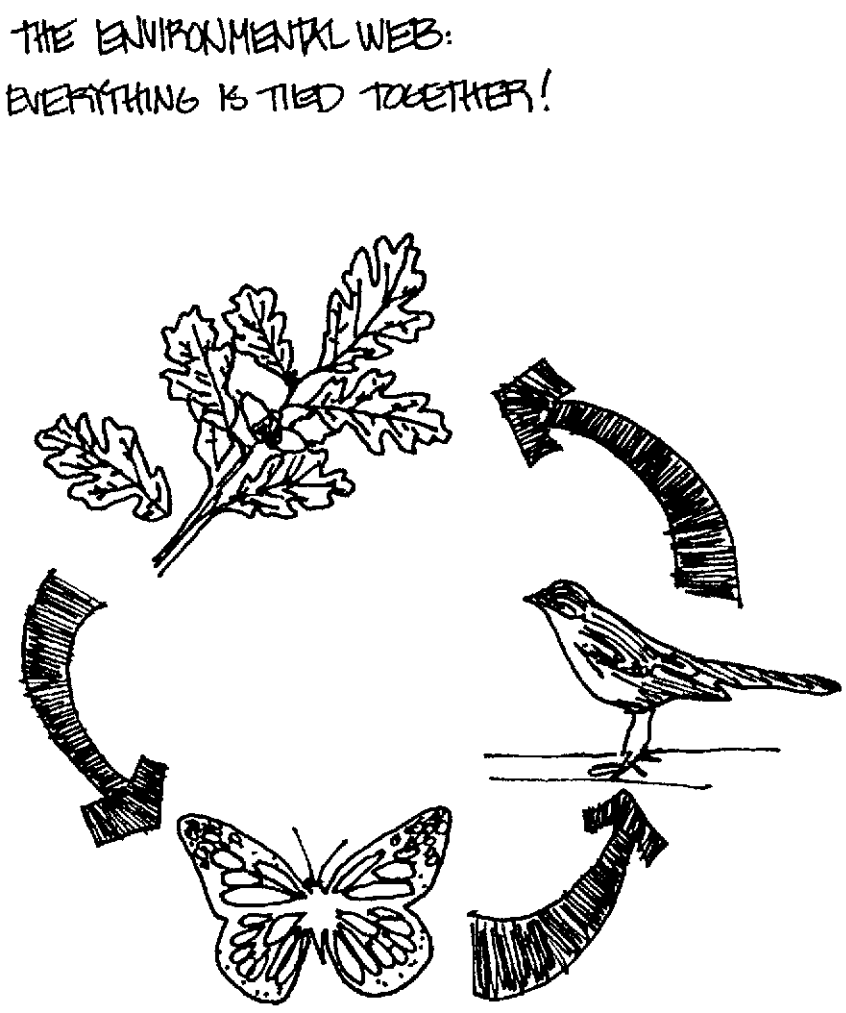
Permanence

Permanence (noun) The condition or quality of being fixed or changeless, being meant to last indefinitely.
All activities related to trail and trail structure construction should be accomplished with the concept of *permanence* driving the process. This concept suggests that careful planning has taken place addressing appropriate origins and destinations, adequate connections, loops and spurs, and that a careful analysis of the intended user experience has occurred. *Permanence* also suggests careful thought has occurred during the design process. During construction, *permanence* suggests that careful thought be given to the brush clearing process. Adequate clearing for safe passage must be provided without visually ravaging the trail corridor. Careful consideration given to the tread cutting process will result in the most durable surface. Careless actions will cause severe impacts to soil and vegetation. While building trail structures, application of the concept of *permanence* will result in fully functioning, long lasting structures. They will nicely complement the trail and its intended uses, while requiring little maintenance.
High quality work of this kind will give tremendous pride to the laborers, and also will give satisfaction to the trail users. Maintenance required will, of course, be minimal, thereby freeing park maintenance crews and budgets for other uses. Please support your park unit in its commitment to quality.

Sustainability

Sustainability can be defined as the *"holding up of the trail to planned and future use, with minimal impact or change to the natural systems of the area."* All actions pertinent to trails location, design, construction, maintenance and management should address this issue of sustainability.





Environmental Concerns

The mere existence of parks, preserves, and other conservation units indicates the country's and/or our state's concerns for the environment. Our most serious concerns are evidenced by our protection of wilderness areas. More typical, but still important concerns are evidenced by the creation of developed areas of our parks. On the primitive end of the developed area spectrum in our parks are trails. Trails function as the corridor by which many participants in a park experience travel between points of interest. In many cases, trails and the immediate trail corridor are the only things that hikers and visitors see. Therefore, a thorough understanding of the immediate trail corridor in regard to three major environmental concerns - *soil, vegetation and drainage* - is very important, especially for trail builders. Other concerns such as wildlife and cultural resources are beyond the scope of this document.

Knowledge of the three major environmental concerns and their relation to trail construction will help in building the best trail possible with the least impact. With that in mind, the following has been put together to introduce trail builders to these concerns. The intent is not to be all encompassing, but to give a brief introduction to these concerns. The comments simply form a foundation of knowledge to which crew leaders and trail builders can expand to be able to solve all but the most complex construction problems.

Each reader is encouraged to keep his/her eyes open to good/bad solutions on the various trails hiked. Keep mental notes. In the long run this information will make you a better trail builder.

Be selective when clearing vegetation or cutting tread. Remove only what is necessary. Take care of what you leave.

Soils

Soils, when looked from the standpoint of their characteristics, goals to strive for during trail construction, and methods in attaining these goals, will yield a sustainable trail surface on large percentages of mountain trail conditions.

Characteristics

- Soil is the substrate necessary for most plant and animal life. Damaging soil will result in the loss organisms and plants, and cause negative aesthetic appeal.
- Soil erodes.
- Once eroded, soil is extremely slow to regenerate.
- Soil will compose over 95% of the finished trail surface and will require adequate protection.

Goals

- Minimize soil disturbance in order to allow plants and animals the best chance for survival. Aesthetic appeal will correspondingly be high.
- Eliminate all potential for erosion.
- Maximize protection of soil for flora and fauna.
- Provide a well sloped/well compacted trail surface for safe passage.

Methods

- Coordinate excavation with vegetative and drainage considerations. (See accompanying construction drawings.)
- Install drainage structures as indicated by need.
- Use select borrow or retaining walls to improve less than adequate trail surface areas.
- Attain proper slope and compaction through a detailed analysis of on site conditions during wet and dry periods.

Vegetation

Vegetation, when looked from the standpoints of its characteristics, goals to strive for in trail construction, and methods to attain those goals, will be minimally disturbed, and provide variety and interest to trail corridors.

Characteristics

- Vegetation varies in growth habit, leaf composition, size, shape, and ecological requirements.
- Light significantly affects plant growth.
- Various plants respond differently to pruning.
- There are desirable and undesirable plants pertinent to trail corridors.
- Water/lack of water affects plant growth.

Goals

- Accurately evaluate vegetative ecology of each area of trail.
- Changes to vegetation which will not be affected by light.
- Arboriculturally correct and aesthetic pruning or removal.
- Encourage desirable plants/discourage undesirable plants.
- Changes to vegetation which will not be affected by water.

Methods

- Use field guides to accurately identify vegetation before pruning or removal. Avoid ecologically undesirable areas. Consider revegetation potential.
- Know light requirements of plants before attempting transplants/heavy pruning.
- Use proper tools. Do not deform plants, but achieve 100% slash disposal.
- Make decisions to benefit the trail user. Remove sharp plants from close proximity to the trail and plant on the inside of switchbacks.
- Know water requirements of plants before attempting transplants/heavy pruning.

Also: Consider the physical and visual relationship of vegetation to the trail. Consider human scale as well!

Drainage

Drainage, when considered from the standpoints of its characteristics, goals to strive for during trail construction, and methods to attain those goals, will be accurately identified and accommodated to ensure minimum disturbance to well designed trail corridors.

Characteristics

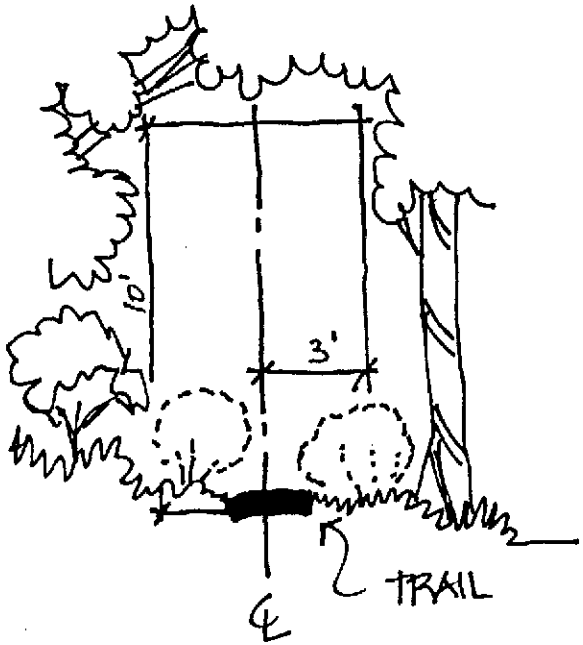
- Drainage is the biggest potential threat to a trail.
- Drainage flows perpendicular to the contour.
- Sheet drainage is generally non-damaging.
- Concentrated drainage is potentially very dangerous to a trail.
- Water freezes and thaws.

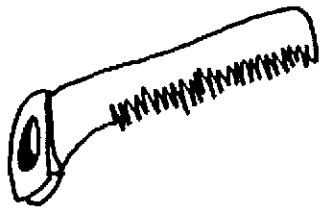
Goals

- Minimize the threat by removing water at the first opportunity.
- Immediate diversion of sheet drainage.
- Use structures to protect trail in areas of concentrated flows.
- Non-slip surfaces.

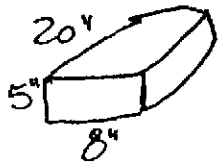
Methods

- Think "positive drainage" at all times. Do not allow water to stand on trail or structures.
- Maintain existing drainage patterns. Don't force nature...you won't win.
- Outslope trail to dispose of sheet drainage. Accurately shape backslope to prevent erosion/damage.
- Choose correct type of structure, locate at proper location. Use adequate materials. Protect as necessary.





CORRECT TOOLS MUST BE USED.



MINIMUM STONE SIZE.

Details

Detail (noun)-Extended treatment of, or attention to, a particular item; the small elements that collectively constitute the whole.

The attention of work to *details*, the drawing up of *detail* drawings, and the interpretation of these drawings pertinent to each field condition are all components of successful completion of work efforts. Most of the great works recorded in history did not succeed on sheer scale, length, size, or beauty.

Typically, it was the attention to the *details*, the small parts, that made the whole successful. It is with that intent that *detail* drawings are included. Additionally, the intent is not to completely describe every possible condition that will arise, but rather to describe minimum requirements of solutions and to give clues as to how better solutions can be attained.

Crew leaders and trail builders should strive to arrive at the best solution possible. These solutions can be attained by constantly asking some of the following questions:

- What is minimally required of the situation?
- What field conditions exist that will affect the solution? Can these conditions be mitigated?
- How does one *detail* solution affect *detail* solutions in the immediate area? In distant areas?
- Are adequate materials available to do the work? Are there adequate tools and manpower?
- How will users use the trail and experience it?
- Will safe/accessible passage be afforded?
- Is there a crew leader/trail builder close by that can help tailor the *detail* to the specific condition? Will more thought be beneficial?

Remember: attention to *detail* can make or break the project. Act cautiously. The results will be a beautiful trail and enjoyment by the users!

Clearing

Proper clearing/pruning can be attained through the following:

- Proper identification of species.
- Understanding ecology of plant in question.
- Accurately predicting beneficial/adverse impacts on trail.
- Deciding what to do.
- Doing this correctly.
- Realize that some plants cannot be pruned, but must be removed.

Some vegetation that is frequently encountered are described:

Gambel oak- Trunk and branches are stout, forms thickets, very slow growing. Prune back to trunk or remove entire tree.

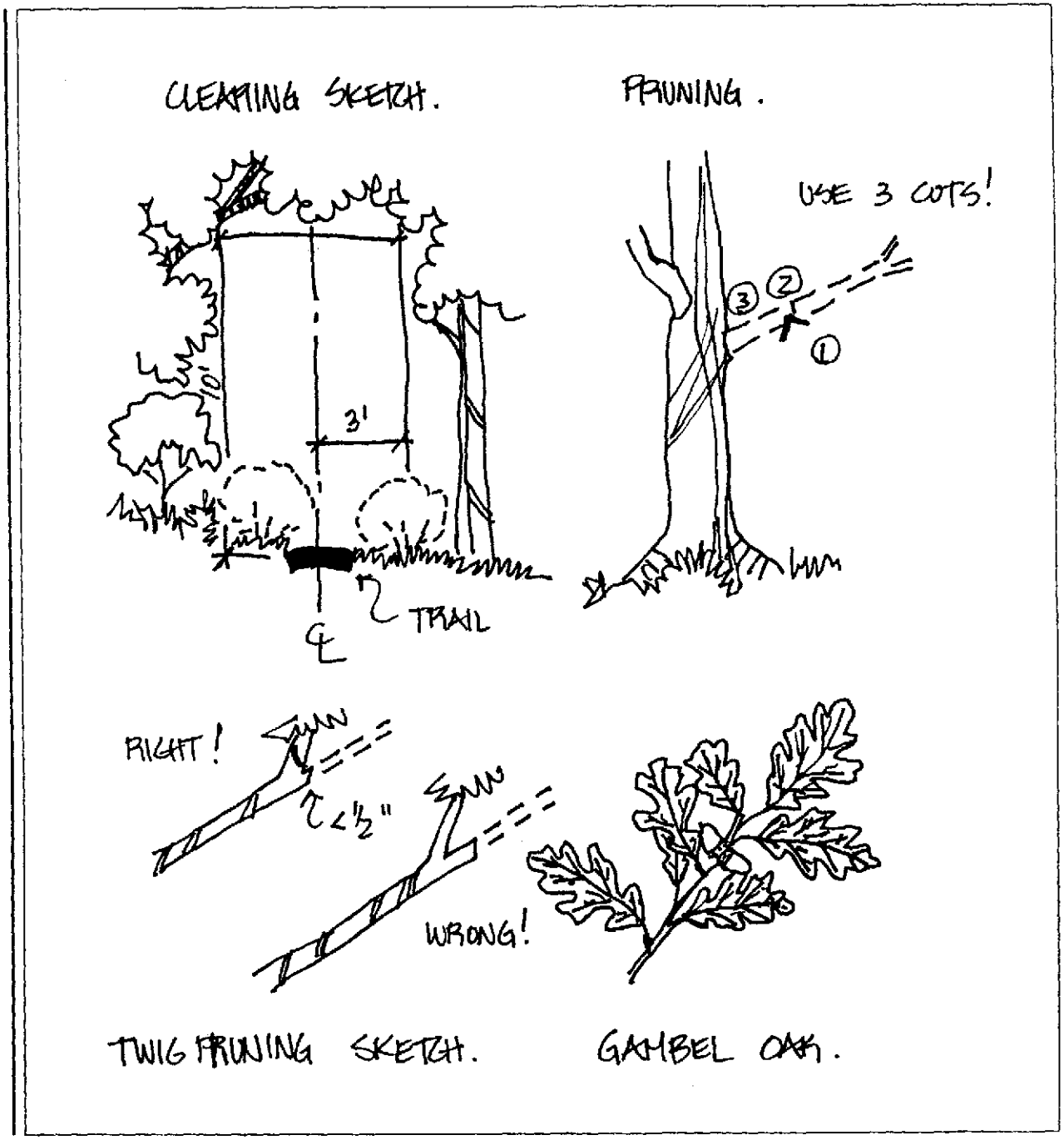
Douglas fir- Evergreen, pyramidal form, soft foliage, stout branches. Do not destroy form of tree, prune lower branches only usually back to trunk.

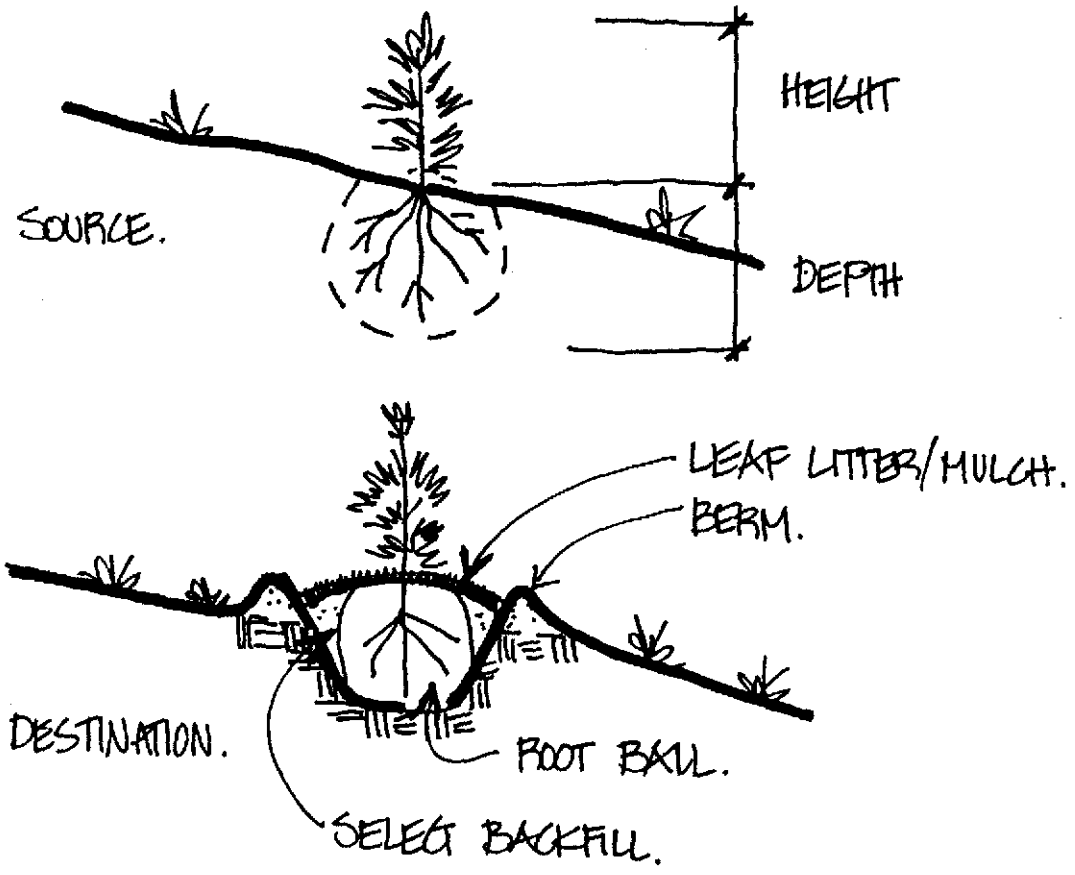
Yucca- Few hikers like these within several feet of a trail. Pruning is impossible. These are good inside switchbacks to prevent shortcuts. Yucca can be successfully transplanted.

Various cactus- Cactus add interest to the trail yet are easily damaged by foot traffic. Transplant cactus outside of the trail corridor if possible.

Mountain Mahogany- Shrubby. This is best preserved as clumps off of the trail. Pruning does not always yield good results.

Aspen- Aspen is a pioneer species that responds to light. It usually needs to be disturbed in order to reproduce. Larger numbers of bird species are associated with aspen stands than with other types of vegetation. Its bark is especially interesting, as is its fall color.





Transplanting

Occasionally, some plants can be transplanted on trail projects. Purposes include:

- To save desirable plants in the trail corridor.
- To increase interest along the corridor.
- To prevent switchback cutting.
- To stop or prevent erosion.

Some Considerations

- When gathering plants to transplant into the trail corridor, go out of view of the trail and randomly select a range of sizes of plants. Restore borrow site to natural condition.
- Transplanting is usually most successful when plants are dormant. Remember to choose healthy, vigorous plants; minimally disturb roots; set plant at original depth and orientation; water and apply 3" of leaf litter mulch; and set securely in ground.
- Transplant plants out of the trail corridors before any other work is begun. Place the plant in conditions similar to those in which it had been growing.
- Use sharp tools to dig. Prune roots with hand snippers or loppers.
- Be very careful.
- When skeptical about a particular plant's chance for survival, transplant it anyway. Dead plants can have the same or similar benefits to live plants.

Tread Cut

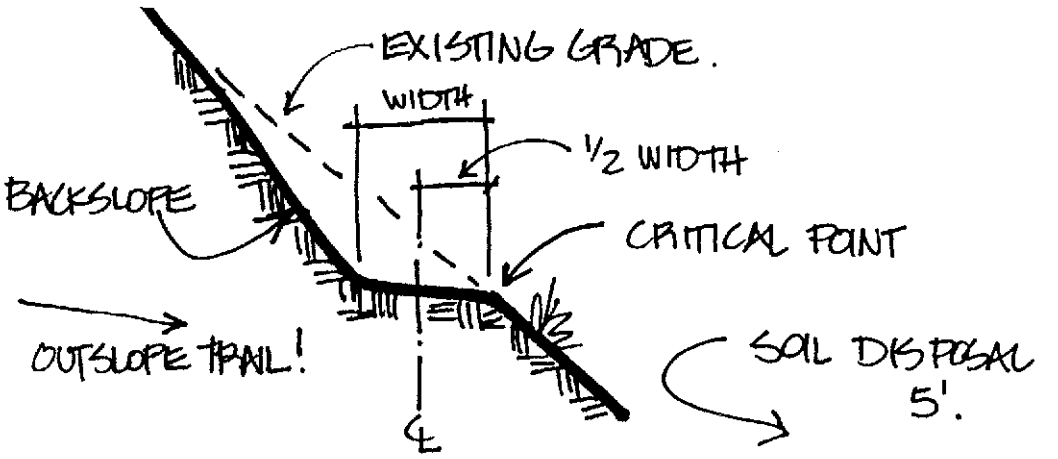
Well constructed, properly sloped, and well compacted trail tread will form over 95% of the finished trail surface. It is therefore, imperative that careful attention to its construction. This can be attained through following:

- Coordinate tread work with clearing and drainage concerns.
- Assure smooth transitions between adjacent crews, and also between tread and structures.
- Begin tread work on the uphill side of the trail centerline and work across the trail. Dispose of unnecessary soil downhill.
- Out slope trail approximately 1" across 24" to allow for drainage.
- Remove all vegetative material from the trail tread.
- Remove all rocks larger than 1" from the trail tread. Stockpile those larger than 2".
- Back slope trail approximately 1:1 to prevent erosion and to allow quick revegetation.
- The critical point shown in the drawing must be on undisturbed ground.
- Compact trail tread with available tools. McCleods work well for this.
- Improve less than adequate trail surfaces with borrowed materials. (Plan for this before you dispose of soil or rocks.) Compact these materials.

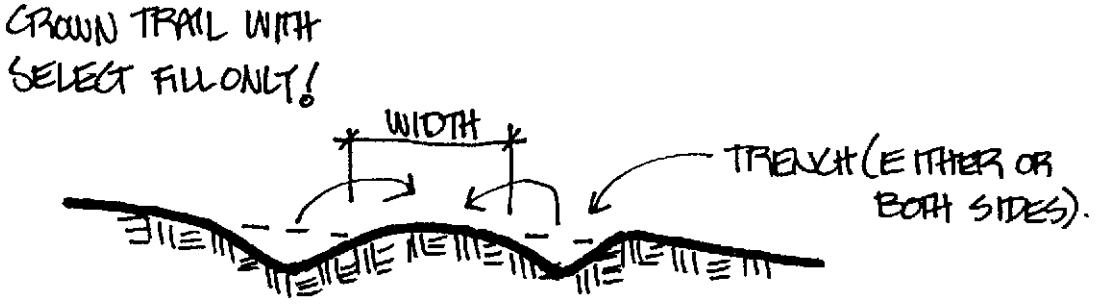
Crowned Trail

- Crown shall be 3" high, minimum.
- Only one trench may be required in some cases.
- Uphill trench may be needed to be daylighted across trail with a structure such as a cobble drain.
- Locate crowned trail so that vegetation to remain keeps people on trail.
- Trail surface must be well compacted.

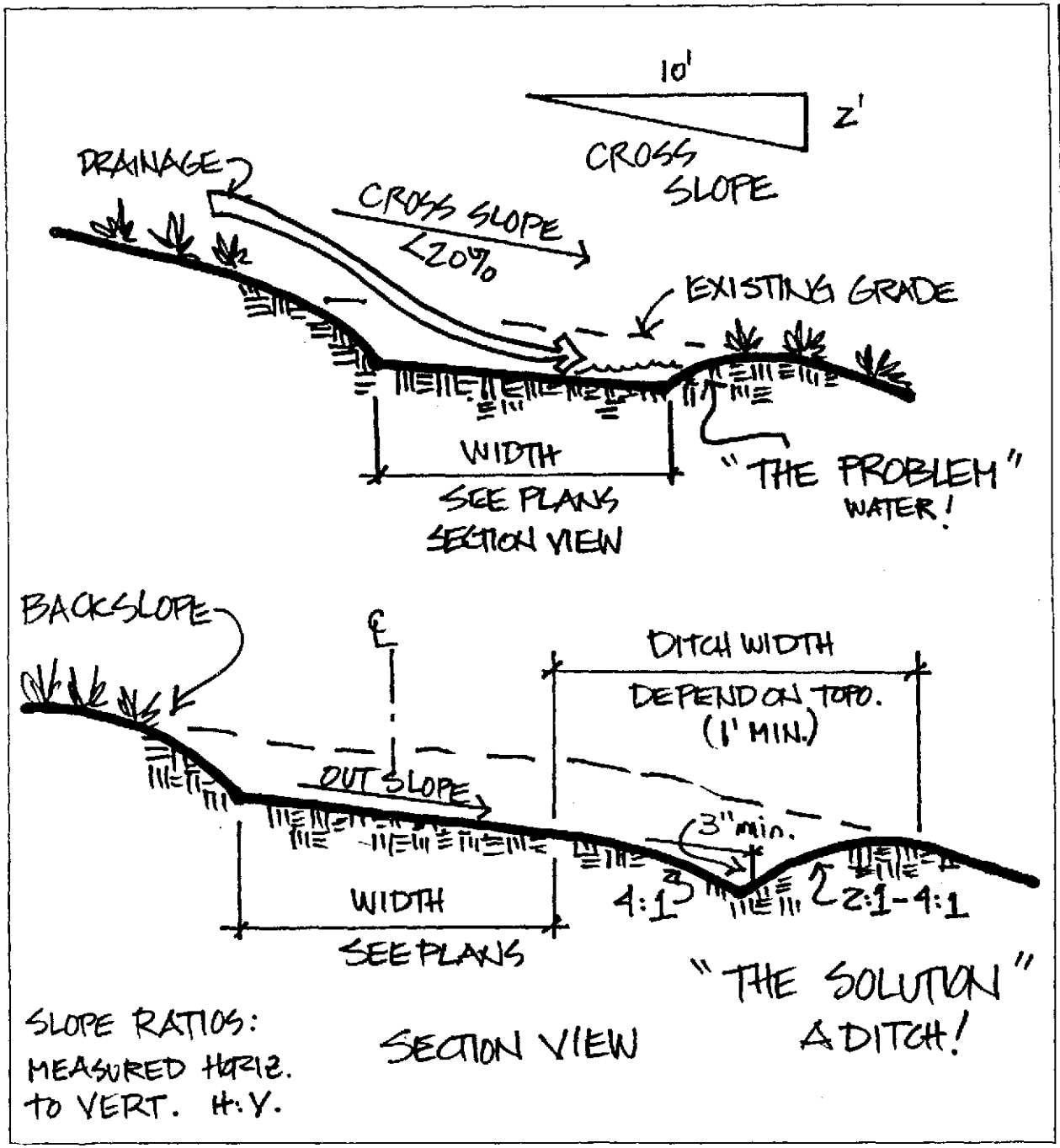
Note: Crowned trail detail is used on flat areas where cross slopes are less than 20%.



TREAD CUT - SECTION VIEW.



CROWNED TRAIL - SECTION.



Tread Cut With Ditch

Cross slope of less then 20 percent is referred to as "flat trail." Drainage is impeded on the downhill side which forms puddles or runs down the trail.

See "Tread cut" for outslope and backslope information. Slope ratios are measured as horizontal to vertical 4:1 = 4' Horizontal to 1' Vertical.

Notes: The tread cut with ditch is used in flat areas and other areas where drainage is otherwise a problem. Trail areas where cross-slope is less than 20 percent should be studied to determine appropriate solutions. Since the major concern is to build a durable trail surface without drainage problems, several solutions exist:

1. Crowned trail - see typical tread cut drawing. This requires ditches on both sides with the tread in fill, occasional stepping stones or trenches across the trails are required.

2. Tread cut with ditch - here, we actually cut a trail tread through sod (usually), dispose of this material, and then cut an appropriate sized trench on the downhill side. We dispose of this material also. Piling this excess up every 100 linear feet approximately 10-20 feet off the trail will leave a neat appearance. Cross drains may still be required.

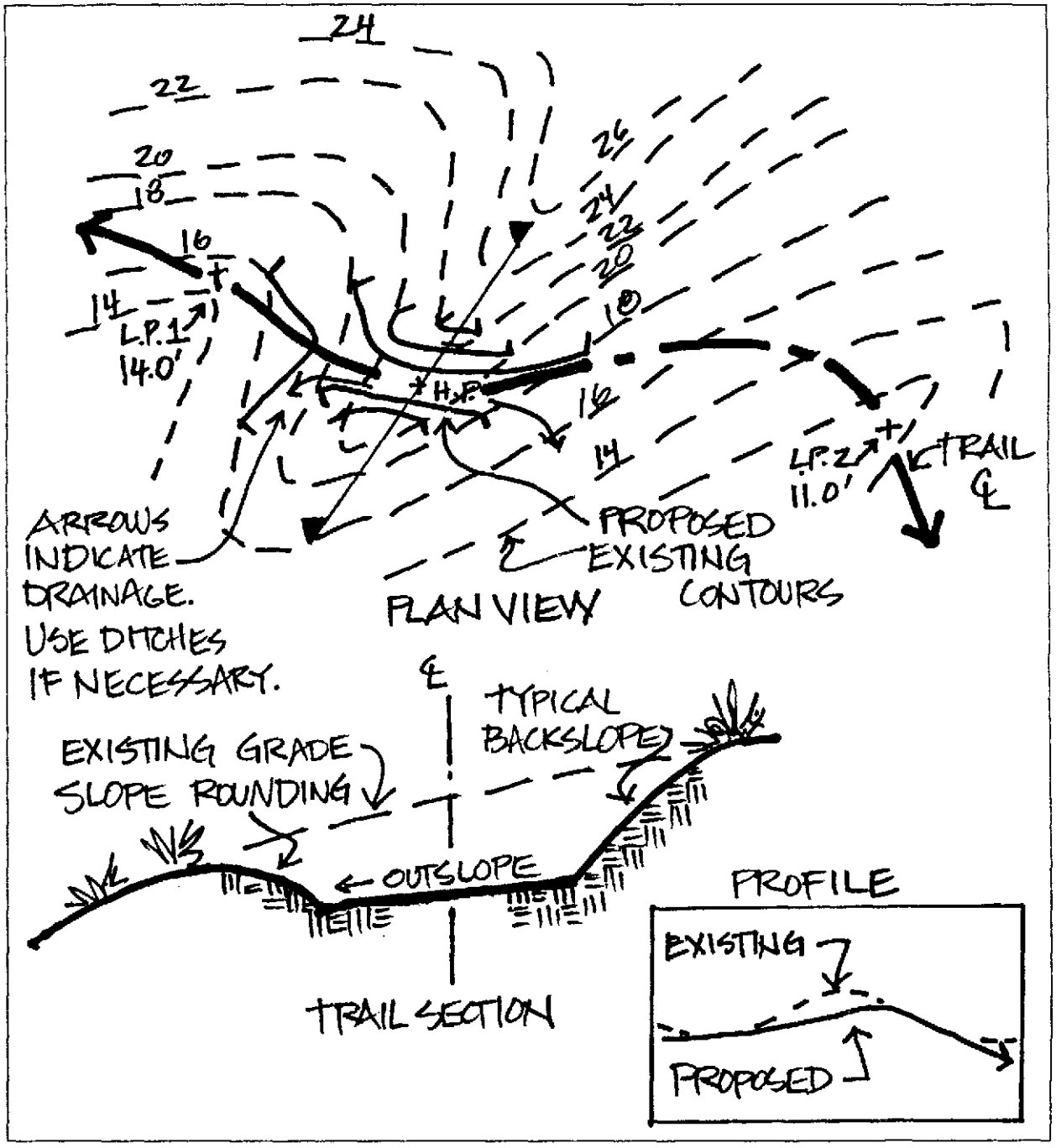
Remember to outslope trail and smoothly grade ditch to allow quick revegetation.

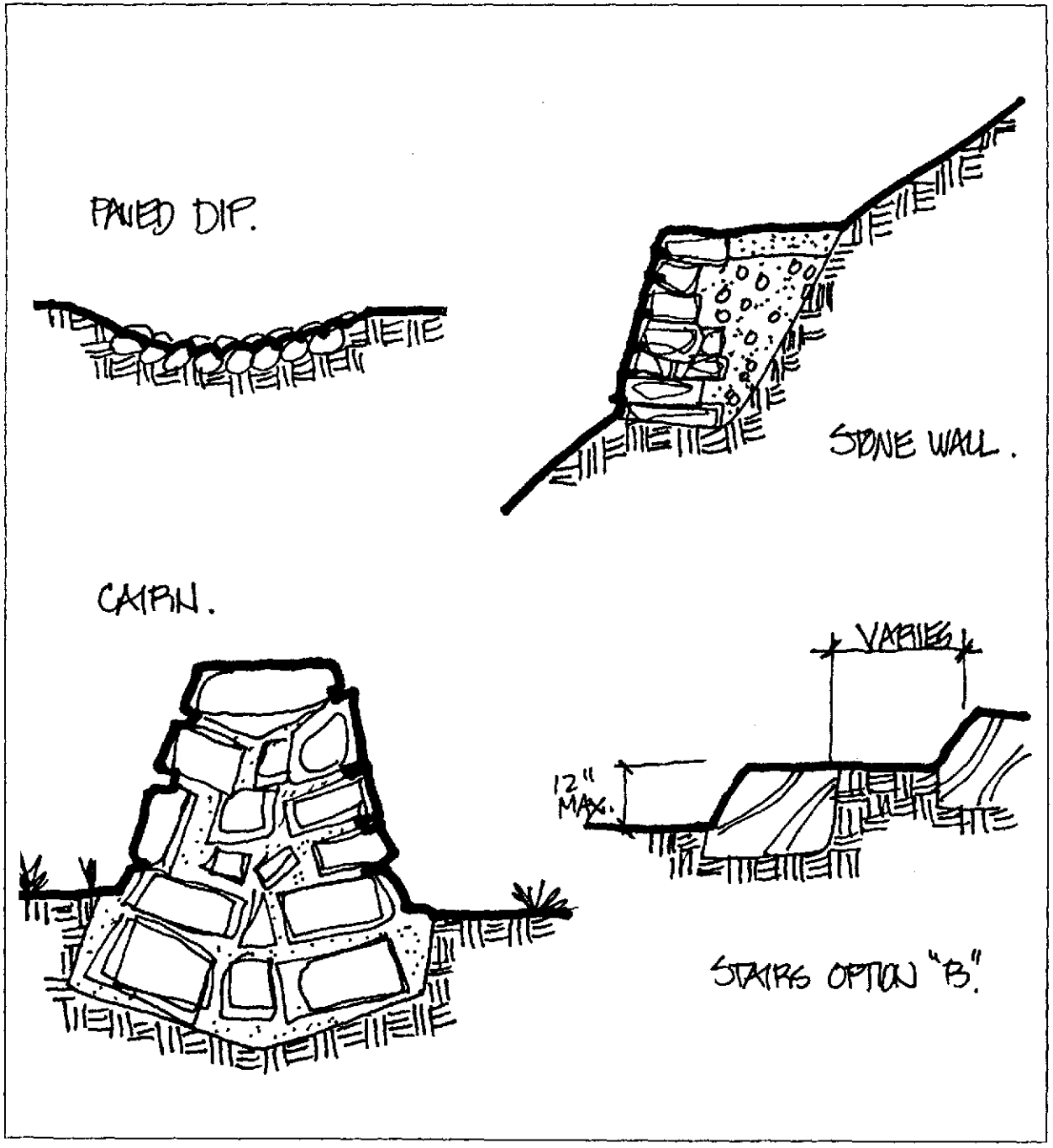
Through Tread Cut

The through tread cut is used where topography does not allow typical tread cut construction. Typical tread cut can only be built on cross slopes between 20 and 70 percent. Sometimes we have a small mound to go over to stay on a good grade, or we have to lower a grade to attain proper profile slope. This is 'advanced' trail construction for an experienced crew leader. A good insight into trail construction, grade requirements and drainage is required. Suggested process:

1. Build trail to both ends of problem area.
2. From Low Points (L.P.), calculate horizontal and vertical distance to High Point (H. P.) where trail profile grades exceed 12 percent, the trail must be lowered at the H.P. Use simple algebra to determine how much. About 3' should be the maximum height reduced by this technique.
3. Make cut down to desired depth. Proceed with outslope for tread, ditches on downhill side, and uphill and downhill backslopes.

Remember - Stone walls can be used to raise the trail going into problem areas. Consult more experienced crew leaders or the trail designer for additional help.





Structures

Structures are critical to the overall success of your trail project. Structures must be planned, located, designed and built properly in order to succeed. They also should be designed similarly if they are in the same area of a park, open space unit or ranger district. Structures are used to improve less than adequate trailside conditions. Walls, switchbacks, stepping stones, and waterbars are examples of structures.

Structures must relate to the trail on which they are built. The design standards of structures and trails such as width should be consistent. They also must be as wide as the trail or wider if they cross the trail.

Typically, preliminary stakes are located in the field for a structure, and then excavation or construction begun. At the same time, the trail legs to each end of the structure are built.

Trail designers are capable of locating and designing simple structures. Licensed professionals should be consulted for culverts and bridges.

Crew leaders should strive for uniformity of design implementation, materials and craftsmanship for all structures in a given area.

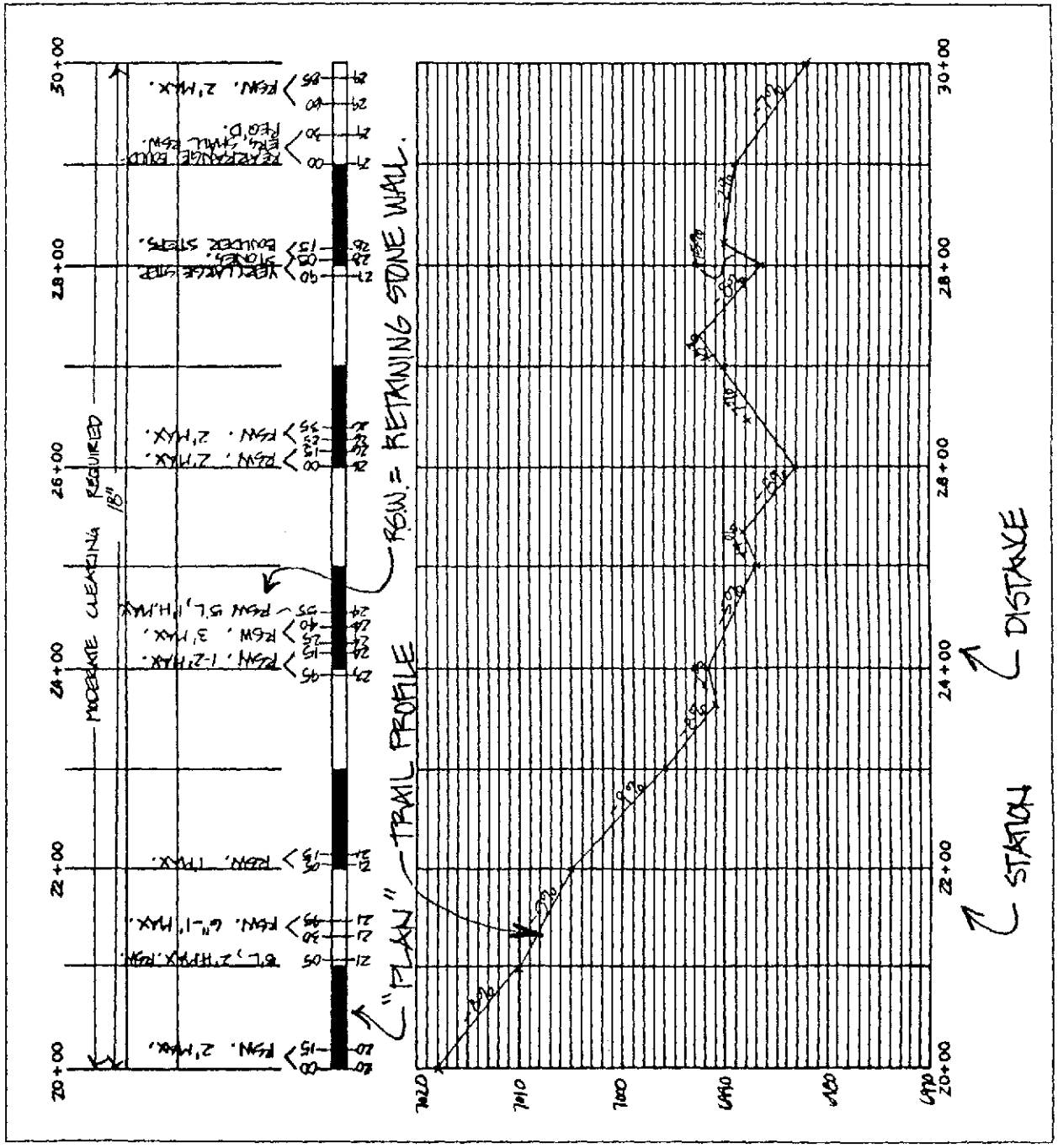
Plan/Profile Sheets

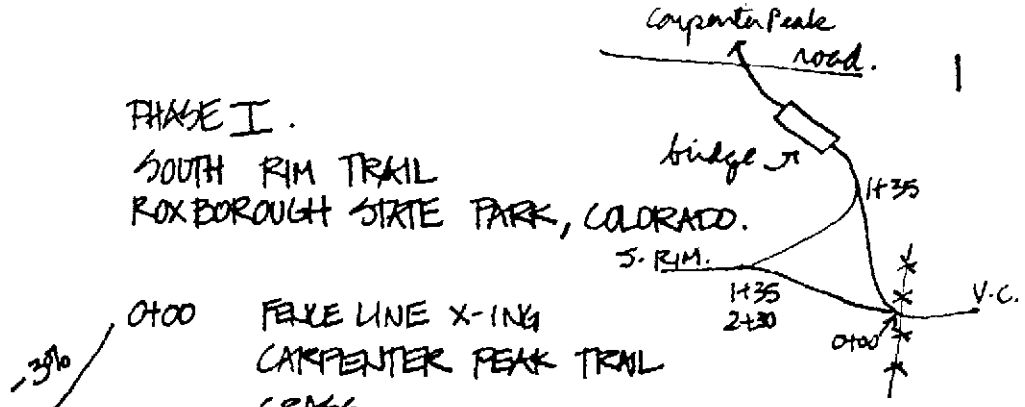
Key to understanding plan/profile sheets is understanding how they are complied and drawn. Some parks, open space units or ranger districts may provide these sheets for your crew. This is the best way to not only design the trail corridor and related appurtenances, but is also the best way to communicate to crew leaders what is required in a given situation.

Basic engineering stationing is used. A station is 100'. Station 1 is referred to as 1+00 ("1 plus zero, zero"). Structures or other improvements required are not only staked in the field, but also identified on the plan/profile sheets to very accurately portray the design intent. These items are noted in terms of a distance from an even station. A wall might therefore be required at station 1, and distance 45'. This is noted as 1+45 ("1 plus four-five").

The profile shows the relative gain or fall of the trail. This is sometimes very important in design to ensure that the designer knows which way they are going. They show the crew leader high points and low points, as well as long and constant grades in either direction.

Plan/profile sheets are scaled for accuracy, and usually reference detail sheets which describe requirements for improvements.





PHASE I.
SOUTH RIM TRAIL
ROXBOROUGH STATE PARK, COLORADO.

-3%
0+00 FENCE LINE X-ING
CARPENTER PEAK TRAIL
GRASS
1+00

flat.
1+35 "Y" INTERSECTION.
1+35 ALSO 25' FROM BRIDGE.
2+30 INTERSECTION "Y"

-2%
2+40 BEGIN CROWNED TRAIL.
2+55 ℄ DRAINAGE SEE DRAWING.
2+70 END CROWNED TRAIL.

±1.
3+00 INCORPORATE CURVI-LINEAR ALIGNMENT
AS TRAIL APPROACHES FENCE.
GENTLE 'S' RECOMMENDED.
3+97 CROSS FENCE.

-3
4+00
-11
4+25 BEGIN LEFT TURN.
5+00 BEGIN RIGHT TURN, BEGIN CROWNED TRAIL

Annotated Notes

Annotated notes are an abbreviated way of describing requirements on construction projects. The same stationing and referencing should be used as in the plan/profile sheets. The only real difference is that the plan and profile are omitted. Reference is still made to the location of required improvements, and to required details.

Drains

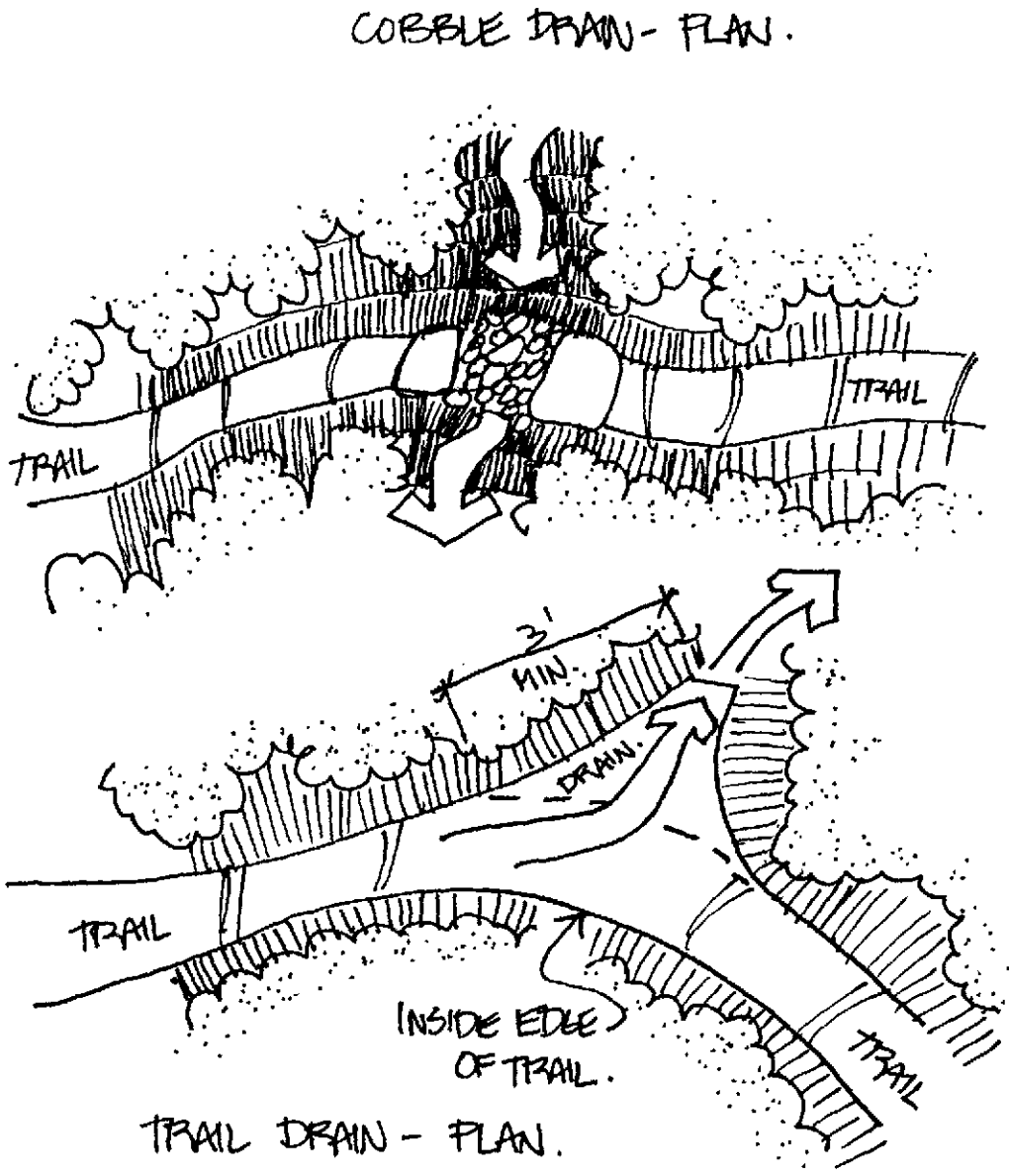
Drains should be installed on trails at locations where normal cross slope will not allow for adequate drainage. In general, drainage should be studied every 50', with provision made to protect the trail. The details shown should be combined (if necessary) with other details. Careful study of topography adjacent to the trail may yield an insight to maximize protection of the trail, while minimizing structures required.

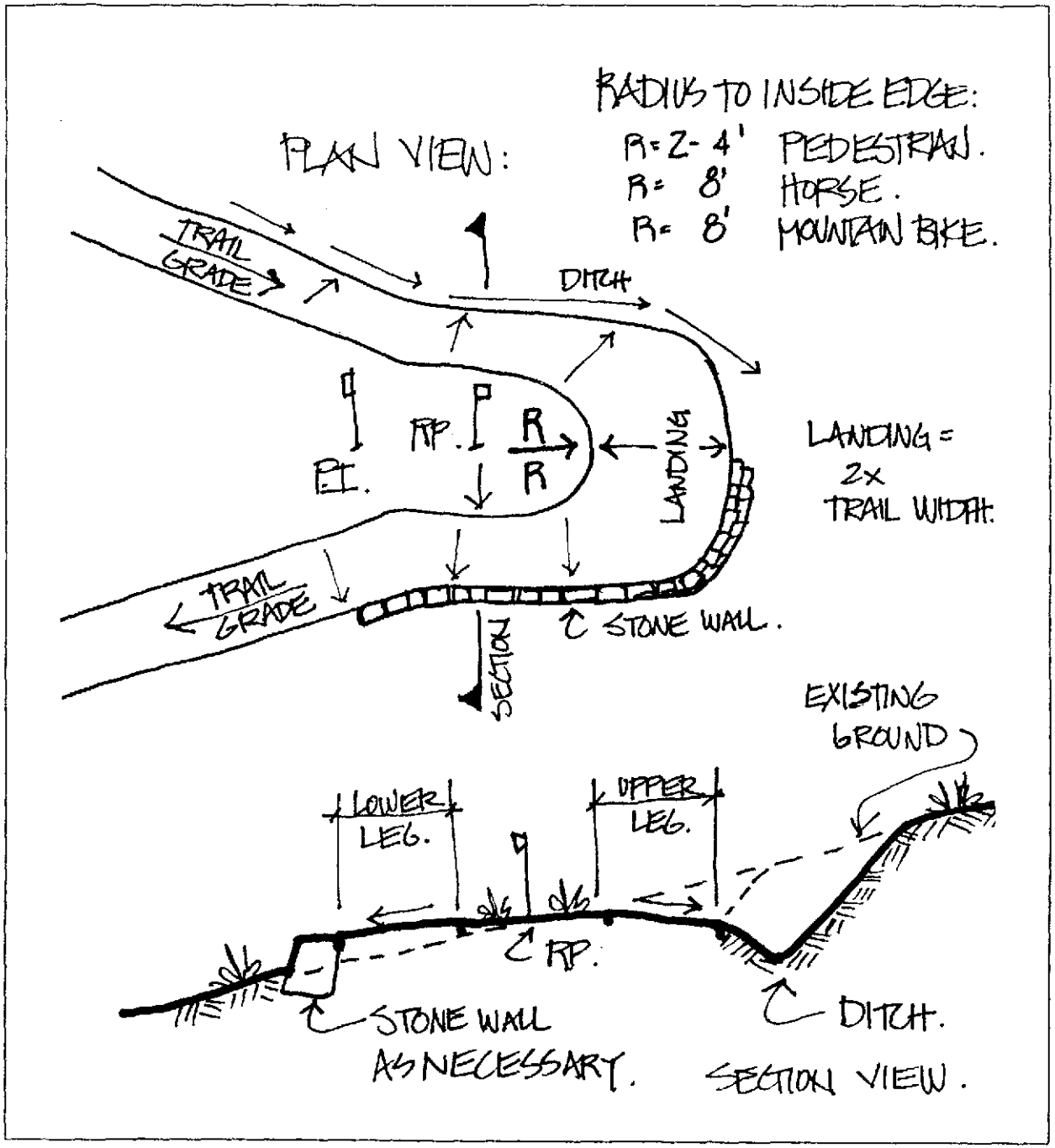
Cobble Drain

Cobbles shall be 2-3" stones stockpiled during trail construction.

Trail Drain

These are best if located at low points or bends in trail. Transition from the trail profile to the natural grade may require 6'.





Switchback

Switchbacks are used where working area is limited but elevation gain is required. Very sensitive alignment and construction methods are required.

The minimum inside radius on a switchback should be 3' for pedestrian trails and 8' for horse trails. Many times stone walls are required to support the landing. Landings should be as flat as possible.

Construction Notes

Starting at the point of intersection (PI), an offset is selected depending on the type of trail and cross slope. This offset is the length to the inside of the trail from the radius point (RP). Offsetting the trail from the PI increases the length of trail and allows for a more gradual slope up the trail profile. At the RP, the actual stake in the center should be a point of no cut, no fill. The uphill leg should be 4% higher, the lower leg 4% lower. These points set your trail profile grades. Work around and up from the lower leg at 4% profile grade max to meet the predicted grade for the uphill leg. This will indicate where walls or cutting should go.

Construction Process

- Clear all organic matter and stockpile.
- Begin footings for lower leg walls.
- Excavate upper leg tread and use (if suitable) on lower leg fills.
- Continue with the lower leg of the trail, either cutting or filling.
- Install barriers and walls as necessary.
- Inslope upper leg of trail as shown minimum distance up from radius point is 20'. Include uphill drain ditch if necessary. Outslope of lower leg of trail shall be typical.

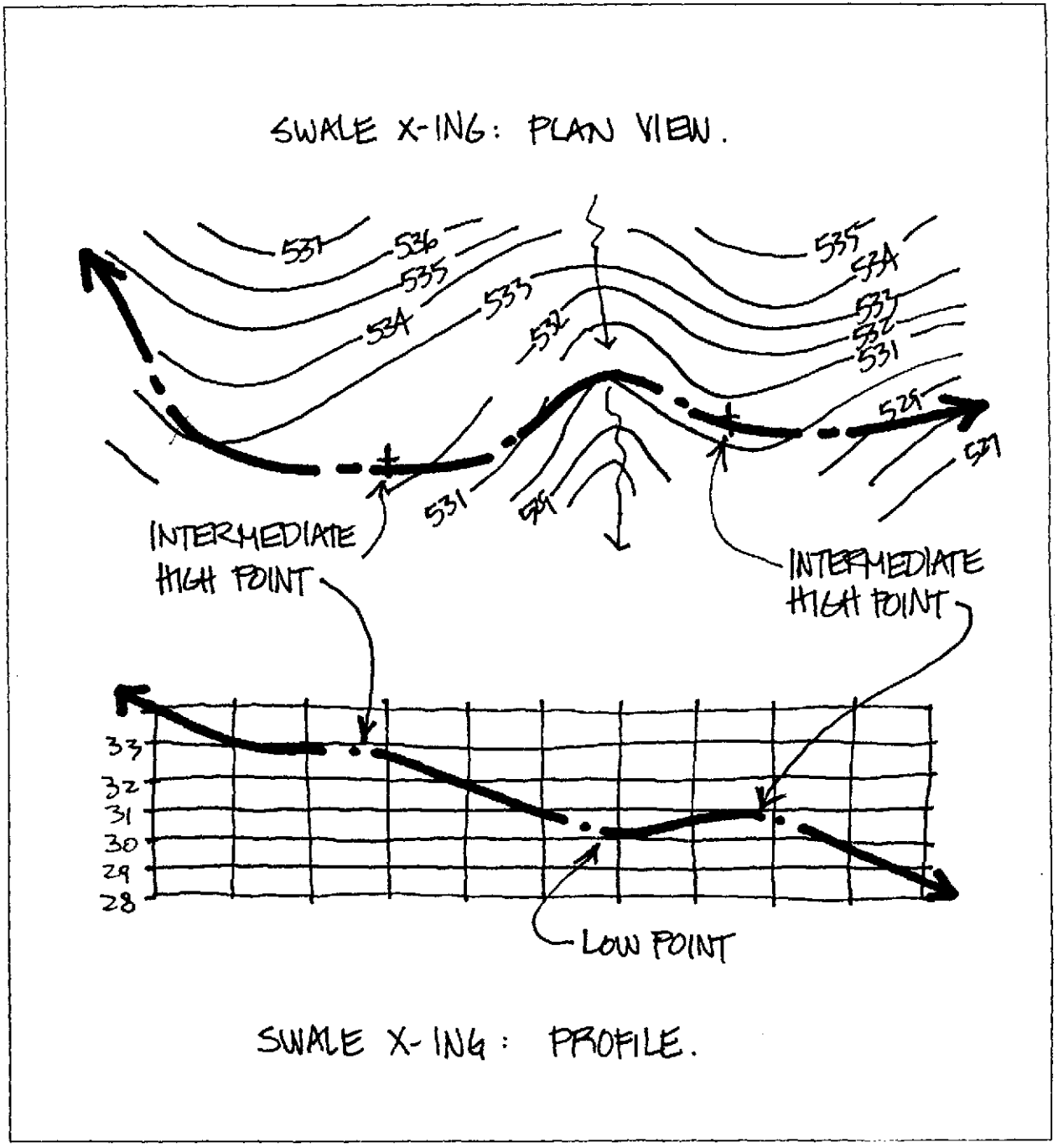
Swale X-ing

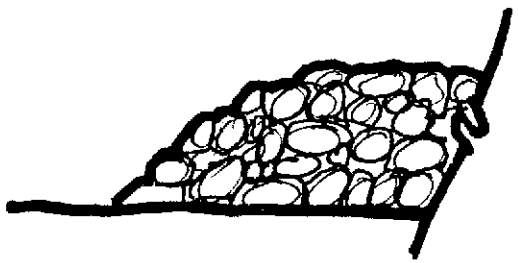
Very important: This drawing applies to all drainage or swale crossings. The intent is to indicate that all trails should go uphill and downstream from all drainage crossings.

Notice in the profile that as you follow the trail from left to right that there are 2 high points noted, one on each side of the water course. Notice, also, that although the trend in the trail is downhill, the 2nd intermediate high point is above the watercourse! This is to prevent the creek from getting onto the trail for very long. The amount of height that the high points should be above the drainage varies according to how much water the watercourse can carry. Look for evidence and make a decision. Generally 1' is ok, but 5' or 6' may be required where a lot of water runs.

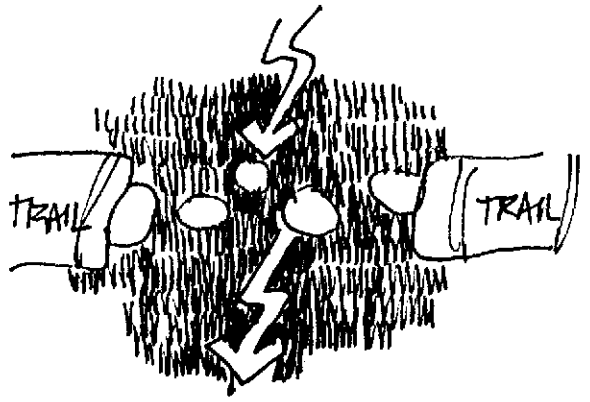
Additional Notes

Slopes on trails in or near drainages should be 4% minimum. Avoid flat areas.





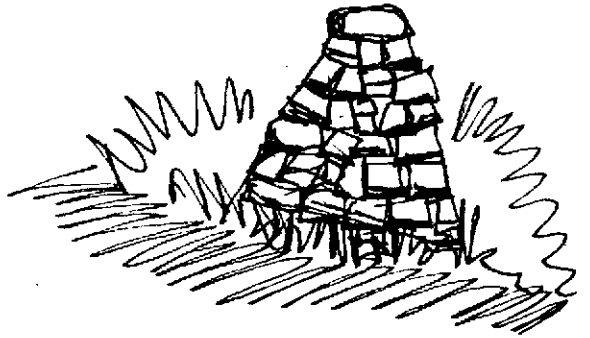
FREESTANDING WALL.



STEPPING STONES.

STAIRS.

CAIRN.



Stone Differentiation

Successful accomplishment of stone structure construction depends to a large degree on the proper use of the various types of stone in various structures. The concepts of differentiation and selection come to mind.

- *Differentiation* - Crew leaders should be aware that different shapes, sizes, and types of stone are useful and appropriate in different details. Good stepping stones are bad waterbar stones.
- *Selection* - Crew leaders are responsible for appropriate solutions, therefore it is important that they go over stone requirements with their crews before crews go looking for stones. If the task is to build a set of seven stepping stones,the crew should gather at least ten. The person actually putting in the stones will have a choice and will be able to choose the best seven. If inappropriate stones show up, just put them aside and ask for new ones. To prevent unnecessary work, make sure the crew knows what is needed.

Proper use of stone will be a lasting contribution to your trailwork. Be judicious in your work.

Pointers

- Brush up on stone knowledge. At least be able to identify granite, the cadillac of stones in trail building!
- Be familiar with all of the stone details attached. Plan your work to use the best stones where they are needed most.
- Communicate with adjacent crew leaders.
- Stress the importance of shape/size and type of stone required to the crew. It is surprising how far they will haul a big rock if it is important to you.
- If rock is abundant, be very selective and choose the most aesthetic.
- Every once in a while when doing stonework, think about some of man's really great stoneworks...the Pyramids, the Great Wall, Stonehenge, or Mesa Verde. If we apply even a little bit of diligence to our stone work, it may last 50 years!

P. S. The Building Stone Institute defines rock as *"that of the earth"* and a stone as *"a rock put to use"*.

Stone Wall

Wall construction allows trails to be built in places where they would not normally go. Walls are built for various reasons. They include:

- To stabilize the trail in less than adequate situations.
- To widen a trail that otherwise would be too narrow.
- To taper up or down in areas where typical tread construction will not work.
- Walls should be built in areas where adequate footings can be dug. A wall without a good footing is worthless.

Stone Selection Tips

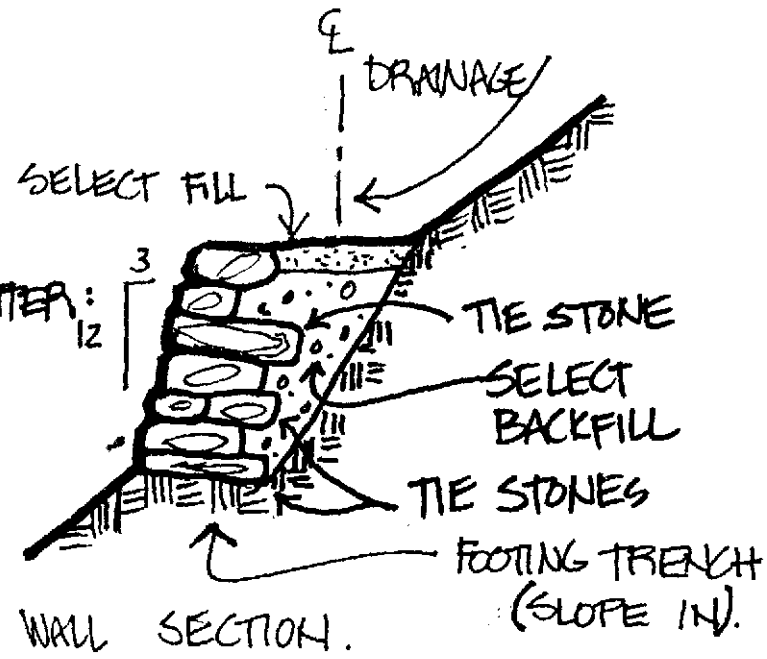
- All stone should be angular, free from defects, projections, and impressions.
- Granite is better than sandstone. Scout out the area and know where the good stones are. Make a good selection based on the stones available to those actually doing the installation.

Stone Installation Tips

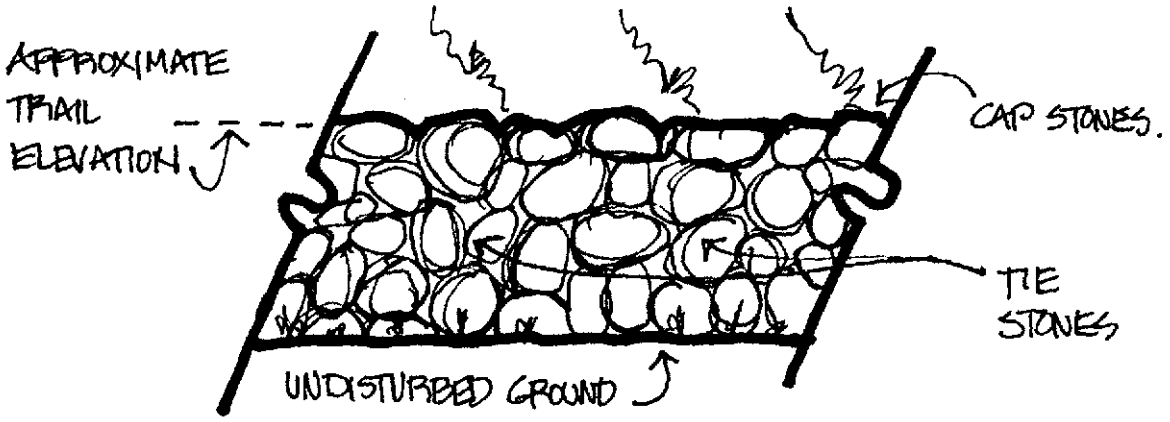
- Approximately 25-33% of wall should be tie stones.
- Maximum height of wall shall be 6'.
- Uniformly distribute sizes and shapes over the entire face of wall.
- Shape stones for best fit. Use a 4" hammer if available.
- All walls must be battered: 3 in 12 through 12 in 12 are acceptable.

Additional Notes

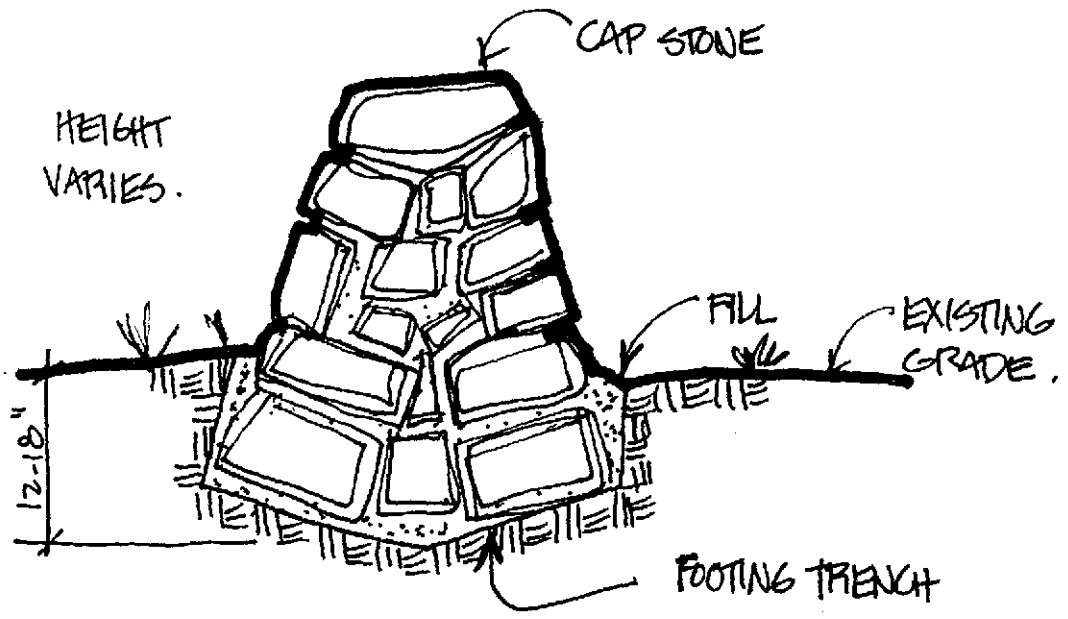
Trench should slope inward as shown, and drain to daylight. Tie stones shall completely penetrate wall. Miscellaneous backfill must be free from organic matter. Select backfill less than 1/2" maximum dimension, 4" depth optimum.



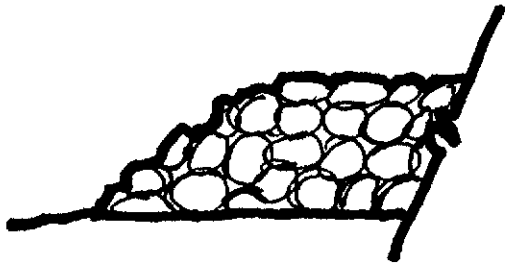
WALL SECTION.



WALL ELEVATION.



WALL - SECTION.



WALL - ELEVATION.

"ONE OVER TWO" METHOD.

Freestanding Wall

Stone walls can be used to guide or direct trail users. They can be used inside switchbacks or in areas where trails have become indistinct.

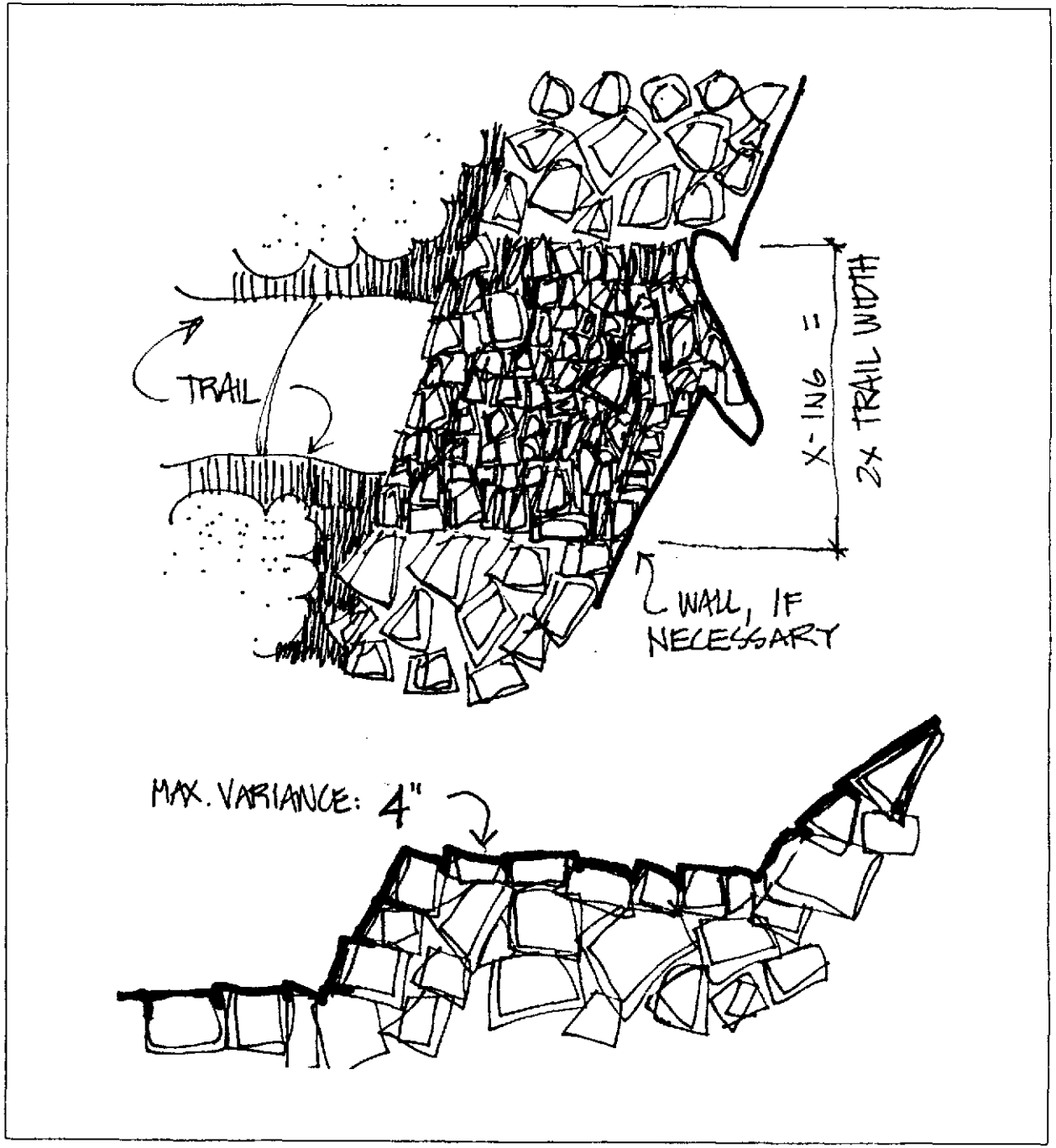
Generally, freestanding stone walls should be high enough to function properly without being too high. Also continuous walls may not be required. Alternating side to side for short lengths may be all that is necessary.

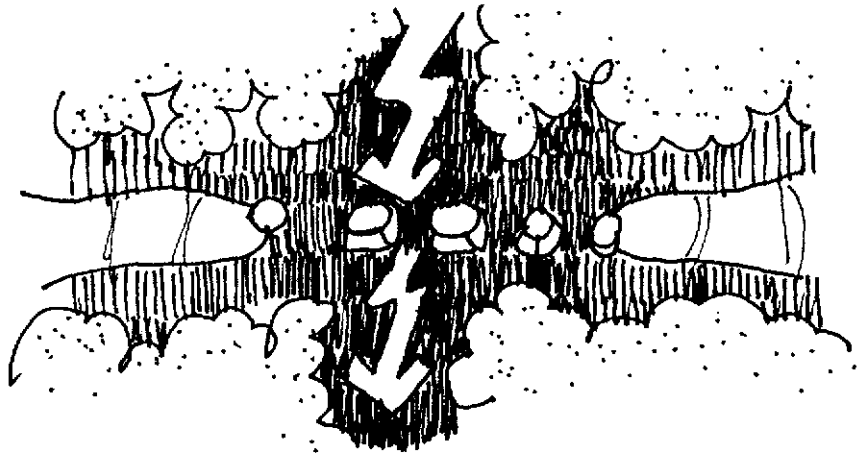
Methods

- Stake out all walls that are required. Plan your walls well to minimize construction and labor.
- Dig your footing trench, slope inward.
- Place or throw stones using the 1 over 2 method to assure stability.
- Uniformly distribute stone sizes throughout wall.
- Continue with inward slope as you build your wall. Use gravity to your advantage.
- Good cap stones prevent water from entering middle of wall. Use them.
- Select backfill less than 1/2" maximum dimension. Compact, properly built walls will last forever. Come back in a few years and admire yours!

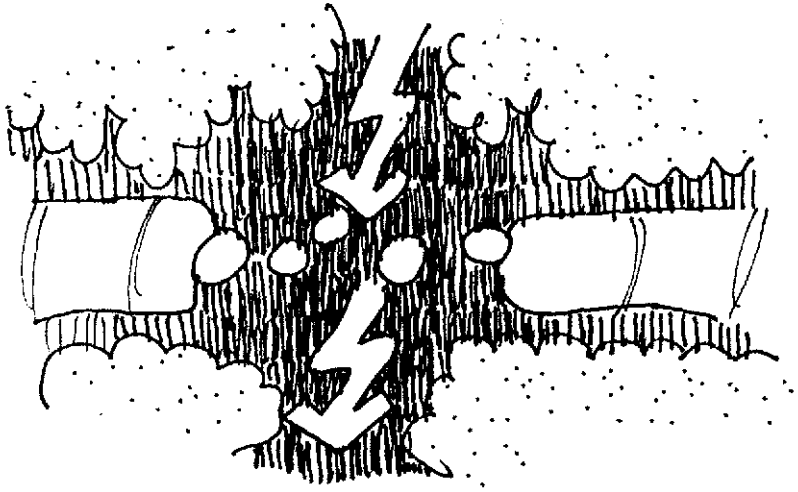
Scree X-ing

It is occasionally necessary to cross scree in complex mountain trail projects. This is usually done by rearranging rocks in the trail corridor, and building stone wall supports if necessary. It is important to point out that a scree crossing must be sufficiently wide to safely accommodate all allowable types of traffic. See stone wall and stone paving details.





BOULDER STONES: PLAN.



STEPPING STONES: PLAN.

Stepping Stones

Stepping stones can be used to provide alternative pedestrian routes across wet areas or intermittent streams. Successful installation of stepping stones depends on several factors:

- Proper stepping stone crossing location.
- Selection of adequate materials regarding type, size, and shape.
- Proper bedding (foundation).
- Accurate stone location for easy crossing.

Methods

- Cross where your work will not be impacted by high flows.
- Always choose granite over sandstone and choose stones of adequate size to cross the drainage. Most stones will need to have at least 2 flat sides.
- Do not over excavate, and improve wet or boggy conditions.
- Place stones for a comfortable crossing. Walk the stones several times yourself and adjust them if necessary.
- Finally, analyze the work during wet conditions and make adjustments if necessary.

Note: Boulder stepping stones are used to cross narrow, but steep, drainages, or where evidence indicates high flows. Stepping stones are used to cross areas on low flow. Strive to choose stones that are between 12" and 18" square for all stones.

Stairs

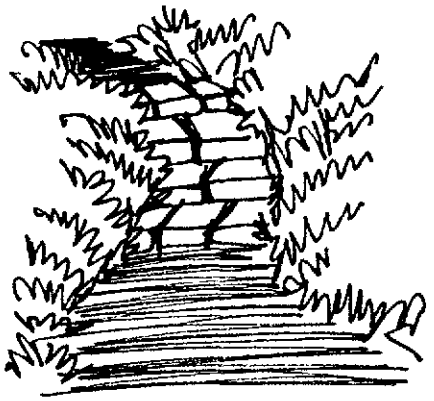
Stone stairs can be used where grade must be gained quickly. Stairs should not be used on main line Colorado Trail in that it is intended to be horse accessible. This detail is included for background information and reference only.

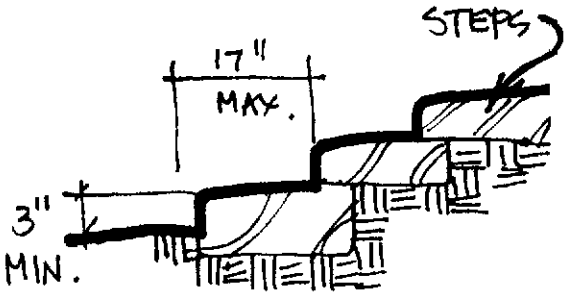
Stone stairs should be built with the intent that thousands of crossings should not impact the stairs the slightest. Several clues will help:

- Choose stones with a good shape for stairs.
- Start at the bottom and work upwards.
- Use the biggest stones possible to span the trail. Make sure strong people are on the crew! One stone would be best, two are fine, and three is maximum.
- Completely cross the trail. Choose the areas where people will stay on the trail and stairs.
- Build to the dimensions shown and make each set of stairs uniform.
- Maximum grade at top and bottom of stairs as well as between stairs should be 8%.
- Walk your staircase to ensure it is smooth and uniform.

Additional Notes

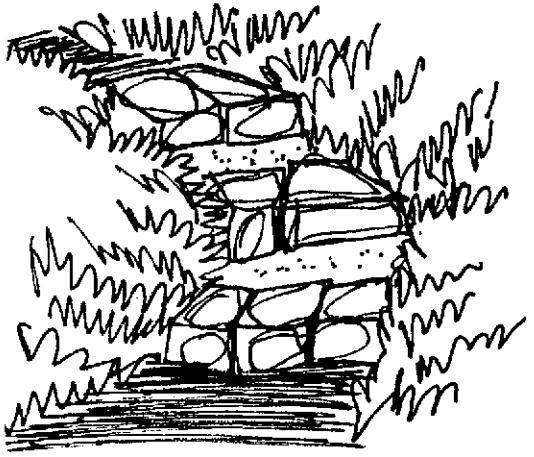
Avoid thin stones, as well as stones that are cracked.

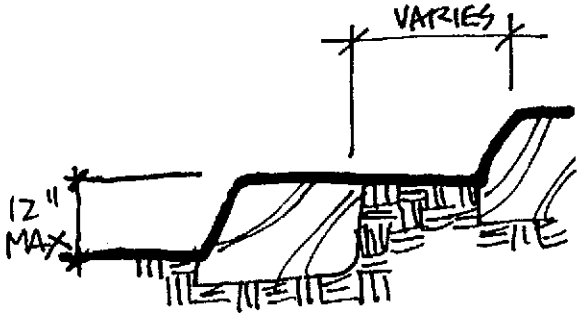




SECTION.

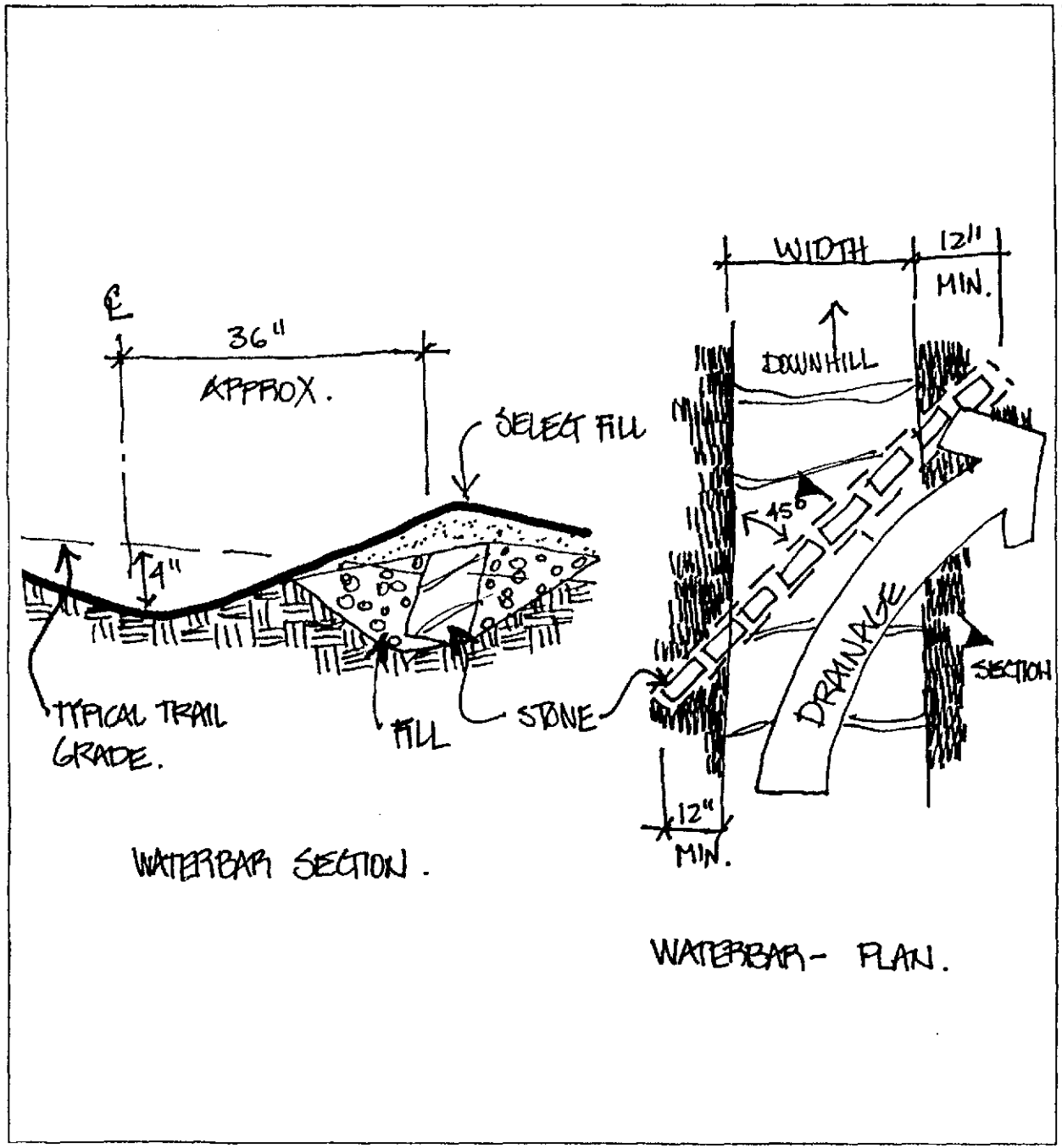
STAIRS: OPTION "A".





SECTION.

STAIRS: OPTION "B".



Waterbars

Good waterbars will cut down erosion and subsequent maintenance of otherwise well built trails. Some pointers:

- Take advantage of natural features when selecting a location for your waterbar. A natural dip or a bend in the trail is a good place.
- Avoid areas without an outlet for drainage.
- Choose 'waterbar stones' for use. These are 6" thick minimum and are generally rectangular in shape. Avoid round or narrow stones.
- After digging the trench, arrange the stones and see how they will work. Rearrange if necessary. Set aside unusable stones. Look for better stones.
- When you are satisfied with the choice, quality, and arrangement of stones, backfill to top of stones with miscellaneous fill and compact. Then grade over the top with 6" of select backfill.
- Test your waterbar by walking over it; adjust it if necessary.
- Create drainage outflow (in cut).
- Come back when its raining to observe your masterpiece.

Additional Notes

- As with all stone work make a large selection of stones available to the installer!
- Save the soil from the trench for use on top of the waterbar if it is acceptable material.
- Miscellaneous fill must be free from organic matter.
- Select backfill less than 1/2" maximum dimension
- Depth of outflow at edge of trail = 4".

Stone Paving

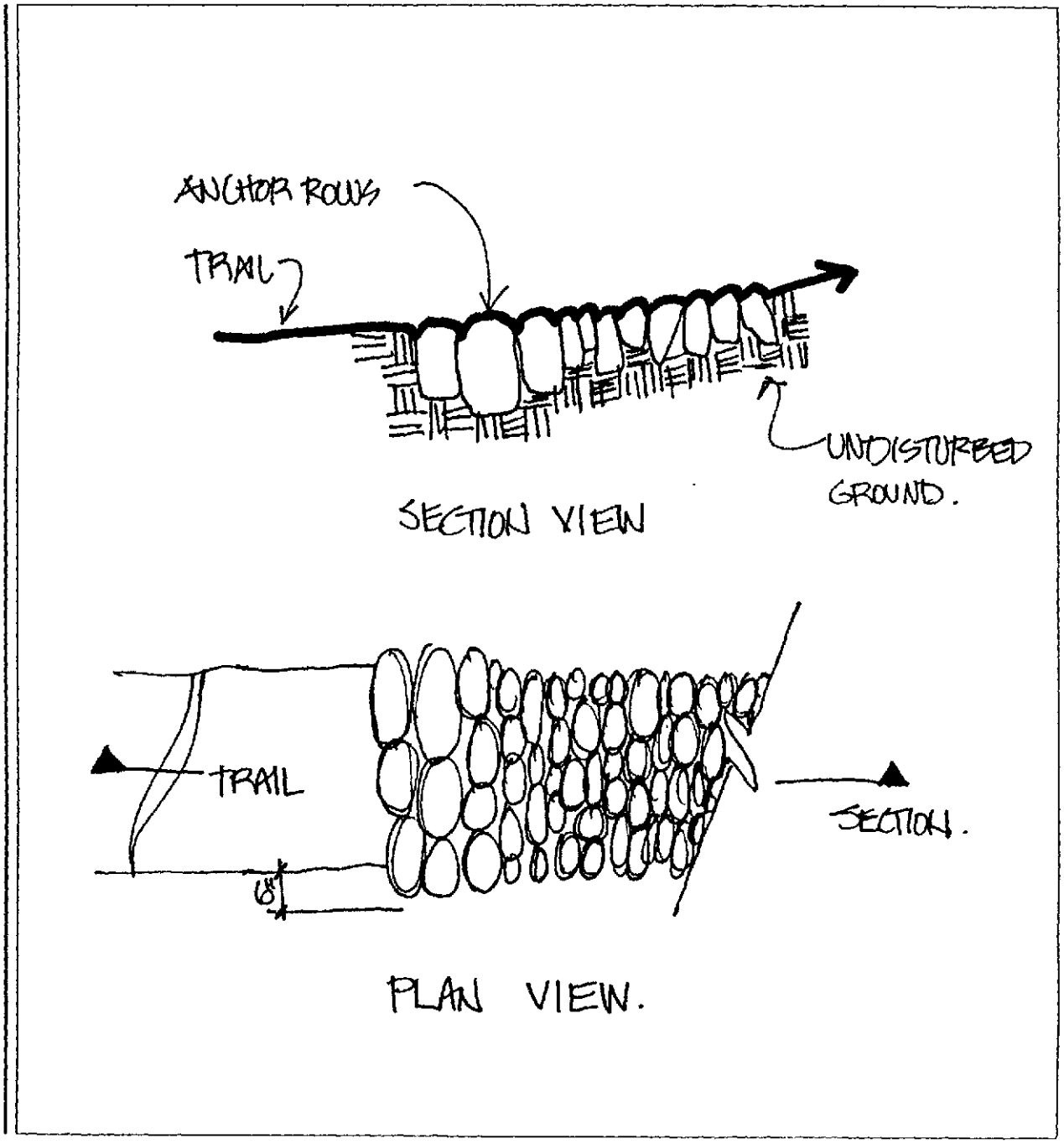
Stone paving can be used in areas that otherwise would not support a trail. These include unnecessarily steep (and eroded) areas, flat areas, as well as areas abundant in rock where tread cut is not practical.

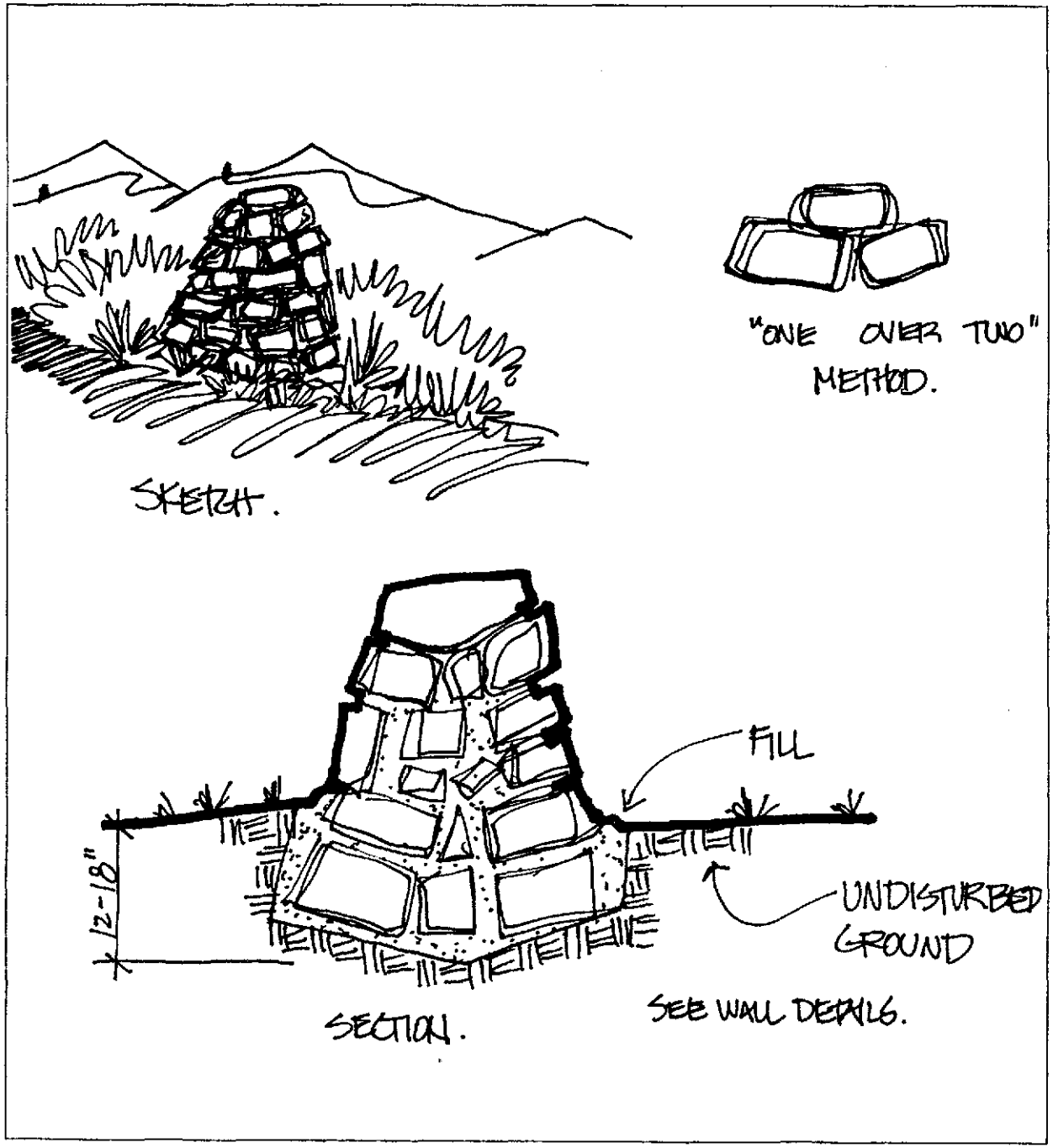
Some important things to remember include:

- A good anchor is required. Either use a rock outcrop 'in situ', or create your own anchor using large stones or other approved materials.
- A smooth surface is desirable. To accommodate various sized stones, excavate just enough for each stone.
- Stones stood on edge work best.
- Install stones as tightly as possible. Fill voids with gravel or stone chips.
- Like all stonework: Some stones are good and some are bad; start at the bottom and work up; and come back in a few years to admire your work.

Stone Requirements

- Anchor stones: minimum dimension 9".
- Stone paving: minimum width 2", minimum depth 6".





Cairn

Cairns, by definition, are made of stone. Generally, they are used in alpine areas where the trail tread is indistinct, although they can be used at lower elevations. A good way to get rid of excess excavated stone (at the lower elevations) is to build a cairn rather than scattering them. Several pointers should be kept in mind when building cairns. They include:

- Cairns are meant to be visible. Build them where they will be seen. Sometimes colored markers are used for even greater visibility.
- Use large angular stones. Round stones will slide on each other during the first winter. Large stones are needed to prevent animals from dislodging them.
- Use the '1 over 2' method of construction.
- Dig a footing trench (as with all stone work). Slope this inward as shown.
- Place on alternate sides of the trail if you are building many cairns.

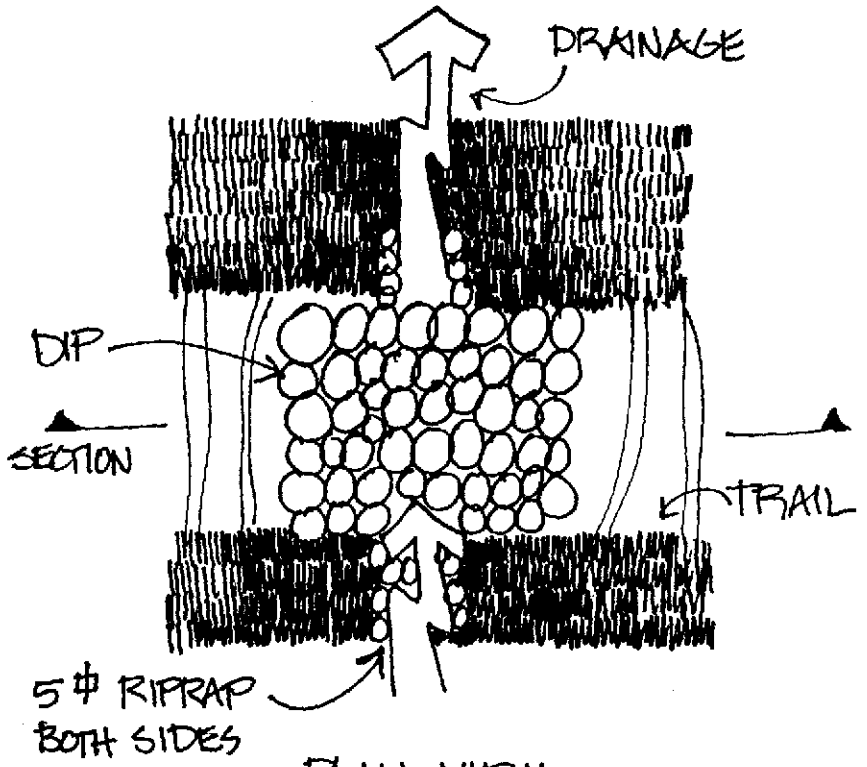
Come back in a few years and admire your work just as hundreds of other people will.

Paved Dip

Paved dips shall be used in unusually wet areas and in high traffic volume areas where stepping stones would be inappropriate. Generally, the drainage flows are infrequent and very low.

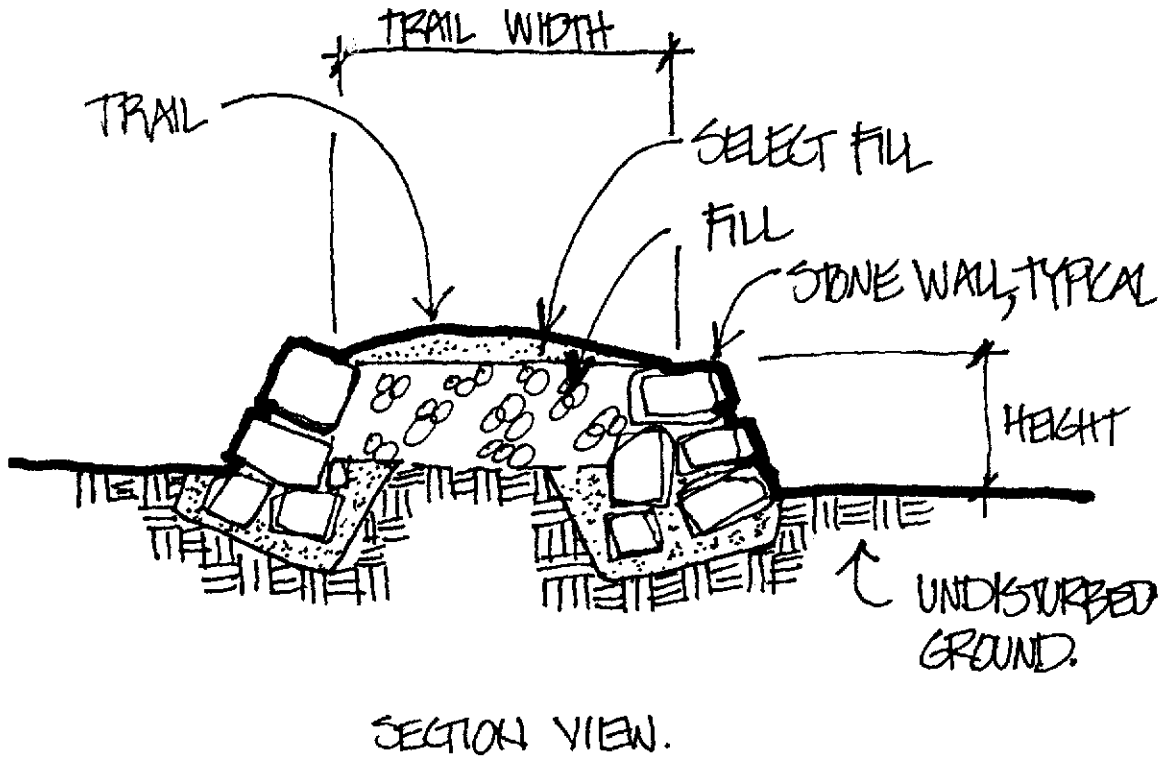
Stone Requirements

Minimum stone dimension shall be 6", granite is better than sandstone. Set stone to achieve a reasonably smooth surface.
Also, the stone used for paved dips is generally of poor quality, not suitable for use in walls or waterbars.



PLAN VIEW.

SECTION.



SECTION VIEW.

Causeway

Causeways are sections of trail which, in wet or drainage areas, enable the trail to be built up above the wet areas to allow safe passage. Usually stone walls are used to support the fill material.

Causeway Reminders

- See stone wall detail.
- Fill material shall be as select as possible. Stone, gravel, and mineral soil are best.
- Start at the downhill end and work up. Dig adequate footings and place stones to prevent movement.
- Place and compact fill as tightly as possible.
- The top 2" of trail tread shall be very select.
- Crown tread 1" for positive drainage.

Corduroy

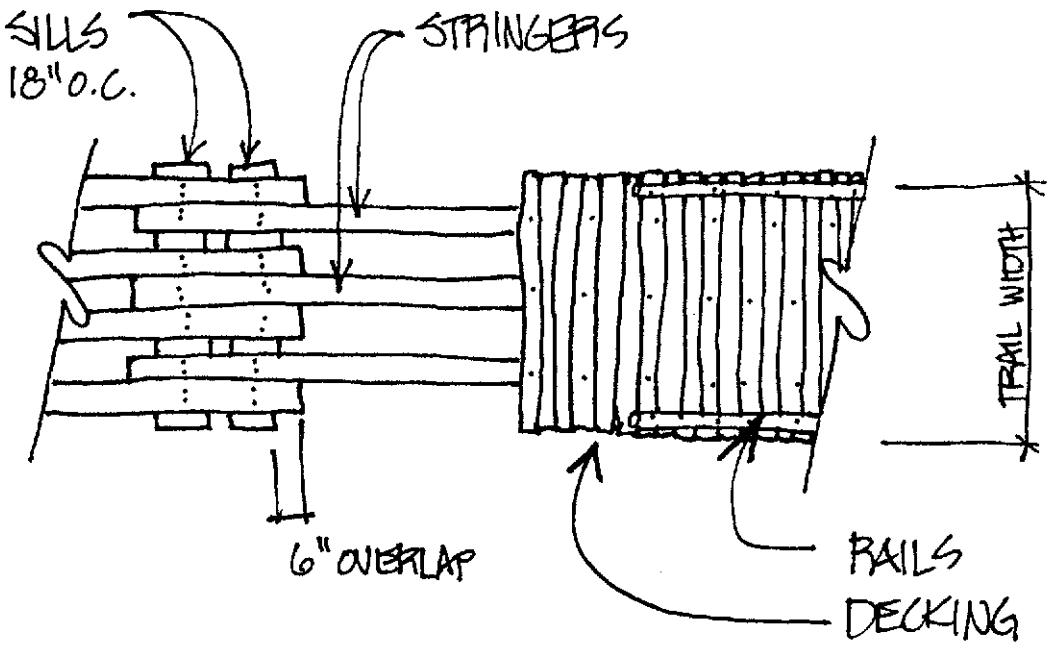
Corduroy is used to improve trail tread conditions where they might be wet or otherwise inadequate. Native logs are usually used. All materials must be peeled.

Methods

- Determine extent of improvement required. Remember to always build structures back to solid trail ground.
- Stake out sill locations to minimize use of wood. Two sills are required at stringer joints. Sill spacing shall be 6'-0" on center maximum.
- Determine stringer lengths and sizes required. Standard lengths shall be 12' or 14'. Shorter lengths may be used. Notch sills to accept stringers. Three or four stringers are usually required. Overlap sills at joints. Attach stringer with (2) 12" spikes.
- Attach decking with 16d nails. Fasten every third decking member for economy.
- Attach rails using 12d nails approximately every foot.
- Remember: Uniformity of materials is very important.

Materials

Sills - 12-18" diameter
Stringers - 10" minimum diameter
Decking - 4" minimum diameter
Rails - 3" minimum diameter
Most durable species: Cedar, fir, larch, pine, spruce.



PLAN VIEW.

SECTION 02204 SELECT BORROW

PART 1: GENERAL

1-1 DESCRIPTION: The work of this section consists of all select borrow work.

PART 2: MATERIALS

2-1 SELECT BORROW: Shall be obtained on site from trail excavation excess, as approved by the Contracting Officer. All material 2 inches or greater in diameter shall be screened out before transporting the borrow to the fill area.

PART 3: EXECUTION

3-1 GRADE: Trail tread shall be constructed to grade shown on plans and staked on ground. Grades shall be uniform between staked points. It shall be the Contractor's responsibility to establish intermediate stakes for grade control.

Horizontal alignment shall not vary more than 8 feet at or between each 100-foot station without approval. Allowable vertical alignment from established centerline stakes shall be plus or minus 2 feet at or between each 100-foot station.

3-2 PLACING AND COMPACTION: After previous work has been inspected and approved by the Contracting Officer, place select borrow in 4-inch horizontal layers. Compact with manually operated vibratory compactor. Provide sufficient moisture to achieve compaction. Compact until material no longer moves under compactor. Areas of settlement shall be satisfactorily backfilled and compacted prior to completion and acceptance of the project.

PART 4: MEASUREMENT AND PAYMENT

4-1 SELECT BORROW: Payment will be included under the bid item to which this work relates.

BLRI-105A

Specifications noted "BLRI-105A" are taken from Blue Ridge Parkway, Grandfather Mountain Trails Project, 1984, designed by Bob Steinholtz. All other specifications in this appendix are from the U.S. Forest Service "Standard Specifications for Construction of Trails, Publication Number EM 7720-102" of 1984.

SECTION 02636 TRAIL TREAD EXCAVATION

PART 1: GENERAL

1-1 DESCRIPTION: The work of this section consists of excavating and grading the trail tread.

1-2 CLASSIFICATION: All excavation under this section shall be considered unclassified, regardless of the nature of the materials encountered. No extra consideration will be allowed on the basis of classification; however, the plans will divide the project alignment into classified sections for informational purposes. Sideslope and material classifications, indicated on the plans, are estimates of existing conditions observed on the ground.

The combination of estimated sideslope and material classification is termed "grading type", and is shown on the plans as sideslope expressed in percent. The following chart shows sideslopes as related to grading type and material.

Sideslope	Materials	Estimated Grading Type
0 - 10 percent	Earth; gravel to 1/4 cubic foot	None - 0
11 - 25 percent	Earth; boulders to 1/2 cubic foot	Light - L
26 - 50 percent	Earth; boulders to 1 cubic foot	Medium - M
51 percent plus	Earth; boulders of all sizes	Heavy - H

1-3 CONTRACTOR'S OPTION: In lieu of explosives, Contractor may elect to remove rock by nonexplosive means, by either feather plugging, or by use of nonexplosive compounds, such as Bristar, or approved equal.

PART 2: MATERIALS

2-1 SELECT BORROW: Section 02204.

PART 3: EXECUTION

3-1 GRADE: Grades between points staked in the field and those shown on the plan and profile drawings shall be varied by the Contracting Officer to fit terrain features. Where the plan and profile indicate trail grades less than 20 percent, sections within the area indicated may vary plus or minus 3 percent. Sections varying from the planned profile grade shall be no less

than 20 feet in length and shall be approved by the Contracting Officer prior to construction.

Where trail grades are 20 percent or greater, any variations shall be determined by the Contracting Officer.

3-2 WIDTH: Normal finished trail tread shall be 24 inches wide full bench, unless specified otherwise on plans or staked on ground. Backslopes shall be constructed in accordance with slope ratios as shown on plans.

A. Sideslope 0 to 10 Percent - Grading Type 0: Where the ground material is a mixture of earth and gravel, no grading is required.

B. Sideslope 11 to 50 Percent - Grading Types L and M: Finished trail tread shall be 24 inches wide full bench, unless otherwise shown.

C. Sideslope 51 Percent or Greater - Grading Type H: Finished trail tread across hillsides, talus, or rock slides shall be the width, full bench shown on plans.

D. Full Bench: As used herein, the term "full bench" is defined to mean that the entire width of the trail tread shall be in excavation. No filling will be permitted within any part of the trail tread, except for the use of select borrow where required by the specifications and construction details or by the Contracting Officer.

3-3 SURFACE: All loose material 2 inches or greater in diameter shall be removed from tread surface. Exposed rock protruding 2 inches or greater above the finished tread surface shall be removed or partially removed to provide a plain tread cross section. Trail tread through solid rock or rock talus material shall be cushioned a minimum 4 inches compacted depth of select borrow material.

3-4 SELECT BORROW: Backfill behind retaining walls shall be select borrow. Place and compact select borrow in accordance with Section 02204.

PART 4: MEASUREMENT AND PAYMENT

4-1 TRAIL TREAD EXCAVATION: Measurement will be the actual number of linear feet installed, measured along the centerline of the trail, to the nearest linear foot. Separate measurements will be made for the 24-inch, 36-inch, and 60-inch wide tread.

SECTION 02637 TRAIL SWITCHBACK

PART 1: GENERAL

1-1 DESCRIPTION: The work of this section consists of constructing trail switchbacks.

1-2 CLASSIFICATION: All excavation under this section shall be considered unclassified, regardless of the nature of the materials encountered. No extra consideration will be allowed on the basis of classification. Refer to sideslope percent on the plans for the various designated switchbacks.

PART 2: MATERIALS None.

PART 3: EXECUTION

3-1 GRADE: Grade around switchback shall not exceed 6 percent. Upper leg shall be cut and lower leg filled to construct flattened grade around turn.

3-2 RADIUS: Radii, as measured from intersection of trail tangents, shall be no less than 4 feet. Certain radii will be greater as staked on ground or shown on plans.

3-3 WIDTH: Tread width through switchback shall be width of trail tangents to and from curve as shown on plan. All earth, rock, and vegetation between switchback tangents shall be left undisturbed.

PART 4: MEASUREMENT AND PAYMENT

4-1 TRAIL SWITCHBACK: Measurement will be the actual number of switchbacks in place. Payment will be made at the contract unit price.

END

BLRI-105A 02637-1

SECTION 04406 FREESTANDING STONE WALL

PART 1: GENERAL

1-1 DESCRIPTION: The work of this section consists of constructing freestanding stone walls.

PART 2: MATERIALS

2-1 STONE: Clean, hard, durable, free from structural defects, weather resistant. Only angular stone free from depressions and projections will be acceptable. Round stone will not be acceptable. Minimum stone size shall be 1/2 cubic foot. 50 percent of stone used shall be greater than 3/4 cubic foot in volume.

2-2 SPALL: Hard, durable chips of stone.

PART 3: EXECUTION

3-1 FOOTING: Base for stone wall shall be excavated into solid undisturbed parent earth or rock to the minimum depth shown on plans. Base stones shall be greater than 1-1/2 cubic feet in volume.

3-2 LAYING: Place stone, without mortar, to form stable, freestanding wall. Stagger joints in wall. At least half of front and back faces shall be stone having length at least 2-1/2 times their thickness, laid with greater dimension extending into wall. Lay each stone with good bearing on broadest face. Batter exposed face of wall 3 inches per 1 foot of height. Batter ends of wall 6 inches per 1 foot of height. Top course shall be stones of at least 1 cubic foot, placed with greatest dimension parallel to centerline of tread.

Use spalls for shimming and keying stones for firm, solid bearing.

PART 4: MEASUREMENT AND PAYMENT

4-1 FREESTANDING STONE WALL: Measurement will be the actual number of square feet in one face of the wall, measured from the bottom of the base stone to the top of the wall. The height and length of this face will be averaged appropriately to accurately compute the face. Payment will be made at the contract unit price.

ELRI-105A 04406-1

PART 1: GENERAL

1-1 DESCRIPTION: The work of this section consists of constructing stone retaining walls.

PART 2: MATERIALS

2-1 STONE: Clean, hard, durable, free from structural defects, weather resistant. Only angular stone free from depressions and projections will be acceptable. Round stone will not be acceptable. Minimum stone size shall be 1/2 cubic foot. 50 percent of stone used shall be greater than 3/4 cubic foot in volume.

2-2 SPALL: Hard, durable chips of stone.

2-3 SELECT BORROW: Section 02204.

PART 3: EXECUTION

3-1 FOOTING: Base for stone wall shall be excavated into solid undisturbed parent earth or rock to the minimum depth shown on plans. Base stone shall be greater than 1-1/2 cubic feet in volume.

3-2 LAYING: Place stone, without mortar, to form stable, backfilled wall. Stagger joints in wall. At least one-half of front and back faces shall be stone having length at least 2-1/2 times their thickness, laid with greater dimension extending into wall. Lay each stone with good bearing on broadest face. Batter exposed face of wall 6 inches per 1 foot of height. Top course shall be stones of at least 1 cubic foot placed with greatest dimension parallel to centerline of trail.

Use spalls for shimming and keying stones for firm, solid bearing.

3-3 BACKFILL: After stone wall has been inspected and approved by the Contracting Officer, stone wall shall be backfilled with select borrow placed and compacted in accordance with Section 02204.

PART 1: GENERAL

1-1 DESCRIPTION: The work of this section consists of placement of stone drainage dips across trail sections as staked on the ground or shown on the drawings.

PART 2: MATERIALS

2-1 STONE: Hard, durable, free from structural defects and weather resistant. Obtained from vicinity of work. Minimum dimension shall be 6 inch, minimum size shall be one cubic foot in volume.

2-2 CRUSHED GRAVEL: 50 percent of the gravel shall have at least one angular face 100 percent retained on a one-half inch screen. Material may be obtained from on site sources, hand crushed and screened.

2-3 SCREENINGS: Material passing the one-half inch screen mentioned above.

2-4 RIPRAP: Section 02271.

PART 3: EXECUTION

3-1 SUBGRADE: Excavate and shape. Compact with manually operated vibratory compactor or hand tamp. Provide sufficient water to achieve compaction. Continue compaction until material ceases to move under compaction equipment.

3-2 BASE: Place shape and compact crushed gravel base. Compact as specified for 3-1 above.

3-3 RIPRAP: Place stone without mortar on compacted base. All stone shall have firm bearing, stagger joints. Choke voids in surface of riprap with stone spalls. Spread screenings over surface and sweep into place. Spray joints with a fine spray of water and repeat process until all joints are filled.

3-4 POSITIONING: Drainage dip shall be perpendicular to trail as detailed.

PART 4: MEASUREMENT AND PAYMENT

4-1 DRAINAGE DIP: Payment will be made at the contract unit price for each length drainage dip installed as indicated.

END

BLRI-105A

PART 1: GENERAL

1-1 DESCRIPTION: The work of this section consists of cutting stairs in existing ledge rock or boulders and/or selecting and placing boulders as stairs.

PART 2: MATERIALS

2-1 CUT STAIRS: Existing ledge rock or boulders lying in their original undisturbed location. Boulders must be sound, free of movement, a minimum size of 1 cubic yard, and a minimum dimension of 12 inches after cutting steps.

2-2 PLACED BOULDERS: Boulders must be solid, sound, free of cracks and other defects, with a minimum size of 1 cubic foot and a minimum dimension of 6 inches.

2-3 SELECT BORROW: Shall be obtained on site from trail excavation excess, as approved by the Contracting Officer. All material 2 inches or greater in diameter shall be screened out before transporting the borrow to the fill area.

2-4 SPALL: Hard, durable chips of stone and angular pieces of sound stone.

PART 3: EXECUTION

3-1 CUT STAIRS: Cut stairs in ledge rock or boulders with chisel point attachment for rock drill, or drill bit, or cut manually with mason's cold chisel and sledge hammer, or any combination of these methods.

3-2 PLACED STAIRS: Place boulders on undisturbed earth or ledge rock. Excavate and use spalls to achieve firm bearing. Use spalls for shimming and keying. Place select borrow fill in 2 inch horizontal layers behind boulders, float in with water and tamp. Continue tamping until material ceases to move under tamp.

3-3 GENERAL: Pitch surface of tread toward riser, with no more than 2 inch variation in a vertical dimension. Batter face of riser, batter no more than 2 inches per riser, with variations in face not to exceed 2 inches in a horizontal dimension. The above standards apply only to the area within the trail tread.

Section 911 - Clearing & Grubbing

DESCRIPTION

911.01
Work

This work consists of clearing, grubbing, trimming, removing, and disposing of, or treatment of, live and dead timber, construction slash, and debris within the areas SHOWN ON THE DRAWINGS or DESIGNATED ON THE GROUND. This work shall include the removal and disposal of designated trees outside the clearing limits. Also included is the protection from injury or defacement of trees and other objects designated to remain and treatment or removal of damaged trees.

911
.06

CONSTRUCTION

911.02
Clearing Limit

The area to be cleared shall be to the dimensions SHOWN ON FORM FS-7700-61 or 1 foot beyond fill or backslope catch points, whichever is greater.

911.03
Material To Be Cleared

All debris, trees, logs, limbs, branches, brush, plants, and other protruding obstructions within the clearing limits shall be removed and disposed of, except the following:

(a) Live, sound, and firmly rooted trees of the size SHOWN ON FORM FS-7700-61.

(b) Live brush, herbaceous plants, and trees between the trailway and the clearing limits that are less than 12 inches in height and less than 1/2 inch in diameter at ground line.

Except as provided above, all limbs and branches more than 1/2 inch in diameter that extend into the cleared area shall be cut flush with the tree trunks or stems or cut at the ground surface, as SHOWN ON FORM FS-7700-62.

911.04
Damaged Trees

Felling, cutting, and trimming methods shall not cause bark damage to standing timber. If damage does occur to standing trees, the injured area shall be treated with a coat of tree-surgery asphalt-based paint. Trees with major roots exposed by construction that are rendered unstable shall be felled and disposed of in accordance with Subsection 911.06.

911.05
Removal of Stumps

All stumps within the trailbed shall be removed. Stumps located between the edge of the trailbed and the edge of the trailway that cannot be cut flush with the finished slope, or are not tightly rooted, shall be removed.

911.06
Disposal of Clearing Slash, Logs, Stumps, Brush, & Roots

All felled trees, including designated trees outside the clearing limits, shall be limbed to a 4-inch diameter top.

All logs, limbs, lopped tops, brush, and grubbed stumps and roots shall be scattered on the downhill side of and outside the clearing limits, with the following exceptions:

(a) Limbs, brush, and lopped tops from trees felled on the uphill side of the clearing limits shall be scattered below the trailway, except where the sideslope above the trail is less than 10 percent; such material may be scattered above the trail.

(b) Logs may be left on the uphill side of the trail if they are placed so that they will not move into the clearing limits.

Debris from clearing and grubbing operations shall not be placed in streams, water courses, snow ponds, lakes, meadows, or in a location that will impede flow through or from drainage facilities.

MEASUREMENT

911.07 Method

The quantity to be paid will be measured in accordance with Section 906.

The following will be considered incidental to other pay items, and extra payment will not be given unless listed in the SCHEDULE OF ITEMS:

(a) Removing trees with major roots exposed by construction.

(b) Removing or treating damaged trees.

PAYMENT

911 .06

911.08 Basis

The accepted quantities will be paid for in accordance with Section 906 at the contract unit price for each pay item shown in the SCHEDULE OF ITEMS.

Payment will be made under:

Pay Item		Pay Unit
911(01)	Clearing and Grubbing	MI
911(02)	Clearing and Grubbing	STA
911(03)	Clearing and Grubbing	L.F.
911(04)	Clearing and Grubbing	L.S.
911(05)	Clearing	MI
911(06)	Clearing	STA
911(07)	Clearing	L.F.
911(08)	Clearing	L.S.
911(09)	Grubbing	MI
911(10)	Grubbing	STA
911(11)	Grubbing	L.F.
911(12)	Grubbing	L.S.
911(13)	Individual Removal and Disposal	EA
911(14)	Individual Removal and Disposal	L.S.

Section 912 - Excavation & Embankment

DESCRIPTION

912.01
Work

This work shall consist of the excavation and placement of all excavated material, regardless of its nature, from within the trailway limits or from other sources SHOWN ON THE DRAWINGS or described in the SPECIAL PROJECT SPECIFICATIONS, except for material included under other pay items listed in the SCHEDULE OF ITEMS.

Included shall be the excavation and embankment construction required to shape and finish the trailbed, ditches, backslopes, fill slopes, drainage dips, and passing sections. Also included is all work required to construct shallow stream fords and gulley crossings, talus and rubble rock sections, and rock or log retaining walls.

MATERIALS

912.02
Requirements

Materials shall meet the requirements of the following sections:

961-Stone and Rock
962-Material for Timber Structures

912
.04

CONSTRUCTION

912.03
Utilization & Disposal of Excavated Material

All suitable excavated material shall be conserved and used in the construction of trailway embankments, trail tread, and backfill for structures and for other purposes SHOWN ON THE DRAWINGS. Excavated rock suitable for specified project work may be conserved and used in place of materials from designated sources.

Before placing embankment, all duff and litter shall, unless otherwise SHOWN ON THE DRAWINGS, be removed from within trailway limits and uniformly spread outside of clearing limits, not more than 4 inches in depth and so placed as to not obstruct drainage.

Excess and unsuitable excavation shall be placed beyond the downslope edge of the trailbed, uniformly spread to a depth not exceeding 4 inches and placed so as not to obstruct drainage. This depth shall include any material removed in the grubbing operation and deposited in the same area.

Rocks over 4 inches in greatest dimension not used in construction shall be placed beyond the trailbed edge on the downslope side. The tops of all rocks so placed shall be 6 inches lower than the trailbed surface. Placement and distribution shall ensure no blockage of drainage or creation of a windrow effect.

912.04
Trailway Excavation & Embankment

Excavation and embankment shall be accomplished to meet the lines and grades SHOWN ON THE DRAWINGS and DESIGNATED ON THE GROUND.

Minor deviations from the trail alignment and grade, as defined in the SPECIAL PROJECT SPECIFICATIONS, will be permitted to avoid or minimize disturbance of physical terrain.

The trailway cross section shall be constructed in accordance with Form FS-7700-63.

Unless otherwise SHOWN ON THE DRAWINGS, the trailbed shall be outsloped 3/4 of an inch to 1-1/4 inches per foot of width.

All embankment shall be constructed of compacted mineral soil. All disturbed soil within the trailbed area shall be recompacted.

Where a safety or traffic barrier is SHOWN ON THE DRAWINGS, the trailbed shall be widened by the amount specified under Section 953 for the particular area shown.

Any rock along or above backslopes that becomes unstable as a result of excavation operations shall be removed and utilized or disposed of in accordance with Subsection 912.03.

Finished slopes shall conform reasonably to the lines SHOWN ON THE DRAWINGS. The finished slope shall be left in a roughened condition to facilitate vegetative growth.

912.05 Trailbed Width & Finish

The trailbed width and finish shall be as SHOWN ON FORMS FS-7700-63 and FS-7700-64.

912.06 Talus or Rubble Rock Sections

Through talus or rubble rock slide areas where little or no soil is present, trailway construction shall be in accordance with Form FS-7700-65. All voids in and under the trailbed surface shall be filled with rock and fine mineral soil to the depth shown to provide a firm trailbed. At least 50 percent of the hand-placed outer rocks shall be a minimum of 1 cubic foot in size.

912
.04

912.07 Retaining Walls

With written approval of the Engineer, trailbed sections utilizing log or rock retaining walls may be constructed in place of full-bench construction. This construction shall be in accordance with Section 934 or Section 935.

912.08 Widened Trailbed

Where rock or log barriers are SHOWN ON THE DRAWINGS, the trailbed shall be widened by the amount indicated in Section 953.

912.09 Drainage Dips

Drainage dips shall be constructed in accordance with Form FS-7700-66.

When SHOWN ON THE DRAWINGS, a rock spillway shall be constructed at the water spillpoint in accordance with Section 923.

912.10 Ditches

Ditches shall be to the dimensions SHOWN ON FORM FS-7700-64. The finished ditches shall be free of obstructions, such as loose rocks, roots, and sticks.

912.11 Trail Passing Sections

Where SHOWN ON THE DRAWINGS, widened or alternate trail passing sections shall be constructed in accordance with Form FS-7700-67.

912.12 Shallow Stream Fords & Gully Crossings--Rock & Log Structures

Where SHOWN ON THE DRAWINGS, shallow stream fords and gully crossings shall be constructed in accordance with Form FS-7700-68 for a rock structure and Form FS-7700-69 for a log structure.

MEASUREMENT

912.13 Method

The quantity to be paid for will be measured in accordance with Section 906.

The following will be considered incidental to other pay items and extra payment will not be given:

(a) Widened trailbed for barriers.

(b) Drainage dips.

(c) Talus or rubble rock sections.

(d) Retaining walls in place of full-bench construction.

Unless listed in the SCHEDULE OF ITEMS, the following will be considered incidental to excavation:

(a) Shallow stream fords and gully crossings.

(b) Trail passing sections.

(c) Ditches.

(d) Rock spillway.

PAYMENT

912.14
Basis

The accepted quantities will be paid for in accordance with Section 906 at the contract unit price for each pay item shown in the SCHEDULE OF ITEMS.

Payment will be made under:

Pay Item		Pay Unit
912(01)	Excavation	L.F.
912(02)	Excavation	MI
912(03)	Trail Passing Section	L.F.
912(04)	Trail Passing Section	MI
912(05)	Shallow Stream Ford & Gully Xing-Rock Str. .	EA
912(06)	Shallow Stream Ford & Gully Xing-Log Str. . .	EA
912(07)	Ditch	L.F.
912(08)	Borrow	C.Y.

Section 922 - Waterbars

DESCRIPTION

922.01 Work

This work consists of installing waterbars in the trailbed at locations SHOWN ON THE DRAWINGS and DESIGNATED ON THE GROUND. Work shall include excavation, backfill, and construction of rock spillways.

MATERIALS

922.02 Requirements

Materials shall meet the requirements of the following sections:

961-Stone and Rock
962-Material for Timber Structures

CONSTRUCTION

922.03 General

Waterbars shall be constructed in accordance with Form FS-7700-78.

922.04 Rock Waterbar

Rocks shall be tightly overlapped and embedded into the existing trailbed. Backfill material around the waterbar shall be compacted mineral soil. The tops of the waterbar shall be even and have no sharp points. Minimum rock size shall be 2 cubic feet.

The outslope of the trailbed on the upgrade side of the waterbar shall be a smooth plane that will form a gutter against the waterbar.

922.05 Log or Treated Timber Waterbars

A native log or a treated timber shall be completely embedded into the trailbed to form a waterbar across the trail. The top of the waterbar log shall be flush with the grade line of the trailbed on the downgrade side and be firmly compacted in place. In the absence of a backslope, the upgrade end of the log waterbar shall be anchored in the same manner as the downgrade end.

922.06 Surplus Material

Surplus excavation shall be spread below the trailbed at a depth not to exceed 4 inches. The surplus material shall be located so that it will not impede the flow of water away from the waterbar. Logs, debris, soil, rock, or other obstructions below waterbars that will impede flow away from the trailway shall be removed.

MEASUREMENT

922.07 Method

The quantity to be paid for will be measured in accordance with Section 906.

PAYMENT

922.08 Basis

The accepted quantities will be paid for in accordance with Section 906 at the contract unit price for each pay item shown in the SCHEDULE OF ITEMS.

Payment will be made under:

Pay Item		Pay Unit
922(01)	Native Log Waterbar	EA
922(02)	Rock Waterbar	EA
922(03)	Treated Timber Waterbar	EA

Section 935 - Rock Retaining Walls

DESCRIPTION

935.01
Work

This work shall consist of constructing native rock retaining walls at the locations SHOWN ON THE DRAWINGS and DESIGNATED ON THE GROUND. Work shall include transporting rocks to installation site, excavation, placing, backfilling, and trailbed and slope finishing.

MATERIALS

935.02
Requirements

Materials shall meet the requirements of the following section:

961-Stone and Rock

All rock shall be of a general rectangular shape, and at least 50 percent of all rocks in a completed wall shall be 1 cubic foot or greater in size.

Small stones, rock fragments, and fine aggregate shall be used to fill voids.

CONSTRUCTION

935.03
Excavation

Excavation shall be of sufficient width and depth to permit construction of the rock retaining wall in accordance with Form FS-7700-90. Excavation shall be performed to provide a full-bench foundation for the wall. The foundation shall consist of stable undisturbed soil or compacted mineral soil.

935.04
Wall Construction

Vertical joints shall be staggered a minimum of 4 inches horizontally from any vertical joint in an adjoining course.

At least 25 percent of the rocks in the front and rear faces of the wall shall be uniformly distributed header stones, each having a length at least 2-1/2 times its width. All header stones shall be laid with greatest dimension extending into the wall (at right angle to trail centerline), except at corners. At corners, alternating courses shall contain headers laid with greatest dimension parallel with wall.

The exposed face of each rock shall be parallel to the face of the wall in which it is set.

Each rock placed shall be stable on the course that supports it and shall be so handled as to not break, jar, or displace rocks already set.

Large rocks shall be used in the bottom course. Voids shall be filled with small stones, rock fragments, or fine aggregate.

MEASUREMENT

935.05
Method

The quantity to be paid for will be measured in accordance with Section 906.

PAYMENT

935.06
Basis

The accepted quantity will be paid for in accordance with Section 906 at the contract unit price for the pay item shown in the SCHEDULE OF ITEMS.

Payment will be made under:

Pay Item	Pay Unit
935(01) Rock Retaining Wall	S.F.

Section 937 - Trail Stairways

DESCRIPTION

937.01 Work

This work consists of constructing log, rock, plank, crib-ladder, and pinned stairways and handrails as SHOWN ON THE DRAWINGS and DESIGNATED ON THE GROUND. This work shall include furnishing all hardware, lumber, and timbers.

MATERIALS

937.02 Requirements

Materials shall meet the requirements of the following sections:

961-Stone and Rock
962-Material for Timber Structures

CONSTRUCTION

937.03 General

Stairways shall be constructed in accordance with Forms FS-7700-91 and FS-7700-92. All backfill shall be compacted mineral soil. The stair run will vary depending on the ground slope but shall not be less than 10 inches.

937.04 Overlapping Rock Stairways

Steps shall be constructed from the bottom to the top. Single rocks shall form the entire tread and riser, and two or more contact points shall be made to provide stability.

937.05 Log Riser Stairways

Single logs shall be used for the entire riser.

937.06 Rock Riser Stairways

Rock risers shall be trenched into the soil to the depth necessary to provide stability. Single rocks shall be used to form the entire riser.

937.07 Pinned Stairway

937 .01

When constructing preservative-treated pinned stairways, the rock base shall be cleaned of spalls, roots, soil, and other obstructions.

Two 5/8-inch holes shall be drilled into the treads from the bottom side to match the positions of the holes in the rock and provide for the correct position of the step. These holes shall not penetrate the top of the tread. The bottom surface of the treads shall be hewn so as to provide a firm, solid contact with the rock base. This contact need not be continuous but must provide a firm, solid bearing.

The tread shall then be placed on the reinforcing bars and driven down to its solid position.

937.08 Crib-Ladder Stairway

Preservative-treated crib-ladder stairways shall be constructed by laying two carriages parallel to each other and firmly supported their entire length to the dimensions SHOWN ON FORM FS-7700-92. The area behind the riser shall be backfilled with compacted mineral soil and sloped outwards.

937.09 Plank Stairway

Preservative-treated plank stairways shall be constructed by laying two parallel carriages as DESIGNATED ON THE GROUND. Each carriage shall be a continuous member throughout its full length. The bottom of each carriage shall be firmly imbedded in the ground. Each carriage shall be supported by a sill at each end.

937.10 Handrails

When shown in the SCHEDULE OF ITEMS, handrails shall be constructed as SHOWN ON FORM FS-7700-92

MEASUREMENT

937.11
Method

When the quantity to be paid for will be measured by linear foot, measurement of the centerline of the stairway will be from the front of the bottom riser to the front of the top riser. Otherwise, measurement will be in accordance with Section 906.

PAYMENT

937.12
Basis

The accepted quantities will be paid for in accordance with Section 906 at the contract unit price for each pay item shown in the SCHEDULE OF ITEMS.

Payment will be made under:

Pay Item		Pay Unit
937(01)	Overlapping Rock Stairway	L.F.
937(02)	Overlapping Rock Stairway	EA
937(03)	Rock Riser Stairway	L.F.
937(04)	Rock Riser Stairway	EA
937(05)	Log Riser Stairway	L.F.
937(06)	Log Riser Stairway	EA
937(07)	Pinned Stairway	L.F.
937(08)	Pinned Stairway	EA
937(09)	Crib-Ladder Stairway	L.F.
937(10)	Crib-Ladder Stairway	EA
937(11)	Crib-Ladder Stairway with Handrail	L.F.
937(12)	Crib-Ladder Stairway with Handrail	EA
937(13)	Plank Stairway	L.F.
937(14)	Plank Stairway	EA
937(15)	Plank Stairway with Handrail	L.F.
937(16)	Plank Stairway with Handrail	EA

937
.12

Section 941 - Aggregate Surfacing

DESCRIPTION

941.01 Work

This work shall consist of furnishing, hauling, watering, placing, and compacting aggregate surfacing. Aggregate production shall be by pit run, screening, or crushing.

MATERIALS

941.02 Requirements

Materials shall be obtained from sources SHOWN ON THE DRAWINGS or other sources approved by the Engineer in writing. Crushing or screening operations on Government land shall utilize all suitable material encountered in the source, unless otherwise SHOWN ON THE DRAWINGS.

941.03 Pit-Run Aggregate

Pit-run aggregates shall consist of native materials of a size and grading that can be taken directly from the source and placed on the trail without crushing or screening. No gradation, other than a maximum size, will be required. The maximum size shall be as SHOWN ON THE SCHEDULE OF ITEMS. Quality requirements will be as SHOWN IN THE SPECIAL PROJECT SPECIFICATIONS.

941.04 Screened Aggregate

Material shall consist of gravel, talus, rock, sand, shale, or other suitable material and be reasonably hard and durable and reasonably free of organic material, mica, clay lumps, or other deleterious materials. The gradation requirements shall be as SHOWN ON FORM FS-7700-94. Quality requirements will be as SHOWN IN THE SPECIAL PROJECT SPECIFICATIONS.

941.05 Crushed Aggregate

Crushed aggregate shall be crushed stone, slag, or gravel meeting the requirements shown in the following table or as SHOWN IN THE SPECIAL PROJECT SPECIFICATIONS.

Description	AASHTO Test Method	Requirement
Percent Wear	T 96	41 Max.
Durability Index, Coarse and Fine	T 211	35 Min.
Liquid Limit	T 89	35 Max.
Plasticity Index	T 91	2 - 11

The crushed aggregate gradation shall be as SHOWN ON FORM FS-7700-94. Aggregate shall be well graded from coarse to fine within the gradation band.

When crushed aggregate is used, at least 90 percent by weight of the particles retained on the No. 4 sieve shall have at least one fractured face. Naturally fractured faces may be included in the 90 percent requirement.

941.06 Handling Materials

Aggregates shall be stockpiled, removed, and transported in a manner that will preserve specified gradation and avoid contamination. Stockpiles of aggregate having different gradations shall not be intermingled.

941.07 Sampling Aggregate

The contractor shall submit test results and a Certificate of Compliance that states that the gradation of the aggregate meets the contract requirements.

Sampling of the material before incorporation into the work shall occur as follows:

(a) For onsite produced materials at crushing or screening plants, after additions of any necessary blending material.

(b) For commercially produced aggregates, at the producer's plant or stockpile.

(c) For gradation of combined aggregate in bituminous plant mixtures, either before or after introduction of bituminous material.

The sampling shall not be considered a final acceptance and shall not preclude later sampling and testing after final processing of the material. Such sampling shall not relieve the contractor of responsibility of providing quality control measures to ensure compliance with contract requirements.

CONSTRUCTION

941.08 Preparation of Trailbed

The trailbed shall be prepared and finished as required under Sections 912, 913, or 915 and approved by the Engineer in writing before placing aggregate.

941.09 Watering

When watering is specified on the SCHEDULE OF ITEMS, the aggregate being compacted shall be damp throughout the mixture and as SHOWN ON FORM FS-7700-94. Water sources, access, and operating procedures will be SHOWN ON THE DRAWINGS. The contractor shall furnish all equipment, labor, and materials needed to operate the water supply.

941.10 Spreading & Compacting

When uniformly mixed, the material shall be spread in layers that will compact to the specified moisture content, thickness, and width SHOWN ON FORM FS-7700-94.

Immediately following final spreading and smoothing, each layer shall be compacted. Any irregularities or depressions that develop shall be corrected by adding or removing material until the surface is smooth and uniform.

941.11 Acceptance, Testing, Sampling, & Tolerances

The total compacted thickness of the aggregate shall not vary more than 1/2 inch from the specified thickness nor shall it be consistently below or above the specified thickness.

The aggregate width shall not vary more than ± 3 inches from the specified width and shall not be consistently narrower or wider than the specified width.

MEASUREMENT

941.12 Method

The quantity to be paid for will be measured in accordance with Section 906.

Work required under Sections 912, 913, or 915 will be measured and paid for under those sections.

PAYMENT

941.13 Basis

The accepted quantities will be paid for in accordance with Section 906 at the contract unit price of each pay item shown in the SCHEDULE OF ITEMS.

Payment will be made under:

Pay Item		Pay Unit
941(01)	Aggregate Surfacing, Pit Run Pit Run - Max. Size [--]"	L.F.
941(02)	Aggregate Surfacing Pit Run - Max. Size [--]"	C.Y.
941(03)	Aggregate Surfacing Pit Run - Max. Size [--]"	Ton
941(04)	Aggregate Surfacing Crushed Rock	L.F.
941(05)	Aggregate Surfacing Crushed Rock	C.Y.
941(06)	Aggregate Surfacing Crushed Rock	Ton
941(07)	Aggregate Surfacing Screened	L.F.
941(08)	Aggregate Surfacing Screened	C.Y.
941(09)	Aggregate Surfacing Screened	Ton
941(10)	Placing Aggregate	L.F.
941(11)	Placing Aggregate	C.Y.
941(12)	Placing Aggregate	Ton
941(13)	Placing Aggregate	L.S.

Section 952 - Sign, Post, & Cairn Installation

DESCRIPTION

952.01 Work

This work shall consist of installing signs, constructing rock cairns, and furnishing and installing posts.

MATERIALS

952.02 Requirements

Materials shall meet the requirements of the following sections:

961-Stone and Rock
962-Material for Timber Structures

952.03 Sign Panels

Sign panels and hardware will be furnished by the Government at locations shown in SPECIAL PROJECT SPECIFICATIONS.

952.04 Native Wood Posts

Native wood post details and dimensions shall be as SHOWN ON FORM FS-7700-96. All wood posts shall be of sound, seasoned wood. The posts shall be straight and all knots trimmed flush with the surface. The requirements for peeling may be omitted for red cedar posts or bracing.

Native posts shall be 5 inches in diameter on the small end.

952.05 Treated Wood Posts

Treated wood posts shall meet the grading, species, and dimensional requirements SHOWN ON FORM FS-7700-96 and the requirements of Section 962.04.

Holes drilled in the post for the carriage bolts shall be snug, making a tight fit for the bolts.

952.06 Stone for Cairns

The stone used for cairns shall meet the requirements of Form FS-7700-97 and Section 961. Round stones shall not be used. Generally, stones shall have thicknesses of not less than 5 inches. Fifty percent of the stone shall be greater than 1/2 cubic foot in volume.

CONSTRUCTION

952.07 Performance

The signs, posts, and cairns shall be erected at the locations SHOWN ON FORM FS-7700-96 or FORM FS-7700-97 and DESIGNATED ON THE GROUND.

952.08 Sign Installation

The signpost shall be notched for the sign panel one-half the thickness of the sign substrate. The top of the sign panel will be flush with the top of the post.

Sign panels shall be mounted as SHOWN ON FORM FS-7700-96. Tightened hardware shall be snug but not rupture the sign panel surface.

When the horizontal length of the sign is more than 36 inches, two posts will be used. The outside edge of the posts shall be inset 2 inches from the end of the sign.

952.09 Post Installation

The posthole shall not be more than 6 inches in diameter unless soil conditions warrant otherwise. If necessary due to obstacles, the posthole may be moved within the tolerances SHOWN ON FORM FS-7700-96.

If the posthole cannot be dug 30 inches deep, the posthole shall be dug again at another location within the limits SHOWN ON FORM FS-7700-96 or the post stabilized by concrete or rock mounds built in accordance with rock cairn specifications.

The backfill material between the post and the posthole shall be hand compacted in 4-inch layers to produce a solid and plumb installation.

952.10
Rock Cairn
Construction

Cairns shall be constructed in layers as SHOWN ON FORM FS-7700-97. Each layer shall slope towards the center. Each stone placed shall have at least three points of contact. Wedging small stones into cracks between large stones to stabilize the large stones will not be allowed.

MEASUREMENT

952.11
Method

The quantity to be paid for will be measured in accordance with Section 906.

Rock cairns built to support signposts will be considered incidental to the pay item for native or treated signpost installation.

PAYMENT

952.12
Basis

The accepted quantities will be paid for in accordance with Section 906 at the contract unit price for each pay item shown in the SCHEDULE OF ITEMS.

Payment will be made under:

Pay Item		Pay Unit
952(01)	Install Sign Panel Government Furnished	EA
952(02)	Treated Posts Length [-]' - Dia. [--]"	EA
952(03)	Native Posts Length [-]'	EA
952(04)	Rock Cairns	EA

Appendix I Optimizing Your Return From Volunteers

Author's note: This document is a result of the synthesis of several years of volunteer work on my part, as well as the organization and design of projects through the Volunteers for Outdoor Colorado (VOC). VOC is a private non-profit organization whose mission is to instill in Coloradans a sense of responsibility for the stewardship of Colorado's public lands. VOC does this by carrying out conservation projects on public lands. These may be trail construction, rehabilitation, fence building or other types of projects. Most of my experience with VOC was on trail projects. I encourage you to determine how you can apply the attached recommendations to your organization, mission and your specific type of project. This paper was originally presented at the Colorado Trail Symposium and the National Outdoor Volunteer Network Conference in May of 1988. It may not reflect the current views or programs of VOC.

Introduction

Optimizing your agency's return from volunteers will depend on many factors. Volunteers for Outdoor Colorado's (VOC) point of view is that, in fact, agency goals should be to *optimize* rather than *maximize* their return. Volunteers are not CD's or stocks, they are human beings who have a value of self worth, have skills to contribute, and may need some kind of recognition or reward for their work. They also have jobs, families, and friends. With that in mind government agency personnel as well as volunteer organizations should develop policies for the development of volunteer projects. The following summary describes the process and framework that VOC has been implementing. It is important to point out that all aspects of this narrative and your project should be considered together, and maybe some items that I have overlooked. They should all be treated equally. Adopting a partial commitment to any one of the items discussed may compromise the value of a project, may result in less than optimum return from volunteers, and may result in unattained goals. Training crew leaders adequately will contribute heavily to the optimization of your volunteers' work.

Measuring 'Return' From Volunteers

Choosing the proper measure by which agencies can determine the success of a volunteer project is very important. For VOC, camaraderie, friendship, stewardship interests, one's personal contribution to society, and self development during the carrying out of a project are all appropriate measures of a volunteer project's success. This pertains to all aspects of project development including food preparation and entertainment. VOC believes that if they take care of the camaraderie, friendship, and stewardship interests, the miles of trail and numbers of waterbars will take care of themselves. Their approach is to develop a framework for the growth of their organization through positive, and fulfilling project experiences. Properly planned projects which do not tax the volunteers are their goal.

Appropriate Project Choice

One of the most important aspects of a successful volunteer project is to choose an appropriate project. Not all projects are suitable for volunteers, and just because an agency does not have money for a project also does not mean that agency should automatically turn to volunteers. When choosing a project, consideration at a minimum, should be given to the goals of the respective agencies. Comparing the goals of the government and volunteer agencies should shed some light on the nature of an appropriate project.

It is important to note that maybe only part of a proposed project is suitable for volunteers. A project can be broken into pieces and parts done by different groups and maybe even by day labor or contract. Volunteers can build part of a project up to a certain point, day labor can be employed for difficult or unsafe portions, and volunteers can pick up on the other side. VOC has no qualms about this approach. So, please look at your respective missions and goals. Plan for what volunteers can do, and make other arrangements for other work that volunteers cannot do. Considering safety, described later, to date, VOC has avoided mountain trail projects that require specialized training or complex tools. Agencies should carefully look at whether they want to risk injury to do a glamourous job, or whether or not they want to tackle a project which exceeds their volunteer's skills.

Working Hand In Hand

The next step in the project development process is for the government agency and volunteer agency representatives to get together and begin clarifying all aspects of the project. The government agency representative should be capable of making decisions for the agency. In the case of the Forest Service, this might be the district recreation forester or district trail foreman. For VOC, our early contacts with the government agencies are through the executive director, project coordinator, and technical advisor.

Early clarification is required so that each agency is up to date with the other. Things that VOC's project coordinators require clarification on include where camping is available, local emergency assistance availability, fire restrictions, and potability of water. VOC's technical advisor will be interested in the standards of trail construction expected, specifications on seeding or other required rehabilitation. The executive director is most interested in assuring mission attainment.

It is important to clarify these and other items early on to prevent conflicts later. For VOC, news releases for projects go out well in advance of the project through newsletters. Directions to project sites, and foreknowledge of special conditions to expect, are all critical to a project's success.

Working hand in hand also includes coming to a preliminary agreement as to what kind and how much work is required to be done. Alternative solutions should be discussed and finalized well in advance of the volunteer's arrival at a project. A complete project design should be done before the volunteer group shows up to work. In the case where it is uncertain how much work a volunteer group can do, extra work can be planned for. This too, should be planned for well in advance of the volunteers. If they can get to it, fine. If not, at least the agencies have an agreement for what needs to be done, and maybe another project day can be scheduled. VOC tries to discourage the government agency and volunteer agency representatives from getting together on a hillside and drumming up work for idle volunteers. Accommodation to uncertain conditions is acceptable, as long as this is a minor amount of work.

VOC usually allows 3 months for the development of project which should be plenty of time to iron out all aspects of a project. Project coordinators usually host bi-weekly meetings to guide project development. Technical advisors usually spend 3 to 6 Saturdays getting ready for each 100 volunteer-day project. Distant or complex projects usually require more time. This working hand in hand in the early stages of project development will benefit everyone in the long run.

Quality Work

Agreement of the work to be done should include the highest attainable quality work. VOC strongly recommends that government agencies NOT ask volunteers for substandard work, and also that volunteer agencies avoid government agencies that want miles of trail more than they want quality. This author has personally been involved in volunteer trail construction projects in several states, totalling over 20 miles. This has been as a volunteer, a crew leader, as a trainer of crew leaders, and as a designer of much of the work. Experience indicated that nothing is more satisfying to a volunteer than doing a job correctly the first time, and doing a quality job. With this goes completeness. Ethical trail construction requires completeness. VOC's point of view is that 500 feet of trail with waterbars is better than a mile without. Consideration must be given to the development of the volunteers also. If a volunteer shows up on his/her first day, and a crew leader tells him/her to build a trail without waterbars, that volunteer will think that that is the way that things are done. This practice does not indicate investment in volunteers.

If the pressures are such that a project has to be completed by a certain date, the State Legislature or Congress will appropriate the necessary money to get the project done. And it will get done. Pushing volunteers or accepting low quality work is not the way to go. Optimizing return from volunteers will occur when quality and completeness are incorporated at the outset of a project. This also helps develop your volunteers quickly into good workers and possibly crew leaders.

Permanence

VOC has a set of standard plans for mountain trail construction. In it, their concept of PERMANENCE is described:

PERMANENCE (noun)- *The condition or quality of being fixed or changeless, being meant to last indefinitely.*

All activities relative to trail and trail structure construction should be accomplished with the concept of permanence driving the process. This concept suggest careful planning has taken place - addressing appropriate origins and destinations, adequate connections, loops and spurs, and that a careful analysis of the intended user experience has occurred. Permanence also suggests careful thought has occurred during the design process.

During construction, permanence suggest that careful thought be given to the brush clearing process. Adequate clearing for safe passage must be provided without visually ravaging the trail corridor. Careful thought applied to the tread cutting process will result in the most durable surface. Careless actions will cause severe impacts to soil and vegetation. While building trail structures, applying the concept of permanence will result in fully functioning, long lasting structures that will nicely complement the trail and its intended uses while requiring little maintenance.

High quality work of this kind will give tremendous pride to the laborers, and also will give satisfaction to the trail users. Maintenance required will of course be minimal - giving volunteers more time to go hiking instead of devoting too much time to construction and maintenance. Please join VOC in our commitment to quality and permanence.

This concept of permanence suggests that temporary trail routes which are 'easy' are unacceptable if, in fact, the trail will be knowingly rerouted in the future. Major portions of every long distance trail in this country have been rerouted over the years, mostly because of poor location originally. A lot of work has gone done the drain even when trail planners were trying to locate

trails in the proper place! The work required to put trails in will continue to grow if trail planners actually plan on reroutes because we already know there will be some.

Details

Also in their set of standard plans for mountain trail construction is our concept of DETAILS.

DETAIL (noun)- *Extended treatment of or attention to a particular item, the small elements that collectively constitute the whole.*

The attention of work to details, the drawing up of detail drawing, and the interpretation of these drawings to each field condition are all components of successful completion of work efforts. Most of the great works recorded in history did not succeed on sheer scale, length, size or beauty. Typically, it was the attention to details - the small parts - that made the whole successful. It is with that intent, that detail drawings are included. Additionally, the intent is not to completely *describe every possible condition that will arise - but rather to describe minimum requirements of solutions and to give clues as to how better solutions can be attained.*

Crew leaders and trail workers should strive to arrive at the best solution possible. These solutions can be attained by asking yourselves some of the following questions:

- *What is minimally required of the solution?*
- *What field conditions exist that will affect the solution? Can I mitigate these conditions?*
- *How does one detail solution affect detail solutions in the immediate area? In distant areas?*
- *Are adequate materials available to do the work? Are there adequate tools and manpower?*
- *How will users use the trail and experience it?*
- *Will safe/accessible passage be afforded?*
- *Is there a crew leader/trail worker close by that can help tailor the detail to the specific condition? Will more thought get you anywhere?*

Remember - attention to detail will make or break your project. Act cautiously. The result will be a beautiful trail and enjoyment by the users.

Project Design

Project design is critical to the success of your volunteer project. Beyond agreeing to permanence, quality and details, a complete project design including volunteer time estimates, breaking of work into crews, identifying skills needed on each crew, and identifying material costs is required. Material estimates should be within the normal 10% range with a contingency being planned for, volunteer estimates should be within about 3%, and length of trail should be within 1%. It is important to know if your trail is 5,280 or 5,380 feet long. That extra 100 feet could be all stone work which could throw off your estimate severely. VOC seems to get volunteers who can build 35 feet of trail per day per person on typical mountain trail projects. This is average production considering the age and fitness level of volunteers, as well as training and orientation required. VOC also usually only works about 4-5 hours even on a full day project!

Details, as mentioned previously, are required so that a government agency knows what is expected of the volunteer group. VOC draws up details to show the minimum solution required. Also included are motivational insights to try to inspire the volunteers. These are usually very

subtle, and are not normally put on contract construction drawings. These drawings form part of the project design. When a question arises in the field, the first thing that is done is to go to the drawings to clarify the situation. VOC does not keep any surprises from the volunteers! Everything required is written on the drawings, and is easily found to show the crew leader or trail worker what is required of a particular situation. It is interesting to observe volunteers reading these drawings. Some volunteers take them very seriously, which is good!

Project design should also include the testing of equipment required, the documentation of where materials are to be delivered, and the overall troubleshooting of possible obstacles to the project's success. Would you like to hear the story about the power auger, scheduled to be used on one of VOC's fence building projects, that couldn't function in the particular soil where their project was? Sure, the auger worked the previous week on someone else's project, but would you like to talk to the volunteers who had to dig fence post holes by hand?

Crew Leader Training

Crew leader training is required to optimize your return from your volunteers. Nothing is worse than an inexperienced crew leader leading volunteers improperly. Aside form the basic leadership skills required, a keen insight into technical problem solving, crew and task organization, safe tool use, and role modeling are required. These are the aspects of crew leading that VOC tries to key in on during leader training. Their programs have developed over the years. Currently, (May, 1988) VOC has evening slide show and discussion seminars in the spring, they will have two formal crew leader training weekend seminars this summer, and have Thursday evening orientation prior to individual Saturday projects. These orientations will be held at the project site. Aside from the seminars, they also have a very well organized crew leader training manual. This is must reading for future crew leader in any volunteer organization. Practice is also required of crew leaders. It is hard to expect volunteers to jump in and become expert leaders. Working with the future leaders to ease the learning process is their goal.

Leaders are in the front line at VOC. For many volunteers, the only real contact they have with VOC is on a project day through the crew leader. This is the main reason that so much emphasis is put into leader training. Leaders must be organized and know what they are doing in order to recruit return volunteers as well as other future leaders. They must be very safe in their actions. Also, a quick look at key volunteers in VOC seems to trace a lot of them back to certain crew leaders. Since VOC is something that must grow, we must rely on eventually those crew leaders recruiting others. Think of it as a Mary Kay Cosmetics pyramid. They do not give out pink cadillacs, but their volunteers do develop a sense of satisfaction in their work, and a sense of pride in Colorado.

Crew Leader Training Agenda

VOC complements its projects with appropriate training. The basic parts of leader training include seminars in both people and technical skills. People skills required include knowledge about dealing with difficult volunteers. Also required is knowledge of leadership modeling, crew organization, and task differentiation. These are all skills which must be developed by practice. Most people can handle these with only a little practice. VOC simulates skits during training which address these aspects of crew leading.

Technical skills required must also be learned by crew leaders. VOC strives to provide crew leaders with the best information available so that they can develop the best technical skills. Skill at problem solving and visualization is required. VOC simulates real technical problems for crew leaders in training to solve. The relaxed atmosphere of realizing everyone is learning is

a major factor in the success of leader training. Ample time is allowed for questions and answers. VOC also tackles an actual project for its leader training. The preparation of detail drawings helps the learning process along. As mentioned earlier, no surprises are kept from the leaders or crews. Crew leaders are able to take these drawings home to study for use later which also helps leadership development.

Safety

Uncompromised safety goals have to be the hallmark of any volunteer project. Besides the fact that even a small accident could impact a non-profit organization, common sense dictates that every precaution should be taken to prevent even the smallest accident. Not only should everyone who goes out on a project be in proper physical condition, proper training for difficult work, proper tools, and proper safety equipment should all be provided and *required*. People getting hurt because of poor preparation or training is unacceptable. People getting hurt because of carelessness is foolishness. Hardhats, goggles and sunscreen should be standard equipment on all volunteer projects.

Safety should be discussed in advance with all project organizers including project coordinators and crew leaders. Clear policies and procedures should be established. Medical personnel such as EMT's should be required on all projects, and local hospital locations and phone numbers should all be noted before a project begins. In addition, one person should be appointed safety coordinator for each project. This person should be knowledgeable about foul weather and storm procedures, egress routes from backcountry areas, and other procedures such as what to do in lightning storms or tornadoes. This person should preferably be a government agency representative with EMT and other emergency training. This person could not function on a project unless he/she was on site, therefore attendance at all times is required. This person can then make decisions about evacuation of sick or injured, can direct others to assist, and can make project related determinations such as cancellation or postponement in the event of severe weather. Decisions such as these should be made outside of the politics of your local mayor coming out to cut ribbons at the end of the day, and whereas your project may be important, your volunteers health is worth more than a completed project.

The safety coordinator should make sure that all required safety procedures are established and followed by crews. The crew leaders should make sure that each crew implements the procedures. Not being completely dedicated to the safety of your volunteers is an undesirable way to treat volunteers. Keeping them healthy and well will bring them back on other projects thereby optimizing your return from them.

Project Day Execution

VOC project days are usually exciting events. In order to be run smoothly, they must be very well organized. Every detail must be attended to. Regarding the optimizing of your return from volunteers, careful and quick scrutiny must be provided for all work. The technical advisor should be available to counsel crew leaders regarding proper execution of the work. Usually, this is a minor aspect of work, but technical advisor attendance and direction will do much to further development of your crew leaders and volunteers. Only properly recognized persons should direct crew leaders. Nothing is worse than an adjacent crew leader or other stranger giving a crew leader incorrect information.

Drawings, if provided, should be well worn by the end of a project day. Crew leaders who do not use the drawings risk missing the finer points of work. The drawings are also a good way to educate volunteers who will be possible crew leaders of the future. Safety should be in the

forefront of everyone's mind at all times. Crew leaders should not tolerate any compromise of safety guidelines, including use of hardhats and goggles. Crew leaders must constantly display appropriate conservation behavior, also.

Regarding work organization, the crews furthest from the trail head should depart first to avoid crews having to crisscross each other on the trail. Nothing is worse than to have a large number of people passing your section of trail while you are working on it. It's very dangerous, also.

Recognition

Recognition or reward can take many forms and is required to maintain the emotional health of your organization. VOC tries hard to recognize those people who continually strive to further its mission in the true spirit of volunteerism. Over the years, VOC has given small gifts to key volunteers, publicized their efforts through their newsletter, and occasionally sent correspondence to a volunteer's employer. Recognition costs so little yet reaps so much in return for your organization. All organizations should determine appropriate ways to recognize their volunteers. Keep them emotionally healthy! Leaders especially are risking themselves, and deserve special recognition.

Post Project Evaluation

Post project evaluation should occur so that the government and volunteer agencies can follow-up on a project and determine mission accomplishment. Items considered should include the technical adequacy of the construction, and the volume of work accomplished. It is interesting to travel down a mountain trail and observe what different crews have done. Sometimes even adjacent crews have wildly differing solutions! This is undesirable, and the only way for improvement is to make notes for suggested improvements in the future. Also, sometimes there are design flaws which must be corrected. Drainage patterns have an incredible ability to hide themselves in dry weather! Maybe a small project day can be scheduled to install extra waterbars, or to unify different sections of the trail regarding clearing, and tread compaction. This evaluation is required to pinpoint areas where the volunteer agency needs to improve its operations. Flaws in the training system can be identified and corrected, and construction methods can be improved. These are all required to improve the efficiency of a volunteer agency's production, to leave more time for volunteers to hike and enjoy themselves. As was mentioned earlier, VOC is convinced that volunteers want to do the highest quality work possible. Teaching them properly in advance and positive yet constructive criticism during or after a project will help optimize your return from them.

Summary

In order to run a successful volunteer project, many factors come into play. The approach VOC takes is to work on the people aspects of the projects, trying to minimize the impact of projects on the project organizers, while making them easy and fun for volunteers to work on. VOC also designs their projects so that everyone understands what is expected. Projects which will be permanent fixtures on the Colorado landscape receive high priority. This will allow volunteers to come back and enjoy their work. Their recommendation is to study all aspects of your projects, and fine tune all of them together. Adequate leader training is not going to get you much if you choose a poor project. Good projects and adequately trained leaders are of no benefit without a good safety program. VOC takes the time to develop the entire program. Take care of your volunteers and they will take care of you and your agency's goals.

Appendix J — Quality Ensures Project Success

Author's Note: This document was originally written in 1988 to motivate project organizers to develop high quality projects.

Do you as an agency representative expect from your volunteers what you would from a contractor? If you do, you are responding to the demands of today's volunteer. Today's volunteers are savvy individuals who well educated, dedicated and interested in making a contribution to society. They typically have a deep interest in your project. Maybe they live near the abandoned rail line that needs to be cleared, or maybe they want to hike the trail you have proposed for their neighborhood. Some volunteers even take vacations to make their contribution to our country's recreation resources! Your project development process should take these values into account so that you continue to meet volunteers growing expectations.

Volunteerism yields so many benefits to today's volunteer that agency representatives should analyze their volunteer programs to ensure that they are challenging those volunteers who display expertise and experience; that they have developed adequate safety and leader training programs to prevent fatigue and injuries, that they are involving volunteers in projects which are permanent legacies to their children; and that they are organizing volunteer projects that will result in high quality work.

From your agency's point of view, the constant theme of high quality work should be the guiding light during your project selection, development and execution process. My experience has been that volunteers, in fact, want to do very high quality work. They can only do the work, however, that is shown as an example to them, or they are trained to do. Can you show volunteers how to do exactly what you want? Do you have a training program? In order to optimize the return from you investment in volunteers I suggest you take a look at your agency's mission and your overall project development process. Also look at different steps in that process where you can stress the need for high quality work and its benefits.

During the project selection process, ask yourself if you want volunteers to hike several miles over trails in need of repair to have them do work further in the backcountry? Do you want to have volunteers build new cabins when there are existing cabins in the vicinity in need of repair? Do you want to have volunteers build something that is temporary and will be rerouted or replaced later? Answer these questions for yourself so that you are satisfied that your volunteers will get involved in a worthwhile and permanent project. Involve them early in the project selection process to determine their viewpoint on projects.

During the project development stage, make sure you develop drawings and standards that you want volunteers to attain. A very clear written description or drawing will ensure that volunteers know what you want. Would you expect a contractor to know what you want, or would you give them a drawing? Put all of the information the volunteers will need in these notes or drawings. It frustrates volunteers if you come along later and change your mind on something. A good package or drawings might even be required at one of the more mature conservation organizations for their review and project approval process, or entice others by indicating that you know what you want. Notes are put on the drawings to *motivate volunteers*, as opposed to notes on contract drawings which *instruct contractors*. Adjust your point of view and tone appropriately. Also develop an estimate of volunteer time required for each task so that enough volunteers are scheduled to carry out tasks. If volunteers do not have enough time or if enough volunteers are not scheduled, they can not do quality work.

Development of a crew leader and volunteer training program will also be required during your project development stage. These are required to ensure that on the project day that everything

will run smooth, and be executed safely. Build into your training program an update loop whereby you tell leaders and then they pass on to volunteers that an agency representative will come by periodically to inspect work and offer suggestions for improvements. It is best if only one agency person, both diplomatic and mature, functions in this role, even on a 100 person project. Knowing this in advance, leaders and volunteers will gladly accept suggestions, and add that last little 10 percent of effort to truly make a worthwhile contribution to a project. Explaining to leaders and volunteers the reason why you want things done a certain way will transfer to them an insight into quality.

During the project execution stage, be on hand to demonstrate exactly what you want in terms of trail solutions, or craftsmanship of woodwork. If you can not do it to your own expectation, how will you be able to communicate your expectation to volunteers? Once a volunteer sees a demonstration, you will be surprised at their ability to accomplish what you want. By my experience, the older people are, the faster they learn. But even children will surprise you at their ability to follow a good example. Also remember to demonstrate safe and efficient work habits. Wear all protective equipment required, and require others to do so also.

Volunteers can be a very valuable resource that your agency can rely on in the future and should be treated as such. Adequate time in project preparation will be invaluable to furthering your agency cause if you develop an overall program that incorporates and expects quality and excellence at each step of the process. If you choose and develop a high quality project, and supervise project day execution (complete with demonstrations) you will be well on your way towards a high quality product. Expect from your volunteers what you would expect from contractors and your volunteers will be very proud of the work they have done and they will be responsible for your project's success. They will leave your project area with the satisfaction and knowledge that they carried out work that was equal to or better than a contractor's. They will then be advocates for your agency's cause, and further the cause of conservation in general! In the long run, everyone benefits from high quality volunteer projects.

Appendix K Crew Leader Development Guidelines

Author's Note: This document was written for the Colorado Trail Foundation in 1989 for weeklong crew leader training projects on the Colorado Trail.

Introduction

Well trained crew leaders can be a great asset to a trails management program. Crew leader trainees are best selected from successful volunteer projects. If you do not have a program yet, consider developing a leader development program right from the very beginning. Start with slide shows, lectures and field trips to local areas. Begin your leader training programs when you begin your trail planning and you will have enough leaders when it comes time to build your trails.

Those starting a new program will have to train the first round of leaders themselves. Or, you can have someone come in from outside your park and teach them for you. It is really important that you carefully select your first crew of leaders. These people will form the bridge of information to successive leaders and crews.

You will also have to develop a crew leader training agenda, a process, and some sources of leaders. Skills that leaders have in their toolkit already should be identified, as well as other qualifications and commitment requirements.

One of your jobs as a crew leader is to convey to the volunteers thanks for their commitment to the legacy of outdoor recreation resources for our future generations. Periodic comments during the week will insure this. The real goal of our work should be to return to work or our families well relaxed and refreshed with the knowledge that we/they have really contributed something to the trail. Strive to develop new insights into how can respond to individual crew person's needs to achieve this. The results of a crew leaders labor should be: 1) volunteers who are refreshed at the end of the week, 2) volunteers who return, 3) volunteers who bring back a friend or encourage others to enjoy working on the trail, and 4) volunteers who have such a successful experience that they undertake other responsibilities in the organization including crew leading.

In order to be a successful crew leader, you must be comfortable with all aspects of leadership on the trail, whether its with the leadership skills, technical skills or interpretive skills. In a word, your TOOLKIT must be reasonably full, and always ready to be expanded.

In order to realize true growth in your organization, the baton must be passed to a new generation of people who are willing to undertake an increased responsibility of stewardship towards our great recreation resources. At an average rate of 30-50 feet of trail per day, one individual can only do so much work. Therefore, new crew leaders must be developed, and you must be constantly thinking about who can be a potential crew leader, or who can take on an increased role in your organization.

Please be reminded that leadership on a conservation project is very exciting. Your success will be measured be how much you can make your projects exciting for your crew leaders and volunteers. You will attain great joy from your projects and your crews, and you have a great opportunity to instill in others a sense of accomplishment, pride in their work, and the ability to reflect back on a unique experience. Leadership responsibilities must be taken seriously, take the excitement that goes with it and yet also as a wonderful privilege. You will truly enjoy your choice and initiative.

The leadership aspects of crew leading is best explained in one sentence: Leadership is best displayed by example. If you want your crew to do something a certain way, you had better do it that way yourself! If you need volunteers to help you do a certain chore, volunteer to be one of them. Ask "Who would like to help me set up the cook tent?". If you want your crew to wear hard hats as the Forest Service requires, you had better be wearing yours. If you want trail or a cairn built a certain way, you had better be able to demonstrate how you want it done. As crew leader, you must be constantly cognizant of how your actions will affect your crews actions. Be constantly thinking about how you can incorporate examples of camp organization or technical skill development into your work week. Think back on this week, and ask yourself about the various aspects of this training seminar and how you would have done things the same or different. Remember: Leadership is best displayed by example.

Leaders are also best when they are silent most of the time, only exerting leadership when necessary. If someone has a way of cooking eggs, you would let them do it if it is acceptable. You would not redirect them solely because they do it differently than the way you would do it. The same goes true for building trail. If the end product will be the same, let them do it their way, as long as it conforms to safety standards.

Suggestions work better than directions. Also explain why we do things certain ways. If volunteers understand why, they will be able to develop their own insight into problem solving.

There are several ways that you may pursue increased knowledge and experience regarding your crew leading skills. You need to be constantly growing, and searching for ways to improve. Pick up a book on leadership. Discuss leadership with a friend or other crew leader. Debrief your project, or other projects you participate in. In addition, evaluation forms, questionnaires and simple phone calls to those on your project or your training instructors can be beneficial.

Safety

Your primary responsibility as a crew leader is the safety of your crew. If we can not do tasks safely, we will not do them. You must be aware of all techniques and procedures necessary for a safe camp, access out to your work site and back to camp as well as safe work during your project. Ensure that your volunteers conform to safe camp practices, especially cooking and around the campfire. Fires can be tragic.

Crew leaders should review with their crews suggested contents for a day pack, how things are anticipated to go on the work day, how access should be attained out to the trail, some anticipated problems, and other things peculiar to their particular project.

Crew Organization/Differentiation of Tasks

A wise crew leader will efficiently organize their crew to optimize results from each member. You can start with finding out what crew members like to do and work from there. Not everyone will like to do a certain task, and in that case, diplomacy will be required. Be advised that the 'more mature' crew members are usually the wisest: they work the most efficiently and are easiest to teach. These people are usually in their forties or older. Younger persons are usually stronger, but usually take breaks to rest from working too quickly. People needing a break from the heavier work can usually do the routine things such as clipping branches. A combination of these people and tasks and people is desired. If you develop an older person's point of view on cairn construction, for example, they will be able to organize younger persons to haul rocks for the cairn. You as a crew leader can then go on to other things.

You may consider, on the other hand, a specialized crew for a certain task that they might accomplish for an extended section of trail. Stump removal is a good task for teenagers. They can go along in advance of others and remove all stumps at their own pace. Consider this also for rock removal. Crew members learning the very fine point of tread cutting and finishing can follow behind others and ensure good backslope and outslope. Experiment a little and work with what is best for you.

Differentiating a task small enough to handle goes hand in hand with your crew's organization. There can be rough tread cutters, tread finishers, rock haulers, tree limbers, and stump removers. When communicating the specific task at hand, be sure to cover all the aspects required, yet also relate these back to the anticipated trail tread. An example of this would be stump removal. All roots greater than 2 inches need to be removed, yet you do not have extend beyond the limits of the trail corridor.

Interfacing with Agency Personnel

Each crew leader working with a different agency will have a slightly different approach to things. It is important to work this out at the very beginning. The agency that provided fire wood for you last year may not be able to provide it this year. The same goes for nearly every other aspect of the work. Find out what this year's strategy is going to be early on. Maybe there will be a little different specification for drainage structures, or other trail requirement. Remain open to input from the agency representative.

Your job as crew leader is to interpret agency direction for work and communicate their concerns to the volunteers. You are also the intermediary if your crew needs additional water, fire wood, or needs letters mailed. Try to set up an agenda for these things to make sure they run smoothly. Monitor supplies and stockpiles to ensure timely resupply.

Estimation of Materials, Time to Carry Out Tasks

It is important to develop good estimates of what your crew can do so that you can stay a few steps ahead of them, constantly encouraging them so that they produce well. Nothing is worse than telling a crew that they can be expected to do a certain series of tasks during the week, and then they only finish half of the original estimate. On the other hand, you really do not wanting your crew doing three times your prediction, either. Keep group morale in mind when you develop estimates for materials and time.

As crew leader, you will be required to make estimates for materials and the time required to carry out tasks. If a stone wall is required on a section of trail, the crew leader must be able to quickly come up with the nature, size and amount of stone required. This can get a small group of crew members started looking for rocks. In the mean time, you can stake out the beginning and end of the wall for someone to start cutting the footing trench. Monitor the estimates, and the progress. This can significantly affect your work. If on Monday you think you will be able to do x, y, and z tasks, and you are only half done at the end of the day, reconsider your weekly production.

Several quick and easy units of measure are available to you as crew leader. A 100' surveyors tape, a carpenters ruler, a calculator, and a note pad and pencil can assist you in making estimates. (Pacing can replace the need for a tape.) Strive to develop your own knowledge of as many tasks and units of measurement as possible. Know how many inches are in a foot, feet in a yard, cubic feet in a cubic yard [the district may deliver a truckload of gravel for you],

shovels in a bucket, pounds per cubic foot of rock, pounds per bucket full of water, and how many nails are in a pound of certain sized nails.

Tool Discussion

Crew leaders must be aware of each tools purpose, correct usage, safe usage, and maintenance. They must also be able to communicate this information to the crew. This knowledge will ensure successful tool use, safety and enjoyment of the tools.

Tool purpose is very important to recognize. Most tools are specialized in nature. Correct usage will be safe, easy and efficient. Crew leaders should know and be aware of each tools intended use. This will result in comfort for the user. If you are unaware of proper usage of a tool, check with an expert. Maybe someone on your crew has experience using it, or maybe your agency host knows correct usage. Proper training is required for chain saw and other technical tool use.

Make sure each volunteer is using the tools correctly. Correction is required early in the first day of use. Occasionally, you will get crew members who use tools incorrectly even after an entire week with repeated, yet gentle corrections. Correcting errant volunteers early is important to prevent this type of misuse as well as copy cat misuse. Few tools require raising them above the waist. Short precise strokes are much more efficient than over the head swings. Tools must be used for the right task. This will prevent needless breakage or damage to tools. Broken handles on pulaskis and shovels are almost inexcusable!

Tools should be properly maintained and removed from service if unsafe. It is imperative that volunteers not use those tools that are not in good repair. Injury can occur. Your agency host should provide you with a file for tread cutting tools. Heads should be tightened on all tools as well. Make sure you consult with the agency you are working with before you actually maintain the tools. Each agency has a little different procedure for maintenance.

Transportation of tools should be such that risk to volunteers is minimal in the event of a slip or fall. All protective sheaths must be used. In general, the sharp edge of the tool should be carried pointing away from the body. This is especially true of tools such as a macleod. If a person carrying a macleod falls, the tines can cause serious damage. Having the sheath on, and carrying the tool with the tines facing down will minimize injury. Tools should also be carried on the downhill side of the trail if possible. A person who starts to fall can release the tool to minimize injury. Carrying the tool on the uphill side, a person is likely to fall onto the tool. Volunteers must use their best judgement in this area. Crew leaders should correct miscarrying of tools immediately.

Maintenance of a safe distance between volunteers carrying tools into the project site is also required. Crew members passing through a section of trail being worked on should ask the workers to stop to allow safe passage.

Your agency representative may call you in advance of the project and ask what kinds of tools are required. A very good recommendation is to have 1.5 to 2 tools for each person on the crew. For a crew of 15, then about 23 to 30 tools should be provided. Request a sharp trail cutting tool for each crew member. These would normally be a pulaski or a macleod. (Pulaskis are the preferred trail cutting tool.) Then add in 1 rock bar for every 7 crew members, 1 round shovel for every seven crew members, several saws, several loppers or clippers, and a few buckets. Hardhats should be provided for each crew member. Different agencies might have some unique tools for their area. Make sure you know how these are to be used before you agree to accept these tools in lieu of pulaskis or macleods.

Problem Solving

Crew leaders require good problem solving skills. Problem solving involves:

- Problem identification;
- Identifying proper design details;
- Determining factors that affect the solution;
- Determining the design criteria;
- Determining if several design details interrelate;
- Understanding how the trail will be used;
- Predicting the vegetation potential in the area;
- Assessing what materials you have access to;
- Assessing what human resources you have;
- Determining if you need to consult with the agency representative;
- Asking if there is someone with more experience than you on your crew; and
- Determining if there is time today, tomorrow or this week to do the task?

Visualization

One of the hardest things for a volunteer to do on a trail project is to visualize a solution to a complex problem that they have never seen before. Your job as crew leader is to be creative in describing or showing a volunteer what you want. Motivation as to a good solution is a good start, as is describing a solution process, as is describing what you want as an end result. Demonstration is also a good way to go. If you want a certain shape stone that is 500 feet from your work site and there are less desirable stones closer by, you better volunteer to help carry some of the stones. Explaining why you need an exact size or shape will also do much to further your cause.

Use the materials you have on hand to help indicate what you want, also. Holding a pulaski handle on a slope will indicate to volunteers the anticipated outslope on a trail.

Creativity

Why should we do things the same old way all the time? If you were on a crew that had a great way of doing things, why should not you incorporate that technique into your crew? These ideas mainly apply to the leadership and organizational aspects of the work. Be creative in your problem solving, your crew organization, and the ways you encourage discussion.

Standards and Uniformity

Believe it or not, there are design standards already developed for different portions of the Colorado Trail. The clearing widths and cross slopes have already been established. Whereas it seems unlikely that the entire trail will be uniform from Durango to Denver, its general characteristics should be. It should then certainly be uniform on your section of trail. If you

have waterbars to put in, they should all be the same in the general area. If you have several cairns to build, they too should have uniform craftsmanship.

Bold Solutions

It is important to remember that trail work revegetates, and that we want to ensure durability of the trail. That is why we are discussing the concept of bold solutions. If your trail route goes up and down over 2 or 3 little humps in just 20 or 30 feet, why not smooth it all out and establish a nice profile of constant grade? Only a little extra work will be required, and yet it will greatly benefit the trail users. The same is true for wall construction and incorporation of other structures. Try to visualize the solution in 20 or 30 years of use and ask yourself if you would do the same solution again after that period of time. Think back about the major perceptions you have about trails you have hiked, or vistas you have viewed. I'll bet you remember the bold aspects of your experiences: the waterfalls, the grand views, the large and long stone walls, the beautiful cairns, the hand crafted bridges.

Physiology of Use

Crew leaders and crew members should be aware of the physiology of use for the different types of trail users. Pedestrians, mountain bikes, horses and cross country skiers will be the common users of the trail. Horses have a tendency to drift to the outside of a trail if no barriers are proximate to prevent this. Pedestrians have to tendency to shy away from intrusive vegetation, or to walk on gentle cross slope portions of a trail. Pedestrians also have a gait. When you are building trail, you need to periodically walk or ride a section of trail to ensure that it feels comfortable to you.

Rehabilitation of Disturbed Areas

It is always our responsibility to rehabilitate areas that were previously disturbed. This demonstrates our concern for our forests. The district personnel working with you should have a revegetation or rehabilitation plan for an area. Scarification of compacted ground, transplanting of plants, constructing barriers and spreading of seed are just a few of the techniques used. You as a crew leader must realize the importance of these activities and communicate them to your crew. Strive to be creative in assisting the district personnel in removing all trace of previous impacts.

Journal

Keeping a journal can be a good way to reflect on the crew experiences in future years. Journals have been found to be extremely successful in recording unique insights into the trail work. A suggestion might be for each crew leader to provide a hard bound 'Nothing' book or a real journal for their crew. About five or six dollars can be a small contribution for the return of joy in later years. Crew leaders would be well advised to be an early entrant. Having people write in their current or planned addresses and phone numbers is also a good idea.

Importance of Recognition

It is important to recognize your volunteers for the work that they do and the growth they exhibit. Simple thank you's are very effective, as are pats on the back. A review of a stone wall or other significant work in group format will bring recognition to the builder. During the Friday

night recognition ceremony, be sure to do a complete rundown of all of the significant contributions that people made to your project.

Delegation Skills

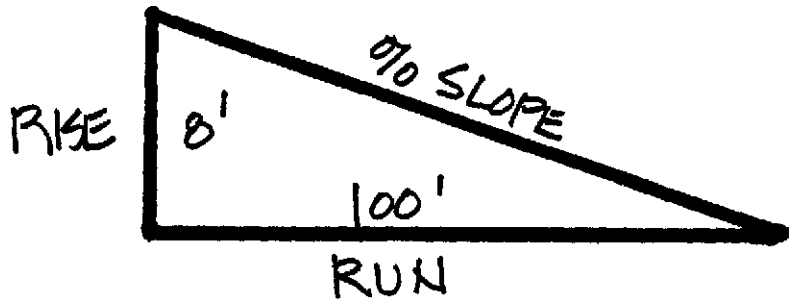
It is important for crew leaders to realize that they do not have to do everything themselves. As a matter of fact, they probably can not. That is why they are given a crew. With this in mind, it is important to develop delegation skills. Several items should come to mind when developing these skills. They include: the knowledge in your own mind what the task is, the understanding of what skills are required, the knowledge of the skills of individual members of your crew, and the accurate transfer of information that person needs to carry out the task. Strive to attain greater and greater insights into this skill so that you can maximize your contribution to the project and develop your crew members to the greatest extent possible.

Interpretation

A good crew leader will have as one of their skills in their toolkit, the ability to share a unique insight into one or more aspects of natural history, or will be able to encourage general discussion with those on your crew who have expertise in this area. A good question to ask yourself in this regard is: "What can I as an individual bring to this group of people who have chosen to spend a day or a week improving our nation's recreation resources?".

It might be that you have an interest in birds, or maybe geology. You might be able to tell stories, or encourage others to tell stories. Pick a topic, and begin to be able to share with others to help make their week more enjoyable. Even sharing a hobby you have might be of interest to someone on your crew. The joy you plant in someone else will come back to you.

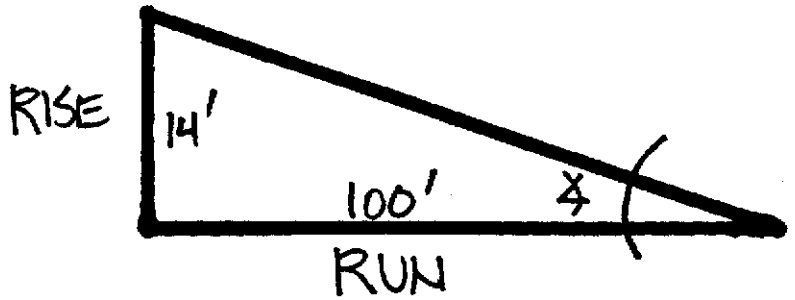
Appendix **AA**.....Sketches
Appendix **BB**.....Legislation
Appendix **CC**.....Sources of Equipment and Supplies
Appendix **DD**.....Combined Glossary of Trail Terms
Appendix **EE**.....Role of the Trail Designer and Other Positions
Appendix **FF**.....Job Descriptions
Appendix **GG**.....NPS-77 Chapter 3 Backcountry Management
Appendix **HH**.....Annotated Bibliography
Appendix **II**.....Liability Bibliography



"% SLOPE"

PERCENT SLOPE = RISE/RUN × 100

8' RISE IN 100' RUN = 8%

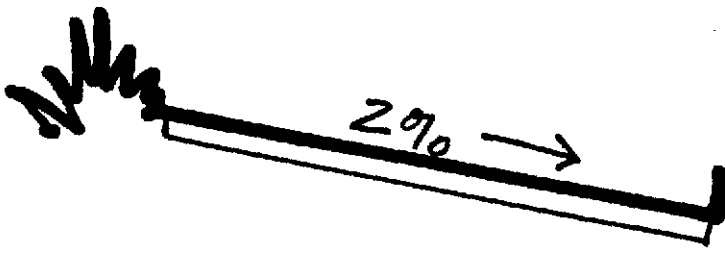


"ANGLE"

IF YOU KNOW THE RISE & RUN, YOU CAN FIND THE ∠. TAN ∠ = RISE/RUN.

TAN ∠ = 14/100

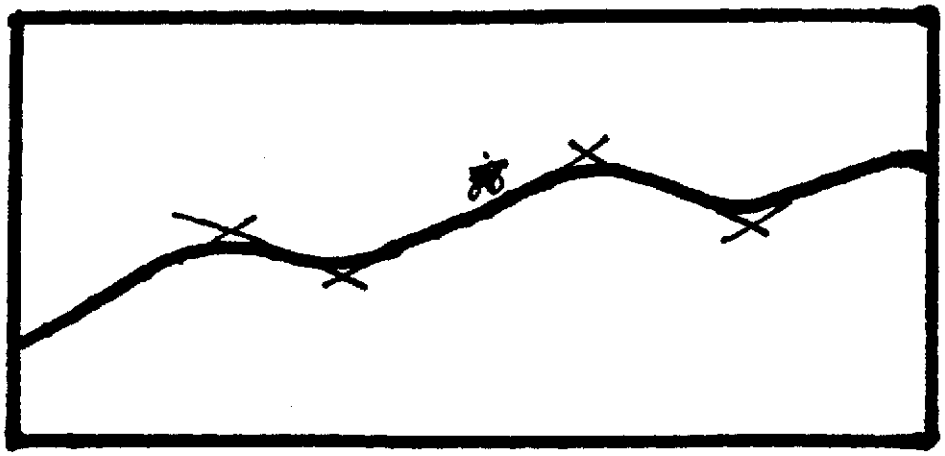
∠ = 7.9°



"CROSS SLOPE"
"SIDE SLOPE"
"FALL LINE"

MOST SURFACES ARE SLOPED FOR DRAINAGE.

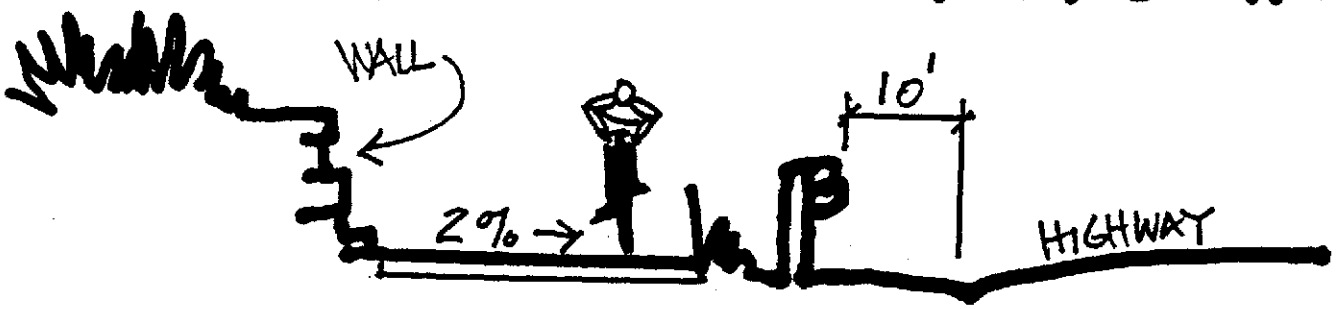
2% IS A COMMON CROSS SLOPE.



"PROFILE"

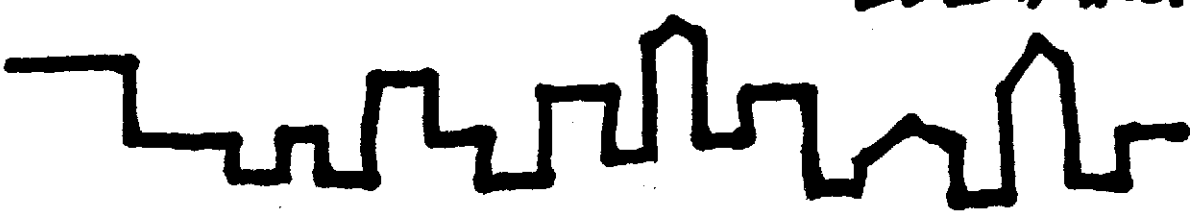
USUALLY TAKEN ALONG A CENTERLINE, AND PARALLEL TO THE DIRECTION OF TRAVEL, A PROFILE INDICATES VERTICAL DESIGN GEOMETRY.

"CROSS SECTION"



CROSS SECTIONS SHOW DESIGN DETAILS SUCH AS EXTENT OF IMPROVEMENTS, AND AMOUNT OF SEPARATION.

"ELEVATION"



ELEVATIONS SHOW OBJECTS FROM A POINT ⊥ TO EACH OBJECT (NO PERSPECTIVE) AS IN A SKYLINE VIEW FROM A BOAT.

Article 11

Recreational Trails

33-11-101. Short title. This article shall be known and may be cited as the "Recreational Trails System Act of 1971".

33-11-102. Legislative declaration. (1) In order to provide for the greatly increasing outdoor needs of a rapidly expanding Colorado population for public access to, travel within, and enjoyment and appreciation of the out-of-doors areas of Colorado and for the conservation, development, and use of natural resources against fire and other natural and geological hazards, it is hereby declared to be the public policy of this state and among the purposes of this article to: Increase the accessibility and encourage the use of such natural resources by the residents of this state and by nonresidents; provide opportunity for the development of public and private facilities for persons visiting and utilizing the natural resources of this state; encourage an increase in riding, hiking, bicycling, and other compatible recreational activities as influences for the improvement of the health and welfare of the people; and to provide for the needs of specialized recreational motor vehicles. It is recognized that joint simultaneous trail use by motorized and nonmotorized interests may at times be incompatible, and it is the intent of this article to provide separate trails and facilities for each of such motorized and non-motorized interests, when feasible.

(2) To implement the provisions of subsection (1) of this section and as additional purposes of this article, the state may: Establish and maintain trails on a statewide basis to connect, when feasible and practical, the units of the parks and outdoor recreation system, federal recreational lands, and other trails systems; perpetuate and provide the use of and access to regions and trails of special or historic interest within the state; assist local governments in serving the requirements of the urban and other populations centers of the state; encourage the multiple use of public rights-of-way and utilize to the fullest extent the existing and future scenic roads, highways, parkways, and federally administered trails where feasible as recreational trails; encourage the development and maintenance of recreational trails by counties, cities, and special improvement districts and assist in such development and maintenance by all means available; coordinate trail plans and development among legal jurisdictions and with the state and federal governments; encourage, when possible, the development of trails on federal lands by the federal government; and promote at all levels of government a more complete use of all or any portion of public property for recreational purposes.

33-11-103. Definitions. As used in this article, unless the context otherwise requires:

(1) "Committee" means the Colorado recreational trails committee.

(2) "Local government" means a city, town, county, city and county, or political subdivision of the state charged by law with and engaged in the administration of a parks or recreation program.

(3) "Motorized trails" means trails for the use of motorized vehicles where designated in the trail plan and as posted on the trail, as may be required by law.

(4) "Nonmotorized trails" means riding, hiking, bicycling, and other recreational trails for the use of the public on which motorized vehicles are prohibited except in emergencies.

(5) "Recreational trail" means a trail which is used for a recreational purpose, such as hiking, horseback riding, snowshoeing, cross-country skiing, bicycling, or the riding of motorized

recreational vehicles along routes of scenic, natural, historic, geologic, or water-oriented interest.

(6) "Riders" and "riding" means, respectively, horseback riders and horseback riding, snowmobile riders and snowmobiling, and recreational vehicle riders and recreational vehicle riding.

(7) "Trail corridor" means the recreational trail plus a scenic or recreational easement, if such easement is acquired as a part of the recreational trail and if it is essential to the recreational experience of the trail user.

33-11-104. Acquisition. (1) In order to provide recreational trails in a statewide system of positive recreational value, the division may acquire reasonable trails rights-of-way or easements. In selecting the rights-of-way, full consideration shall be given to minimizing the adverse effects upon the adjacent landowner or user and his operation. Development and management of each segment of the trails system shall be designed to harmonize with and complement any established multiple-use plans for that specific area in order to insure continued maximum benefits from the land. Acquisition shall be, whenever possible, through donations, purchased with donated funds, or through easements and exchanges. When such methods fail, the division may authorize expenditure of state appropriations for acquisition in fee. Agreements for less than fee shall be for terms of not less than twenty-five years whenever possible.

(2) The division may abandon all or any portion of a trail or easement acquired for trail purposes which is no longer necessary for such purposes, or it may transfer any trail or easement acquired for trail purposes to a local government having jurisdiction over the area in which the trail or easement is located if such local government agrees to maintain and operate the trail.

(3) The division shall notify the owner of land through which any trail or easement acquired for trail purposes passes prior to entering into an operating agreement for that trail with any local government, and it shall secure the consent of the landowner prior to the transfer of any trail or easement acquired for trail purposes to a local government.

(4) Nothing in this article shall permit the acquisition of recreational trails by proceedings in eminent domain by any state agency; except that, when a recreational trail is included within a highway right-of-way, the state department of highways may acquire such contiguous land as a part of the right-of-way as is necessary to permit the uninterrupted continuation of the recreational trail.

33-11-105. Recreational trails committee. (1) There is hereby created the Colorado recreational trails committee, which shall be advisory and shall consist of seven members to be appointed by the board. Members shall be appointed for terms of four years. No member shall serve more than two consecutive terms. One member shall be appointed from each congressional district, and one member shall be appointed from the state at large. The committee shall include in its membership representation of the broad spectrum of trail users. Vacancies on the committee shall be filled for the unexpired term by the board.

(2) The committee shall meet not less than four times annually to advise the division on all matters directly or indirectly pertaining to trails and their use, extent, and location and the objectives and purposes of this article.

33-11-106. Responsibilities of committee. The committee, with the approval of the board, shall coordinate trail development among local governments and shall assist local governments in the formation of their trail plans and advise the board quarterly of its findings. In carrying out this responsibility, the committee shall review records of easements and other interests in land which are available and may be adapted for recreational trail usage, including public lands,

utility easements, floodplains, railroad and other rights-of-way, geological hazard areas, gifts of land or interests therein, and steep slope areas. The committee shall advise the board in the development of uniform standards for trail construction which may be adopted by the board for statewide use and which shall be made available to participating local governments. The committee shall offer plans and methods for funding a trails system through user fees or other financing methods.

33-11-107. Aid to local governments. The board is authorized to make funds, appropriated by the general assembly for the purposes of this article, available to local governments in accordance with criteria developed by the committee and adopted by the board. The committee shall advise the board of its recommendations for the allocations of such funds among participating local governments.

33-11-108. State trails system. (1) The board shall designate a state trails system. The trails comprising such system shall meet criteria established by the board and shall be consistent with objectives of this article.

(2) The board shall establish a procedure whereby federal, state, and local governments and nongovernmental organizations may propose trails for inclusion within the system.

(3) In consultation with appropriate federal, state, and local governments and nongovernmental organizations, the board shall establish a procedure for review and public hearings upon proposals for the inclusion of trails in the system.

(4) The board may participate in the planning, establishment, development, and long-term operation and maintenance of segments of national scenic trails which might be authorized by the congress of the United States.

33-11-109. Trails categories. (1) Any of the following categories of trails may be established:

(a) Cross-state trails which connect scenic, historical, geological, or other significant features which are characteristic of the state;

(b) Water-oriented trails which provide a designated path to or along lakes, streams, or reservoirs in which water and other water-oriented recreational opportunities are the primary points of interest;

(c) Scenic-access trails which give access to quality recreation, scenic, historic, or cultural areas of statewide or nationwide significance;

(d) Urban trails which provide opportunities within an urban setting for walking, bicycling, horseback riding, or other compatible activities. Where appropriate, urban trails shall connect parks, scenic areas, historical points, and neighboring communities.

(e) Historical trails which identify and interpret routes which were significant in the historical settlement and development of the state.

(2) The planning and designation of trails for the state trails system shall take into account and give due regard to the interests of federal agencies, state agencies, individuals, and interested recreation organizations. The categories set forth in subsection (1) of this section need not be used to label specific trails, but the division shall assure that full consideration is given to including trails from all categories within the system.

33-11-110. Uniform signs and markers. The board may establish uniform signs and markers including thereon appropriate and distinctive symbols. Where trails cross lands administered by federal agencies, such markers may be provided and erected by the appropriate federal agency at appropriate points along trails and maintained by the federal agency administering

the trails in accordance with standards mutually established by the division and the federal agency concerned. Where trails cross lands of state or local governmental agencies, the division may provide such uniform signs and markers to such agencies in accordance with written agreements and may require such agencies to erect and maintain them in accordance with standards established in such agreements.

33-11-111. Cooperation with state agencies. The state department of highways, the state board of land commissioners, the Colorado land use commission, the urban drainage and flood control district, and other state agencies and political subdivisions having jurisdiction or control over or information concerning the use, abandonment, or disposition of highway or utility rights-of-way or other properties which may be suitable for the purpose of improving or expanding the state trails system shall cooperate with the division to assure, to the extent practicable, that any such properties which are suitable for trail purposes may be made available for such use.

33-11-112. Trails enforcement. It is unlawful for any person, except a parks and recreation officer or other peace officer, to operate a motorized vehicle on a designated nonmotorized trail. Any person who violates this section is guilty of a misdemeanor and, upon conviction thereof, shall be punished by a fine of twenty-five dollars.

Forestry Suppliers, Inc.
205 W. Rankin St.
Jackson, MS 39284-8397
(800) 647-5368
(601) 354-3565

Ben Meadows
3589 Broad Street
Atlanta, GA 30341
(800) 241-6401
FAX (800) 628-2068

Surveyor's Supply Co
(800) 334-0095

Cross Cut Saw Co.
P.O. Box 7870
Seneca Falls, NY 13148
(315) 568-5755

Appendix DD Combined Glossary of Trails Terms

Compiled from glossaries of the following trails documents:

National Park Service, Denver Service Center. 1983. *Trails Management Handbook.* Lakewood, CO: _____. [NPS]

US Forest Service. n.d. *Guide for Mountain Trail Development.* Lakewood, CO: _____. [FS]

Proudman, Robert D. and Reuben Rajala. 1981. *Trail Building and Maintenance.* Boston, MA: Appalachian Mountain Club. [AMC]

Stanley, Harvey and Hartesveldt. 1977. *A Report on the Wilderness Impact Study.* San Francisco, CA: Sierra Club Bookstore. [WIS]

Pennsylvania State Trails Program. 1980. *Non-Motorized Trails/An Introduction to Planning and Development.* Harrisburg, PA: Pennsylvania Bureau of State Parks. [PG]

Combined Glossary of Trail Terms

Abutment

The foundation of either extreme end of a bridge that supports the superstructure (sills, stringers, trusses, or decks). [NPS]

Anchor Row

That row of larger stones used to anchor stone paving to undisturbed ground. [Author]

Annotated Notes

Those notes written for construction which include detailed descriptions of the work required to accomplish the intended improvements to the trail corridor. [Author]

Backcountry

Areas away from vehicle (wheeled) access; land remote from public or heavy use roads; occasionally used in reference to de facto wilderness, especially within National Parks. [WIS]

Backpacking

A method of visiting remote regions for recreational purposes by means of carrying all items needed for survival and recreation on one's back in a backpack; the combined activities of hiking with a pack or bag with straps, or attached to a frame with straps over the shoulders, used to carry cargo on one's back and, camping out with supplies carried in such a pack. [WIS]

Backslope

The cut bank formed by the excavation extending upward from the tread. [NPS]

Ballast

That material (usually crushed stone) in a railroad used to transfer the load from the railroad ties to the embankment below. [Author]

Base

The primary excavated bed of a trail upon which the tread, or finished, surface lies. [NPS]

Batter

The receding upward slope on the outside of a structure or wall. [Author]

Berm

The ridge of dirt or rocks placed on the outside of the trail base. [NPS]

Blaze

A standard trail mark cut into the bark of a tree with an axe to designate the trail location. [FS]

Blowdown

A fallen tree or large limb encountered within the trail area to be cleared. [PG]

Boulder Stones

Stepping stones (see step stones) made from boulders (usually larger than 12 inches). [Author]

Bridge

Any structure spanning and permitting passage over a river, stream, chasm, canyon, or road. [NPS]

Cairn

A constructed mound of rock located adjacent to a trail. Used in open alpine areas or mountain areas where the tread is indistinct. [NPS]

Campsite

A place one or more people use temporarily for sleeping, eating, relaxing, and carrying on various activities (permanent facilities, i.e., firepits, toilets, tables, corrals, may or may not be present); an area designated for camping. [WIS]

Carrying Capacity

Number of people which the land can accommodate and still retain its wilderness characteristics related to its ability to provide experiences of a certain specified minimum quality to the individual participants; number of visitors (probably broken into specific categories) which an area can tolerate without damage. [WIS]

Classification

The general designation indicating the standard of a trail. [FS]

Clay

A fine-textured soil which usually breaks into clods or lumps that are hard when dry; quite plastic and sticky when wet. [AMC]

Clinometer

Instrument used for measuring angles of elevation or inclination. [NPS]

Cobble Drain

A cobbled improvement to the trail surface which allows drainage (usually from a intermittent wet seep) across the trail for continued passage along the trail without damage to the soil. [Author]

Contour

A line on a map connecting points of the land surface that have the same elevation. Relating to this publication, contour refers to landforms which trail alignments must follow in order to provide a free-flowing travel sequence. [PG]

Corduroy Puncheon

A log structure laid on the ground for the purpose of crossing swampy areas. Usually consists of stringers, decking, and often a soil or loose gravel tread on top of decking. [NPS]

Critical Point

That point of the trail cross section which is the outer limit of the trail and on undisturbed ground from which point trail width measurements originate. [Author]

Cross-Country

Travel in backcountry or wilderness other than on established or readily identifiable trails, roads, paths; travel (though not necessarily just foot travel) over terrain without benefit of trail, road, path or other improved routes. [WIS]

Cross Slope

The measurement of the prevailing existing grade or trail cross section taken perpendicular to the existing or proposed trail centerline. [Author]

Crowned Trail

That cross section condition where the trail surface is built up from the surrounding area (and sloped for drainage) usually by excavating trenches parallel to the trail profile or from an external borrow source. [Author]

Curvilinear

A free-flowing movement pattern characterized by the general absence of straight trail segments. [PG]

Damage

Injury of any kind to plants, animals, that may be temporary or permanent, (implying no exact or quantitative meaning); changes to organisms or ecosystems that are long-enduring and regarded as detrimental by mankind. [WIS]

Deck or Flooring

That part of a bridge structure that provides direct support for trail traffic. [NPS]

Degree of Difficulty

A rating of trails or trail segments established to determine the experience level (novice, intermediate, advanced) which should use them. [PG]

Destination Trail

A trail which connects two distinct points (A to B) rather than returning the user to the original beginning point. [PG]

Disperse Use

To spread backcountry/wilderness users over a broad area, rather than allowing large numbers to concentrate in one area; move users from an area of higher concentration of use to one of less use; to redistribute use within an area so as to avoid overuse of historically popular and overused area; spread visitors out over as wide an area as possible in a somewhat evenly distributed pattern. [WIS]

Dominance

Expresses the size or bulk of the stems of each species in relation to space. [WIS]

Drainage, Cross

Running water in swamps, springs, creeks, drainages, or draws that the trail must cross. [NPS]

Drainage, Surface

Rain or snow runoff from the surface of the tread. [NPS]

Duff

Organic matter or a deep mat of tree needles or leaves in various stages of decomposition on the ground of a forest. [NPS]

Ecological Impact

A measurable or observable disruption, damage or change to the interrelationship of plants, animals or physical attributes of an area that affect organisms; damage to the physical environment, or especially to the living organisms. [WIS]

Ecological Region

Drainage basin where similar climate and substrate have produced an integrated set of ecosystems. [WIS]

Ecology

The study of interrelationships between organisms and their physical environment. [WIS]

Ecosystem

The cooperative functioning of a biotic community and the non-living environment; a functioning, interacting system composed of two or more living organisms and their effective environments, both physical and biological; any unit that includes all of the organisms in a given area interacting with the physical environment so that a flow of energy leads to clearly defined trophic structure, biotic diversity, and material cycles (i.e. exchange of materials between living and non-living parts) within the system (ODUM). [WIS]

Embankment

That engineered soil structure used to raise the trail, rail bed or roadway profile above the existing grade. Embankments are usually used to cross drainages or other low points. [Author]

Environmental Impact

Addition, removal, change, or damage to any aspect of the biological or physical characteristics of an area; damage plus its effects on wilderness users, i.e. noise, odors, visual insults, etc. [WIS]

Flagging

That material used for marking purposes during the location, design, construction or maintenance phases of a project. [Author]

Flat Profile

That trail, rail bed or roadway profile which is less than approximately 3 percent in both the longitudinal (parallel to center line) and transverse (perpendicular to center line) section. Usually this profile is built up above the surrounding grade for the purposes of positive drainage. [Author]

Foot Traffic

Passage over an area by people on foot; the circulation of pedestrians over an area. [WIS]

Footing Trench

The trench excavated below a structure usually to undisturbed ground which serves to support the structure. [Author]

Ford

A natural stream crossing improved sufficiently for use by saddle or pack animals and trail users. [NPS]

Fragility

The relative susceptibility of a given component of an environment, or of the composite environment, to damage from external forces and activities. [WIS]

Full Bench Trail

The most stable of trail, rail bed or roadway cross section conditions where the surface is completely cut into a hillside to undisturbed grade. [Author]

Grade Dip

A reverse in the grade of the trail accompanied by an angling outslope that will divert water off the trail. [NPS]

Grade, Maximum

The steepest grade permitted on any part of a trail. [NPS]

Grubbing

To dig, to clear of roots, to uproot shallow roots near or on the ground surface; also grubbing of tree stumps. [NPS]

Hardpan

A layer of rock, or compacted clayey layer of soil which forms a durable and generally erosion-free trail surface. [PG]

Horizontal Alignment

The course of a trail as it meanders across the landscape. [PG]

Horizontal Clearing Width

That width which must be cleared of all surface vegetation, rocks, and other obstructions which would otherwise infringe upon freedom of trail passage. [PG]

Landing

That portion of a switchback between the upper and lower legs with a low profile grade which functions as the turning surface for users. [Author]

Litter

Waste materials, scraps, or carelessly dropped objects strewn about the landscape. [WIS]

Loam

A mixture of different grades of sand, silt, and clay; it has a gritty feel, yet is fairly smooth and plastic. [AMC]

Loop Trail

A trail which returns the user to the original beginning point. [PG]

Maintenance Activity

A specific type of work that is carried out to keep a trail in its originally constructed serviceable standard. [FS]

Maintenance Level

The degree to which each maintenance activity must be performed to satisfy the purpose and the safe use of the trail. [FS]

Management

The practice by responsible lawful authority of setting regulations, devising rules, enforcing laws, informing the public, locating trails and facilities (including campsites) such that the land serves the purposes for which it is to be managed; the use of regulatory powers to enable supervisory organizations to control use/misuse of natural areas, i.e. stock limitations, firewood use limitations, etc. [WIS]

Measuring Wheel, or Cyclometer

An instrument that measures circular arcs. A device that records the revolutions of a wheel and hence the distance travelled by a wheel on a trail or land surface. [NPS]

Optimum Group Size

That sized group which results in the maximization of the values to be gained from travelling in a group but [with] minimized impact. [WIS]

Outrun

That section of a trail, usually at or near the base of a descent which provides adequate length and grade reduction in order for the user to safely stop or negotiate turns, intersections or structures. Outruns are usually associated with ski-touring. [PG]

Outsloping

A method of base grading that leaves the outside edge of the trail lower than the inside. [NPS]

Overgraze

Level or grazing which leads to a change in species composition characterized by invasion species; these may be native or introduced. [WIS]

Pack Stock

Animals taken into backcountry areas to carry either people or dunnage, usually horses, burros, [llamas], and mules. [WIS]

Paved Dip

A reverse in the trail profile grade, usually through a naturally occurring low point, which is paved with stone to prevent damage to the soil. [Author]

Per Person Impact

Amount of impact caused by one person per unit time; sum total impact divided by the number or people causing such impact. [WIS]

Percent (%) Grade

A figure used in determining the degree of climb or descent of a trail. (Vertical distance divided by horizontal distance equals % grade.) [PG]

Permanent Campsite

A site typically utilized by many different parties or campers, and which is utilized throughout the season as such; a site generally characterized by one or more fire circles or rocks, trampled cook and sleeping areas. [WIS]

Pier

Intermediate bridge supports located between two adjacent bridge spans. [FS]

Plan and Profile Sheets

Those engineering drawings (usually prepared for trail construction) used to record horizontal and vertical geometry as well as other required improvements to the trail corridor. [Author]

Portage

A situation which exists when a boater must temporarily leave a stream in order to bypass hazards such as dams, downed trees or dangerous white water. [PG]

Positive Drainage

The provision for the efficient removal of water from improved trail surfaces. [Author]

Preservation

To keep intact or unimpaired; attempt to maintain a resource in its natural condition. [WIS]

Pristine

Original, natural, primitive condition. [WIS]

Puncheon See Corduroy.

"Purist"

Wilderness user who seeks the most primitive experience possible, with the use of equipment designed to minimize impact; a person who generally experiences a dislike for forms of wilderness use and types or modes of wilderness travel which encroach upon the ability of the area to provide a very primitive experience. [WIS]

Put-in Point

A defined area which provides public access to water trails. [PG]

Radius

An arc or curve which connects two straight trail segments in order to provide smooth horizontal and vertical alignment. [PG]

Rails

On corduroy, the timber members parallel to the trail centerline fastened to hold down the decking. [Author]

Recoverability

The relative rate of recovery of the environment, and organisms in that environment, from damage or destruction. [WIS]

Recovery

The natural regeneration of a site from impact; example, vegetation; changes leading toward a pristine condition; the return to natural (or at least acceptable) conditions within a unit of time. [WIS]

Recreational Carrying Capacity

That character of use that can be supported over a specified time by an area developed at a certain level without causing permanent damage to the physical environment and without excessively degrading the experience of the visitor. [WIS]

Riprap

Stones placed randomly for the purposes of support by means of the weight of the stones. [Author]

Rock Treadway

Simply a more intensive use of rock than is the case with step stones. Many rocks are set side by side, or are set into what is called a "rock box." With a rock box, a frame is constructed of logs which are peeled and spiked together, and rock is used to fill in the interior. With particularly good, square rock such a frame is not needed since the rocks can be laid in flagstone fashion. [AMC]

Run Plank

Usually wood planks laid lengthwise (along the axis) on top of a bridge decking used as the tread surface. [NPS]

Sand

Loose, single grains; individual grains readily seen and easily felt. [AMC]

Scars

Any mark, damage, or lasting effect resulting from past injury, stress, etc.; visible marks of man's use on the environment. [WIS]

Scenic Resources

Those natural resources which are looked upon as having visual beauty. [WIS]

Select Backfill

Material carefully selected for its engineering qualities as a subordinate component of a structure or other trail improvement. [Author]

Select Fill

Material carefully selected for its engineering and aesthetic qualities for trail improvements such as the trail tread. [Author]

Sideslope

The natural slope of the ground measured at right angles to the centerline of the trail, or the adjacent slope which is created after excavating a sloping ground surface for a trailway, often termed a cut-and-fill-slope, left and right of the trail base and tread. [NPS]

Sight Distance

Refers to the distance a trail user can safely and clearly observe the trail ahead of him or intersecting trails and roads. [PG]

Sill

A crosswise member at the top of an abutment or pier that supports the stringers, beams, or trusses. [NPS]

Skew

Deviation from a straight line; slant. [NPS]

Sociological Impact

Any man-induced change in circumstances or behavior which adversely affects an individual's satisfaction of his or her wilderness experience; the effect of backcountry travellers on the experience of fellow users with whom they either come into contact or affect by means of leaving signs of (or remnants from) their prior activities. [WIS]

Soil Depth

Shallow soils over bedrock or hardpan can lead to problems on hiking trails. Such soils are often heavy and saturated with water, causing them to erode quickly and slough off when walked upon. This is especially true in steep terrain, where steep rock slabs can become dangerously exposed after some wear from hiking. Hikers seeking safe passage use plant life on the edge of the trail for handholds, killing the plants and aggravating trail widening problems. This process is, in most cases, unsuitable to enjoyable hiking and disruptive to the natural environment. [AMC]

Soil Structure

The relationships between horizons [a reasonably distinct layer of soil] and the characteristics of each horizon affect the percolation of water into soils. Many soils have hard, compacted horizons called hardpans. These hardpans are generally impervious to the downward movement of water. In areas where hardpans are evident, trail surfaces may become wet and soft, making them susceptible to damage. [AMC]

Soil Texture

Soil texture refers to the relative proportions of various sized groups of grains in a mass of soil. It is an important characteristic in the trafficability of soils. In general, loam soils with a mixture of sands, clay, and silt will resist compaction and erosion most successfully. The smaller sizes of silt and clay particles add cohesion; sand and gravel are present for porosity and water absorption. These moderately sandy soils will resist compaction and will absorb a high level of rainfall, making them good for trail use. [AMC]

Specifications

The standard of workmanship and type of materials for all component parts of a trail base, trail tread, clearing, grade, bridge, culvert, puncheon. [NPS]

Stakes, Grade and Slope

Stakes set by the trail locator to establish the elevation and cross section of the completed tread. [NPS]

Stakes, Line

Stakes set by the trail locator to establish the centerline of the trail. [NPS]

Station

One hundred feet measured along the centerline of the trail. [NPS]

Step Stones

Basically just rocks set into the mud so that a stable and spacious treadway is formed. Any size and shape of rock can be used. Of course, the larger ones are less prone to unwanted movement. Set them so the best surface for walking upon is presented. [AMC]

Stile

A step or set of steps for passing over a fence or wall. [NPS]

Stock Animals

Mules, horses, [llamas] and burros used in carrying equipment, supplies and dunnage into the wilderness for visitors. [WIS]

Stringer

The lengthwise member of a structure that supports the bridge deck. [NPS]

Sustainability

Sustainability of natural surface trail corridors is defined as the characteristic of a travel surface to support currently planned and future uses with minimal impact to the natural systems of the area. Sustainable trails have negligible soil loss or movement while allowing the naturally occurring plant systems to inhabit the area, recognizing required pruning and eventual removal of certain plants over time. Sustainable trails will not adversely affect the naturally occurring fauna. Sustainable trail design will accommodate existing and future uses while only allowing appropriate uses. The sustainable trail will require little rerouting and minimal maintenance over extended periods of time. [Author]

Swale

Low lying ground where drainage usually collects. [Author]

Switchback

A sharp short radius curve in a trail that is used on hillsides to reverse the direction of travel and the gain elevation. [NPS]

Take-out Point

A defined area which provides public egress from water trails. [PG]

Tangent

Relating to this publication, tangent refers to a straight trail section. [PG]

Tie Stones

Those larger stones in a wall which serve to tie together other stones for added strength either penetrating the depth of the wall or parallel to the wall face. [Author]

Timberline

The upper limit of tree growth on mountains and in arctic regions; the demarcation above which no trees grow; line (point) of delineation between alpine and sub-alpine; designated by foresters to be the highest altitudinal region that merchantable lumber can be harvested. [WIS]

Topography

The configuration of the land surface including natural and manmade features. [PG]

Trail Clearing Height

Normally a trail is cleared to a height of eight feet, or as high as one can reach. On slopes, members of the crew can stand uphill from their work, bringing high branches more easily into reach. Where trees are large enough, a canopy should be left over the trail. This will help shade shrubs, weeds, and grasses, dampening their usually prolific growth. Correspondingly, one can enable wildflowers to grow by clearing back the canopy to let in sunlight. This can be done selectively to minimize the "highway" appearance of excessive clearing. In the case of a trail that is popular in winter, the maintainer may want to clear it particularly high. This will enable easier travel when snow up to three or four feet deep lies on the ground. This high clearing can be done in the summer with special tools such as a pole pruner or pole saw. However, it can be more easily accomplished with a winter trail clearing session. [AMC]

Trail Corridor

The area of influence through which a trail passes. A trail's character is largely determined by the natural, cultural, or historic features within this corridor. [PG]

Trail Drain

An outslope to the trail at a naturally occurring low point for the purpose of allowing drainage off of the trail without other more intensive improvements. [Author]

Trailhead

A developed area which serves as the beginning point of a trail or trail segment. [PG]

Trailhead

The start or end of a trail often accompanied by various public facilities, such as a horse unloading dock or chute, parking areas, toilets, water, directional and information signs, and a trail use register. A picnic or campground may also be a part of the trailhead facility. [NPS]

Trail Prism

The complex three-dimensional volume created by the limits of work above and below the trail extended along the trail's length. [Author]

Trails

Paths or routes of travel by which persons walk or ride into the mountains or other outdoor areas, composed of a tread usually one to two feet wide; a path or track made by the passage of persons or animals; especially, a path made by repeated passage. [WIS]

Trail Transect

A permanent monitoring station set up transverse to the centerline of a trail for the purposes of making repeated measurements of the trail cross section for long term analysis of trail profile, cross section and soils and vegetative changes. [Author]

Trail Width

The proper width for a cleared trail varies with terrain and vegetation. A four- to six-foot clearance suffices in most situations. In thick growth a three-foot clearance may be most practical and possibly even desirable, if it provides a pleasant tunnel effect. [AMC]

Traverse

To ascend a slope by flowing diagonally up and across in lieu of the more direct up and over approach. [PG]

Tread

The surface on which trail movement occurs. [PG]

Tread

The surface portion of a trail excluding backslope, ditch, and shoulder. The tread surfaces could include native material or gravel surface crushed to size. Another tread surface could be soil cement, which is a combination of local trailbed soil mixed with a cement to form a hardened soil cement trail tread. Asphalt is a various combination of asphalt mixes with a controlled blend of small crushed gravel or screened pit run gravel to provide a hard surfaced trail tread. [NPS]

Turnout

A place where the trail is widened to permit trail traffic traveling in opposite directions to pass. [FS]

Untrammeled

Lack of hindrances or impediments to free action; unfettered. [WIS]

Utilitarian

The highest and best physical use to which a resource should be put; practical purpose; that which is necessary; fitness to supply the natural needs of man. [WIS]

Vegetative Trampling

Flattening, or crushing of vegetation as a result of being stepped upon repeatedly by humans on foot or stock. [WIS]

Vertical Alignment

The course of a trail as it ascends or descends a slope. [PG]

Vertical Clearing Height

That height above the trail surface which must be cleared and maintained to allow freedom of trail passage. [PG]

Water Bar

A device for turning water off the trail, usually made of logs, stones, soil cement, or by contouring the native material within the trail prism. An enlarged modification of a dip installed at an angle across the trail base, with approximately a 45 degree skew. [NPS]

Wilderness

Portions of the land which have been designated officially as Wilderness areas under the 1964 Wilderness Preservation Act; de jure wilderness under Federal or other law. [WIS]

Wilderness

Both designated and de facto wilderness areas; areas capable of providing a "wilderness experience." [WIS]

Wilderness Experience

The sum total of the perceived values that accrue to an individual as a result of personal encounter with a wilderness; a generic term used to describe the broadly held, commonly perceived values which accrue to most individuals who undertake a wilderness visit; the ideal set of values a person might gain from a visit to a wilderness with the optimal conditions present. [WIS]

Wilderness Parameters

(Dimensions) Specifically, a list of notions which are generated using a factor analytic technique to arrive at independent clusters of values which in sum total define a wilderness experience. [WIS]

This glossary is taken exclusively from:

US Forest Service. 1973. *National Forest Landscape Management Volume 1*. Washington, D.C.: US Government Printing Office.

Glossary of Landscape Management Terms

Accent

(a) A detail or area emphasized. (b) Emphasis laid on a part of a design or composition. (c) A small detail or area emphasized. (d) An object used for emphasis.

Aesthetic(s)

(a) Generally, the study, science, or philosophy dealing with beauty and with judgements concerning beauty (b) Giving visual pleasure. (c) The theory of perception or of susceptibility.

Amenity

(a) An area or location that provides comforts, conveniences, or attractive surroundings to residents or visitors. (b) A feature, trait, or characteristic that makes for pleasantness.

Association

The mental connection or bond existing between any sensations, perceptions, ideas, or feelings that to an observer have a relational significance with one another.

Asymmetry

(See Balance, asymmetrical.)

Axis

(a) A main line of direction, motion, growth, or extension. (b) A straight line with respect to which a body, figure, or system of points is symmetrical.

Background

The distant part of a landscape, picture, etc.; surroundings, especially those behind something and providing harmony or contrast; surrounding area or surface.

Backlight

Light coming from behind the object being viewed; condition whereby observer looks toward light source; solid objects are in shadow, with highlighted edge.

Balance

(a) Stability produced by even distribution of masses. (b) An aesthetically pleasing integration of elements; harmony.

Balance (symmetrical) (or formal)

An imaginary line drawn vertically through the center of the arrangement will divide it into two equal parts, and each part will appear as the reverse of the other.

Balance (asymmetrical)

Occult balance. Disposition of objects neither similar nor similarly placed but still so chosen and arranged that the sum of the attractions on one side of the vertical axis is equal to the sum of the attractions on the other side.

Beauty

(a) The evident harmonious relationship of all parts of a thing observed. (b) The quality or aggregate of qualities in a thing that gives pleasure to the senses or exalts the mind or spirit.

Canopied

Covered or bridged by the uppermost spreading branchy layer of a forest.

Characteristic

That which constitutes a character; that which characterizes; a distinguishing trait, feature, or quality; a peculiarity.

Codominance

Two dominating features of relatively equal visual importance in one scene.

Color

A phenomenon of light (as red, brown, pink, etc.) or visual perception that enables one to differentiate otherwise identical objects. A hue, as contrasted with black, white, or gray.

Compose

To form by uniting two or more things; to put together; to form, frame, or fashion; to create.

Composition

The putting together and organization of components in a work of art; the product of such organization.

Continuity

Uninterrupted connection, succession, or union.

Contrast

(a) Diversity of adjacent parts, as in color, tone, or emotions. (b) The closer the juxtaposition of two dissimilar perceptions, in time or space, the more powerful the appeal to the attention.

Design

A mental project or scheme in which means to a end are laid down. A good design may be defined as one that allots to each of the relationships a weight proper to the task at hand and combines them as agreeably and efficiently as possible.

Discontinuity

Lack of continuity or cohesion.

Discord

(a) Lack of harmony. (b) Disunity or conflict.

Dominance

Dominant position in an order of forcefulness.

Dominant

Ruling; governing; predominant; exercising great influence.

Edge

The line where an object or area begins or ends; serve as boundaries.

Emphasis

A forcefulness of expression that gives special impressiveness, calls to special attention, or gives special significance .

Emulate

(a) To strive to equal or excel. (b) Imitate.

Enclosed

Enveloped or surrounded; bounded or encompassed.

Ephemeral

Anything lasting but a brief time.

Feature

A distinct or outstanding part, quality, or characteristic of something.

Frontlight

Light coming from behind the observer and falling directly upon the object being viewed; places landscape in full light.

Light

(a) The sensation aroused by stimulation of the visual receptors. (b) Something which makes vision possible.

Line

(a) An intersection of two planes. A point that has been extended; silhouette of form. (b) Any of various things that are or may be considered as arranged in a row or sequence.

Mass

A quantity of matter cohering together so as to make one body, usually of indefinite shape.

Middle distance; middle ground

The space between the foreground and the background in a picture or landscape.

Monotony

Complete repetition; tedious sameness.

Order

(a) The manner in which one thing succeeds another; arrangement, sequence, or succession in space or time. (b) The totality of arrangements composing some sphere of action or being.

Panoramic

An unobstructed or complete view of a region in every direction; hence a complete and comprehensive view.

Pattern

An arrangement of parts, elements, or details that suggests a design or somewhat orderly distribution.

Perception

(a) Man's impression of an object or space as based on past and/or anticipated experiences. (b) Making oneself aware of all conditions and applicable factors; comprehension.

Proportion

The relation of one part to another or to the whole with respect to magnitude, quantity, or degree.

Quality

A degree of excellence; superior in kind; a distinguishing attribute.

Repetition

Units all the same in interest and ability to attract attention, or at least the same throughout in some characteristic.

Rhythm

Harmonious or orderly movement, fluctuation, or variation with recurrences of action or situation at fairly regular intervals.

Scale

Generally a size relationship between an object and its environment or surroundings.

Sequence

A continuous or connected series.

Shape

Spatial form, often two-dimensional.

Sidelight

A light coming from the side.

Silhouette

Any dark shape or outline seen against a light background.

Space

A limited extension in one, two, or three dimensions; a volume.

Subordinate

Inferior to or placed below another in size, brightness, etc.; secondary in visual impact.

Symmetry

Balances proportions; the correspondence of parts in size, shape, and relative position, especially on opposite sides of a dividing line or about an axis (see Balance-symmetrical).

Texture

The visual or tactile surface characteristics of something.

Transition

A passing from one state, stage, place, or subject to another, especially without abruptness.

Unity

A definite quantity or aggregate of quantities taken as one.

Utility

Something designed primarily for use.

Value

Relative lightness or darkness of a color.

Variety

An intermixture or succession of different things, forms, or qualities.

View

Something, especially a broad landscape or panorama, that is looked toward or kept in sight; the act of looking toward this object or scene.

Vista

A confined view, especially one seen through a long passage, as between rows of houses or trees. A vista is often toward, or focuses upon, a specific feature in the landscape. Unlike a view, the vista is sometimes man-created and, if it is, is thereby subject to design.

Visual

A mental image attained by sight.

Appendix EE Role of the Trail Designer and Other Positions

Author's Note: This document was originally written in 1988.

Trail Designer

The trail designer, as quoted in the NPS/CCC Construction of Trails Handbook is the landscape architect and "...is charged with utilizing the scenic features and blending the trail with the landscape...". Utilizing scenic features while blending the trail with the landscape can be a very big challenge, and very rewarding if accomplished correctly.

Trail designers must be willing to undertake this very serious responsibility to utilize the scenic features while blending the trail into the landscape. Modern trail design bridges all of the major design and ecological fields of the day. This includes 'landscape ecology', engineering, architecture, ecology, geology, drainage, design, and construction practices. Trail designers must have an uncompromising responsibility to the trail users, the general public. They also have an uncompromising responsibility to the environment, to the parks and open space lands which the trails traverse. Decisions made must reflect a very dedicated responsibility to preserving our natural resources while allowing minimal yet purposeful access to users.

Trail designers also must be dedicated to the client who may be a park manager or superintendent. The designers' interest will be in communicating various alternatives, providing leadership in discussing merits and associated construction and management costs of each, and other necessary tasks. The trail designer must also have a vision. You must be able to see the future clearly, must be very creative in problem solving, and must be able to trouble shoot in your mind, pro's and con's of alternatives.

A trail designer must also be able to stay out ahead and prepare a project well ahead of any volunteer agency or contractor. At all levels, they must be able to stay ahead of decision makers, park management, directors, and foundations. As you mature as a trail designer, you need to be looking for ways to have an increased impact on trail design as a whole, and maybe not just in your park or agency.

Finally, trail designers must be able to be constantly thinking about future trail connections, potential problems, and research needs in their areas. They also must be able to completely prepare a trail project for construction whether it be by contract or by volunteers.

Qualifications of the Trail Designer

The mature trail designer must be well versed in state of the art trails management with an overview knowledge of recreation facility design to meet the needs of a complex trails management program. An exhaustive list of required skills follows. The entire list is provided that you may see where you fit in the spectrum of trail design, and identify areas where you might grow. It is suggested that you review this list with your supervisor if time and funds permit training or other development opportunities.

Trail planning requires the knowledge of planning techniques necessary to develop preliminary design criteria and standards for a proposed trail route; to analyze and efficiently plan alternative trail routes; to study multiple trail routes and uses in combination; to determine appropriateness of trail corridors; to study alternative routes around impassable areas; to determine related recreational amenity connections such as a highway bike path connections,

connections, or easements across adjacent lands; and to locate necessary and related facilities such as trail heads, bike racks, and restrooms.

Sound ecological knowledge is also required. Some of the skills and knowledge necessary include those related to the identification of soil and vegetative types and ability to predict changes, problems, opportunities over time; to identify drainage patterns and potential drainage problems and related solutions; and to realize implications of ecological values on trail corridors.

Trail design knowledge includes that related to the fields of architecture and engineering to be able to work with these disciplines in locating and designing structures, and buildings; to the physiological and functional requirements of pedestrian, mountain bike and horse trail planning, design and construction, as well as the requirements of snow mobiles; to efficient and professional communications with the local county and state highway departments when pertaining to locating trail heads, relocated highways, or access drives to private property; to draw up cost and time estimates as well as schedules for facility planning and construction; and to develop a maintenance and management schedule for the trail system and its amenities.

Trail construction knowledge required includes that necessary to understand the construction implications of alternative trail locations and design; to understand the building process of each of the structures designed; and to schedule equipment, tools and crews for individual construction tasks.

At times, the trail designer will require good coordination and training program development skills. Being able to efficiently communicate with other agencies or landowners where appropriate to negotiate trail head locations or easements may be required, as well as being able to develop a training program for construction, maintenance, and management of the trail and related facilities in question.

Establishing a Network

Trail designers must be able to establish and maintain a network of trail enthusiasts who can keep them headed in the right direction. They can share new techniques with you, give you advice, refer you to others, and maybe help you solve a problem. You can also attend the annual Colorado Trail Symposium, the biannual National Trail Symposium, and other locally available courses.

As a trail designer you need to be able to say "I don't know", temporarily of course, and go and find out needed answers. Compare yourself to an expert birder who may just get a glimpse of a rare bird. You will hear a lot of "I don't knows" from experienced birders. They will not call a bird unless they are really sure. Yearn to keep learning. Strive to improve all aspects of your toolkit. You also want to know which park areas in your region have the best trails so that you can learn from them.

Trail Duties Framework

The following is the author's suggested responsibilities framework for those developing an entire trails program.

Park Manager [Trail Responsibilities]

- overall trails program management
- interface with other branches/resources/agencies
- vision for future trails program
- programming and budget interface with others

Trails Management Specialist

- yearly trail program planning
- specific trails program responsibilities
- trail condition report
- recommendations for closures/openings
- sign standards
- developing trail planning/design standards

Trails Foreman

- seasonal trail program planning
- scheduling work crews
- insuring material availability
- scheduling tools

Trails Worker

- construction tasks
- maintenance tasks
- management tasks

Park Ranger [Trail Responsibilities]

- patrol
- enforcement
- liability awareness
- very routine maintenance/reporting

Park Technician [Trail Responsibilities]

- simple trail tasks

The following are three job descriptions, the first two from the National Park Service, and the third from the US Forest Service. It is hoped that they will help you develop job descriptions in your own project area.

1) Trails Foreman (NPS)

Nature of Supervisory Responsibility

Serves as the foreman directly responsible for the maintenance and repair of approximately 300+ miles of foot and equestrian trails in _____ National Park.

Responsible for all trails, corral and stock operations.

May be required during off-season to supervise construction projects such as bridge construction, rock retaining walls, or other projects.

Assures continued high quality of the park trail system. This includes timely openings, adhering to established trail maintenance standards, following safe and established construction and maintenance techniques for suspension and truss bridges and retaining walls and other trail structures.

Coordinates work of the trails operation with supervisors of other maintenance units, the district rangers, the Resource Management Specialist and the Research Biologist.

Maintains liaison with military and commercial helicopter units which fly logistic support for numerous trail maintenance projects.

Projects the annual operating trails budget for approval of the Roads and Trails Foreman and the Chief of Park Maintenance by determining the personnel, material and equipment requirements and the general methods and procedures to be used in accomplishing work programs. This includes cyclic, routine preventative, rehabilitation, special projects, day labor contract construction projects, helitack and packing support.

Prepares and maintains _____ National Park's Trail Standards Handbook, trail sign inventory and trail bridge inventory, to assure work planning consistent with cyclic review and maintenance of affected structures and facilities.

Planning

Plans weekly work schedules and sequences of projects for subordinates. Establishes deadlines and priorities, on the basis of program schedules, methods, and policies established by Roads and Trails Foreman. Determines how many trails projects can be done concurrently or which must be delayed, with personnel available to do the work, and the availability of materials and equipment required.

Work Division

Motivates subordinates to operate as an effective working unit.

Explains work requirements, methods and procedures as needed; defines the standards or quality and quantity to be met; instructs subordinates on difficult work operations; reviews

work while in progress or upon completion; and changes work plans, work assignments, and methods as necessary to reduce or control costs, and to accomplish the work of the unit as effectively as possible. Determines equipment, material, and maintenance required.

Identifies deficiencies or problem areas in the park trail system through personal inspections and communications with subordinate trail maintenance personnel. Analyzes needs. Develops and prioritizes work assignments to correct deficiencies in accordance with: (a) the health and safety of the trail user and (b) the protection of the park resource.

Administration

Establishes performance standards of subordinates, makes appraisals of their work performance, prepares final evaluations and ratings, and determines training needs. Initiates reassignment of individuals or crews. Counsels subordinates.

Adjusts informal complaints and grievances through discussion with employees. Initiates time, tour of duty, overtime, environmental differential, inventory and purchasing records for personnel under his/her supervision and submits other reports as requested or required.

Is under the direct supervision of Roads and Trails Foreman. Work is reviewed by supervisor to assure it is performed in accordance with park standards and requirements. Incumbent has full supervisory responsibility for control over work operations and subordinates, and is accountable to his/her superior for the quantity and quality of the work done. He/she is responsible for assuring the efficient and economical accomplishment of work assignments by subordinates.

Non-Supervisory Requirements

Possesses journeyman level and specialized skills such as drilling and blasting, masonry work, equipment repair and maintenance, and heavy equipment operation. Incumbent must be thoroughly familiar with packing and pack techniques and horsemanship. Operates gasoline powered machinery, such as generators, rock drills, and chain saws. Is familiar with the safe and proper method of: falling and bucking logs and handling, transporting, and safely storing dynamite and other blasting materials. Possesses current blaster's permit and Federal operator's permit. Has knowledge of safety requirements in sling loading helicopters.

During Winter, the incumbent is required to operate snowplows up to 32,000 CUW in snow removal operations; loaders to 2-1/2 cubic yards for snow removal and loading sand; small bulldozer to open trails and maintain walks and ski areas; dump trucks with sander equipment for snow and ice control; rotary snowplows; and road graders.

Works outdoors and at times in extreme temperatures. Is required to work in dusty, dirty, hot, rainy conditions. The incumbent may have to work in heavy rain, falling snow, and blizzard conditions. Works in rough terrain and around hazardous conditions, subject to falls, sprains and cuts. Exerts heavy physical effort in moving logs, shoulders, bridge materials, and packing trail materials. Is required to carry a heavy pack and hike up to 20 miles a day.

Incumbent must also possess experience in trail maintenance and must be knowledgeable about the impacts of trail construction and maintenance operations on the park resources.

Size and Level of Workforce Supervised

2 - Laborer Foreman

4 - Laborer Leaders

1 - Maint. Wrkr. (Ldr)

20 - Laborers

1 - Animal Packer

EEO

As a Supervisor, incumbent is responsible for ensuring equal opportunity for all employees supervised in the selection of employees for training, promotions, awards and recognition, and other career development opportunities. Ensures fair and unprejudiced employment practices in the recruitment and selection of candidates for appointments to positions supervised.

Is responsible for supporting programs relating to the training and the advancement of employees in dead-end positions. Is responsible for actively supporting the Equal Opportunity Program in day-to-day activities and will be evaluated on personal performance in this area on a regular basis.

Safety

Is responsible for the on-the-job safety and health of all employees supervised. Initiates efforts conforming to established local and Bureau Safety Programs to satisfy this responsibility. Responsibilities include identifying and correcting job safety health hazards, instructing employees on safety requirements for job assignments, reviewing and reporting loss incidents in accordance with Bureau of Office of Employees' Compensation regulations, initiating corrective measures for violations of the Occupational Safety and Health Act standards, and directing the periodic inspection of all workplaces.

2) Roads and Trails Foreman (NPS)

A. Nature of responsibility

The incumbent is responsible for the supervision of maintenance and repair of roads, roadsides, ditches, culverts, bridges, overlooks, and parking areas. Due to the remote location and high elevation to the _____ Highway, it is a prime responsibility to manage and coordinate independently with cooperating agencies the opening and closing of the highway during severe blizzards and snowstorms, to direct emergency operations, and maintain a high degree of safety for the public. This is an unusual responsibility since the incumbent operates outside of National Park Service legal jurisdiction on portions of what essentially are both _____ and _____ State highway systems.

B. Planning

The incumbent plans and schedules work according to priority and available funds, consolidates and implements work projects and materials requested by subordinate crews. He plans overall work schedules to eliminate overtime, hangups, and delays in work accomplishments. Submits to unit maintenance supervisor existing and proposed workloads and backup materials to base future programs.

C. Work direction

The incumbent supervises and coordinates work in and between work groups in his/her own area and others, provides supervision and directs emergency operations when needed. Inspects completed work and corrects inadequacies. Directs safety programs within own area, providing for talks, instructions, and demonstrations. Strives for a high standard of quality and production as set by the maintenance supervisor.

D. Administration

Incumbent maintains daily time and attendance and monthly equipment reports, provides program and planning information to the supervisor, and makes studies of manpower and equipment needs. Keeps supervisor and crews informed of changes in rules, regulations, and policies, and administers the same. Investigates, prepares, and coordinates accident reports for own area. Accepts broad responsibility as part of the management team.

E. Non-supervisory duties

The incumbent is required to operate all types of snow removal equipment, graders, and trucks, filling in as engineer equipment operator, WG-10, and motor vehicle operator, WG-7. During winter season, operates snow plow from northeast entrance. Sixty percent of time spent is in non-supervisory duties.

F. Size and level of work force supervised

Incumbent supervises for 6 months or more an engineer equipment operator, (1); engineer equipment operator, (2); motor vehicle operator, (1); and laborers, (2).

G. Supervision and guidance received

Incumbent receives instructions from the north unit manager either in oral or written form. He has to rely largely on his own judgement as to techniques and procedures balanced with available resources to accomplish assigned tasks for projects. Because of the isolated location and climatic conditions, incumbent functions more on the level of an independent unit. Maintenance will be accomplished according to standards set forth in the maintenance handbook, standard specification of road and bridges BPR, and other standards set forth by the chief of park maintenance.

H. Equal employment opportunities

As a supervisor, incumbent is responsible for ensuring equal opportunity for all employees supervised in the selection of employees for training, promotions, awards and recognition, and other career development opportunities. Ensures fair and unprejudiced employment practices in the recruitment and selection of candidates for appointments to positions supervised. Is responsible for supporting programs relating to the training and the advancement of employees in dead-end positions. Is responsible for actively supporting the Equal Opportunity Program in day-to-day activities and will be evaluated on personal performance in this area on a regular basis.

I. Safety

Is responsible for the on-the-job safety and health of all employees supervised. Initiates efforts conforming to established local and Bureau safety programs to satisfy this responsibility. Responsibilities include identifying and correcting job safety and health hazards, instructing employees on safety requirements for job assignments, reviewing and reporting loss incidents, in accordance with Bureau of Office of Employees' Compensation regulations, initiating corrective measures for violations of the Occupational Safety and Health Act standards, and directing the periodic inspection of all work places.

J. Labor management relations

Regardless of the status of local employee organizations, is responsible for being knowledgeable about management's role and responsibilities in labor management relations. Where a local agreement is in effect, is responsible for becoming completely knowledgeable of the terms of the agreement.

3) Trails Specialist (USFS)

The position is located in the Recreation Department of the Multi-Resource Section of the _____ National Forest. The incumbent serves as a trails program manager with the responsibility for providing trail planning, program review, trail program development in construction, reconstruction, and maintenance on the forest's _____ miles of system trails.

Trail System Administration

Administers the Forest trail maintenance/construction program. Prepares short and long range trail management plans and provides the technical expertise in developing interdisciplinary access management plans for the Forest. Works with each district to coordinate the district programs. Provides training and technical advice to districts as needed. Works with districts to incorporate district input into the Forest trail management system.

Performs trail log, condition, and prescription surveys; develops cost estimates for trail maintenance, rehabilitation, reconstruction, and construction projects; prepares project work plans; and develops contract or force account work documentation. Reviews district surveys and progress to ensure completeness and compliance with program plans.

Monitors Forest Trail Program to ensure that management plans, NEPA documentation, and wilderness management requirements are met.

Prepares annual trails management project planning documents and performs budget analysis to ensure completion within budget requirements. Develops and maintains project cost data for historical records and use in program planning. Reviews district program proposals for compliance with regional and Forest directions.

Responsible for review of program plans, supporting program documentation, and accuracy of accomplishment reports of programs. Provides technical training to trail crew foreman and trails personnel in current planning, maintenance, and construction techniques.

Acts as contracting officer's representative (COR) and/or inspector for trail survey, maintenance, and construction contracts administered by the unit. Prepares trail survey, maintenance, reconstruction, and construction contract specifications, reviews all Forest trail contracts for technical accuracy and uniformity.

Develops and maintains standard uniform exhibits for Forest force account and contractual trail work.

Serves as the coordinator of information related to low impact camping and low impact horse and pack stock use. Becomes aware of new techniques and equipment and helps provide information for such as they become available.

Provides the technical expertise in packing to provide for primitive skills in freighting trail construction/reconstruction and maintenance tools and supplies (i.e., lumber bunks, trail plows, and skids).

Provides the technical expertise in review of primitive skills needed to maintain trails and facilities in wilderness. This includes trail construction, bridge construction, building construction and maintenance.

Forest Blaster

Serves as Forest certified blaster providing technical supervision, coordination, and training to other forest trail and wilderness personnel who are either blasters-in-training or certified blasters. Will be responsible to ensure that state and Federal regulations are met in uses and storage of explosive materials for projects under his supervision.

Forest Recreation Sign Coordinator

Serves as the Forest recreation and trails sign coordinator and works closely between the Forest sign coordinator in engineering and with district trails/recreation sign coordinators to ensure trail/recreation sign plans are developed and that signs are maintained to the proper standards of each unit.

Trail System Planning

Maintains the Forest RIM trail inventory by monitoring and tracking the district data and update requests. Provides leadership in completing Forest transportation B maps for trail systems. Takes an active part in access management analysis and documentation.

Factor 1 - Knowledge Required by the Position

A working and technical knowledge of trail survey, maintenance, rehabilitation, construction and reconstruction objectives, standards, and operational techniques.

A working and technical knowledge of trail transportation planning, location, survey, design, cost estimation principles, and contract preparation.

A working and technical knowledge of trail program planning including access management, maintenance planning, and funding.

A working and technical knowledge of trail log, condition, and prescription surveys.

A basic understanding of the preparation/interpretation of project work plans and other budget/accounting documents used to support present and outyear budget records.

A knowledge of trail contract documentation, compliance review and enforcement with the ability to serve as COR or project inspector.

Knowledge in effective communications (both oral and written) techniques and demonstrated intrapersonal communications skills as used in completing inspections, reporting and crew training.

A working knowledge of proper stock management, handling, and care techniques.

A working and technical knowledge of wilderness administration policies, direction, and regulations as they pertain to trails and trail uses.

Have and maintain primitive skills in trails, outdoor recreation, and horsemanship.

Technical knowledge regarding the uses and limitation of explosives as they relate to roads, trails, and fire line construction/reconstruction.

Technical knowledge of the development and maintenance of trail/road signs as they relate to purchase, maintenance, and installation.

Factor 2 - Supervisor Controls

The supervisor for this position is the recreation specialist in charge of recreation, trails, and wilderness plans, programs, and budget.

The supervisor furnishes general objectives, reviews priorities for completion, and reviews expected timeframes for completion of approved projects. The supervisor is available for advice and consultation when necessary. Employee must make on-the-job decisions regarding the adequacy of work and compliance with approved plans and specifications.

The supervisor meets with the employee to review quality and quantity of completed work and to adjust work priorities as conditions change.

Factor 3 - Guidelines

Guidelines include Forest Service manuals and handbooks, policy memorandums, oral and/or written work plans, approved land use and special area management plans, legislative acts (Wilderness Act), and Federal and state laws and regulations.

The incumbent is expected to select methods or approaches to accomplishing assigned tasks which are consistent with these established guidelines.

Factor 4 - Complexity

The work involves considerable recurrent tasks in a variety of functional fields including trail system maintenance, construction, access management (transportation system planning), system management, and supervision of seasonal work crews. The complexity is compounded by size of forest and limited access to 60 percent of the land base, by the geology and the fragile, highly erosive soils, and the management direction of three separate wilderness's.

The complexity is compounded by vastness of its bridge inventory with the variety of bridges varying from 20-foot native footbridges to large suspension bridges.

The varied users groups and needs of each user group, varying from snow trails to motorcycle-ATV and pack stock to hikers.

The Forest administers over 1,800 miles of Nation Forest System trails on 1.8 million acres.

The incumbent must be able to analyze field situations; apply the referenced guidelines to the situation; and respond appropriately to actions needed and/or recommendations for corrections of substandard conditions.

Factor 5 - Scope and Effect

The purpose of the work is to provide technical support in meeting unit objectives in the administration of the Forest trail systems.

Factor 6 - Personal Contacts

Contacts are with: special use permittees, contractors, wilderness users, and co-workers. Contacts may be either oral or written.

Factor 7 - Purpose of Contacts

Contacts are made to provide technical assistance to district trail coordinators.

Contacts will be made with different user groups to inform and acquire involvement of user groups in Forest trail system management.

Factor 8 - Physical Demands

The work involves extended walking; riding of snowmobiles or motorcycles; and/or horseback riding over rough mountainous terrain on steep, winding, and narrow trails.

The animal use task also involves lifting of heavy loads (60-120 pounds) and frequent bending. The trail administration task involves some uses of hand tools such as cross-cut saws and grub hoes. Such handtool use requires bending and use of the hands and upper body.

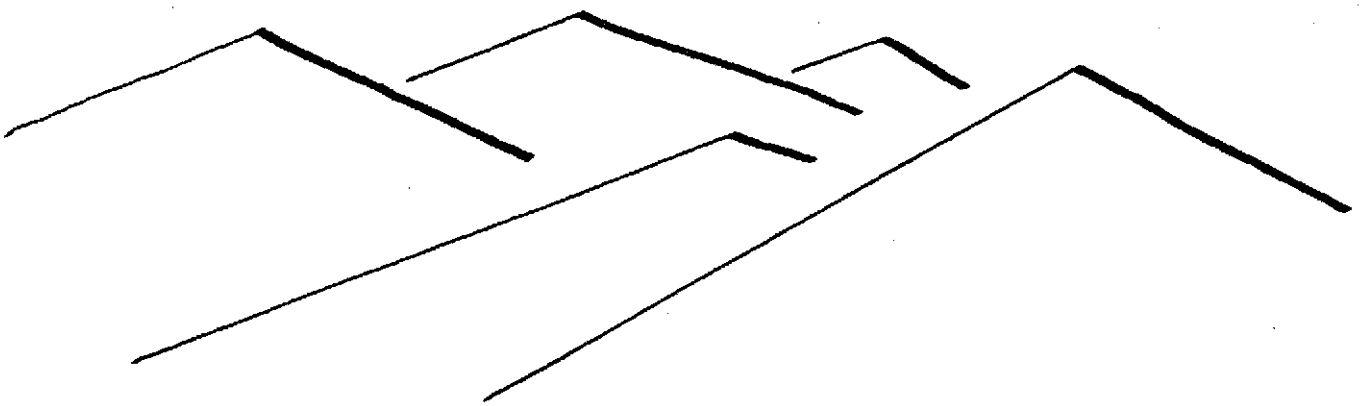
The day-to-day work will require the employee to spend considerable time in primitive camping environments with limited conveniences and sanitation.

Factor 9 - Work Environment

The work takes place both in field and office situations. From April through November the tasks require the employee to be generally in a field situation. This situation is normally in a setting where transportation is limited to foot or horseback.

Trail work often includes use of high explosives and heavy mechanized power equipment.

Other hazards include exposure to inclement weather, falling, possible hand tool injuries, possible stock handling related injury, and lack of potable water in many areas.



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BACKCOUNTRY RECREATION MANAGEMENT

Over half of the NPS units include large undeveloped areas which provide opportunities for backcountry recreational activities. In fact, a number of NPS areas were established primarily for the recreational opportunities they offer. Types of backcountry recreational activities that may be allowed include, but are not limited to, boating, camping, day hiking, overnight camping, horseback riding and pack stock use, picnicking, scuba diving, cross-country skiing, caving, hunting, mountain and rock climbing, snowmobiling, off-road vehicle use, bicycling, and swimming.

DEFINITIONS

Backcountry As used by the NPS, this term refers generically to "primitive, undeveloped portions of parks" (Management Policies 8:3). While backcountry areas are most often zoned as natural zones, backcountry areas may occur in any land classification zone, except the developed zone. Any area designated or determined eligible for wilderness designation is considered to be backcountry. Developments within backcountry areas are generally limited to trails, unpaved roads, and administrative facilities associated with dispersed recreational use. Dispersed recreational use is the most prevalent human use in backcountry areas.

POLICY AND PROGRAM OBJECTIVES

NPS policy recognizes that providing for visitor recreational use has been a fundamental purpose of NPS areas since the establishment of Yellowstone National Park in 1872. The NPS Management Policies states:

> The National Park Service will encourage recreational activities that are consistent with applicable legislation [and] that promote visitor enjoyment of park resources through a direct association or relation to those resources. (8:2)

Most of the recreational use in parks occurs in developed areas (e.g., along road corridors, day use areas, campgrounds). In the management of recreational activities, the NPS is guided by the following objectives:

1. protection of both natural and cultural park resources and natural processes, including prohibition of consumptive uses of park resources except where authorized by law or regulation,

2. protection of unique or important backcountry recreational opportunities by avoiding inadvertent changes in the recreational experience,

3. provision of a varied spectrum of backcountry recreational uses as appropriate in the diverse NPS areas, and

4. avoidance of unacceptable levels of danger to the welfare and safety of the public, including recreational participants.

Limitations imposed on recreational uses should be the minimum necessary required to achieve these objectives. Where practicable, any restrictions should be based on the results of research. Appropriate tools for managing recreational activities may include plans for backcountry, river, cave, and other recreational uses; general or special regulations; permit and reservations systems; and local restrictions implemented under the discretionary authority of the superintendent. "The Park Service will seek consistency in recreation management policies and procedures on both a servicewide and interagency basis to the extent practicable." (Management Policies 8:2) Because of extensive variation in both the physical environment and nature of recreational use across the National Park System, it is not envisioned that a single set of resource impact standards or use level standards can be established. Each superintendent should develop standards based on research and input received through the planning process. These standards should have some relevancy to other parks with similar conditions. "The National Park Service will identify acceptable limits of impacts, monitor backcountry use levels and resource conditions, and take prompt corrective action when unacceptable action when unacceptable impacts occur." (Management Policies 8:3)

AUTHORITIES

In addition to the general authorities discussed in Chapter 1, backcountry management is affected by the National Environmental Policy Act (NEPA), the Wilderness Act, the Wild and Scenic Rivers Act, the Federal Cave Resources Protection Act, the Alaska National Interest Lands Conservation Act, Executive Order 11644 "Use of Off Road Vehicles on the Public Lands," the National Historic Preservation Act, and park-specific enabling legislation.

A number of sections of the NPS general regulations (36 CFR Parts 1-5 and 13) relate to backcountry recreational use management. Parts 2, 3, and 13 of the regulations are particularly relevant. General regulations addressing aircraft use, off-road bicycling, hang-gliding, off-road vehicle use, and snowmobiling require that special regulations be developed before these uses may be authorized in a park. (Special provisions pertaining to some of these activities in Alaskan parks are codified in 36 CFR Part 13.) Any recreational activity may be further regulated by restrictions imposed under the superintendent's discretionary authority (36 CFR 1.5) and by special regulations (36 CFR 7 and 13).

RELATIONSHIP TO OTHER GUIDANCE

Policies and guidelines which relate directly to management of backcountry recreational use are numerous. The portions of NPS Management Policies which are most relevant include sections of Chapter 8 regarding visitor use and all of Chapter 6, covering wilderness management. Specific NPS guidelines which are relevant include NPS-4, the Diving Management guideline; NPS-53, the Special Park Uses guideline; NPS-12, the Environmental Compliance guideline; and NPS-2, the

Planning Process guideline. The NPS Trails Management Handbook, 1983, provides guidance on maintenance and construction of trails. In this Guideline, see especially Chapter 3, Grazing, Hunting and Trapping, and Fishing; and Chapter 4, Special Park Designations and Environmental Compliance.

PROGRAM GUIDANCE

I. Backcountry Recreational Use Planning

A. General Guidance

Each area with a sufficient level of backcountry recreational use must develop the necessary backcountry recreational use management plans. Several options exist for completing these plans. The plan can be a component of the park general management or resource management plan; it can be a single integrated plan which addresses a broad spectrum of recreational activities, such as a park backcountry management plan, which discusses all backcountry recreational uses; or it can be an activity-specific document such as a river use management plan, a cave use management plan, etc.

For most parks with significant levels of backcountry recreational use, the relatively brief discussion contained in general management or resource management plans will not be adequate. These parks will require the preparation of broad spectrum and/or activity-specific plans. The scope of these plans will vary from park to park. In some parks, a single plan may be adequate to address all types of backcountry visitor use; in other parks, activity-specific plans may be required; and some parks may have both broad spectrum and activity-specific plans. Specific types of backcountry recreational use plans most often prepared are trail stock use, cave use, river use, backcountry use, and off-road vehicle plans for beach use.

By definition, any recreational use will result in some level, perhaps unmeasurable, of impact. Therefore, the backcountry planning process is not so much a process of determining how to prevent any human-induced change as one of deciding how much change will be allowed to occur. Determining appropriate use levels is a technical procedure only in limited cases, such as protecting endangered species or National Register of Historic Places properties, where resource protection goals are absolute. In other cases, integration of research data, management constraints, and citizens' interests must be combined to achieve a successful plan. One widely accepted method for accomplishing this is the limits of acceptable change model developed by the U.S. Forest Service.

In the development of backcountry recreational use plans, it is critical that the plan focus on the visitor use as opposed to focusing on developments being considered to facilitate that use. While it may be true that the actual developments cause the greatest environmental impact, it is critical to remember that developments are only constructed in support of the recreational use and are not

the final goal of the planning effort. It would be inappropriate, for example, to complete a trail development plan for an area without first completing a visitor use plan for that same area.

While plans are necessary for proper management of backcountry use in many situations, restrictions contained in these plans should be the minimum necessary. Any restrictions on use should directly relate to the accomplishment of specific management objectives identified in the plan, or resolve specific, documented impacts. Where restrictions are imposed, they should be implemented on a graduated scale from indirect controls such as public education and trail relocation to direct controls such as use limitations and area closures.

A wide range of preferences for recreation use opportunities exists among NPS visitors. The wide diversity of resource opportunities and settings found in parks provides the opportunity for a broad segment of the public to pursue the particular recreational experiences they are seeking. These recreation use opportunities are defined by various physical, biological, managerial, and social conditions. Each of these conditions can be best characterized as a continuum. For example, access can range from paved highway access to remote trailless areas. High quality recreation experiences can be derived at any point along this continuum, depending on the values of the recreationists. Superintendents should develop an understanding of the various conditions, both existing and desired, and ensure that actions taken preserve desired recreational opportunities and avoid unacceptable impacts on visitor expectations.

One common technique for preserving this diversity of high quality experiences is the stratification of use levels through zoning. In developing backcountry use management plans, zoning has proven useful as a means of achieving management objectives and providing different experiences for satisfying various user demands. Managers may want to establish different recreational use zones ranging from areas with high concentrations of use to pristine areas with very little use. This management concept has broad applicability from management of boating to off-road vehicle use to river use.

Persons assigned responsibilities for preparation of backcountry recreational use plans should have both educational and practical experience in managing visitor recreational use. In addition, depending on plan complexity, expertise in the following areas may be needed: natural resource management, planning, environmental compliance, cultural resource management, law enforcement, interpretation, maintenance, and concessions management. Most plans will be completed at the park level with input from the regional office. On unusually complex plans, assistance of the Denver Service Center should be considered.

Public participation is essential for the development of a successful plan. The amount of public involvement will have to be determined on a plan-by-plan basis. Key publics to be involved besides the particular recreational user or special interest groups affected include adjacent landowners/managers, persons engaged in other recreational activities which could conflict with activities being considered (e.g., hikers should be involved in the development of a stock use plan), concessioners, conservation organizations, local communities, and park support groups. The most

important times during the planning process to seek public input are at the beginning of the planning process, in the scoping of issues and development of management objectives, and in the review of the draft plan/compliance document. Information to be sought from the recreational users includes identification of unique aspects of the recreational experience; facility needs; user expectations, motivations, and satisfactions; and threshold values for specific resource impact values and social parameters which could be used in the development of specific management objectives.

All backcountry recreational use management plans are public documents developed through a sequential planning process. Compliance with the NEPA through preparation of an environmental assessment or an environmental impact statement, depending on the level of impact associated with the proposed action, is required on all plans. Since a major purpose of the compliance document is to assist in the decision-making process by analyzing alternative actions, it must be prepared prior to the final plan except under special circumstances. The compliance document can be either a separate document or integrated with the draft plan. Copies of all final plans should be sent to the Technical Information Center at the Denver Service Center for accessioning into NPS records.

B. Specific Plan Requirements

The following 11 topics should be addressed in all visitor backcountry recreational use planning efforts. However, these documents may summarize more extensive discussions contained in the environmental compliance document.

1. Previous Planning History

The status of previous plans applicable to this effort should be discussed. This section should outline key changes proposed in any previous plans. The strengths and weaknesses of previous plans should also be outlined, as should the reasons for initiating a new planning effort.

2. Authorities

The plan should reference the relevant authorities, including a brief discussion of all laws of general applicability and more detailed discussions of directly relevant and park-specific laws. The detailed discussions should consider relevant legislative history, including House and Senate reports and statements made by sponsoring legislators. NPS management policies must be reviewed and referenced as applicable, as should any appropriate guidelines and regulations.

3. Critical Resources

The plan must identify any critical resources which could be impacted by visitor recreational activities or associated developments. This should include natural and cultural resources as well as important aspects of the visitor use experience. The plan must discuss the current condition of those resources and whether or not mitigation is currently needed to achieve management objectives. Prior to approval of the plan, adequate information on critical resources must be

developed to determine the likelihood of potential impact. Surveys for endangered species and associated critical habitat and archeological resources must precede implementation of any actions with possible adverse effects.

4. Visitor Use Analysis

The plan must discuss trends in visitor use activity levels and should discuss any changes over time of the visitor experience. The plan should include both historical data and projections of future visitation. Future visitation projections should be based on past local experience, regional and national trends regarding the particular recreational activity, and demographic projections based on the visitor profile, and should include identification of factors influencing visitation and the appropriate level of impact the factors have on visitation.

The plan should also provide a sociological profile of the recreational visitors. The expectations and satisfaction of recreational users should be identified along with any existing concerns regarding the recreational experience. It is not envisioned that exhaustive sociological surveys will be required to develop this profile, but where they are required, approval from the Office of Management and Budget must be sought.

5. Regional/National Context

The plan must identify how the particular activity relates to other recreational opportunities either locally or nationally. Is this an activity for which there are abundant other opportunities to participate locally or is this an activity with unique qualities which need to be preserved? Where appropriate, interagency planning and management strategies will be pursued as part of this planning process to provide continuity to the visitor experience.

6. Existing Facilities

The plan should identify all existing facilities in the backcountry. These facilities should be described verbally as well as presented on a map. Where feasible, this should include the location of all trails as well as any physical developments. The current uses of these facilities should also be outlined.

7. Specific Management Objectives

The specific management objectives should be described and linked to critical resources identified through the park's resource inventory program or through the public involvement process on the plan. These objectives should be specific enough to enable the park to measure them.

One of the most important management objectives that needs to be developed for each plan relates to the determination of appropriate use levels. The objectives should outline how much resource degradation will be acceptable to park management. Research findings in the fields of physical,

biological, and social science can be used as guides for determining the importance of various impact levels. However, managers will usually need to consider public input and management considerations such as cost, personnel requirements, and logistics before arriving at final use level determinations.

8. Action Plan

This is the heart of the plan. It contains the prescription by which the park will achieve the management objectives. The action plan must identify the range of remedial actions to be undertaken if the management objectives are not being achieved. The action plan should also contain an identification of any facilities which are necessary to support the recreational activities or other park management needs. The type and number of facilities should be limited to the minimum necessary to achieve a park's backcountry management objectives. Maintenance considerations (e.g., life cycle costs, accessibility, technology requirements) for all backcountry facilities must be fully analyzed. Construction materials used should harmonize with the park environment. Program responsibilities and funding requirements for carrying out the plan's provisions should be identified. This section of the plan should also discuss administrative actions that will occur in the backcountry, such as aircraft use and research projects. Timing for implementing the various actions outlined in the plan should be identified. Public education efforts should be discussed.

9. Commercial/Concessioner Activity

Based on the management objectives developed and public input, a determination should be made as to whether a concession operation is required. The plan should contain a written analysis of whether a concession operation is necessary and appropriate.

10. Monitoring Program

The plan must outline a monitoring program which will be used to determine whether the management objectives are being achieved. The monitoring program must be capable of identifying specific mitigation actions directed at specific locations, periods of time, and types and amount of visitor use. The plan should identify the offices responsible for implementation of monitoring.

11. Plan Review and Update

The plan must identify the procedures for updating. This should include the frequency of plan review, or identification of the conditions which would require a plan review. Unless conditions are particularly constant, the life of recreational visitor use plans should not exceed 10 years. Most plans will need to be reviewed in depth at a three to five year interval. The necessity for additional compliance under the NEPA should be addressed in all plan revisions.

C. Special Types of Plans

1. Wilderness Management Plan

Each park with designated wilderness is required by NPS Management Policies to develop a wilderness management plan. This plan will preferably be an integrated plan which addresses all visitor recreational uses (e.g., hiking, stock use, caving, river use) and other ongoing or projected activities in the wilderness area. All wilderness plans must be reviewed and approved by both the regional and Washington Offices in order to ensure nationwide consistency.

A separate wilderness plan is not required for areas where the Administration is recommending wilderness or where wilderness designation is pending in Congress. In those situations, the recommendation itself provides the basic management direction. In accord with NPS policies, parks must not implement actions or programs that are inconsistent with that recommendation until Congress has made a final determination.

The central objective of every wilderness plan should be ensuring perpetuation or restoration of the wilderness character of the area. Designated wilderness requires higher standards for protection of the visitor experience than would normally be found in backcountry plans for park areas managed as natural zones. Therefore, upon wilderness designation, each park must review its current backcountry visitor management plans and make a determination as to whether those plans provide for "outstanding opportunities for solitude" as well as the other legal requirements of the Wilderness Act and park-specific wilderness designation. Recreational activities to be emphasized in wilderness should be those that depend to a significant degree on wilderness settings or conditions. Where recreational use conflicts occur, uses that depend most on wilderness should be favored. Management activities should strongly favor preservation of wilderness values over other potential uses.

a. Motorized Equipment Use

One of the important issues which needs to be addressed in all wilderness management plans is the administrative use of motorized equipment. While limited use of this equipment may be allowed when justified in wilderness, this does not imply that such use is compatible with wilderness values. Use of motorized equipment must be discussed in detail in a programmatic fashion in the plan or in a subsequent written request to the superintendent or Regional Director. Written approval for use of equipment can be provided on either a project or program basis. For example, chain saw use for a specific type of trail maintenance during certain time periods would need to be approved only once.

Motorized equipment and aircraft may be used for an emergency situation involving human health or safety or protection of wilderness values without going through the approval process, but a contingency plan for this should be outlined in the wilderness plan itself. Any administrative use of aircraft over wilderness below 2000 feet above ground level must be approved in writing by the

superintendent (unless it is specifically contained in the park's general management plan or wilderness management plan or authorized by law).

An exception to this policy occurs in Alaska: motorized equipment use is permitted in Alaska in all designated wilderness areas, subject to appropriate regulation, for all traditional activities and for travel to and from villages and homesites. This includes snowmachines, motorboats, and airplanes. For further information on the specifics of use of motorized vehicles in Alaska, refer to the Alaska Native Interest Lands Conservation Act of 1980 and special Alaska park provisions in 36 CFR 13. For park-specific information, consult the general management plan.

Each written request to the superintendent for the use of motorized equipment in wilderness must be accompanied with an analysis which includes an outline of the project, options for completing the project, and description of the preferred option and mitigation actions. The discussion of the project should include a clear statement of the nature and quantity of work to be done. It should also outline whether the project relates to the wilderness management plan and management objectives for the area. A discussion of compliance with the NEPA and other environmental laws should be included.

The range of alternatives discussed should include as a minimum:

1. the no action alternative, or what will happen if the project is not implemented,
2. implementing the project without motorized equipment,
3. use of the minimum amount of motorized equipment, and
4. the preferred action (if different from alternative 3).

The comparison of alternatives should discuss environmental, social, and management impacts (e.g., costs and personnel requirements) of the alternatives as well as the relationship of the proposal to adjacent land uses. Note that economic considerations alone will not be adequate to justify use of motorized equipment. The discussion of the preferred option should include all appropriate mitigation actions.

2. Cave Use Management Plan

Caves often contain cultural, paleontological, biological, and/or geological resources which are essentially nonrenewable. In recognition of this, cave use management plans for areas with numerous cave resources or particularly outstanding cave resources should consider a full range of use levels. These use levels should range from caves which are open to all human use without permit to caves which are closed to all use including management and research use. See also, Chapter 2, Cave Resources Management.

3. Stock Use Management Plan

Discussed in Chapter 3, Grazing.

II. Management Issues and Strategies

Management of backcountry recreational use programs often requires intervention by superintendents to address problem issues and concerns. As a general rule, and depending on the severity of environmental impacts, the level of management intervention exerted in addressing these issues should be on a graduated scale from indirect to direct methods.

Indirect methods to be applied include providing information and education to visitors about other recreational opportunities or impact limiting techniques, rehabilitation of impacted sites, trail delineation or improvement, signing, rerouting of primary transportation corridors away from major destinations in combination with establishment of spur trails to attraction sites, and strategic location and design of developments (e.g., number of parking spaces, additional trail construction, road improvements, designation of campsites).

Management techniques which provide for direct control of recreational use are usually based on some type of rationing or limitation. The most common forms of rationing include limits on types of recreational use, numbers of users, party size, activities such as campfires and use of mechanized equipment, timing of use, and location of use. Backcountry use permits are generally required in order to implement use limitation plans. However, these permits should only be used when limits on use are needed to prevent specific impacts and after indirect control methods have failed; to assist the visitor in pre-planning a trip; for providing critical safety information regarding climatic, geologic, wildlife, disease vectors, or other hazards; or for limited periods of time to gather basic visitor use data. These permits should not be required for the general purpose of controlling visitor use.

The six most common backcountry management issues are trail deterioration, campsite deterioration, littering, crowding and visitor conflict, human waste, and wildlife impacts. Deterioration of trails and deterioration of campsites are the most common and widespread impacts in backcountry settings. Each of the six management issues is discussed in detail below, along with various management techniques appropriate for addressing them.

A. Trail Management

The majority of environmental impacts from recreational trails results from inappropriate trail construction and maintenance. Thorough site analysis, careful planning and design, and thoughtful maintenance and monitoring, guided by the concept of sustainability, will benefit backcountry resources while affording a reasonable standard of safety and comfort for the traveler.

1. Sustainability

Sustainability of backcountry trail corridors is defined as the ability of the travel surface to support current and anticipated appropriate uses with minimal impact to the adjoining natural systems and cultural resources. Sustainable trails have negligible soil loss or movement and allow the naturally occurring plant systems to inhabit the area, while allowing for the occasional pruning and removal of plants necessary to build and maintain the trail. If well built, a sustainable trail minimizes seasonal muddiness and erosion. It should not normally affect natural fauna adversely nor require re-routing and major maintenance over long periods of time.

2. Planning

One key to ensuring long-term trail sustainability is identifying new and rebuilt trails projects in relevant planning documents such as a general management plan (GMP), a development concept plan (DCP), and/or an interpretive prospectus (IP). This ensures the involvement of an interdisciplinary planning team. Each project should include information on site topography, soils, visitor trip origins and destinations, design guidelines, and anticipated maintenance strategies. Backcountry management plans should be coordinated with related plans, such as sign plans. Good planning can avoid problems such as steep grades and erosion, which destroy sustainability.

Factors which must be considered to achieve trail sustainability include soil types, the grades of the trail profile relative to existing cross-slopes, surface moisture and drainage, solar aspect, exposure, types and seasons of use, use volumes, desired design and maintenance standards, ecological implications for trailside vegetation, and functional and aesthetic control points (trailheads, scenic views, lakes, etc.). Planners should develop sustainability criteria tailored for each trail project which provide a reference point from which the achievement of future accomplishments can be measured.

3. Design and Construction

Experience in trail design, construction, and management is essential for implementing projects that involve poor soils, complex topography, high levels of use (especially when stock animals are involved), and extensive improvements, such as surfacing or structures. Experience is also essential to design multiple use trail corridors to meet standards which allow safe use of the trail.

Two of the most common problems of backcountry trails--deterioration through overuse of popular trails and the development of undesired routes at popular destinations--can be avoided by drawing on personnel with trail design and management experience and by following commonly accepted standards of trail design after thorough field study. Observing proposed or existing routes through several seasons, including winter, will assist the planning team in determining the fitness of new corridors for trail development, as well as the level of improvement or rerouting required to achieve sustainability for rebuilt trails.

Design guidelines can aid in decision-making on specific trail locations at different levels of improvement. A simple outline, with supporting sketch plans and views is usually sufficient to describe the desired criteria, trail segments, trail destinations, nodes, natural and cultural resource points of interest, design intentions, design and construction standards, and the anticipated investment in improvements.

There are a variety of factors necessary for a sustainable, low-impact trail. For example, sidehill trail design is the surest way to prevent erosion. Cross-slopes for backcountry trails should range between 10% and 70%. The maximum grade for natural-surface trail is about 12%. By carefully fitting the trail profile to the local topography, erosion will be minimized, thus increasing the durability and sustainability of the natural surfaces.

The grades of sustainable trail surfaces are almost always less than 15% and should be less than 1/4 the prevailing adjoining cross-slope. The maximum grade of a length of a trail should also vary, since steeper topography is able to sustain steeper trail grades. This relationship suggests 5% grades in 20% cross-slope areas, 10% in 40%, and 12% maximum profile grades in 48% or more cross-slopes. Trails with grades greater than 15% are especially prone to erosion. Where trail relocation to areas with grades less than 15% in good soils is not possible, surfacing or structures may be required. Natural surface trails where the cross-slope is less than 10% usually require surfacing, such as corduroy or gravel, and drainage improvements, such as ditches, culverts, and French drains, if they receive even a moderate amount of use. Natural-surface trails in cross-slope areas between 70% and 90% usually require retaining walls to hold them in place. Where cross-slopes exceed 90% it is usually not possible to build natural surface trails.

4. New Uses on Existing Trails

When new uses (e.g., mountain bikes on hiking trails) are being considered for existing trails (many of which evolved through use and not design), planning teams must carefully consider sustainability factors. The design principles used for old roads and railway beds are significantly different from those used for trails, so it is necessary to evaluate sustainability factors when redeveloping these types of corridors for new uses. In addition, the evaluation of other trail projects in the local area can assist in developing sustainability criteria for the current project.

5. Maintenance and Monitoring

Some degree of maintenance is required to perpetuate a trail's intended dimensions and integrity. This often occurs at the beginning and end of each use season, as well as in response to emergencies. On some trails, routine activities may be required each month during peak use. Long-term maintenance should be part of the planning and design considerations. Typically, trails require about 10% of the original time and dollar investment each year after construction in routine maintenance. Much of this work can be carried out by volunteers. Monitoring and updating maintenance schedules each season and year ensures continued sustainability.

In addition, monitoring various use factors over time such as access, patterns, and intensity is important to ensure ongoing sustainability. Consistent multi-year record keeping is important to ascertain trends. The type and amount of use on a particular trail, along with that trail's ability to support changing patterns of use, will influence the type and complexity of the monitoring program.

Using photographs to monitor trail use at access points and high-use locations can be effective in recording changes to the natural environment, especially vegetation. Transects can be used to monitor changes to soils. Effective trail monitoring will help pinpoint specific use and resource problems early and thereby suggest modest improvements or management actions in lieu of more intensive and intrusive remedial measures at a later date.

Undesired trails develop when use cannot be sufficiently limited to existing trails. Undesired trails most commonly develop close to managed trails, along switchbacks, and in wet meadows. Away from managed trails, undesired trails develop along frequently used cross-country routes and in popular destination areas as multiple trail braiding. Management techniques available for resolving this problem include keeping visitors on the managed trails by locating and delineating them properly or by enforcement, proper timing of visitor use, education on wilderness ethics, and limiting overall use patterns.

B. Campsite Management

Similar to trail deterioration, the problems with campsite deterioration involve both deterioration of desired campsites and development by campers of more sites than are desired or needed.

The most pronounced ongoing impact at established sites is enlargement, caused by spreading out to adjacent undisturbed or lightly disturbed areas. The most important influences on the amount of deterioration on established sites are the types, amount, and season of use; substrate durability; visitor behavior; and where they camp. Management tactics which should be employed to address this problem include restricting camping to certain categories of users based on number in party or by limiting stock use, location of designated campsites in durable areas, limits on camping duration, campsite rotation, restricting camping to designated sites, hardening of campsites, prohibition of campfires, encouraging dispersed use combined with education on minimum impact camping techniques (in low use areas only), and prohibition of damaging practices or equipment.

The primary cause of campsite proliferation is overuse of destination areas where use is not confined to a relatively small number of sites. The most important influences on site proliferation are where and how people camp. The primary options for resolving this issue in heavily used areas require restricting use to previously impacted sites, designation of sites, or limiting overall use. In lightly used areas, impact mitigation can be achieved by dispersing camping to previously undisturbed sites along with an education program on low-impact camping techniques.

C. Litter Management

Litter has been identified in a number of studies as a significant source of impact on the backcountry experience. Certain activities, such as bait fishing, are highly correlated with increased litter. Litter is one of the easiest backcountry problems to resolve. Continual reinforcement of the pack-it-in, pack-it-out philosophy has already resulted in reduction of backcountry littering. Careful management of activities associated with litter, visitor education, maintenance of a litter-free environment by park personnel, and enforcement are the primary techniques for resolving this issue.

D. Crowding and Visitor Conflict Management

Research provides evidence that the perception of crowding is a function of more than how many other parties are encountered: the location of the encounter is important, with encounters at campsites being less acceptable than encounters enroute, and encounters at a long distance from developed areas being more objectionable than contacts at access points. Crowding is also affected by the type and behavior of party encountered: encounters with larger parties or parties pursuing different recreational activities are less acceptable than encounters between parties possessing similar characteristics. Visitor expectations also have an effect on the extent to which the number and type of encounters contribute to crowding.

Crowding occurs where there are simply too many people in the same place at the same time. This situation is influenced not only by the absolute number of users, but also by the timing and destination of visits. The primary methods for addressing crowding include advising visitors of alternative opportunities or discouraging use during crowded periods; limiting numbers of users, party size, or length of stay; designation of campsites; controlling development of access routes or facilities, and encouraging behavior which will limit the number of contacts. While dispersal of visitor use is an important management tool for addressing crowding, decisions to disperse use should be made carefully and only after a thorough analysis of the potential effects. Dispersal of recreational use often results in increased impacts in more pristine areas or areas containing sensitive resources. Baseline data and monitoring programs should be used to measure the impacts of a dispersal strategy.

The level of visitor conflict is influenced by the same factors that influence the level of crowding: location of encounter, recreational use and behavior of the other party, and visitor expectations. Conflict can be especially severe if the use or behavior of the other party is considered inappropriate. The primary tactics for dealing with visitor conflict are segregation of different types of users, elimination of conflicting uses, educating visitors about potentially conflicting uses in the area, and educating parties on how to reduce conflict.

E. Human Waste Management

Human waste usually becomes a problem where use is relatively high or where options for placement of waste are restricted. Where use is heavy, reduction in visitor use through overall use

limitations, length of stay limits, designation of campsites away from water bodies, or restriction of areas to day use only may be necessary. Where locations for waste disposal are particularly limited, such as along river corridors and technical climbing routes, the option of carrying out waste should be explored. If these techniques are unsuccessful, then regularly maintained toilet facilities may be required. Selection of the type of toilet facility to be installed must carefully consider such factors as soils, potential water source contamination, maintenance, and cost. Aerobic composting offers a mechanism for waste degradation/recycling which produces an organic product that can be used to improve impacted soil situations. Parks currently using systems utilizing aerobic composting include Chesapeake and Ohio Canal National Historical Park and Redwood National Park. The San Dimas Technological Center (USFS) is also involved in development of this technology. Note that installation of toilet facilities in wilderness is a last resort, to be implemented only after a thorough investigation of alternatives. The human waste problem may be partially mitigated by education of visitors on proper waste disposal methods.

F. Wildlife Impact Management

Destruction of wildlife habitat by human recreational use in backcountry settings can have an adverse effect, especially on smaller mammals. The primary habitat loss results from impacts on vegetation and soils along trails and at campsites. However, the wildlife impacts of greatest concern to park staff are wildlife disturbance and attraction and feeding.

Wildlife disturbance by visitors in backcountry settings includes both intentional and unintentional disturbance. These impacts can be serious when they occur during critical breeding, feeding, or times of the year when animals are weak or engaged in reproduction. The magnitude of impact can also be increased if recreational use areas coincide with important wildlife habitat. Primary techniques or strategies for addressing this concern are educating visitors about potential impacts of their behavior and restricting access in locations or during times which are critical for wildlife survival.

Attraction and feeding of wildlife can be a serious problem, especially in bear country. However, attraction of smaller mammals also leads to impacts on those animals, or to equipment damage and visitor injury. The primary techniques for addressing this concern are educating visitors on proper food storage and potential impacts of wildlife feeding, avoiding bear concentrations, and providing food poles or other food storage devices. (See also, Hazardous Animals, in Chapter 2, Public Health and Safety.)

ROLES AND RESPONSIBILITIES

I. Park

The **superintendent** has the primary responsibility for developing and implementing backcountry recreational use programs in a park. The superintendent should ensure that the programs implemented are consistent with all applicable laws and policies. The superintendent should initiate

the development of backcountry recreational use plans as necessary. The superintendent is responsible for assuring that adequate funding and technical expertise is available to prepare and implement visitor backcountry recreational use management programs. The superintendent should coordinate the visitor use management plans with neighboring land managers as appropriate. Each superintendent with designated or eligible wilderness should designate a wilderness coordinator to review all activities ongoing in the wilderness.

II. Region

The primary role of the regional office is to provide oversight and guidance to superintendents in carrying out their backcountry management programs. Since all visitor use management plans require either an environmental assessment or an environmental impact statement, the regional office becomes involved in the overall planning effort.

In addition to technical review of the compliance document, the regional office is responsible for policy level review of all plans. The regional office also provides consultation to parks in situations where the existing policies are not fully applicable or require interpretation. Regional offices are also responsible for development of consistent and comprehensive programs on a regionwide basis.

Regional offices should assure that adequate technical expertise is available to advise parks on visitor use management issues. Regional offices are also responsible for providing scientific expertise in environmental and social sciences to ensure that programs developed for implementation by parks are scientifically defensible. Each regional office should designate a wilderness coordinator to oversee the wilderness program within the region.

III. Washington Office

The Washington Office has overall responsibility for establishing and refining national policy. The Washington Office is responsible for development and approval of necessary guidelines for policy implementation. The Washington Office should strive for a well coordinated and consistent application of backcountry recreational use management programs among all park units. The Washington Office wilderness coordinator conducts reviews of all wilderness management plans. The Washington Office provides review of any other significant or technically difficult visitor use plans upon request by the regional offices. The Washington Office also provides leadership in information sharing designed to improve program consistency and quality. This will include sponsoring training activities and sharing research results on backcountry management issues of broad applicability.

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Alberta Recreation and Parks. 1988. Cross Country Ski Trails. Edmonton, Alberta.

American Hiking Society. 1984. Bibliography of Trail Construction, Maintenance and Management. Washington, D.C.

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Appalachian Trail Conference. 1981. Trail Design, Construction and Maintenance. Harpers Ferry, West Virginia.

Burch, William R., Jr. 1979. Long Distance Trails, The Appalachian Trail as a Guide to Future Research and Management Needs. New Haven, Connecticut.

Duffy, Hugh. 1991. Developing Sustainable Mountain Trail Corridors. Colorado State Trails Newsletter. Denver, Colorado.

Hallman, Richard G. 1988. Handtools for Trails Work. U.S. Forest Service, Missoula, Montana.

Hooper, Lennon. 1983. NPS Trails Management Handbook. U.S. Dept. of the Interior, Washington, D.C.

National Park Service. 1989. An Annotated Bibliography of Non-Motorized Trails Literature. Denver, Colorado.

Parks Canada. 1978. Trails Manual. Ottawa, Ontario.

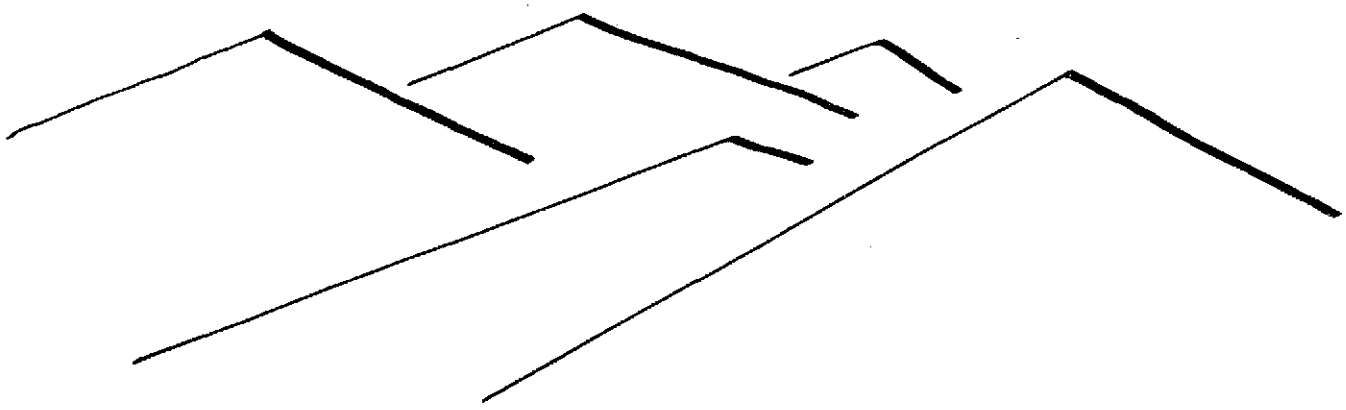
Pennsylvania State Trails Program. 1980. Non-Motorized Trails/An Introduction to Planning Development. Harrisburg, Pennsylvania.

Proudman, Robert D. and Reuben Rajala. 1981. Appalachian Mountain Club Field Guide to Trail Building and Maintenance. Boston, Massachusetts.

U.S. Forest Service. 1984. Standard Specifications for Construction of Trails, Publication Number EM 7720-102. Washington, D.C.

U.S. Forest Service. 1985. Trails Management Handbook. Forest Service Handbook FSH 2309.18. Washington, D.C.

Vogel, Charles. 1982. Trails Manual. Sylmar, California.



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Bibliographies

Albrecht, J. and T.B. Knopp. 1984. *Trail Planning, Construction and Maintenance: A Bibliography, Miscellaneous Publication 26-1984.* St. Paul, MN: University of Minnesota.

"The purpose of this bibliography is to bring together literature on the state of the art. Thus it will enable trail planners, managers, and users to benefit from what others have learned through research and experience."

Numerous documents are listed in each of the following categories: trail uses, trail-use studies, planning documents, and general trail development. Those undertaking extensive research into trails-related issues can benefit from reviewing this document. A few annotations are included.

American Hiking Society. 1984. *Bibliography of Trail Construction, Maintenance and Management.* Washington, DC: ____.

The purpose of this bibliography was *"to compile an authoritative list of publications on trails that would be complete, useful, and accessible to trails users and clubs. "* Included are listings on trail construction, maintenance, management, and volunteerism. Also included are listings of statewide trail plans, off-road vehicle trails literature, and listings of documents pertaining to scenic and historic trails. Rather concise, this bibliography does contain many of the most useful and widely accepted documents. A few annotations are included.

Ames, Gregory P. 1981. *Recreational Reuse of Abandoned Railroad Rights of Way: A Bibliography and Technical Resource Guide for Planners.* Chicago, IL: Council of Planning Librarians.

As stated in the introduction, *"The purpose of this bibliography and technical resource guide is to bring together a wide variety of materials of conceivable interest to local [trail] planners contemplating potential [rail] conversion projects."* Divided into its two parts, this document achieves its purpose. Many citations for feasibility studies, master plans, and guides published through 1980 are listed, as are many resources useful to the planner.

Duffy, Hugh. 1989. *An Annotated Bibliography of Non-Motorized Trails Literature.* Denver, CO: National Park Service.

This document highlights readily available regionally and nationally significant non-motorized trails documents.

Lavely, Phillip E., Ph. D. 1978. *Trails Bibliography.* Washington, DC: National Trails Council and the Heritage Conservation and Recreation Service.

This document is a comprehensive listing of trails-related documents. Numerous documents are listed in each of the following categories: Types of trails, legislation, construction and maintenance, planning and design, procedures, research, bibliographies, bulletins, periodicals, and related materials. Those undertaking extensive research into trails-related issues can benefit from reviewing this document. No annotations are included.

Schmid, Jim. 1992. *Coronado National Forest Trails Library Bibliography.* Tucson, AZ: Coronado National Forest.

A bibliography of trails related materials in the library of the Coronado National Forest, this listing is very current and contains good listings of mountain bike trails documents as well as rail trail booklets and general trail reports.

Reference Documents

Good, Albert H. 1938. *Park and Recreation Structures.* Washington, DC: National Park Service.

"In any area in which the preservation of the beauty of Nature is a primary purpose, every proposed modification of the natural landscape, whether it be by construction of a road or erection of a shelter, deserves to be thoughtfully considered."

This outstanding document summarizes this National Park Service/Civilian Conservation Corps philosophy of rustic architecture. Many examples of successful park structures are described. In addition, there are many insights into the use of rustic materials such as wood and stone that would be useful to today's trail designer. There is an excellent section on trail steps made of stone.

Conflict Resolution

Arizona State Committee on Trails. 1992. *Trail Use Policy.* Tucson, AZ: _____.

This paper summarizes the policy of the Arizona Bicycle Task Force and the Arizona Hiking and Equestrian Trails Committees regarding multiple use trails. It includes an introduction, definitions and assumptions, a policy statement, a discussion of Issues, Concerns, and Opportunities, and a list of organizations and trail education programs.

Merriman, Kristin. 1988. "Multiple-Use Trails: A Question of Courtesy." *Outdoor Ethics* 7, no. 3 (Summer 1988).

This article discusses some of the multiple-use ethics of rail-trail conversions. The most important suggestion in this article is to resolve multiple-use conflicts early in the planning process. A key observation noted is the fact that other forms of transportation such as automobiles, boats, and airplanes have laws regulating their use, but there are very poor laws on how trails should be used.

User Conflict Subgroup, National Trails Agenda Task Force. 1988. "Report on the Ninth National Trails Symposium." Baltimore, MD: League of American Wheelmen.

The user conflict subgroup of the National Trails agenda task force developed two papers to help identify solutions to reduce conflicts on trails. The first is entitled "A List of Ideas Presented at The User Conflict Discussion: Creating an Agenda For The Future." This is a concise document that describes: where users can work together, some expectations among users that will reduce conflicts, some models that have insights into problems, where trail allocation policies are needed, strategies for a systematic approach to trail allocation, criteria for trail allocation, and indicates where more research is needed. Also included are recommendations for education and trail design to reduce conflict. Suggestions for user groups who play a vital role are described, as are some case studies.

The second document is entitled "Managing Trails for a Diversity of Users." This is also concise, suggesting principles for the future development, support, and management of trails. Several goals are included: 1) the development of a nationwide network of National, State, and local trails, 2) provision of support needed by the network for today and tomorrow, and 3) assurance of continued trail development and management. These goals and their accompanying objectives can form a very sound origin for those developing trails constituencies, trails councils, and draft legislation and ordinances.

Leadership

Parker, Troy S. and Helen Grigson. 1989. *Crew Leader Manual.* Denver, CO: Volunteers for Outdoor Colorado.

This document clearly describes what it takes to be a crew leader on a Volunteers for Outdoor Colorado (VOC) project. It delves into many of the characteristics and qualities required to have a successful VOC project day. This document can easily be adapted for use in other organizations.

Student Conservation Association. n.d. *Supervisor's Handbook.* Charlestown, NH: _____.

"This supervisor's handbook is intended to be a distillation of the thoughts and experiences of you, the supervisors, as well as a setting forth of the regulations and policies of the Student Conservation Association [SCA]. It is intended to be both a comprehensive introduction for new supervisors, and a reference and guide for those more experienced."

The SCA carries out various types of conservation projects on public lands using high school or college aged students. This handbook describes the overall process by which supervisors operate including a site visit, checklists, and environmental education. It can be a good source of ideas when planning a complete conservation project.

Volunteers

Ellis, Susan J. and Katherine H. Noyes. 1981. *No Excuses: The Team Approach to Management.* Philadelphia, PA: Energize.

This document fills a void by directing its message at volunteer managers who also raise money and do other duties. Other documents are usually more directed at persons who manage volunteers full time. Ellis and Noyes concentrate on realistic ideas regarding a team approach to carry out a volunteer agency's mission. Two very good recommendations in this document are to develop an orientation and training schedule for *every* task in the organization, and to develop reporting procedures for training success. Other items discussed include planning, recruitment, public relations, interviewing and screening, supervision, and motivation.

Haines, Mike. 1977. *Volunteers: How to Find Them ... How to Keep Them! A Workbook.* Vancouver, BC: VARC.

This handbook is a springboard for exciting and new ways to involve people in the volunteer world. It gives a straightforward description of an entire volunteer program. Descriptions cover getting ready for recruitment, procedures for volunteers hired, and also methods of recruitment.

MacBride, Marie. 1979. *Step by Step, Management of Volunteer Programs in Agencies.* Hackensack, NJ: Volunteer Bureau of Bergen County.

This document describes characteristics of volunteers, benefits to volunteers and agencies, and development of your agency volunteer program. Pointers for directors of volunteers and pointers on recruitment, interviewing, selection, and placement of volunteers are included. Training, supervision, advanced workshops, retaining volunteers, and record keeping also are discussed. Finally, budgeting, funding, public relation tools, and measuring success are discussed.

Moore, Roger L., Vicki LaFarge, and Charles Tracy. 1992. *Organizing Outdoor Volunteers: A Step-by-Step Program for Grassroots Environmental Action Groups, 2nd edition.* Boston, MA: Appalachian Mountain Club.

This is an excellent summary of the Appalachian Mountain Club's experience with its' National Outdoor Volunteer Network Project. It documents successful organizational development techniques including: "getting started", planning, fundraising, finances, committees, publicity, working effectively with government agencies, developing and training leaders, and getting the most from volunteers while keeping them motivated.

Naylor, Harriet H. 1973. *Volunteers Today, Finding, Training, and Working with Them.* Dryden, NY: Dryden Associates.

This excellent document offers insights into common volunteer program topics such as: volunteers of the future, new forms of volunteer participation in service, trends in volunteering, volunteer staff work patterns, motivation, determination of volunteer assignments, recruitment and placement of volunteers, initiation and supervision of volunteers, training, development of learning opportunities, design of training events, and personnel administration of volunteers. This document strongly encourages consideration of volunteers as individuals, and suggests *state-of-the-art and advanced training* to keep volunteers on the cutting edge. A good bibliography is included.

The Tahoe Rim Trail Association. n.d. *Tahoe Rim Trail Volunteer Handbook.* South Lake Tahoe, CA: _____.

This handbook is an excellent example of how volunteers can be organized to accomplish a major trail program effort. Included is a description of the overall program broken into several committees, a description of the trails committee structure, and job descriptions for various tasks required. Approximately 45 job descriptions are included! A volunteer application which asks very specific questions to assist in determining possible roles for volunteers also is included. This document can be the model for *all* trails organizations to follow when developing or reviving their programs.

US Department of the Interior, National Park Service. 1987. *Volunteers in Parks, Getting the Most Out of Your Park's Volunteer Program.* Washington, DC: _____.

This publication's target is National Park Service units and managers. It describes avenues to pursue funding, and describes working with cooperating nature associations. Ways to provide housing for volunteers such as campground hosting are included. This document advocates a comprehensive, systematic approach to developing a volunteer program.

Volunteers for Outdoor Colorado. 1992. *Extending Your Reach - A Guide for Agencies Working With Volunteers.* Denver, CO:_____.

This outstanding handbook offers insight into all aspects of running a successful volunteer program. Included are discussions on designing volunteer jobs, recruiting, interviewing and accepting volunteers, leadership, management, learning and training, motivation, feedback and evaluation, recognition and reward, resolving conflicts, work settings, and what to do when a volunteer leaves. It also includes an excellent sample volunteer coordinator job description.

Wilson, Marlene. 1981. *The Effective Management of Volunteer Programs.* Boulder, CO: Volunteer Management Associates.

This excellent reference document describes a modern approach to managing volunteers. It is practical as opposed to theoretical. All volunteer managers and key personnel can benefit from this small book. The most common aspects of volunteer management are discussed, including manager characteristics, motivation, planning, interviewing and placing volunteers, and training.

Ethics

Backcountry Horsemen of the Flathead. n.d. *Backcountry Horsemen's Guidebook.* Columbia Falls, MT: ____.

This guidebook's dedication describes its intent: *"We would like to dedicate this book to future generations that they too may find the same peace and beauty that we now enjoy in the backcountry and to the dedicated people who are working diligently to keep it unchanged by human hands."*

Topics covered include preparing for your backcountry horse trip, recipes, horse handling, environmental concerns, selecting camp sites, camp chores, grazing, sanitation, fire precautions, trail courtesy, packing, and first aid.

Utah Trails Council. 1983. *Trail Ethics-Another Conservation Tool.* Ogden,UT: ____.

The Utah Trails Council has developed a good summary of trail ethics for backpackers, horsemen, and motorbikers. As evidenced by this handout, two ways that the Utah Trails Council pursues protection of resources along trail corridors are by gaining political clout and by public education in the development of trail ethics.

Program Development

Parks Canada. 1978. *Trails Manual.* Ottawa, Ontario: ____.

This excellent bilingual document describes the entire trail planning, design, and construction process. There is a wealth of technical background material to educate even the seasoned trail planner. This document is useful for park managers before beginning trail planning and design activities. Proper planning and design will minimize work required of trail builders, and help agencies decide on appropriate trail configurations and locations.

Pennsylvania State Trails Program. 1980. *Non-Motorized Trails/An Introduction to Planning and Development.* Harrisburg, PA: Pennsylvania Bureau of State Parks.

This excellent document covers the aesthetic and environmental considerations to trails development, the anatomy of a trail, design and layout, and has appendices covering stream crossings, trailheads, and signs. A bibliography is included. The companion document on *Motorized Trails* is also excellent.

Safety

Colorado Mountain Trails Foundation. 1976. *Mountain Trail Volunteers, A Guide to Working Safely.* Lakewood, CO: ____.

This pamphlet describes safety tips for travel by foot or animal, loading and carrying a pack, proper use of hand tools, precautions for poisonous plants, first aid for insect and snake bites, precautions in severe weather, prevention and the treatment of hypothermia. This document can be of assistance to those developing a safety program.

Access Trails

Bilhorn, Comras and Miller. 1980. *Accessible Trails, A Case Study At Malibu Creek State Park.* Pomona, CA: California Polytechnic Institute, for the National Park Service.

This excellent document describes a thorough and rational process of developing an accessible trail plan for a small park. It describes details overlooked in most access projects. Included in the process is a human inventory, suggested guidelines, a case study at Malibu Creek, a physical analysis, a sensory inventory, and design details. Also included are a questionnaire, a listing of organizations consulted, and references.

Nordhaus, Richard S., Min Kantrowitz and William J. Siembieda. 1984. *Accessible Fishing: A Planning Handbook.* Santa Fe, NM: New Mexico Natural Resources Department.

This is an excellent reference document for planning an accessible fishing area. Planning guidelines are discussed, as are levels of accessibility, evaluation, and design aids. A glossary, survey checklist, and bibliography are included.

Park, David C. 1989. "Access 2: What is Accessibility?" *Design* (Spring, 1989).

This issue of *Design* provides the specifications for the combination of elements that must be provided for a building or facility to be fully accessible. They are excerpted from the Uniform Federal Accessibility Standards (UFAS), and are in a very readable form.

Park, David C. and Andrea Farbman, Ed.D. 1989. "Access 3: Accessible Outdoor Recreation Facilities." *Design* (Summer, 1989).

This issue of *Design* includes access solutions for outdoor recreation facilities that comply with the Uniform Federal Accessibility Standards (UFAS) and are in a very readable form.

Park, David C. 1989. "Access 4: Recommended Guidelines for Campgrounds and Picnic Areas." *Design* (Fall, 1989).

This issue of *Design* includes recommended guidelines for accessible campgrounds and picnic areas. Also included is a summary of the philosophical concept of access.

Uniform Federal Accessibility Standards (UFAS). 1984. Washington, DC: 49 CFR 31528, August 7, 1984.

"This document presents uniform standards for the design, construction, and alteration of buildings so that physically handicapped persons will have ready access to and use of them in accordance with the Architectural Barriers Act, 42 U.S.C. 4151-4157."

This document deals primarily with buildings, but there are many sections that deal with ramps, stairs, and parking areas which can also apply to most developed area trail projects. [Facilities signed and advertised as *Accessible* must comply with these regulations.]

Americans With Disabilities Act (ADA). 1991. Washington, DC: 28 CFR Part 36, July 26, 1991.

The ADA describes state and local government as well as private enterprise applications of the UFAS listed above.

US Department of the Interior, Heritage Conservation and Recreation Service. 1980. *A Guide To Designing Accessible Outdoor Recreation Facilities.* Ann Arbor, MI: _____.

This document is outdated pertaining to meeting current standards for access; however, there are several good examples shown here that may inspire the novice. A good annotated bibliography is included.

Whole Access. 1989. "Accessibility and Recreation Trails." Redwood City, CA: _____.

Whole Access has put together very good information regarding accessible trails in a series of handouts. "Provide The Public With Good Information" contains a listing of suggested information that should be conveyed to the public. Items suggested include public transportation opportunities, terrain and trail surfaces, travel distances, and special features on the trail. "Recommendations For Prioritizing Trail Projects" contains a hierarchial approach to prioritizing your project. Items suggested include ease of access, proximity to a developed area of your park, and natural features of interest. "Accessibility and California Recreation Trails" contains a very thorough description of what is being done in the California State Park System regarding access. This handout is outstanding in its concise summary of access trail requirements. The "Trail Accessibility Survey Form" is a concise questionnaire that will help you inventory your accessible trails system. This questionnaire can be used in your area to determine areas of needed improvement on your trails.

Hiking and Horse Trails

California State Parks. 1978. *Hiking and Equestrian Trails in California, An Element of the California Recreation Trails Plan.* Sacramento, CA: _____.

Although this is a routine statewide plan, Appendix B contains a good description of "Trail Facility Construction Guidelines and Standards," and Appendix C contains a good description of "Corridor Identification Criteria."

Vogel, Charles. 1982. *Trails Manual.* Sylmar, CA: Equestrian Trails, Inc.

This is the most authoritative horse trail publication. Everything needed for planning, designing or constructing horse trails in California is included. This is an excellent book, and can be an important component of every trail planner's library.

Mountain Bike Trails

Bikecentennial. 1992. *Mountain Bike Trails: Techniques for Design, Construction and Maintenance.* Missoula, MT: _____.

This document describes mountain bike trail planning and layout concepts as well as construction and maintenance techniques.

Havlick, Scott. 1986. "Mountain Bicycles on Federal Lands: Over the River and Through Which Woods?" *Journal of Energy Law and Policy* 7.

This commentary addresses the issues regarding mountain bicycle use on public lands. Included are discussions on the problems generated by mountain bicycles, the various rules and regulations being used by Federal agencies, and the obstacles that remain for those who wish to challenge the existing regulations. Also included is a discussion that covers portions of those same regulations that agencies can use to deflect challenges brought against them. The suggestion is made for early clarification of issues in the policy formulation stages with respect to mountain bicycle use.

Keller, Kit, J.D. 1990. *Mountain Bikes on Public Lands: A Managers Guide to the State of the Practice.* Washington, D.C.: Bicycle Federation of America.

This document is a compendium of information about managing mountain bicycle use on public land. It explores management issues and techniques, and suggests possible actions.

Maurer, George J. 1986. "Mountain Bike Research and Recommendations." Golden, CO: Jefferson County Open Space Division.

This document contains a background of mountain bike usage, a summary of agency and user-group experiences with mountain bikes, some concepts for planning and managing mountain bike trails, several conclusions, and recommendations.

Rail-Trails

Montagne, Charles H. 1989. *Preserving Abandoned Railroad Rights-of-Way For Public Use: A Legal Manual.* Washington, DC: Rails-to-Trails Conservancy.

This outstanding manual summarizes the rail abandonment process, reversionary interests, Section 8(d) of the Trails Act, NEPA and other environmental statutes, overviews of State laws relating to public use, and many other topics of interest to rail-trail advocates.

Moore, Roger. 1992. *The Impact of Rail-Trails: A Study of The Users and Nearby Property Owners From Three Trails.* College Park, PA: Pennsylvania State University.

This Benefits of Rail-Trails study was the first extensive study to examine the benefits and impacts of rail-trails, and the first to systematically examine both the trail users and nearby property owners of the same trails. The document discusses the selection of the three trails, the user survey methodology, the trail neighbor methodology, the study results and conclusions drawn from the research. This is an excellent document that will help planners alleviate perceived fears of rail-trail conversions during the conversion process.

Ski Trails

Alberta Recreation and Parks. 1988. *Cross Country Ski Trails.* Edmonton, Alberta: _____.

This excellent document summarizes cross country ski trail development requirements. It covers all aspects of project development including project feasibility, funding sources, planning, design, construction, maintenance, and programming. A short bibliography is included.

Bourgois, Peter. n.d. *The Planning and Design of Cross Country Ski Trails, A Guide for the Boise National Forest.* Boise, ID: Boise National Forest.

This document attempts to standardize the criteria to provide safe and meaningful ski experiences to forest users. A good planning process is described, starting with an inventory, going through an alternative development process, design according to standards, trail configurations, and trail development concerns. Clearing, signs, maintenance, and trail inventory and evaluation also are described.

Rasmussen, Paul F., Gary R. Clay and Stuart H. Spetzner. n.d. *Cross Country Ski Trails, A Guide to Their Design and Management.* Chicago, IL: Northern Illinois Planning Commission.

This document contains some practical details peculiar to cross country ski trails, discusses the pro's and con's of one-way compared to loop trail systems, the depth of trail snowpack, various layout systems, signs, and location for protection of snow from sun. A good bibliography is included.

Wisconsin Division of Tourism. 1978. *Wisconsin Cross Country Ski Trail Development Guidelines.* Madison, WI: _____.

This publication presents guidelines with the primary focus on physical design to promote safety and the utilitarian aspects of a good experience for skiers at varying levels of ability. The intent is to develop facilities that are logical and uniform throughout the State and thereby available to the general populace as needs warrant. This document is entirely text. Good graphics or sketches would have made this an excellent document.

Bridges

Reiach Hall Blyth Partnership. 1989. *Footbridges in the Countryside, Design and Construction.* Edinburgh, Scotland: City Litho Co.

Produced for the Countryside Commission for Scotland, this is an outstanding reference document that provides sound and imaginative advice on the location, design, and construction of informal recreation facilities in the countryside. There are many illustrations that show options for the designer. Engineers and other designers can adapt the suggestions included for use in their local area.

Construction and Maintenance

Arkansas Department of Parks and Tourism. 1991. *So You Want to Build a Trail? A Guide to Developing Urban Trails.* Little Rock, AR: _____.

This handbook contains very good answers to some of the common questions that face those who undertake urban trail projects. The discussion on design and construction considerations is unique and worth reading.

Arkansas Department of Parks and Tourism. n.d. *Arkansas Trails System Maintenance Manual.* Little Rock, AR: _____.

This handbook contains some unique details not seen elsewhere. Included are discussions on: standards and dimensions, maintenance techniques, tools, organizing a crew, marking and signing, and a very good description on blazing.

Boy Scouts of America and the US Forest Service, Rocky Mountain Region. n.d. *Guide for Mountain Trail Maintenance.* Lakewood, CO: _____.

This is a complete trails maintenance guide for use on trails in the Rocky Mountain Region. Typical problems expected to be encountered are described. A key point identified here is the requirement for orientation sessions before undertaking an adopt-a-trail program.

Douglas, Jim. 1981. *Guide to Trail Maintenance Techniques and Standards for Trails Maintained by the Potomac Appalachian Club in Shenandoah National Park.* Washington, DC: Potomac Appalachian Mountain Club.

While specifically written for trails maintained by the Potomac Appalachian Mountain Club, this is a good handbook on maintenance, although lacking quality sketches. The text description on blazing is very good.

Griswold, Stephen S. 1989. *Trail Handbook for Sequoia and Kings Canyon National Parks.* Sequoia National Park, CA: National Park Service.

This excellent fieldbook offers a good overview to the trail program at Sequoia National Park as well as some unique solutions to backcountry construction problems.

Huxley, T. 1975. *Footpaths in the Countryside.* Edinburgh, Scotland: [City Litho Co. ?].

This book is referenced in other documents as an excellent guide to trail construction, maintenance and management experiences in Scotland and Britain. [The companion document *Footbridges in the Countryside* is also excellent.]

Indiana Division of Outdoor Recreation. n.d. *Indiana Trails Construction and Maintenance Manual.* Indianapolis, IN: _____.

This is an excellent reference handbook that provides guidelines for the design, construction, and maintenance of hiking trails. Discussion covers personnel and tools required, technical considerations for layout, and detailed information on erosion control, crossing fences and streams, and marking and maintaining trails.

Magary, Frank A. 1985. *The Tahoe Rim Trail: A Guide to Construction.* Nevada City, CA: Tahoe National Forest.

This short handbook contains a few good descriptions of trails work not found elsewhere. These include discussions on trail grades, trail layout by stationing, and drainage concepts.

Miller, Jay. 1983. *Construction and Maintenance of Horse Trails.* Little Rock, AR: Arkansas Department of Parks and Tourism.

This excellent document details requirements of horse trail projects. Space requirements, camp layout, trail grades, and construction details are included.

National Park Service. 1937. *Construction of Trails, CCC Project Training Series No 7.* Washington, DC: _____.

Although originally developed for the Great Smoky Mountains National Park, this outstanding document was found to be very useful elsewhere and distributed servicewide. This document identified the need for an interdisciplinary team approach to trail design (in 1937)! Its strength is in its frank discussion as to why certain cultural practices are required in trail construction. It also successfully integrates written text with graphics. Because it was originally developed as a training manual for CCC camp use, this can be an important component of any trails document library. It is as timely today as it was more than 50 years ago!

Proudman, Robert D. and Reuben Rajala. 1981. *AMC Field Guide to Trail Building and Maintenance.* Boston, MA: Appalachian Mountain Club.

This is an excellent reference guide to trail planning, design, construction, and maintenance. It is complete in that it covers the design of trails, environmental considerations in trail design, trail layout and clearing, trail marking, guidelines for reconstruction, erosion control, trail hardening in wet areas, stream crossings, stiles, tools and tool maintenance, and potential management problems. Also included is a section on cross country ski trails development.

The Appalachian Trail Conference. n.d. *Appalachian Trail Fieldbook: A Self Help Guide for Trail Maintainers.* Harpers Ferry, WV: _____.

This fieldbook is designed to help the trail maintainer evaluate trail conditions. It has been written as a field supplement to the Appalachian Trail Conference Stewardship Series Handbook on *Trail Design, Construction and Maintenance.* [See below]. Part I of the fieldbook covers trail maintenance standards and evaluation that gives a brief description and list of specifications of what the trail should look like if properly maintained, and what it should not look like. Part II of the fieldbook covers treadway construction and rehabilitation guidelines that can be used to remedy trail erosion and saturation problems. This is a very good reference for those undertaking a trail maintenance program.

The Appalachian Trail Conference. 1981. *Trail Design, Construction and Maintenance.* Harpers Ferry, WV: _____.

Part of the Appalachian Trail Conference Stewardship Series, this is an excellent reference guide to the planning, design, construction, and maintenance of trails. It is complete in that it covers trail clearing, trail marking, trail signs, design objectives for the trail, recommendations for construction and reconstruction, as well as for trail bridges and stiles. There are also sections on tools and tool maintenance.

US Forest Service, Rocky Mountain Region. n.d. *Guide for Mountain Trail Development.* Lakewood, CO: _____.

This handbook is very good in that it covers all of the construction aspects of trail work. Some of the descriptions on trail location and accommodating unique situations are good, also. Many sketches are included.

US Forest Service. 1923. *Trail Construction on The National Forests.* Washington, DC: US Government Printing Office.

This is an outstanding reference document. Originally published in 1915, it is the oldest available document on trail planning and construction. It is breathtaking to contemplate the historical perspective evident in this document! This document covers trail planning and design very adequately. It strongly suggests that only experienced planners should prepare trail projects, and only after they know the implication of their decisions. It also suggests that entire trail systems should be staked out before construction begins. Better wisdom has not been offered to this day! New tools for trail grades have been developed, and the appendix covering the equipment required in 1923 is curious at best considering today's methods, but these items add a little character to the document.

Volunteers for the Outdoors. 1984. *Adopt a Trail Handbook, A Guide to Volunteer Trail Maintenance in the Southwest.* Albuquerque, NM: University of New Mexico.

This handbook presents a unique perspective on trail maintenance in that it suggests the trail adopter and the agency agree to responsibilities for trail maintenance at the very beginning of the project. It also includes a few sketches for trails layouts not seen elsewhere, including the *horseshoe* layout. Soils are discussed, and a good description of trails maintenance tasks and a section on safety and tools are included.

Specifications

US Forest Service. 1984. *Standard Specifications for Construction of Trails, Publication Number EM 7720-102.* Washington, DC: _____.

This is an excellent reference document for trail specifications for all trail designers. Much of the language, although in Forest Service terminology, is adaptable to other agency use. General specifications, earthwork, drainage, structures, surfacing, incidental construction, and materials are included. Standard drawings also are included.

State of Wisconsin, Department of Natural Resources. 1984. *Trail Specifications Handbook (2540.5).* Madison, WI: _____.

This document includes specifications for many common trail requirements, although the specifications are very simple. They appear to be directed towards maintenance contracts as opposed to new construction. Some sketches are included.

Tools

Hallman, Richard G. 1988. *Handtools for Trails Work.* Missoula, MT: US Forest Service, Missoula Technology and Development Center.

Abstract: *"The Forest Service Equipment Center at Missoula Montana, working with trail crews throughout the United States, has standardized a comprehensive manual on the use and maintenance of handtools involved in trail work. Information collected from industry experts, from interviews with trail crew members, and from extensive literature and market research on the subject provides the text for this manual. The manual stresses safe and efficient tool use. It describes each tool and presents nomenclature and maintenance procedures, including sharpening techniques and rehandling methods. A list of manufacturers and supply outlets is included. The manual is intended for both experienced and inexperienced trail crews."*

Signs

Trapp, Suzanne, Michael Gross and Ron Zimmerman. 1991. *Signs, Trails, and Wayside Exhibits- Connecting People and Places.* Stevens Point, WI: UW-SP Foundation Press, Inc.

This document is an outstanding reference guide for those involved in providing interpretive services in parks and other natural areas. It is thoughtfully organized, well written and beautifully illustrated. The combination of text, graphics and example photographs combine to make this document a required component of a trail planners' library.

Management of Trails

Arizona State Parks. 1992. *Public Trail Access- A Guide to the Protection of Arizona's Trails.* Tucson, AZ: _____.

This document is an excellent summary of trail access issues, land preservation methods, tips for forming trails advocacy groups, sources of funding, and ideas for finding help for those interested in preserving trails in Arizona.

Adams, Carol. 1989. "Old Trails, New Trails, and Trails That Never Should Be." *Trail Breaking News* (April-July, 1989).

This article presents a very concise point of view regarding trails and how they can be used to accentuate a participant's experience if the trails are developed properly. It also describes Volunteers for Outdoor Colorado's role in upgrading the outdoor recreation experience for Coloradans.

California State Parks. 1974. *Guidelines for Establishing Continuing Trail Project Priorities.* Sacramento, CA: _____.

As part of the California State Trails Handbook, this is an overview of the major aspects of trails planning and management used in the California State park system. Included is a guideline for establishing trail project priorities, a suggested analysis of the proposed trail use, trail location criteria, trail design and construction guidelines, and management criteria. Some of the terminology and suggestions in this document are unique and worthy of review.

Florida Trail Association, Inc. 1988. *Trail Manual of The Florida Trail.* Gainesville, FL: _____.

This is a well organized document that describes the Florida Trail Association approach to an entire trails-management system. Beginning with trail mapping, this document describes chapter responsibilities, job descriptions for officers and volunteers, preliminary trail planning activities, construction activities, and maintenance tasks. Suggestions for trail condition reports and for the annual overall trail condition report are key items suggested here that are not suggested in other documents.

Godin, Victor B. and Raymond E. Leonard. n.d. "Guidelines for Managing Backcountry Travel and Usage." Durham, NH: US Forest Service.

This document describes four types of barriers that managers can use to alter backcountry travel and use behavior. They include: administrative, written, oral and natural barriers. This article clearly describes the administrative side of trails management that is required to ensure the success of an entire trails program.

National Park Service. 1991. NPS 77- Natural Resources Management Guideline. Washington, D.C.: _____.

This Natural Resources Management Guideline contains the information necessary to design, implement, and evaluate a comprehensive natural resources management program. Chapter 3 contains a section on Backcountry Recreation Management. This description is a very concise summary of the National Park Service's ethic regarding backcountry trails. Sustainability, Planning, Design and Construction, New Uses on Existing Facilities, and Maintenance and Monitoring are topics discussed.

National Park Service, Denver Service Center. 1983. *Trails Management Handbook.* Lakewood, CO: _____.

This is a basic description of a trails management system. Planning considerations, design guidelines, construction guidelines and signs, and overnight facilities and trails maintenance logs are discussed.

State of Minnesota, Department of Natural Resources. 1981. *Trails Manual.* St. Paul, MN: _____.

This document covers the complete spectrum of trails use including identifying goals and objectives, developing trail proposal procedures, and trail design and construction. Many figures and a short bibliography are included.

US Forest Service. 1985. *Trails Management Handbook, Forest Service Handbook FSH 2309.18.* Washington, DC: _____.

This lengthy handbook is used by the Forest Service to outline their trails management program. Discussions cover trail planning, development, preconstruction and construction activities, and trail operations and maintenance. Numerous exhibits showing forms used, and suggested construction details are included. Volunteer agencies considering an extensive undertaking on Forest Service land can benefit from reviewing this document. Land management agencies considering publishing a trails management document can also benefit from review of this document.

Research

Burch, William R., Jr. 1979. *Long Distance Trails, The Appalachian Trail as a Guide to Future Research and Management Needs.* New Haven, CT: Yale University.

This is an outstanding reference document summarizing research on the Appalachian Trail. It introduces the concept of management as opposed to maintenance, and makes a very convincing point in this regard. It delves into the detailed research roles of the various trails-related people. This document can serve as a model for other organizations contemplating management of a long distance trail system. Each chapter has its own extensive, annotated bibliography.

Cole, David N. 1983. "Assessing and Monitoring Backcountry Trail Conditions, Research Paper INT-303." Ogden, UT: US Forest Service Intermountain Range and Experiment Station.

Abstract: *"Three types of trail assessment techniques-- replicable measurements, rapid surveys, and censuses-- can provide useful information for backcountry managers. This paper discusses how to apply these methods in the field and utilize the results to improve backcountry management. To illustrate their application, specific techniques are applied to the Big Creek trail system in the Selway-Bitterroot Wilderness."*

In the research summary, author Cole indicates that poor trail location is the cause of most major trail problems. He further indicates that vegetation and soil types should be used to guide trail location, and to add required design techniques when unstable soils cannot be avoided.

Hazel, Kelly L. and Tim P. Mead. 1988. "Attitudes Toward Forest Trail Usage: Research and Policy Implications." East Lansing, MI: Michigan State University, Department of Psychology.

This paper was presented at the 19th annual meeting of the Environmental Design Research Association in Pomona, CA, in May of 1988. Abstract: *"Conflicts, potential and existing, between recreation setting users present resource managers with difficult decisions. Research which focused on generating an understanding and/or predicting recreation conflicts is necessary in order to increase effective resource management practices. The Pigeon River Country State Forest, located in northern Lower Michigan, was the focus of an intense study of the potential conflict between motorized trail vehicle users and self propelled trail users in the forest. This study analyzed visitor preferences for off-road vehicle trails and opinions regarding management actions to limit motorized access in the forest. It was hypothesized that motorized trail users would display a higher level of preference for or approval of off-road vehicle trails than nonmotorized trail users. Results supported the hypothesis and indicated a strong negative opinion regarding motorized trail usage by a majority of PRCSF visitors. Implications for future management decisions regarding forest trail usage are discussed."*

Lucas, Robert C. 1983. "Low and Variable Visitor Compliance Rates at Voluntary Trail Registers, Research Note INT-326." Ogden, UT: US Forest Service, Intermountain Forest and Range Experiment Station.

Abstract: *"Only 20 percent of the visitors to the Bob Marshall Wilderness, Montana, during 1981 complied at voluntary trail registers. Rates varied from 0 for day-use horseback riders to 47 percent for backpackers. Summer rates were seven times as high as fall rates. Unless rates are higher, trail registers do not provide a good base for estimates. Methods of raising registration rates are discussed."*

Oltman, Jerry L. 1975. "Project Record, An Evaluation of Two Man Backpack Crews for Trail Maintenance, Equipment Development and Test Report 2103, Crew Support Equipment." Missoula, MT: US Forest Service, Equipment Development Center.

As noted in the report: *"This report discusses the feasibility of using two person backpack maintenance crews as evaluated on 6 National Forests in 1973. Five crews maintained approximately 650 miles of trail at an average cost of $21.00/mile and an average rate of 4 miles/day. Typical maintenance activities were performed."*

Stanley, Harvey and Hartesveldt. 1977. *A Report on the Wilderness Impact Study, The Effects of Human Recreational Activities on Wilderness Ecosystems with Special Emphasis on Sierra Club Outings in the Sierra Nevada.* San Francisco, CA: Sierra Club Bookstore.

This is an outstanding collection of documents, each with its own lengthy bibliography. Those interested in undertaking a complete trails management program can benefit from consulting this document early in the process. Selected investigations include: human trampling damage, pack stock damage to meadows, recovery of Sierran meadows, firewood production and use, human waste and garbage disposal.

Tinsley, Bradford E. and Ernest B. Fish. 1984. "Evaluation of Trail Erosion in Guadalupe Mountains National Park, Texas, College of Agricultural Sciences Publication T-6-139." Lubbock, TX: Texas Tech University, Department of Park Administration and Landscape Architecture.

Abstract: *"Guadalupe Mountains National Park, located in southwest Texas, is primarily a park for hiking and backpacking. Trails provide the only access to most scenic features and attractions. Permanently established erosion transects were studied to determine whether on-trail erosion was significantly greater than that occurring off-trail and to establish the factors which significantly contribute to the erosional/depositional process. Results after 3.5 years of study indicate that the net erosion and deposition of soil on the trails closely approximate those occurring naturally off the trail. Trail sites are relatively more unstable and experience greater soil movement (measured in absolute area change) than do off-trail sites. Differences in environmental site factors did not significantly affect the on-trail erosion process. Factors resulting from human impact (trail width and visitor use) were directly related to increased amounts of soil movement (absolute area change), but did not necessarily result in greater net erosion."*

US Forest Service. 1975. "Surfacing Forest Trails with Crushed Rock, Equipment Development and Test Report 7700-5." Missoula, MT: US Forest Service, Equipment Development Center.

Abstract: *"Heavy traffic by shod horses and mules can cause portions of forest trails to deteriorate rapidly. Where suitable rock exists for crushing, a layer of crushed rock is a fast and relatively cheap method to repair trails and increase trail durability. In 1972, a rock crusher and 2 different models of self-propelled rock carriers were evaluated for crushing, transporting, and spreading rock. Surfacing rates and costs were calculated for the 3 methods of application. The machines evaluated proved sturdy and practical. It was found that crushing rock laying along the trail was the fastest and cheapest method of application."*

Appendix II — Liability Bibliography

Baley, James A. and Davis C. Matthews. 1984. *Law and Liability in Athletics, Physical Education and Recreation.* Newton, MA: Allyn and Bacon.

Fowler, Timms R., Esq. 1991. *Private Landowner Liability And Urban Trail Development in Colorado.* Grand Junction, CO: _____.

Frakt, Arthur N. and Janna S. Rankin. 1982. *The Law of Parks, Recreation Resources and Leisure Services.* Salt Lake City, UT: Brighton Publishing Co.

Gold, Seymour M., Ph.D., AICP. 1990. *Trail Safety and Liability: The Standard of Care.* Pacific Grove, CA: Statewide Recreation Trails Conference, Asilomar Conference Center.

Gold, Seymour M., Ph.D., AICP. 1989. *A Basic Risk Management Library.* (In Trends, Volume 26, number 4). Alexandria, VA: National Recreation and Parks Association.

Kaiser, Ronald A. 1986. *Liability and Law in Recreation, Parks, and Sports.* Englewood Cliffs, NJ: Prentice-Hall.

Kozlowski, James C. 1984. *Recreation and Parks Law Reporter Quarterly.* Alexandria, VA: National Recreation and Parks Association.

National Park Service, Western Region. 1989. *The Issue of Liability.* San Francisco, CA: _____.

Page, Joseph A. 1988. *The Law of Premises Liability.* Cincinnati, OH: Anderson Publishing Co.

Peterson, James A. 1987. *Risk Management for Park, Recreation and Leisure Services.* Champaign, IL: Management Learning Laboratories.

Sharpe, Grant W., Charles H. Odegaard and Wenonah F. Sharpe. 1983. *Park Management.* New York, NY: John Wiley & Sons.

Shivers, Jay S. 1986. *Recreation Safety: The Standard of Care.* Cranbury, NJ: Associated University Presses, Inc.

van der Smissen, Betty. 1990. *Legal Liability and Risk Management for Public and Private Entities. (Volume 1- Legal, Volume 2- Situations Which Give Rise to Lawsuits, and Volume 3- Statutes and Cases).* Cincinnati, OH: Anderson Publishing Co.

Wasserman, Natalie and Dean G. Phelus (eds.). 1985. *Risk Management today: A How-to guide for Local Government.* Washington, D.C.: ICMA.