ROCK CREEK PARK

HORSE TRAIL STUDY

SEPTEMBER 1993

WASHINGTON, D.C.

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EXECUTIVE SUMMARY

The study describes and assesses the system of horse trails in Rock Creek Park. A discussion of general horse trail problems is applied to the conditions in Rock Creek Park. Trail deterioration is associated with drainage failure; through erosion on slopes or saturation/mud formation on flat terrain. Trail widths tend to increase from use as riders move to trail edges to avoid eroded ruts and gullies or muddy areas on the treadway.

Excessive trail widths need to be reduced, and the methods should be evaluated in a trail-specific practical way. A standard is recommended for a maximum eight-foot wide treadway within a ten-foot clearing limit. The park should obtain maintenance vehicles narrow enough to operate within this limit, including a small dump-truck to haul soil.

Rock Creek trails were laid out at a time when trails were not designed for the heavy use characteristic of today's urban park. Soil types in the park have limitations and the park's trails run predominately on highly erodible soils on steep slopes. Trails, especially main "arterial" trails, should not run straight up and down slopes, but should be aligned more parallel to the contours of the land to avoid erosion problems. The worst trail areas should be evaluated by the park for possible restoration. Five specific trail sections are discussed with alternatives provided for relocation or reconstruction. Multi-disciplinary involvement is recommended to best develop an appropriate trail restoration plan.

The trail system presently lacks definition and the trail signing is inadequate and inconsistent; therefore, it is confusing to the public. The park should install a new complete system of directional signs that is consistent with those of the other park trails. The study includes examples of new signs at selected trail intersections. The horse trail system should be considered as a whole and the relationship between the main north/south oriented trails and the east/west oriented lateral or cross trails should be evaluated. Consideration of this distinction in a system plan would help limit the levels of traffic on the steeper, more fragile trails.

Rock Creek Park's trail maintenance procedures are described, and waterbars and importing soil are discussed. On sloped trails, the continuation of the use and installation of waterbars is recommended to achieve the critical separation of water from the treadway. Importing soil is useful, as long as drainage problems are corrected first. Few records of trail maintenance activities are now kept and it is recommended that trail logs be kept and records of work be established.

Draft trail standards and work item specifications are provided for the park. These include clearing and excavation limits, drains, retaining walls or cribs, and turnpikes. Other recommendations are given for treatment of abandoned trails or restoration of trail edges and establishment of a regional trail crew.

INTRODUCTION

This Horse Trail Study has been prepared for Rock Creek Park, Washington, D.C., by the Denver Service Center and trail consultant Robert D. Proudman. Its purpose is to provide professional guidance for park staff in their development of an effective trail management program. To ensure that this study included up-to-date trail maintenance and design procedures, consultant Bob Proudman was contracted to assess trail conditions and provide recommendations. Don Bailey of the Soil Conservation Service (SCS) provided on-site soil analysis and recommendations. Other trail specialists, resource specialists, user groups, and individuals were consulted during this study, including Tom Lennon, U.S. Forest Service Trail Manager; Jim Patterson, National Park Service (NPS) Soil Scientist; Jim O'Connor, University of the District of Columbia Geologist; Barry Macintosh, NPS Historian; Bill Archibald, Trail Specialist, British Columbia; Peno Dwinger, National Trails Consultant for Equestrian Trails, Inc.; Bob Young, Associate Director of Parks, Maryland National Capital Park and Planning Commission; Don Roush, National Capital Region (NCR) Concessions; John Spurgeon, Rocky Mountain Region Concessions; Joyce Hanson and Mary Angevine, Trail Riders of Today; Jeri Hall, NPS; John McClure and Dennis Ayers, U.S. Park Police; Rock Creek Horse Center staff; the riding public; and Rock Creek Park staff. Special thanks to Donna Turner, Voluneer In the Park, for her vigilance in patrolling the trails and providing important observations and map resources.

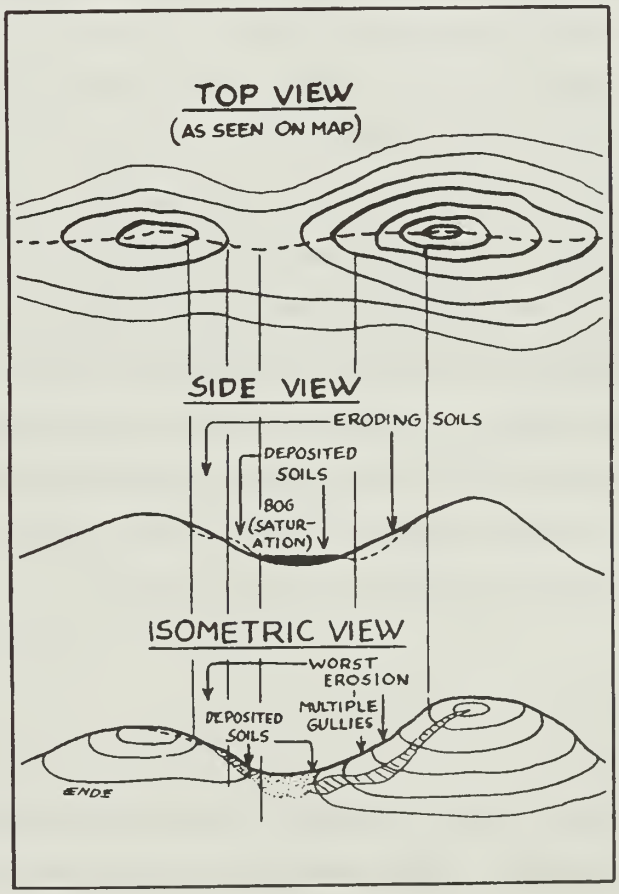
The study covered almost 12 miles of horse trails in Rock Creek Park, including the 4.49 miles of White Horse Trail, the 4.23 miles of Black Horse Trail, and 3.02 miles of cross trail connectors. The document discusses general horse trail problems as applied to the conditions in Rock Creek Park and covers management and maintenance of the trail system. The study moves to possible relocations of trail segments and finishes with specific recommendations for trail standards, directional signing, maintenance, and other concerns.

ANALYSIS OF HORSE TRAIL SITUATION IN ROCK CREEK PARK

TYPES OF TRAIL DETERIORATION

Like other heavily-used urban trail systems, the equestrian trails in Rock Creek Park (RCP) suffer from erosion on slopes and saturation of soils in flat terrain. Erosion is most serious on the steepest trail sections (10-26%) on the White Horse Trail and Cross Trails 6, 7, 8, and 9. Erosion on Cross Trails 2, 3, 4, and 5 is the predominant problem, though it is less advanced. Saturation and mud formation is most prevalent on the flat (0-3%) slopes of the Black Horse Trail next to Rock Creek, where many sections cross the creek's floodplain.

The illustration below shows where landscape erosion and mud formation from saturation occur (from *Trail Design, Construction and Maintenance)*:



The drawing illustrates the two kinds of problems designers should avoid, showing where on a ridge crest they are most likely to occur. Erosion is most likely at the steepest point; saturation is most likely at the flattest point.

These two processes of trail deterioration should be understood by park policy makers, maintenance personnel, and the horse trail concession. Questions within Rock Creek Park about the use of motorized equipment or waterbars do not take on meaning unless these techniques are understood in terms related to the Park Service's legal mandate to protect park soil resources from unacceptable degradation. There are no perfect solutions, only tradeoffs. To protect soils, one must pay a price to another park goal. For instance, a relocation to more suitable terrain is a tradeoff between the benefits of rehabilitating the old, eroding section, and the risks and costs to resources on previously undisturbed terrain. Another example: waterbars are essential on a poorly designed, steep trail. The benefit of improved drainage is a tradeoff with loss of visitor experience quality to equestrians who are impeded by waterbars. This theme will be more apparent to the careful reader as he/she progresses through the report.

TRAIL EROSION IN ROCK CREEK PARK

Generally, erosion is a much more serious impact on trails than saturation/mud formation. It is both harder to control and more difficult to rehabilitate. It is serious in terms of impacts beyond the trail if sediment-loaded waters enter Rock Creek and its tributaries, or when Rock Creek is flooding. Erosion that has advanced to the gully stage may be apparent for years. Lastly, erosion that has advanced to a gully can destroy the equestrian experience. Stones ranging from tennis ball to bread loaf size litter the damaged treadway. These stones are the only residual material heavy enough to still reside near their original location in the soil profile. All the lighter silt, sand, and gravel particles have washed downhill. "I wouldn't bring a good horse into Rock Creek Park," commented one experienced equestrian about the dangerous footing in these unfilled gullies.

Causes of Trail Erosion

There are two principal conditions or environmental constraints that are the primary causes of RCP's most serious erosion problems: soil limitations and poor trail lay-out/no trail design.

Soil Limitations. Comparison between Soil Conservation Service (SCS) soil maps and the worst erosion problems in RCP shows that almost all of the park's erosion problems are located on Manor Loam soil type. This soil is described by the Soil Survey of Washington, D.C. (1976) as subject to rapid runoff and severe erosion. A component of the SCS Manor Loam classification is steep slope (typically about 25%). These slopes predominate along the trail system, particularly on east/west trails that are routed directly up the steep-sided valley walls of Rock Creek Park.

Managers sensitive to resource conditions might question the long term wisdom of routing heavily traveled trails on soils with such serious limitations. Experience has shown, however, that park soils choices are often severely limited and park trails are frequently routed in severe terrain. Consequently, the SCS severe classifications should act as a "red flag" rather than an outright prohibition to managers. Extraordinary caution during design, construction, and maintenance is necessary to build and maintain trails under such severe environmental limitations. Future relocation and reconstruction should be well planned to avoid repeating the errors of the past.

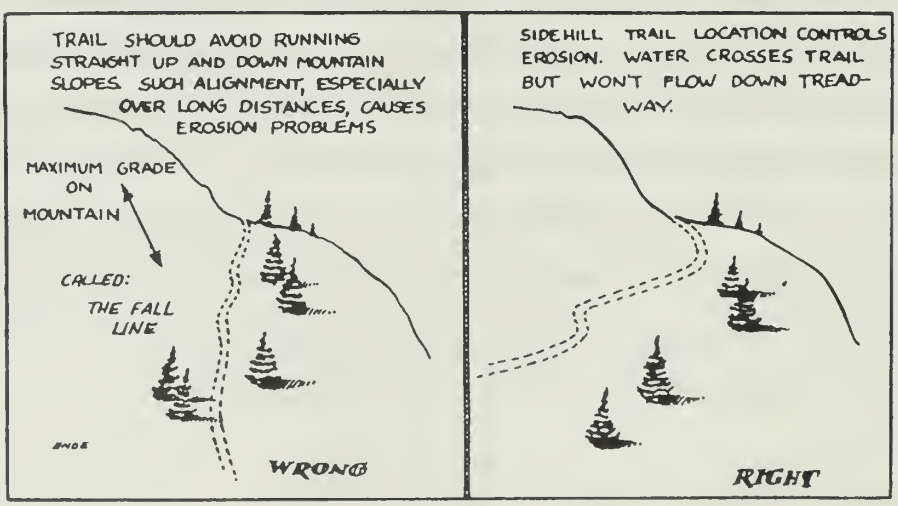
Poor Trail Lay-out/No Trail Design. Today's RCP managers "inherited" the current trail system from a bygone era, when trails were not designed for the heavy use characteristic in today's parks. As a result, there are several "fatal flaws" in the current system that will cause long term resource problems and unusually high annual maintenance requirements. One basic flaw is that trails are routed straight up steep grades. Currently, trail slopes of 20-27% on several heavily used horse trails are evident. These slopes are two to three times the customary national standard of 8-12% for both horse and hiking trails. In too many cases the inflexibility of the trail system itself constrains managers to route trails in an east/west direction straight up the fall line, the direction of maximum slope on the landscape.

Over the long term, it is certain that trail soils will degrade on such steep slopes. These fall line trail locations require unusually intense construction of waterbars, drains, and crib structures. These drainage structures impinge on the preferred riding experience in RCP. It is highly desirable from the horse rider's perspective to have horse trail treads free of trip hazards

and artificial barriers, such as waterbars; unlike hiking trails where steps and waterbars are acceptable tools in the maintenance staff's arsenal of techniques. Some equestrians consider these essential drainage structures very disagreeable to the equestrian experience. In a brief meeting with Bob Douglas, of the Rock Creek Horse Center, he asked the Park Service "to get rid of the waterbars." It should be apparent that the need for waterbars is a symptom of the problem, not the cause. The causes of the problem are steep trail slopes straight up the fall line combined with unusually fragile soils.

Current efforts to install waterbars by the park resource staff and the Youth Conservation Corps (YCC) are highly commendable. Their waterbars are well designed and placed, given the more fundamental problems of poor location of several park trails. It is necessary for these efforts to continue, to achieve drainage of problem trails.

Proper Trail Design. Proper design of trails requires routing trails in a "side-hill" location, relatively parallel to the contour of the land. Trails should cross steep slopes at angles of 60 to 90% to the fall line or maximum landform gradient.



Trails located according to this design always have a low edge which permits outsloping of the trail tread for natural, continuous drainage with a minimal number of waterbars. Water would tend to drain from the low edge of the trail, rather than run down the trail with erosive effects. Several fine examples of such trail design exist in RCP: on the gradual section of the Black Horse Trail between Cross Trails 8 and 9 where the trail cuts across steep grades approximately 100 vertical feet above Rock Creek, at the "Horse Shoe Bend" on the Black Horse Trail north of Riley Spring Bridge, and on the White Horse Trail near Broad Branch where the trail, while steep for short stretches, always has a low drainable edge.

Relocation versus Reconstruction

The hardest choice that Rock Creek Park managers will face consists of choosing, on a long term basis, which fatally flawed existing trail sections they will continue to maintain versus which of these sections will be relocated to improve their basic design and their ability to accommodate horse traffic without unacceptable long term impact. Theoretically, well-designed relocations have the following effects on the park:

Relocations will lengthen trail sections as grades are tackled with new, longer, more moderately sloped trail.

Relocations will require some reallocation of park land because undisturbed areas would need to be used. The cost to site specific park resources in the new trail area would need to be balanced with the resource benefits of reduced erosion on the abandoned and rehabilitated trail section.

Long-term maintenance impacts and costs would be greatly reduced. The impacts of repeated annual or biennial importation of non-native soils by motorized equipment would be greatly reduced.

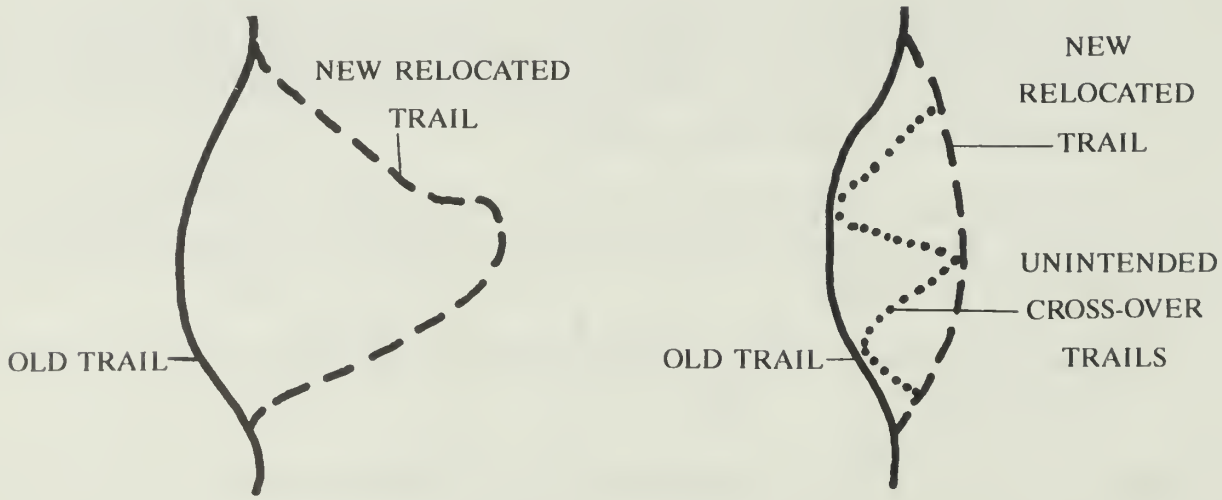
Quality riding experience on well drained, well-surfaced, and barrier-free trail sections would increase.

Relocations, to be truly effective, must be large enough in scale to adequately separate the old and new routes. In this manner, the former route can be permanently closed. The most frequent error made by park managers doing relocations stems from a kind of timidity

regarding really striking out into new terrain. The result of a relocation not adequately separated from its older antecedent is two parallel routes, with both open to horse traffic, both deteriorating at the same rate, and with new crossover trails and confused users. To close an old route, the perception of the horse rider should be clearly understood. He/she should not "desire" using the old route because it appears shorter, easier, or more desirable. The "desire line" should follow the new route. The new route should be a dramatic change in direction and slope, or be a much easier and more desirable route, to be successfully used as a permanent relocation.

In some cases, particularly on short relocations, the old trail route should be blocked with brush barricades four to six feet high. New vegetation could be planted across the beginning of the old trail route, but it must be backed by a brush barricade to discourage use. Temporary trail signs would also help explain trail changes and secure the cooperation of riders.

Specific alternatives for relocations are presented in Part IV.



Right Wrong

SATURATION AND PERIODIC FLOODING

The Black Horse Trail is generally located on flat terrain. Where culverts have clogged or the trail is poorly drained with no low side, water is trapped and saturates the trail treadway. Under repeated churning action by horse hooves, these areas become mud holes. As equestrians seek better footing, they walk on the margins of the wet areas exacerbating widening. The worst areas are approximately 15' wide and 200' long, though there are many smaller areas that should be drained as well.

From a resource point of view, these conditions are less serious than erosion because there is little or no soil movement. If traffic were to cease, lush vegetation would prevail in a year.

Saturated, muddy trail soils are very undesirable to riders and horses alike. Horse shoes are sucked off in deep mud and horses may be skittish about muddy footing. If hikers share a trail with equestrians, they may perceive mud as evidence of "damage" inflicted by horse users. Thus, strongly negative emotions may exacerbate differences, if any, between these two kinds of trail users.

Techniques to Combat Saturation Problems

A variety of techniques are available to combat saturation problems. Some techniques increase drainage, such as culverts, french drains and open-topped drains; and some techniques raise and harden the treadway to resist wear, such as turnpiking and puncheon (raised wooden bridging). The availability of new synthetic fabrics called geotextiles gives the park the opportunity to improve subsurface drainage with french drains in these muddy areas. All these drainage and hardening techniques are discussed in Part V, "Trail Standards and Work Item Specifications."

Culvert Situation in Rock Creek Park

The park's system of culverts is old and variable in condition. Many culverts are too small in diameter to accommodate peak rates of runoff for the 10 to 25 year floods. One might surmise that the original culverts were installed when ground conditions outside the park were more rural and pervious. Or they may have simply been calculated incorrectly. In either case, culvert diameters, particularly along the Black Horse Trail from Boundary Bridge to Riley Spring Bridge, should generally be increased to 36" (see Appendix C). Older metal culverts are damaged from rusting out below the common water line. Another problem is that silt accumulation at culvert outlets backs water into the culverts. These situations make annual maintenance a short-term exercise in futility. Many culvert inlets and outlets have no headwalls, allowing lateral erosion into the trail treadway. Some culverts are too short; perhaps designed when six to eight foot trail widths were more common in a bygone era. Some culverts appear to have collapsed at their midpoint. In some locations there is no visible evidence of culverts, just blocked drainage and saturation.

MOTORIZED EQUIPMENT AND TRAIL WIDTH

The U.S. Forest Service's national standard for horse trail tread width is usually four feet with a clearing limit of eight feet. Based on this standard, the trails in RCP are much too wide. Trails average 12-15' wide, with the widest trails reaching widths of 20-25'. However, the appropriate width should be reconsidered in light of several factors:

- The need to accommodate heavy two-way horse traffic.

- The need to accommodate motorized equipment for maintenance efforts adequate to the task of keeping trails stable and properly surfaced.

- The need for providing security to the President of the United States and/or his family. Every administration since Roosevelt appears to have used the park.

There will be more control of trail width once reconstruction begins and work items recommended here are installed. By improving the treadway, traffic on the trail's margins will be reduced. The margins of many widest trail sections can then be rehabilitated. From a resource standpoint it is highly desirable to relocate or reconstruct the worst trails and then work to narrow trail widths toward a standard of an eight-foot maximum treadway within a ten-foot clearing limit (two horses abreast and room for security vehicles). This effort must consider the extent of narrowing compatible with the three listed factors, and should proceed practically - experimenting with methods of establishing a good tread surface that equestrians will use. If a good tread cannot be established and maintained, there will be continued deterioration of the tread boundaries where equestrians and hikers will seek better footing. Poor footing leads to uncontrolled trail boundaries and widening trail widths and/or shortcuts, as users seek the path of least resistance.

If possible, less frequently used trails should be designated for even more narrow widths, if motorized access can be avoided. Some narrower trails would satisfy an unmet need for those who seek a more wilderness-like trail experience in RCP.

Further research is needed into available, short-axle motorized equipment. While an eight-foot width tread standard seems to fit eight-foot wide vehicles, problems of turning radius suggest that narrower equipment be purchased.

A small four-wheel drive pickup with low pressure balloon tires, the Bob Cat series of narrow excavating equipment (four and one-half feet wide), and possibly the Morrison Trail Blazer, a 24" to 30" wide back hoe, all hold promise for use by the park. Further research is also needed into equipment smaller than standard dump trucks for importation of non-native trail surface soils onto park trails.

PARK MAINTENANCE PROCEDURES

The park staff has done some excellent work. The waterbars installed by YCC crews under resource staff direction are well designed and well located at key drainage points above the steepest gradients. The practice of the maintenance staff of importing non-native soils is unusual; however, the work is well done. The worst sections have new treads and are crowned for drainage with well-packed surface soils.

Both practices can continue; however, greater planning and coordination are needed because once waterbars are installed, resurfacing would bury them. Waterbar installation should be timed to follow the last resurfacing project, for trails slated for long-term waterbar drainage.

Importing non-native tread-surfacing soils and installing waterbars are two critical techniques for the steepest trail grades in the park, and are the only techniques that work on trail sections that go straight down the fall line. (Sidehilling, outsloping, and crib construction may only be installed on a side-slope where there is a low side to which the trail can be sloped and/or drained.) Because the grades where RCP has imported non-native soil are so steep, either technique installed separately may not withstand the tremendous erosive forces that prevail at some of these locations. The most important goal in maintaining such trails is drainage. Water must be separated from the tread's surface and not allowed to flow down it, particularly at the high velocities that increase with steepening slope. This can be achieved by waterbars, high on the slope and at mid-slope (so water is removed early, before doing damage) and, if imported soils are used, crowning the tread so water is shed to the sides. The waterbars not only control erosion, but are effective as a preventive measure when erosion is not yet evident. Detailed description of waterbar design and installation can be found in *Trail Design, Construction, and Maintenance* or *Trail Building and Maintenance*.

Continuing installation of waterbars is recommended as an effective technique to drain sloped portions of trails. The importing of soils is also useful, but if chronic drainage problems are not corrected first, importing soil is only a temporary treatment and leads to more soil loss and water pollution in Rock Creek. From a resource protection perspective, a gully that has

stabilized as a gully may be less of a source of water pollution impacts than a continually eroding trail that is treated with imported soil. It is desirable that less importation of non-native materials be required for the park's trails in the future. Through gradual capital improvement, new trail sections will be better designed and easier to maintain, reducing the need for annual or biennial importation of non-native surface soils.

Annual Maintenance Procedures

It is recommended that the park staff keep simple written reports of work accomplished. These reports should be tabulated to work logs. (See Appendix E, for recommendations about work logs.) In the investigation of the park's past trail projects, there appeared to be no straightforward written documentation of annual maintenance work done on individual trail segments.

Park maintenance and resource staff should regularly patrol the trail system to monitor maintenance conditions. Foot patrol should be a regular priority, with at least monthly patrols of the most heavily used trails. When soils are wet and soft, usually following rain and snow storms during the winter, spring, and fall, motorized use of the trail system should be avoided, if possible.

The following schedule may provide guidance for use in the park:

Fall: Clean out and repair drainage structures for winter runoff. Work evaluation and preparation of trail work logs. The season when leaves are off trees is a good time to plan relocations (long sight-lines through the forest).

Winter: Do work that has not been done during the regular season when demands on maintenance staff are highest.

Spring after rains: In general, prepare trail system for heavy use season. Give priority to safety problems, such as broken bridge railings or poorly marked trail sections. Check

drainage structures for winter damage. Maintain waterbars, clean culverts, and repair bridge abutments.

Summer: Major reconstruction projects. Projects requiring motorized equipment should be planned for those times when trail soils are dry and hard. Use YCC or volunteers to maintain waterbars, clean culverts, and repair bridge abutments.

THE TRAIL SYSTEM AS A WHOLE

It is imperative that RCP managers take a step back and look at the horse trail system as a whole. It is easiest and often most practical, given the busy atmosphere of Rock Creek Park, to react only to the public's (or politicians') complaints and quick follow-up evaluations made by park personnel. People complain about what is obvious: the symptoms of trail deterioration under their feet (or hooves). It may, however, save long-term efforts to look at the park's trail system as a whole.

Lack of Trail System Definition

The trail system of RCP lacks definition. There should be precise delineation of all trail segments from point A to point B, to point C, etc. Main "arterial" trails, such as the White Horse and Black Horse trails, should be named and marked in a continuous manner. All trailheads (access points to the system) and trail junctions should be delineated in park records, on large scale maps, and on the ground with permanent trail signs. Now there is confusion by the riding/walking public. The trails in RCP are almost only for guided parties; the system is closed in the sense that the visitor unfamiliar with the park cannot move confidently through the trail system to intermediate and final trail destinations.

A good example of the lack of trail system definition is the present ambivalence about trail names among users and managers on the White Horse Trail parallel to Oregon Avenue. (Other trails in the park share this problem.) The White Horse Trail has been referred to by four

separate names: the White Horse Trail, the Green Trail (because of green hiking trail blazes), the Potomac Appalachian Trail (because of a misreading of Potomac Appalachian Trail Club sign at Oregon Avenue and Military Road), and the Western Ridge Trail.

All trails in the park, including hiking, biking, and equestrian, should have single names, at least for use by managers. (Different user groups may have different names for the same trail segment). All trails should be accurately mapped at a scale of at least 1" = 800' (1:9600) and indexed by segment. A segment is defined as one continuous piece of trail between trail heads, junctions, road crossings, fords, and bridges.

Arterial Trails and Lateral Trails

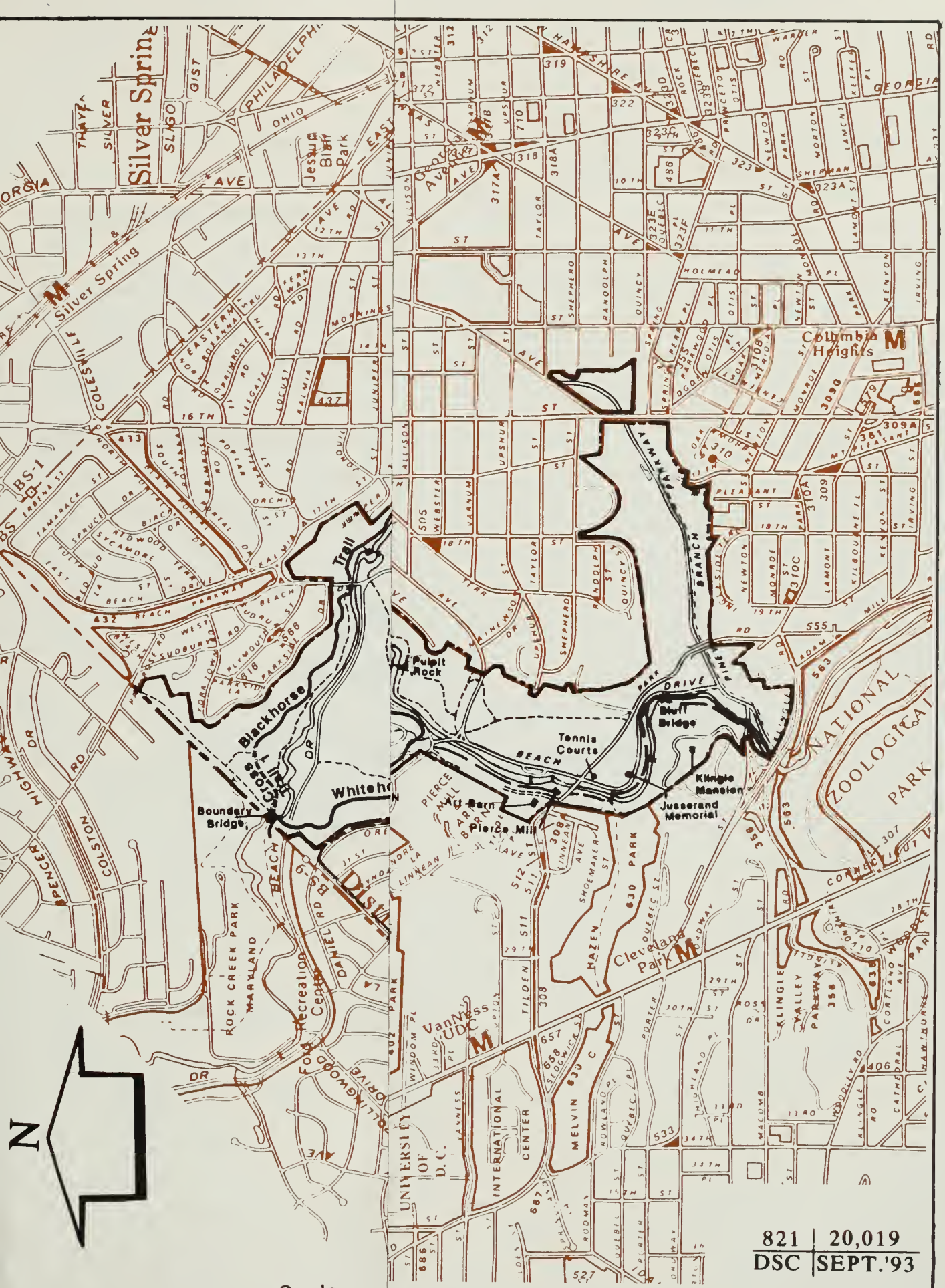
Studying the relationship between parts of the trail system (or any transportation system for that matter) leads to the discovery that each particular segment either carries "arterial traffic" and is "main load bearing" or that the trail bears "lateral or local traffic" and, as such, carries smaller amounts of through traffic. In general, the White Horse and Black Horse trails follow the main north/south axis of the park and carry larger amounts of traffic than the numbered, east/west cross trails. Therefore, the White and Black Horse trails are arterials and should, in theory, have the most stringent design criteria for maximum grade: less than 8 percent (8%) with maximum slopes short and able to be practically drained. Arterial trails should also have the most frequent maintenance, if other factors are equal.

This distinction between trails in a system as arterial and lateral can be used to the managers' advantage to prevent serious erosion. Deliberate trail system design can be used to enhance or inhibit travel among its various parts, to give the park much more powerful control over the impacts of trail visitor use on park resources. Lateral trails can be located on more sensitive, steeper slopes, as they are subject to lower levels of traffic.

The configuration of the White Horse Trail on each side of Military Road offers a dramatic example of this problem. At these locations, the White Horse Trail moves east/west up and down steep grades, rather than following its otherwise thematic north/south design. Slope

measurements on the segment south of Military Road show grades of 20%, and on the segment north of the road approximately 27%.

If the White Horse Trail was relocated to cross Military Road at the Oregon Avenue traffic light, use on both these erosive slopes parallel to Military Road could be dramatically reduced. A horse trail "walk button", similar in height above ground to those used in California, would need to be installed. If this relocation were installed, the sensitive sections of the existing White Horse Trail would become laterals similar in trail system characteristics to the cross trails. These two sections could even be periodically closed in wet weather, when trail impacts on soft soils are most severe, if an arterial alternative was available. This report cannot evaluate the public safety considerations of a decision to cross a main highway at-grade with an arterial trail. However, the environmental consideration would be served by routing the White Horse Trail in its thematic north/south orientation, to permanently bypass two long, steep, eroding and basically not maintainable slopes.



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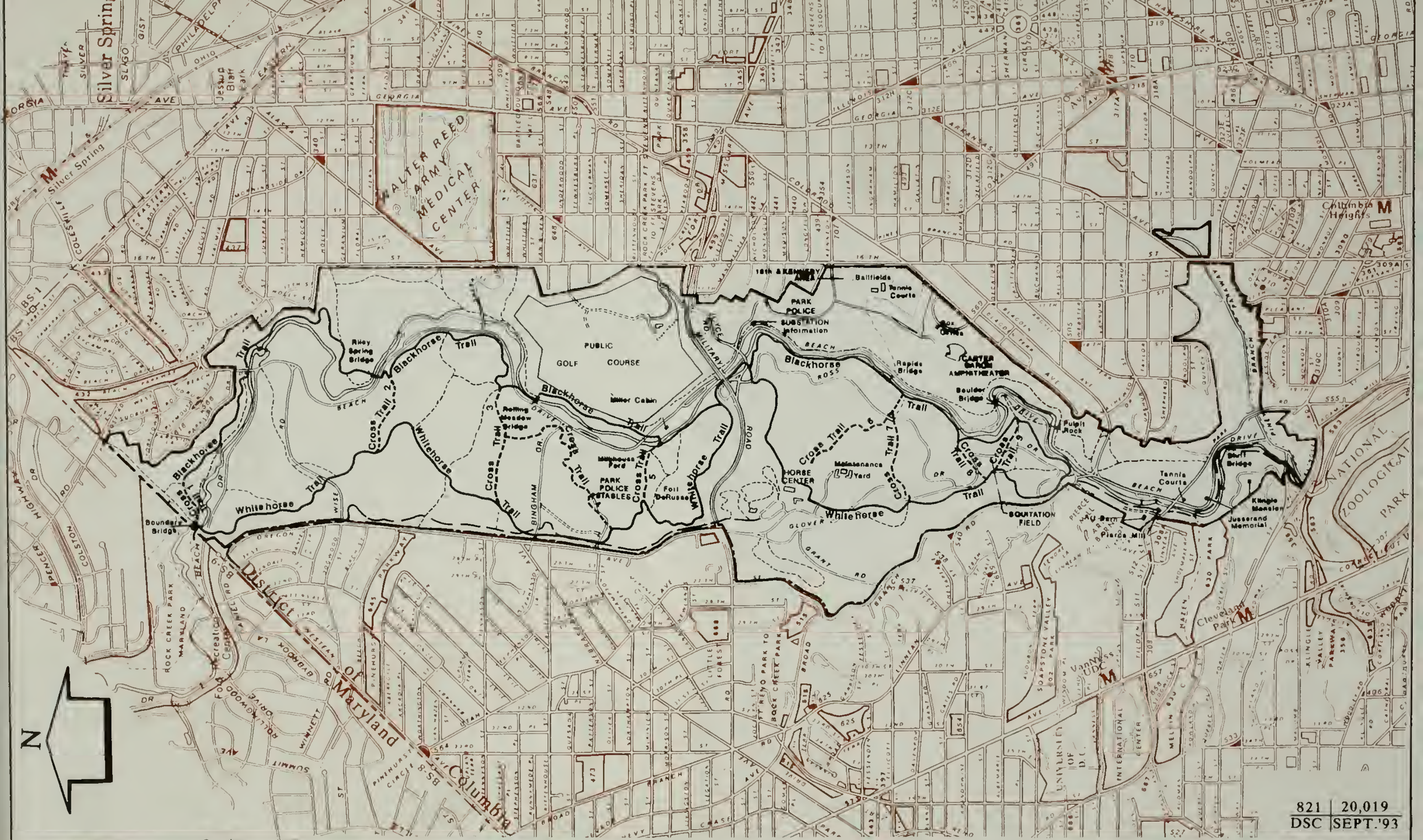

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ALTERNATIVE SOLUTIONS

SPECIFIC EROSION PROBLEMS

Currently there are five trail sections in the park with severe ongoing erosion. This part is a discussion of alternative solutions for each of these areas. See the work logs (Appendix E) for work recommendations on existing trail sections, if no relocations are considered.

Selection of preferred alternatives needs to be approached in a multi-disciplinary manner. Park resource managers, soil scientists, landscape architects, and maintenance personnel should work together to study the characteristics and impacts of each alternative. A consensus of the participants is necessary to select preferred alternatives for developing an appropriate plan to restore the park's horse trail system.

The five specific problem areas are:

1. White Horse Trail north of Military Road
2. White Horse Trail south of Military Road
3. White Horse Trail near Cross Trail 7 above Glover Road
4. Cross Trail 7 below Ross Drive
5. Black Horse Trail at the lower junction with Cross Trail 8

1. White Horse Trail North of Military Road

There are several sections of this trail that are gullied and widening, and slopes measure 27%.

Alternatives:

1A. **Investigate relocation to the north**. The study team did not thoroughly search for a relocation. The feasibility of relocation to the north should be thoroughly checked in the field by an experienced resource manager/trail builder. Estimated cost $4,500.

1B. **Reconstruct Trail on Existing Location**. Improved waterbar drainage and wooden cribs installed on the edge of this gully may stabilize the tread; however, the slope is so steep that even an improved crib tread may be difficult for horses to negotiate.

2• **White Horse Trail South of Military Road**

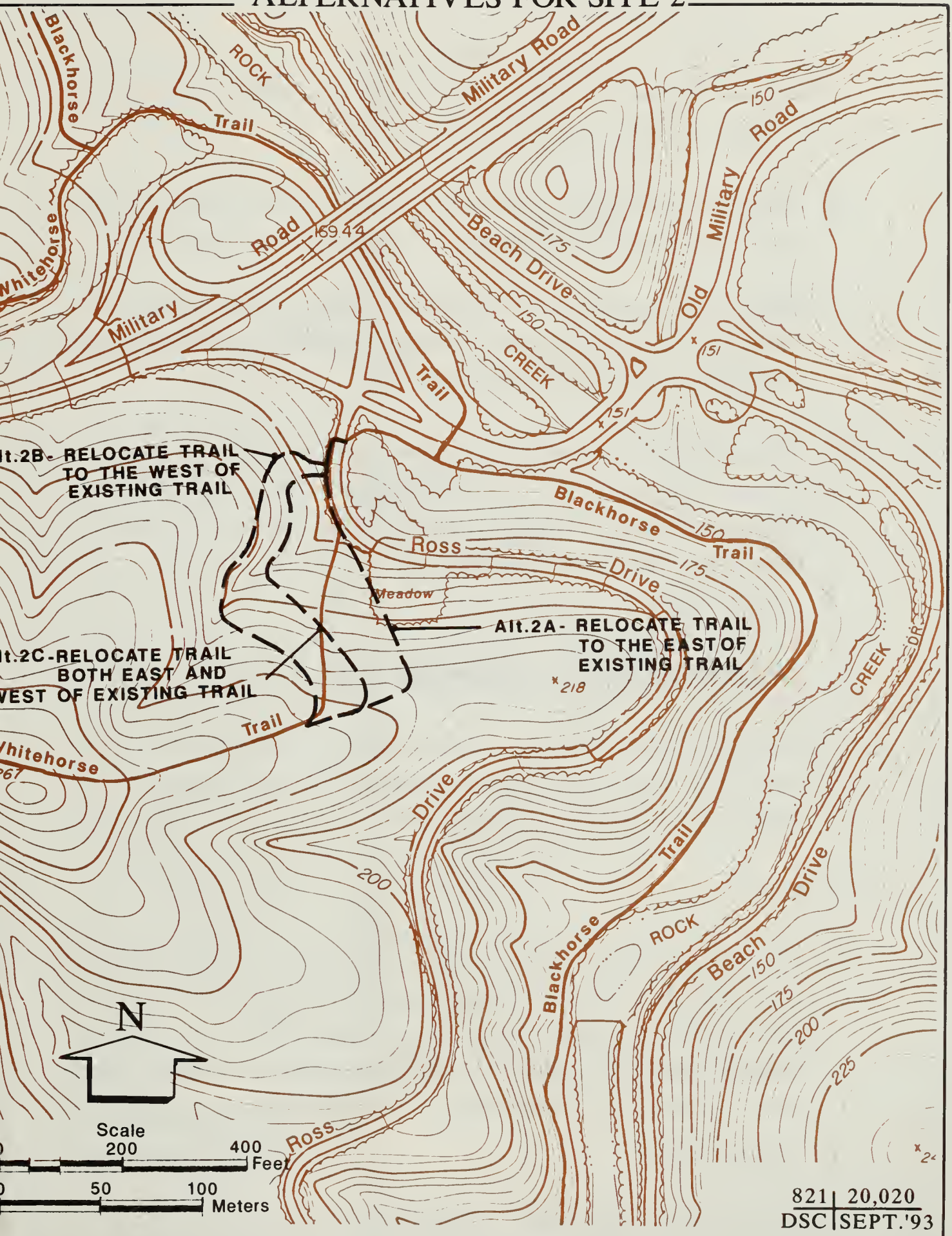
An average of 781 tons of soil per acre per year are now eroding from the slopes of the White Horse Trail at this location, according to on-site inspections by George "Don" Bailey of the Soil Conservation Service (see Appendix A). The steepest slope at this location is 20%. At the steepest point of the slope, 1.5" depth of soils are being lost each year despite the commendable efforts of the park maintenance staff to import and firmly pack non-native soils at this location in FY 83.

Imported fills are now covering the root collars of several large oak trees adjacent to this trail section. These trees will suffocate and die unless the root collars are dug out and the former surface of the ground is exposed to air. Small stone or corrugated steel retaining walls should be installed to prevent reslumping of tread soils onto roots. This is an easy and important project to prevent tree mortality on an already fragile slope.

Alternatives:

2A. **Relocate trail to east**. Topographically, it is feasible to dramatically reduce the most severe (20%) lower slope of this trail with a relocation to the east. However, an

ALTERNATIVES FOR SITE 2



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important park meadow adjacent to Ross Drive would have to be crossed, making this alternative undesirable. Estimated cost: $3,000.

2B. Relocate trail to west. This is a more difficult design, and a relocation to the west would require a wooden bridge across a 15' wide gully. Estimated cost: $4,000

2C. Relocate both east and west. An "S" shaped relocation both east and west of the existing trail would avoid the park meadow and permit designing a trail with more moderate slopes (see map). Estimated cost: $4,500.

2D. Maintain trail on existing slope. The park maintenance staff refilled this gully in FY 83. The existing waterbars should be lengthened as noted in the work logs. After making drainage improvements, the margins of this trail should be rehabilitated to reestablish native plant life and narrow the 20' wide tread.

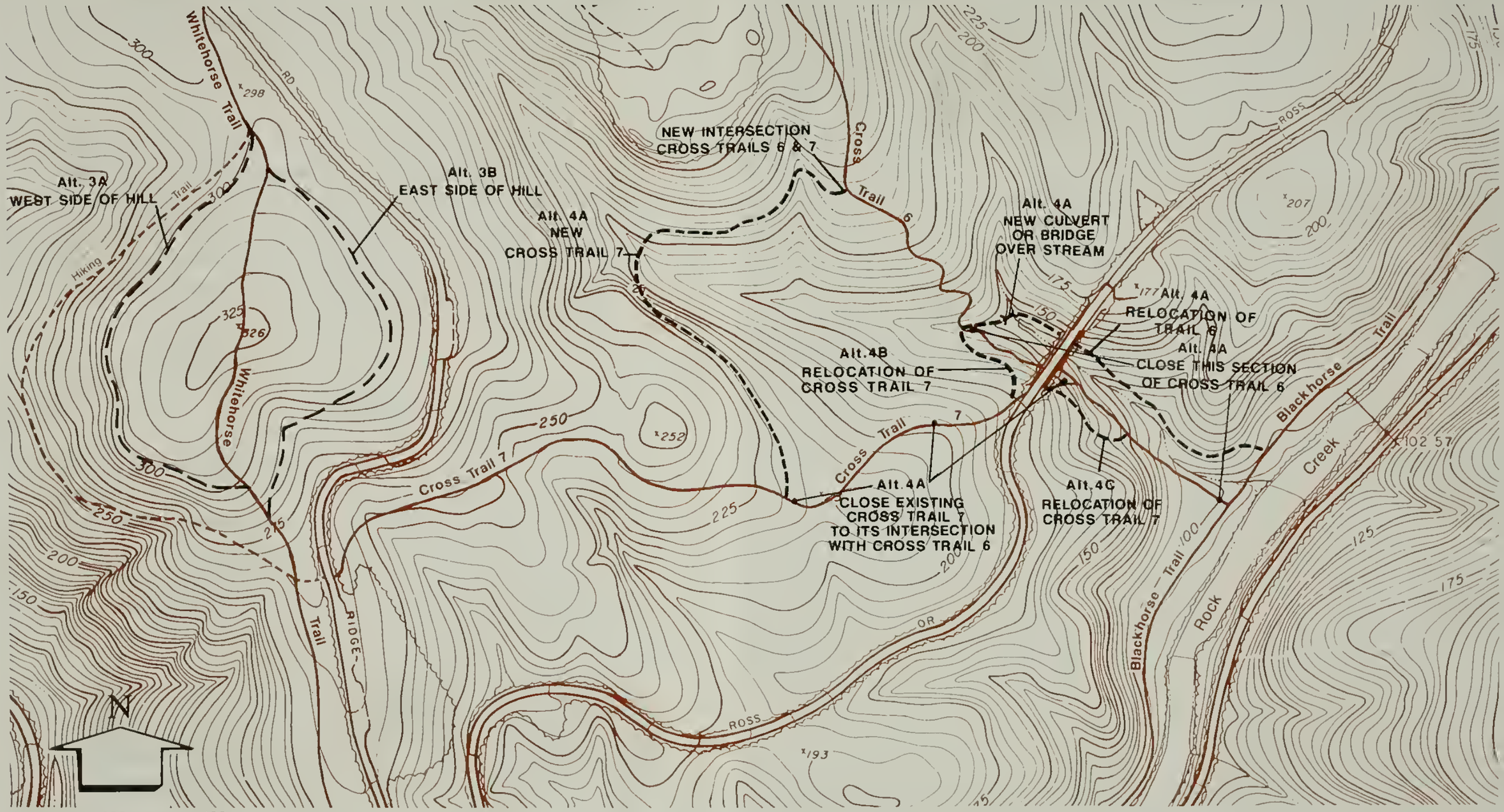
3• White Horse Trail at Glover Road and Cross Trail 7

This trail section passes over a hill. The trail on the south side is gullied about 2.5' below grade for 200'. The study team investigated two relocations to bypass this hill, one on the west of the hill and one on the east.

Alternatives:

3A. West of Hill. The study team flagged with blue surveyor's tape an alternate trail location from the junction of an unnamed hiking trail around the west side of the hill parallel to and above the existing hiking trail. This relocation would require substantial excavation because of steep side slope. Resource Manager Bob Ford expressed concern for a small spring water habitat in the watershed below this relocation alternative. Estimated Cost: $6,000.

ALTERNATIVES FOR SITES 3 AND 4



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ROCK CREEK PARK / HORSE TRAIL STUDY

3B. **East of Hill**. Terrain east of the hill adjacent to Ross Drive is more gradual, making a relocation feasible. However, the probability of uncontrollable crossover traffic from horses using both the trail and roadside makes this alternative a potential safety hazard and resource problem. Estimated cost: $6,000.

3C. **Reconstruct existing location**. Cribs should be constructed on the west edge of the existing trail, which has become recessed and is becoming a gully. (See crib description in Part V, "Rock or Wood Retaining Walls or Cribs.") A smooth, hardened tread could then be outslope-drained. Drainage considerations need to be addressed first in any reconstruction plan; and with installation of a crib on the edge of the gully, the old gully acts to drain the new trail location, providing the critical separation of water and traffic. The gully should be closed and rehabilitated by filling it with dead brush.

4. **Cross Trails 6 and 7 Near Ross Drive**

Cross Trail 7 below Ross Drive is eroding at an average rate of 31+ tons per acre per year (See Appendix B). The lower slopes of this trail are only 50' from a tributary of Rock Creek. Slopes at this location are the steepest measured in the park: 27% on the grade below Ross Drive. This slope exceeds the Forest Service 12% standard by 217%. Of all the relocation alternatives considered in RCP, alternative 4C, below, offers the greatest benefits to the park's trail system, for the smallest investment and least resource risk.

4A. **Major relocation**. Relocate the section of Cross Trail 7 connecting with Cross Trail 6 by traversing the slope uphill of Ross Drive; close Cross Trail 7 below this; and build a new alignment of Cross Trail 6 from the Black Horse Trail to just above Ross Drive, on the east side of the unnamed stream.

Substantial excavation would be required between Cross Trails 6 and 7; however, the design would be very stable because there is modest elevation change. This part of the relocation would eliminate old C.T. 7 to its current junction with C.T. 6. The second part of this relocation consists of building a new trail to pass, like the current C.T. 6, under the Ross Drive highway bridge, but on the east, rather than west side of the stream. Terrain here is much more moderate than on the current trail location. A culvert or bridge would be required to cross the stream and join the existing alignment of C.T. 6. (A 4" diameter culvert, the size of the existing culvert that drains this stream where it crosses the Black Horse Trail, would be adequate. A wooden bridge with railings, like the bridge north of Milk House Ford on the Black Horse Trail, would be an attractive facility.)

This relocation would eliminate the trail segment with 27% slopes on C.T. 7, and an at-grade crossing of Ross Drive.

The relocation of Cross Trail 6 to the east side of the stream enters the periphery of the bird census area, which naturally concerns the resource staff at RCP. On balance, the study team believes that the impacts on bird life on a new trail, only 50' from the existing trail and within 100' of Ross Drive, are insignificant compared to the benefits in reduced soil erosion from closure of existing steep trails. Estimated Cost: $12,000.

4B. Minor Connection of Cross Trail 7 to New Cross Trail 6 Section. Instead of the major relocation of the upslope portion of Cross Trail 7 desrcribed in 4A, a new short trail section near Ross Drive would eliminate the at-grade crossing of Ross Drive and the steepest trail section below Ross Drive. As C.T. 7 comes down the slope toward Ross Drive, the new section would curve to the left through the woods to connect with C.T. 6. The new alignment of Cross Trail 6 would be created, crossing the stream and continuing along the east side of the stream as in Alternative 4A.

4C. Minor Relocation. If no changes in Cross Trails 6 and 7 are planned, a much smaller relocation of C.T. 7 was marked with engineer's flagging tape just below Ross Drive.

It would replace the steepest section just below Ross Drive with a more gradual climbing turn. Estimated Cost: $2,200.

4D. Reconstruction on existing location. Waterbars should be installed as noted in the work logs if the relocation is not installed.

5• <u>Black Horse Trail at Cross Trail 8</u>

Because of ice formation, which is characteristic of eroding trails during the winter, an alternate route was cut immediately adjacent to the steepest slope (Sergeant Ayers conversation). Now the section is approximately 25' wide, more than three times the standard 8' width recommended for western horse trails. Besides a vicious circle of increased soil erosion from exposed bare earth, such trail widths increase maintenance costs by requiring longer drainage structures (30'+ culverts and waterbars) and 30-50% more imported soil for trail surfacing.

There are few, if any, relocation alternatives to the existing trail locations at the junction of Black Horse Trail and Cross Trail 8. Improved drainage above the steepest slopes on both the trails should help significantly. There should be an additional culvert installed at a point about 465' above the existing culvert on Cross Trail 8 and several 30'+ waterbars should be installed on the steepest, widest sections at and below the trail junction. During a rain storm, rivulets of chocolate-colored water run down the center of the treadway moving at velocities that carry gravel-size particles. Recrowning and packing with imported trail soils, followed by installing waterbars, will lengthen the life of these trails.

TRAIL STANDARDS AND WORK ITEM SPECIFICATIONS

The following draft trail standards and work item specifications are based on U.S. Forest Service specifications and experience from work on eastern trail systems. This list is not all encompassing, but describes the work items most frequently referred to in this report: Clearing Standard, Excavation Limits, Trail Cross-sections, Rock or Wood Retaining Walls, Turnpikes, Underdrains, and Geotextile Drains.

The park's use of **waterbars** on the horse trails is well established. Other standards and specifications that the park should adopt, with additional study:

1. **Culverts**: Standard specifications for culverts designed to at least the 20-year flood event are needed for RCP (See Appendix C).

2. **Imported Trail Soils**: With the help of a soil scientist, the park should define the characteristics of imported trail soils ideally suited for trail surfacing. George Bailey, SCS, recommends a loam type soil with low clay and stone content, which will be bound together and not shift. A method usable by any lay person should be developed to evaluate the suitability of surfacing soils, and for selecting fills available from Washington-area developers. (See the discussion in Part III, "Park Maintenance Procedures.")

   Gravel and wood chips can be used, but only on stable well-drained trail sections with moderate slope (≤ 3%) and no active erosion. This is because they are "unbound," or loose and potentially shifting.

3. **Rehabilitation**: Techniques and strategies for rehabilitating trails should be developed with the help of soils/botanical specialists. Rehabilitation of existing trail margins will be required along many trails in RCP to achieve the 10' clearing width standard. (See the discussions in Part III in "Motorized Equipment and Trail Width" and "Park Maintenance Procedures.") Because of existing poor

stony or muddy conditions in the center of the tread, horses are using the margins of trails, causing widening. Improved treadway reconstruction, surfacing, and maintenance will do much to contain traffic and reduce damage to soils and plant life next to the trail. Other treatments, such as liming with pellet-form lime, can enhance the ability to reestablish native growth in highly acidic Manor Loam soil. This technique is worth trying only after improved tread conditions permanently remove traffic from damaged trail margins.

Old abandoned trail sections should be closed with brush and log barricades. Filling old trails with brush to a height of 4-6' will virtually eliminate traffic and permit nature to take its course.

4. **Trail Marking**: Standards for signing and marking trails should be implemented in Rock Creek Park.

The following standards and work item specifications are suitable for adoption and use in Rock Creek Park. However, the park superintendent may wish to use them on an interim basis until adoption of the park's general management plan. In planning for the future, the park must define the preferred trail experiences and aesthetic qualities it will offer equestrian visitors. In general, it is assumed that trails should be narrower, more intimate for recreation, and with less visible deterioration. While this assumption seems obvious, the park needs specific long-term objectives for trail improvement in the general management plan.

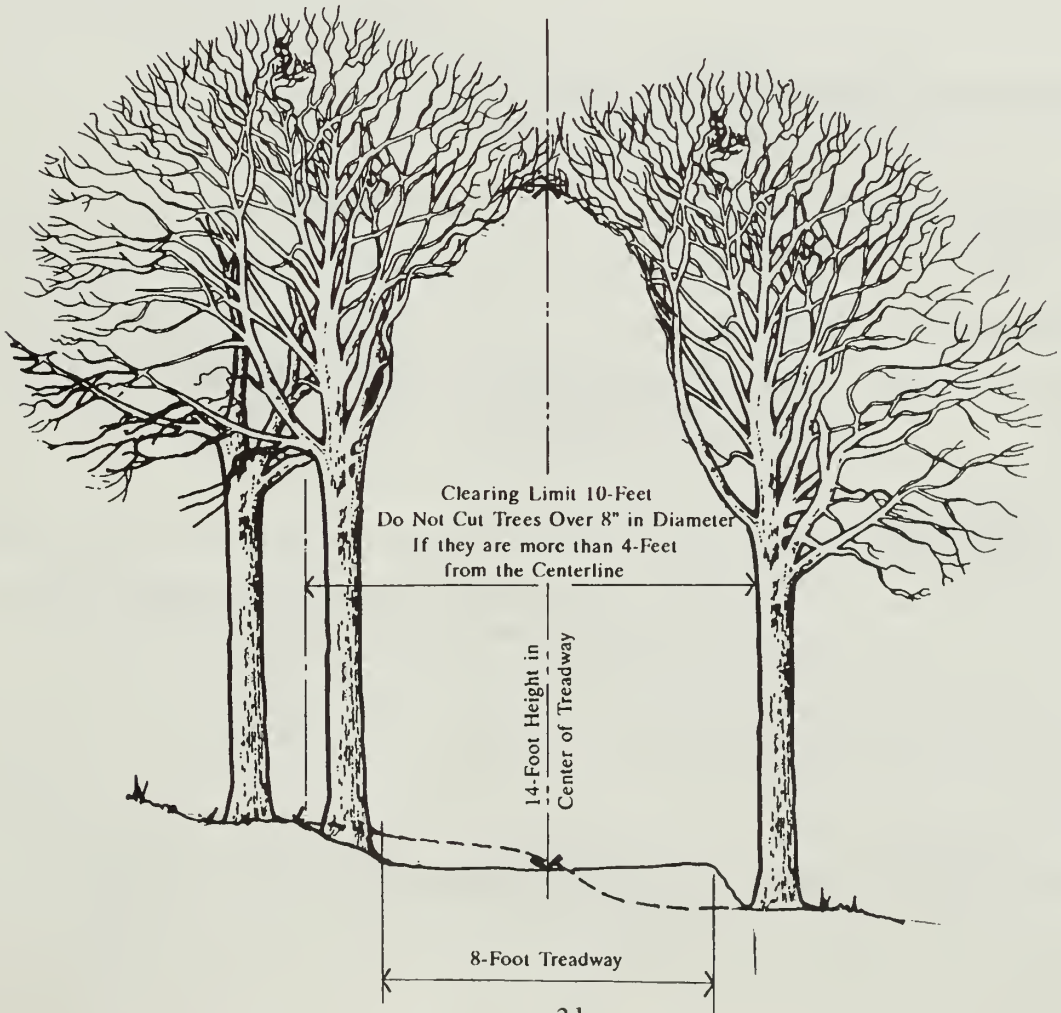
For additional information about standards and work item specifications, see *Standard Specifications for the Construction of Trails*, Forest Service, USDA 1984.

CLEARING WIDTH AND HEIGHT STANDARD

Recommended Standard for Clearing Width and Height: 10' X 14'

The area within 5' of the centerline of the trail treadway should be kept clear of live and dead brush, timber, and slash to a height of 14' at the center of the tread, as shown below on the trail cross-section drawing. All live and dead trees and brush should be removed from the cleared area, preferably to the low side of the trail. All stumps and organic soil matter should be removed from the treadway, 4' on each side of the centerline to the trail. Branches should be cut flush with main stems, and trees that are removed should be cut flush with the ground.

EXCEPTIONS: Live trees more than 8" in trunk diameter and live brush less than 1' high ,more than 4' from the centerline (between the trail treadway and the clearing limit) may be retained for the trail.



EXCAVATION LIMITS

Typical Trail Cross-Sections

With a tread width of the 8' maximum, excavation limits will vary with sideslope, greater excavation being required for steeper side slopes. The maximum backslope of the sidehill should be 1:1 unless a wood or rock retaining wall is installed.

Trail tread constructed on side slopes above 50% should be full bench: the 8' tread should be located completely within the cut. On side slopes of less than 50% the trail bench can be located partly on fill material (see drawing). The maximum fill slope should be 1.5:1.

In all cases the trail tread should be outsloped 3-5% to allow drainage.

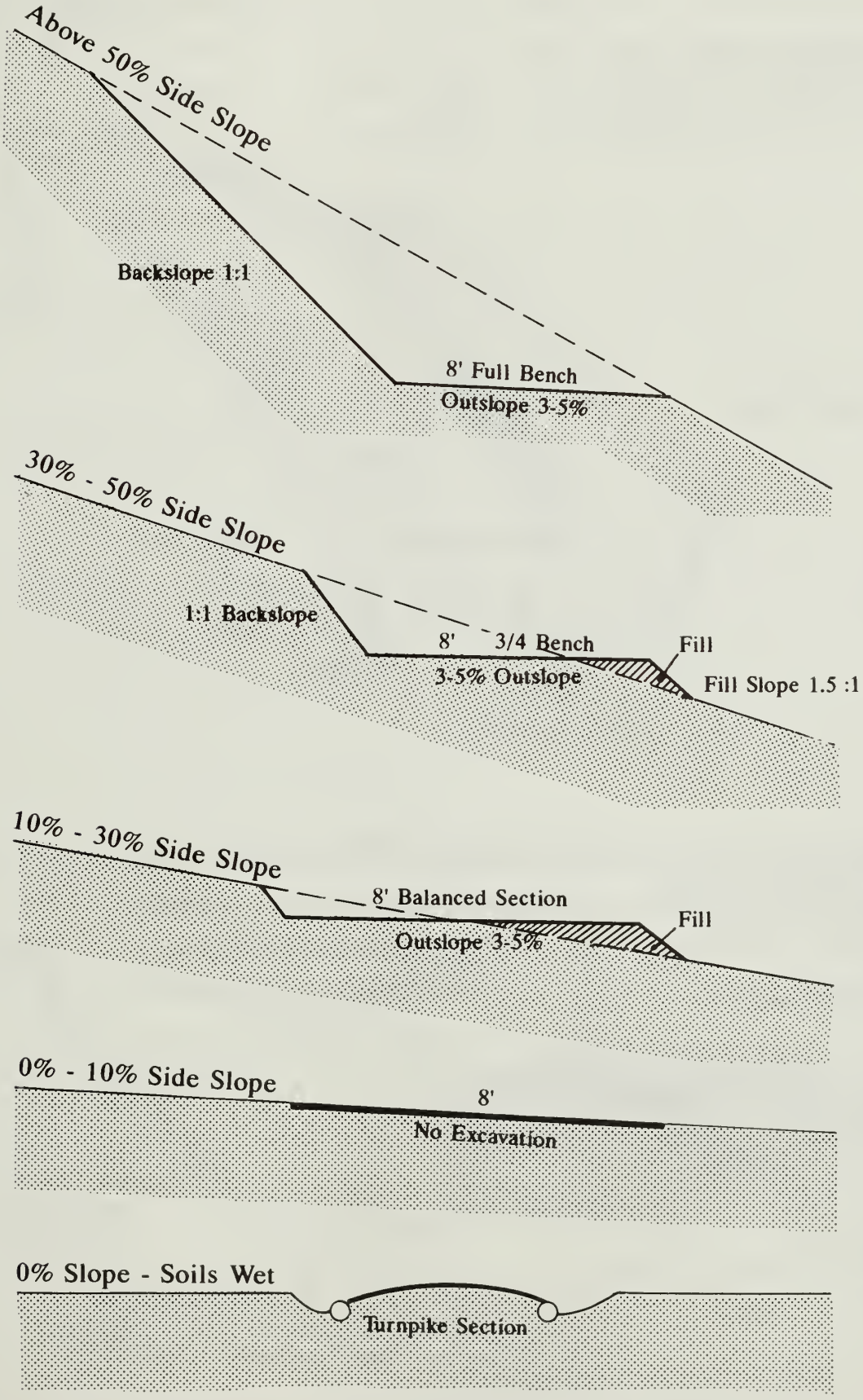
ROCK OR WOOD RETAINING WALLS OR CRIBS

Retaining walls or cribs are used to support either the cut or fill slopes of a trail so that it provides a durable 8' tread. The technique stabilizes the steep wall of a gully with wooden or rock structures, instead of importing new soil. With the installation of a crib on the edge of a gully, the old gully acts to drain the trail location, providing the critical separation of water and traffic.

Retaining walls should be constructed so that they are firmly footed on rock or mineral soil. They should be wider at the base than their height and they should slope inward 1" to 2" per vertical foot.

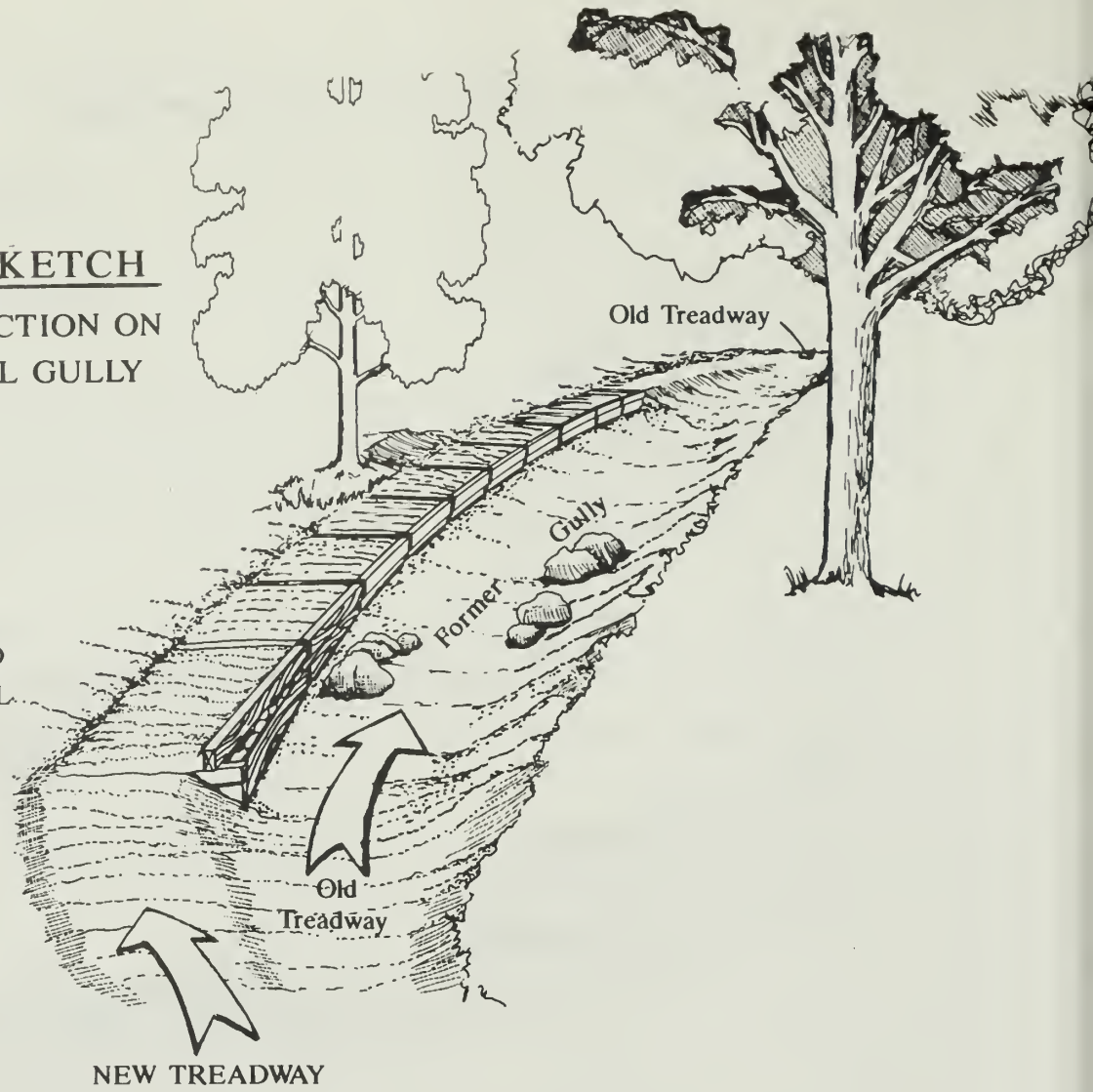
Rock cribs should be constructed with rock that is rectangular in shape and at least one cubic foot in volume. Rock retaining walls should be constructed with the largest stones at the bottom, using offset joints and other appropriate and accepted stonemason techniques.

Excavation Limits-Typical Trail Cross-Sections



CONCEPT SKETCH

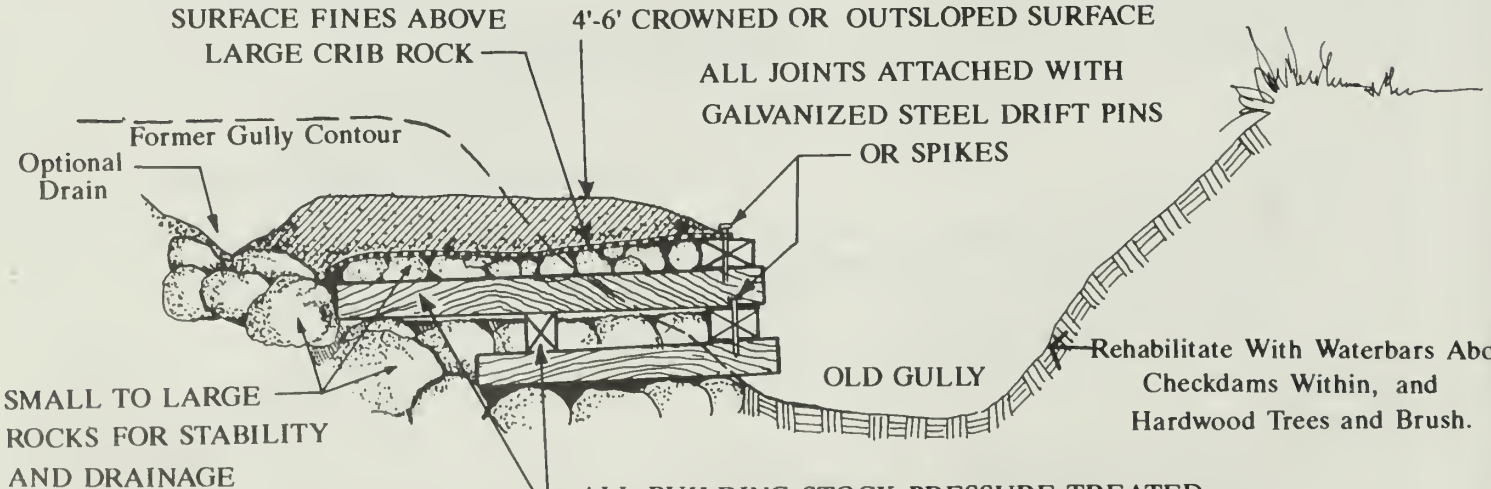
CRIB CONSTRUCTION ON
RIM OF TRAIL GULLY



FORMER GULLY USED
TO DRAIN NEW TRAIL

NEW TREADWAY

CRIB CROSS-SECTION



Wood retaining walls should be built with pressure treated lumber. The largest pieces should be used for the sill. All pieces should be pinned with 1/2" galvanized drift pins or spikes. All notched joints should be treated twice on the work site with preservative. The inside of wood cribs should be filled with a mix of large and small rock to allow drainage.

The tread surface above crib structures should be outsloped 3-5% with no berm to inhibit drainage unless a drain is installed, in which case the surface should be crowned. Geotextile cloth can be used above crib rock to support soil fines making up the surface of the treadway.

UNDERDRAINS OR GEOTEXTILE DRAINS

For muddy and poorly drained flat trail sections underdrains can be installed to remove standing water from the treadway without the difficulty of maintaining open-topped drains. (Open-topped drains are simply drainage ditches that do not cross the tread, but are used above or below the trail to collect or disperse water through a culvert or geotextile drain. They generally are about 18" by 18" in cross section, which should be an adequate size to prevent filling with sediment between maintenance visits.)

Construct underdrains by digging a two foot deep trench across the trail at the low point. The ditch should be downsloped 3-5% and directed to the low side of the trail to remove water permanently. It can be angled slightly downhill as with a waterbar, and should have square sides measuring 14-18" in height and 12" in width. The trench should be lined with geotextile cloth and then filled with rock ranging between 1" and 4" in diameter. After the trench is filled, the cloth should be folded over so that the top of the drain has two layers of fabric. Fill in above the drain with 6" of native material. Be sure to completely bury the fabric because it deteriorates in direct sunlight unless the fabric is treated with specific ultraviolet inhibitors.

Geotextile Fabric: The study team called Mirafi Inc. for technical literature (see Appendix D) and talked with Jim Weeden (704/523-7477). The most commonly used fabric is 140N, an economical choice for the park's needs. Mr. Weeden said that GSA prices are about 75% of

retail costs. The GSA contract number is GS-OOF-79343 and the GSA product number is NIS-G-4994. The park may want to compare this product with similar fabrics manufactured by other companies.

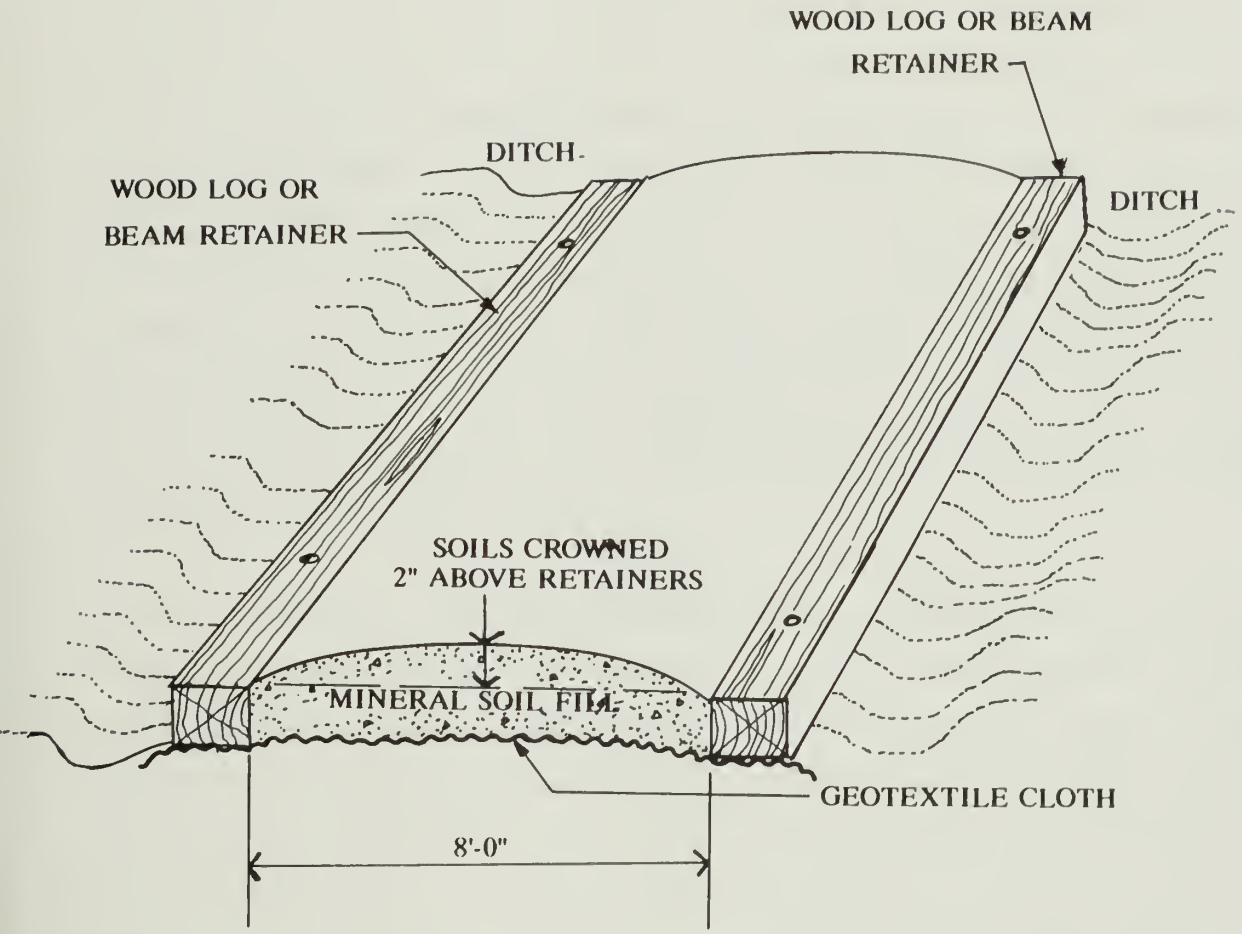
TURNPIKE

Turnpike is used in flat poorly drained areas to provide a dry raised tread surface. A good example of turnpike has been recently constructed about 1/4 mile south of Military Road on the Black Horse Trail.

Turnpike consists of two wood log or beam retainers laid parallel to the trail, 8' apart. Geotextile cloth is laid in the area between the logs. Then either native or imported mineral soil is used to fill the area between the retainers. Ditches on either side of the turnpike can provide soil material as well as direct water away from the trail. The turnpike is filled so that the new surface of the trail is crowned 2" above the top of the retainers.

Before construction, rocks, stumps, and other obstructions should be removed from the trail bed. Drainage structures below the trail bed such as culverts should be repaired or replaced before turnpike construction. In the wettest areas geotextile drains should be installed first to improve drainage and keep the new turnpike from becoming saturated.

TURNPIKE SECTION



ANALYSIS OF TRAIL SIGN SYSTEM

For previous visitors to Rock Creek Park, there probably is little confusion about how to find one's way around. But for the newcomer or infrequent visitor, the park equestrian trails are very confusing. This confusion is due in part to the park's size and urban setting. The park's two main north-south trails are cut into many segments by roads and connecting cross trails. There are very few signs at these intersections that help visitors learn where they are in the park in relation to other features or destination points. This situation causes apprehension in visitors and discourages use. The problem applies to foot and bicycle trails as well. It is highly recommended that a comprehensive trail sign system be developed along with a high quality trail map. Due to the myriad of access points into the park, a trail map by itself would do little to help most visitors. Informational trailhead displays should be installed at key entry points to the trail system such as the Boundary Bridge, the Rock Creek Horse Center, and near Beach Drive and Broad Branch Road. Content should include a trail map and information regarding regulations and trail etiquette.

In addition to improved signing, thought should be given to diversifying and standardizing trail names so that visitors will have an easier time identifying their location within the park. Trail names that are more closely associated with nearby park features would help to accomplish this and would possibly stimulate interest in the park's natural and cultural history. Renaming a trail system is a difficult task since current trail users are familiar with certain names and would likely be confused or annoyed by introduction of new ones. However, there already is a problem with overlapping trail names. For example, a section of the White Horse Trail is also known as the Western Ridge Trail and sometimes is referred to as the green-blaze trail because of the green trail blazes found along its length. The Black Horse Trail is also known as the Valley Trail and most of the Cross Trails 1-9 have other names. Adoption of a detailed, labeled trail map and sign system would require the park to standardize these trail names.

Current directional signing takes on two forms in Rock Creek Park. The Potomac Appalachian Trail Club (PATC) has installed and maintains signs for blue and green blazed foot trails that they help maintain. These signs are essentially a wood post with a wood routed sign board at

trail junctions. They convey up to three pieces of information including the name of the trail, the name of an intersecting trail, and the destination of other trails or landmarks. This type of sign is ideal for the amount of information it can convey, its attractiveness, and the fact that it can be read even if the paint wears off. Drawbacks include susceptibility to vandalism because of its design and attractiveness. These signs are scattered through the park and cannot be considered a comprehensive system for the foot trails. Where the PATC-signed trails overlap onto the horse trail system, there exists a confusion of names for the same trail.

The horse trail signs are quite different in that they are designed more to be vandal-proof than to communicate information. They are made of 6' tall metal posts anchored in concrete with small 10" square signs attached that show a horse's head. A major flaw in this setup is the assumption that visitors will immediately understand that a black horse head on white background means "Black Horse Trail" and the reverse means "White Horse Trail." The most the visitor can truly be expected to understand from these signs is that horses are allowed on that trail. The Black Horse and White Horse trails extend the full length of the park, so knowing you are on one or the other trail does not really help a person know where they are in the park. It is necessary to give people not just the trail name, but information on where they are in relation to other trails or landmarks, including mileage. An effort has been made to add information to the metal posts identifying the cross-trail number that links the main trails. This information is hard to read and tends to flake off the pole, but is a good effort at helping orient trail users.

It is our recommendation that these metal signs be replaced with new signs that communicate more information and, if possible, are more aesthetically pleasing. Ideally, the new sign design should be used throughout the park trail system, including foot and bicycle trails. Recommendation of a comprehensive trail sign system goes beyond the scope of this study and probably should be addressed within the context of a general management plan. It is important to note that this problem is network-wide and should be addressed as a whole.

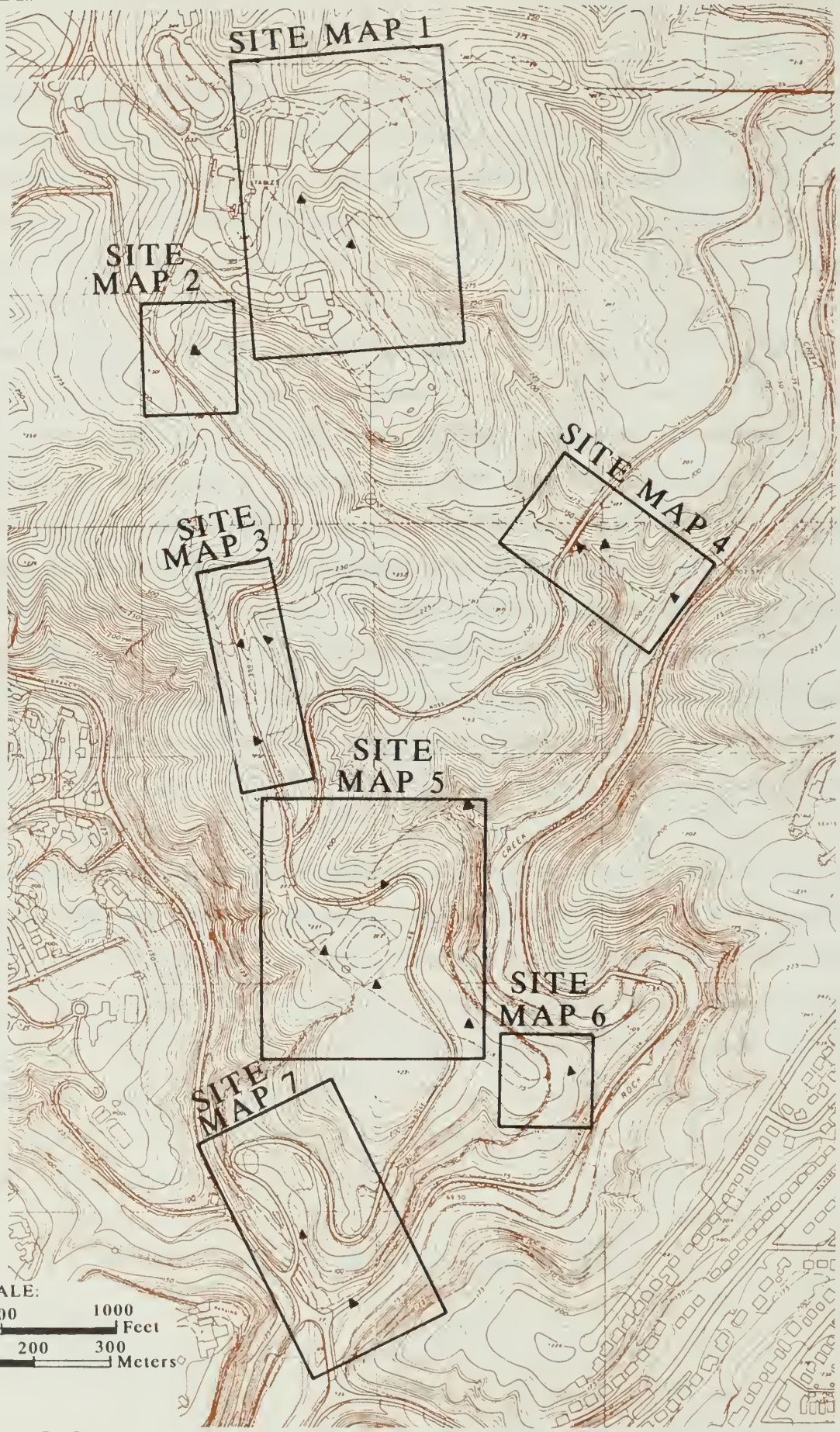
If and when a new trail sign system is adopted, issues such as cost, ease of maintenance, amount of information that can be conveyed, susceptibility to vandalism, and appearance will

all be important in deciding what sign materials are chosen. A full range of options is available to the park, from rustic routed signs like those used by PATC, to the type of wood routed signs developed by Jeri Hall at Great Falls Park, Virginia, to metal signs. All of these sign types can easily be read by equestrians. Horsetrail signs do not need to be extra tall to be readable.

As noted before, the PATC-type signs are very attractive, convey much information, and can be read even if the paint wears off. Their production is labor intensive and their design is likely to make them susceptible to vandalism and therefore create even more work for maintenance crews. The signs used at Great Falls are attractive, labor intensive initially, but much more vandal proof. The design restricts how much directional information can be conveyed, but allows for regulation symbols such as "no pets," which would help eliminate additional sign clutter. See Appendix E for design and inventory sheets used by Great Falls Park. A metal sign system would cost less initially, be easier to make, and probably require less maintenance. It would be necessary to make the sign boards larger to convey more information and this may increase their susceptibility to vandalism. Also, they are considerably less attractive.

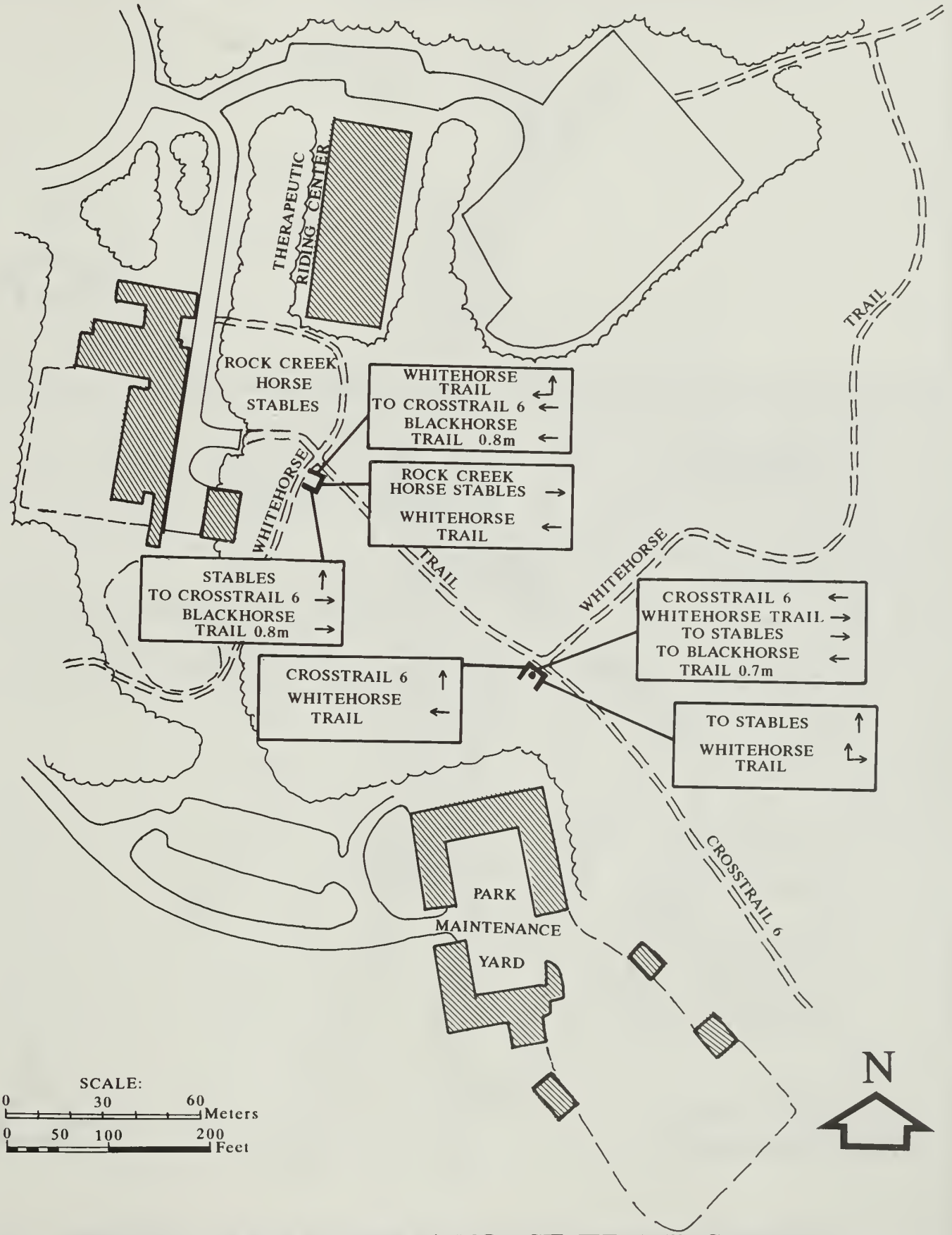
Enclosed is a map showing the locations of a sampling of horsetrail intersections where the following detailed maps show recommended new signs. The site details included are possible sign locations at the intersection and directional information. A balance must be achieved between providing enough information for visitors to navigate confidently through the park and avoiding sign clutter and maintenance burden.

MAP OF TRAIL INTERSECTIONS



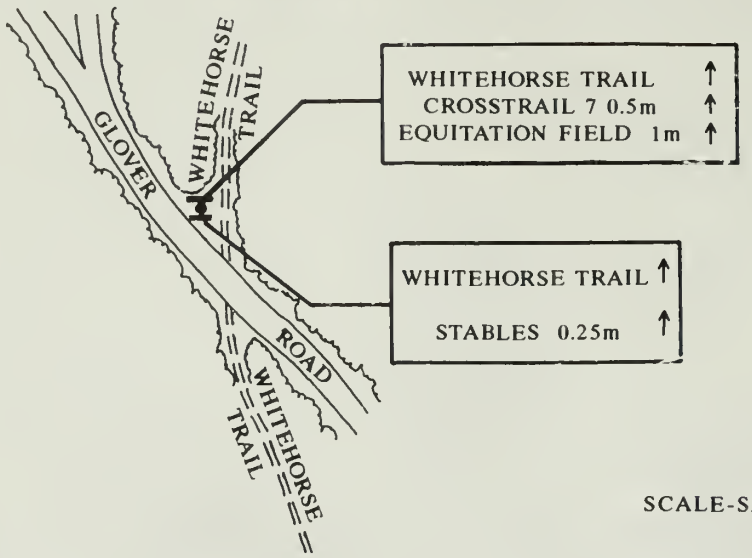
ROCK CREEK PARK / HORSE TRAIL STUDY

SITE MAP 1



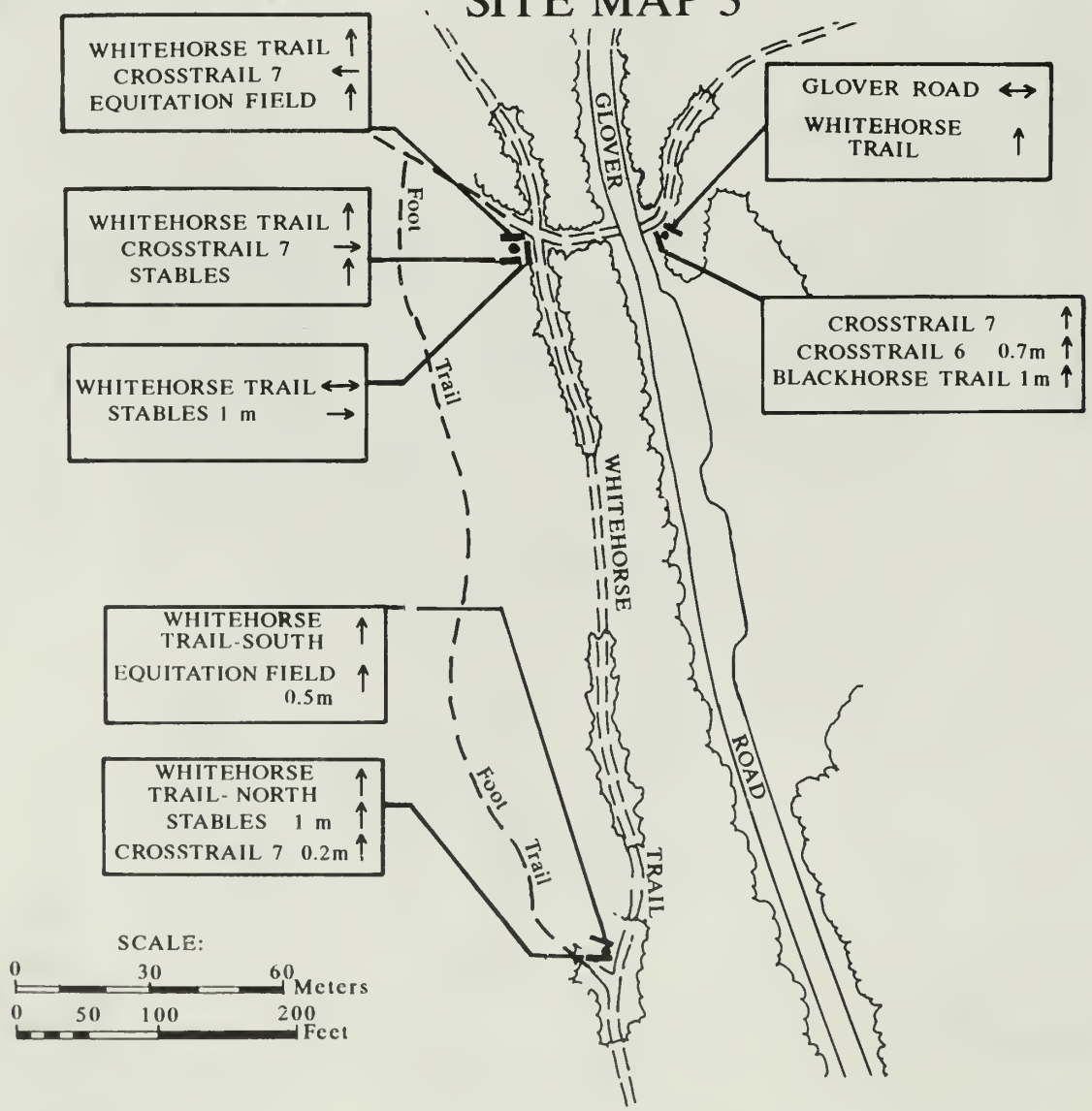
ROCK CREEK PARK / HORSE TRAIL STUDY

SITE MAP 2



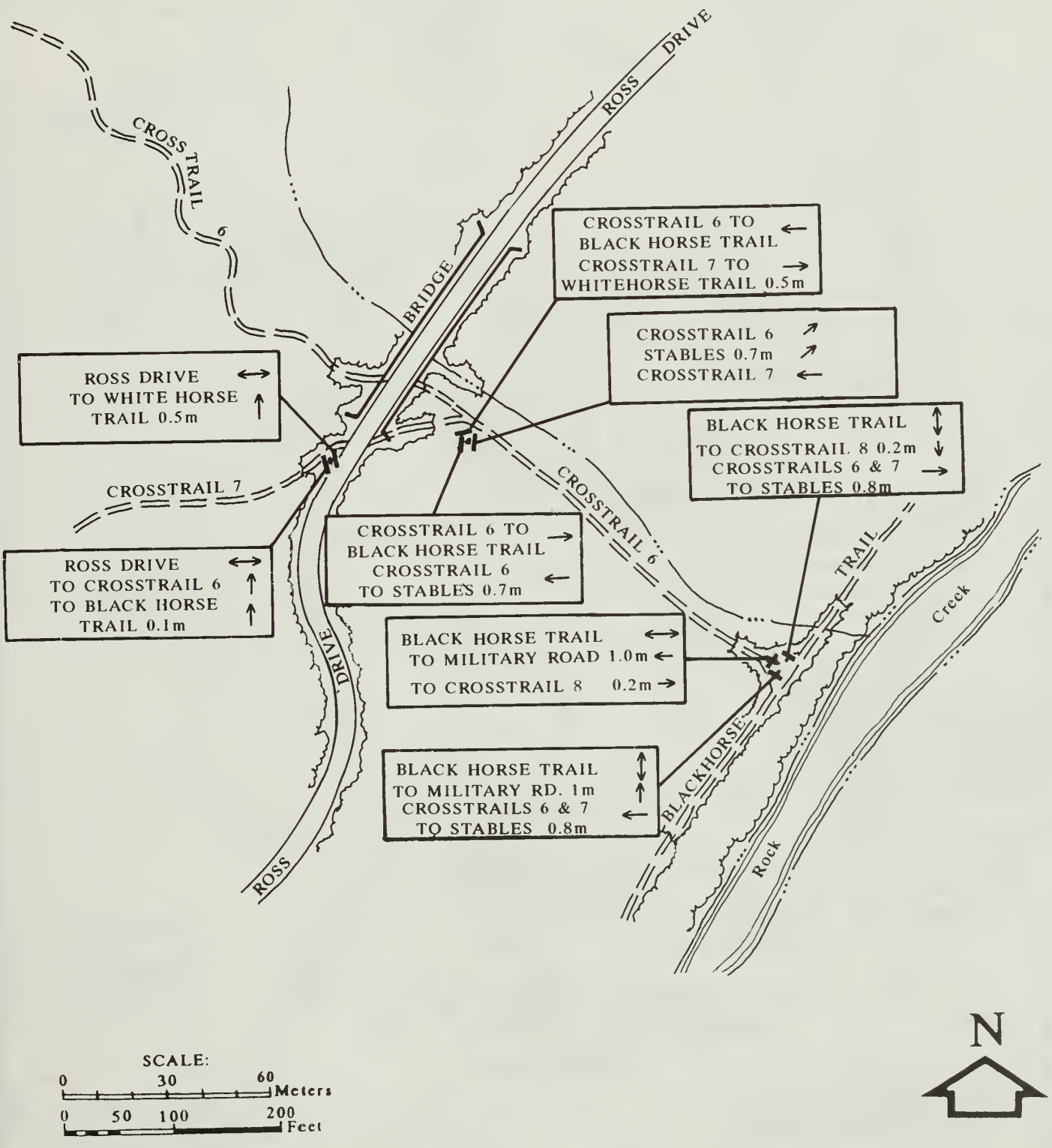
SCALE-SAME AS SITE MAP 3

SITE MAP 3



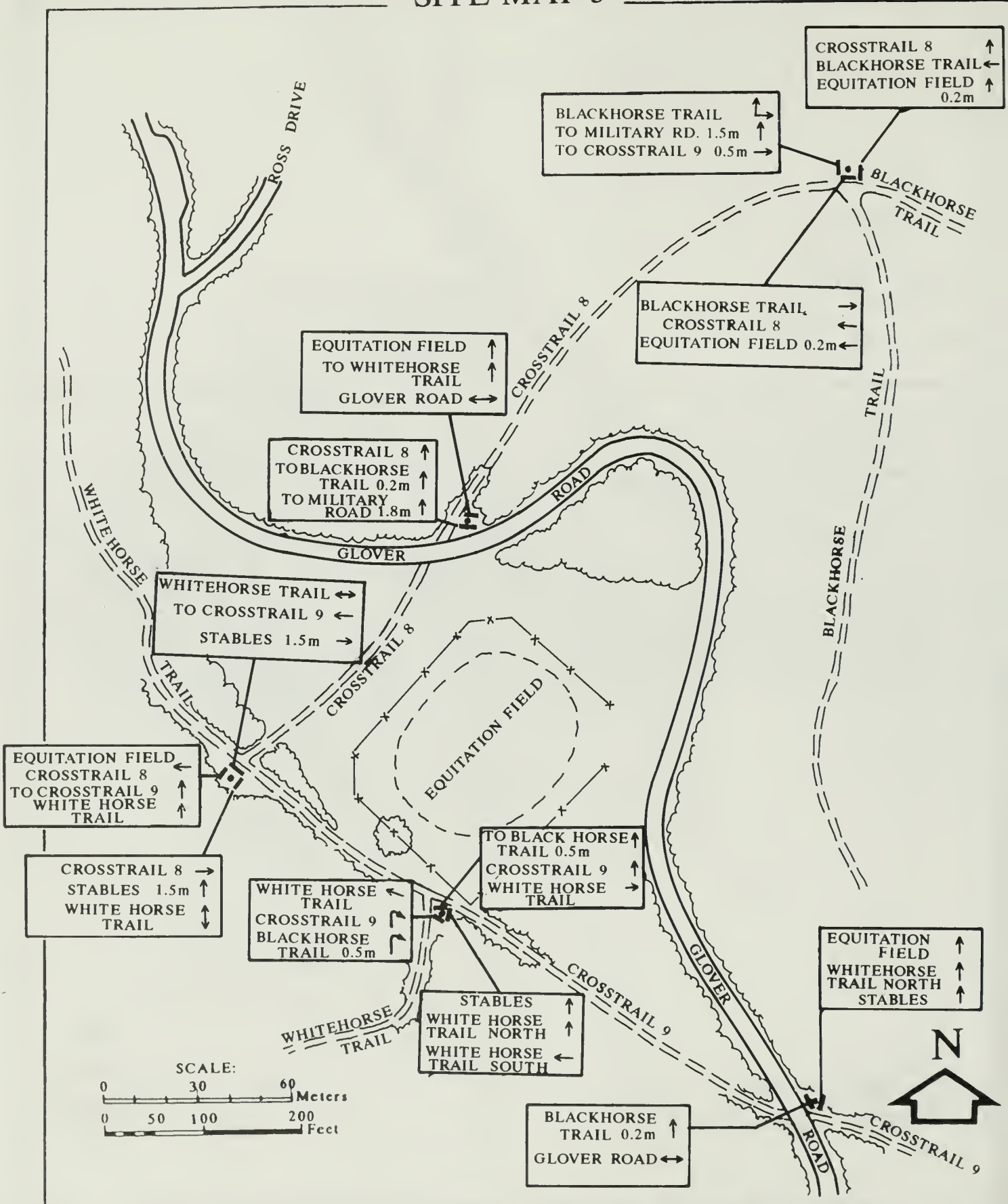
ROCK CREEK PARK / HORSE TRAIL STUDY

SITE MAP 4



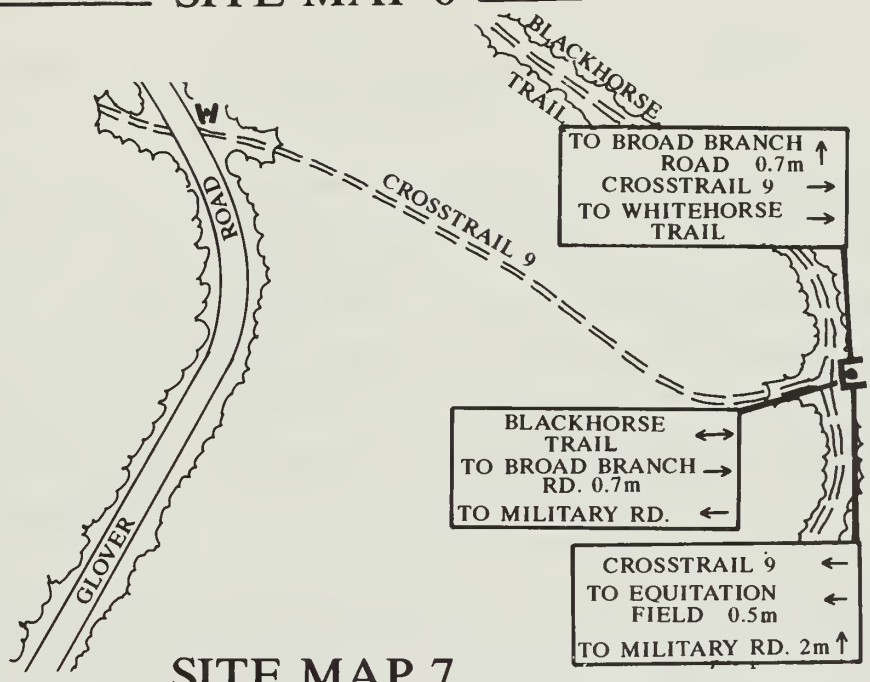
ROCK CREEK PARK / HORSE TRAIL STUDY

SITE MAP 5

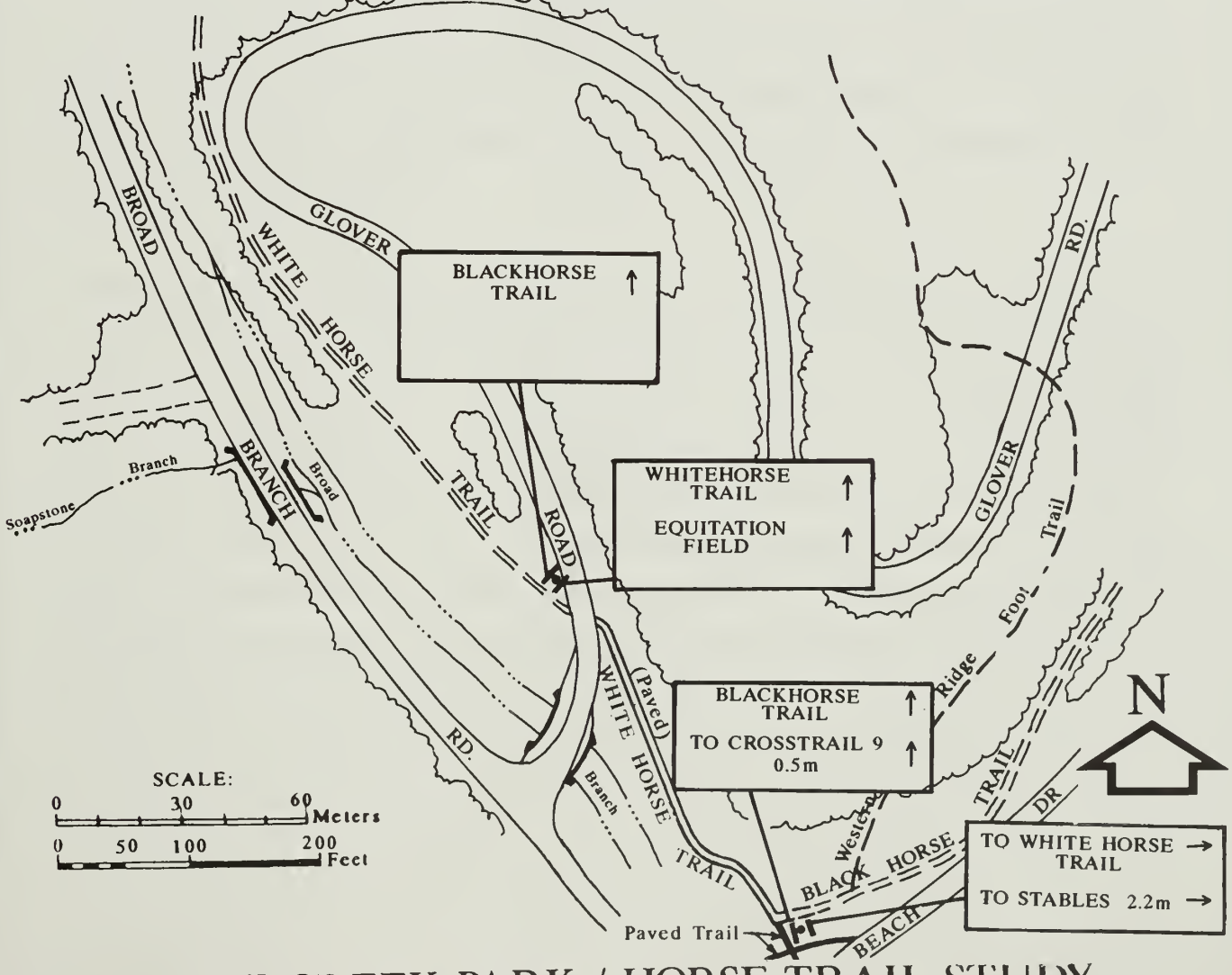


ROCK CREEK PARK / HORSE TRAIL STUDY

SITE MAP 6



SITE MAP 7



ROCK CREEK PARK / HORSE TRAIL STUDY

IMPACT OF TRAIL RIDES

The horse trail system south of Military Road was consistently in worse condition than the trail system in the northern half. Through observation and discussion with trail users and horse center staff, it became clear that this situation is due to the intensive use of the southern trails by the guided trail rides offered by the Rock Creek Horse Center. These trail rides by far make up the largest percentage of horse trail use in the southern half of the park. The horse center staff estimated that in 1984, over 5,000 persons took trail rides, and these all occurred on the southern trails.

A major problem of these guided rides, which involve 6 to 12 horses at a time, is the way horses tend to follow each other and churn up the soil in narrow strips. This pattern is repeated several times a day, day after day, along the same trails and exacerbates erosion conditions. The trails affected the greatest by this activity are the steep cross trails. Such heavy use, combined with poor trail design, results in the need for frequent maintenance to keep trails in an acceptable condition.

Various approaches to improve this situation can be tried, besides direct maintenance. For example, more trail rides could be taken into the northern half of the park to disperse use and lessen impacts on the southern half. Trail rides are not taken north currently, according to Robyn Douglas of the horse center, because the horses are not familiar enough with those trails. Familiarity is important because it makes the horses comfortable and predictable in their surroundings. She feels this is an important safety consideration because of the many beginners that go on trail rides. Another reason horse center staff, and persons boarding horses at the stables, gave for not using the northern trails is the inconvenience of reaching them via the White Horse Trail connection under Military Road. Trail rides last only one hour and a substantial portion of that would be spent getting to and from the northern trails. Horse center staff and boarders requested more direct access from the stables to the north by allowing horses to cross Military Road at Oregon Avenue. Increased use of the northern trails may well lead to greater degradation of those trails and require more maintenance. Also, many people who board their horses in the park prefer the north section because the trails are in better

condition and are not as congested. An increase in trail rides there may diminish some of this experience.

Another option for decreasing impacts is to encourage group leaders to vary their tracks across the full width of the tread. Also, during periods when trails are wet and most susceptible to damage, trail rides should be canceled or limited to the better drained and more level trails.

ADDITIONAL RECOMMENDATIONS

TREATMENT OF ABANDONED TRAILS

During trail relocations, thought must be given to treating abandoned sections to prevent their continued use. Relocation and treatment of abandoned sections should go hand in hand. Time and money has to be scheduled for both to be successful. Treatment of abandoned trails is labor intensive and can be approached in two ways. A slow inexpensive approach is to haul debris – logs and limbs – across the length of the trail to a significant depth of about two feet or more to physically prevent use. The debris would act as natural erosion control structures. This would allow the soil to stabilize and plants to become reestablished. This method would not hide the trace for a significantly long time but would physically keep people off the abandoned trail.

In discussions with Jim Patterson and Don Bailey, they suggested a more intensive approach to rehabilitating the abandoned trail to accelerate revegetation and hide it from view.

This involves the following actions:

- for severe gullies, import soil to meet original ground level
- test the pH of both trail and surrounding soils.
- adjust soil pH of trail to match surrounding soil to improve the natural revegetation process
- loosen compacted soils
- place deadwood across trail to act as natural waterbars and checkdams
- selectively plant trees (native species found in that area)
- distribute leaf and wood chip mulch

Much of this process can also be followed for narrowing trails. Edging, in the form of logs or rocks, should be placed to protect the edges that are being revegetated. Selected planting is important to visually mask the old section.

REGIONAL TRAIL CREW

The National Capital Region would benefit from establishing a "regional trail crew" that has the specific responsibility of working safely on trails. A well-trained trail construction and maintenance crew with its own pool of specialized trail equipment would be a great boon to the upkeep of NCR trails. Currently many of the region's parks, for lack of expertise, money, or labor, are not maintaining their trails at a satisfactory level.

DESIGN SERVICES

If the park endeavors to do major trail rehabilitation and relocation work in-house, "experts" in on-site trail layout and construction should be employed from the Denver Service Center or elsewhere to ensure new trails and trail structures are properly designed.

Two Denver Service Center (DSC) employees, located in Lakewood, Colorado, are experienced in this work – Bob Steinholtz (303/969-2283) and Jack Dollan (303/969-2330).

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Forest Service, USDA, Engineering Staff. 1984. *Standard Specifications for Construction of Trails*. Publication #EM-7720-102.

Proudman, R. and B. Birchard. 1981. *Trail Design Construction and Maintenance*. Published by the Appalachian Trail Conference, P.O. Box 807, Harpers Ferry, West Virginia.

Proudman, and R. Rajala. *Trail Building and Maintenance*. Published by the Appalachian Mountain Club, 5 Joy St., Boston, Massachusetts.

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APPENDIXES

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APPENDIX A

ESTIMATE OF EROSION RATES IN A SECTION OF WHITE HORSE PATH ROCK CREEK PARK, WASHINGTON D.C.

George D. Bailey
Soil Conservation Service
Washington, D.C.

At the request of Robert Proudman, Consultant to the National Park Service, a section of the White Horse Path, Rock Creek Park was studied to determine the rate of soil erosion of the path tread. This section of bridle path is considered to be one of the most troublesome maintenance problems in the Park.

The path section is located near the intersection of Military Road and Ross Drive. The section measured 592 feet from the toeslope adjacent to the Ross Drive parking area to a point on the path located on a terrace just downslope from an area of a deposit of eroded sediments from a continued section of path; the vertical relief of this section if about 50 feet. A sketch of the path section is included in this report.

Due to the high rate of erosion on this path, earth fill (compacted) has been applied to the tread periodically as a standard maintenance practice; the latest application prior to the field study was in the Spring of 1985. To prevent sediment deposition from entering the Rock Creek drainage, a berm has been constructed at the bottem of this section, which directs all tread drainage into a natural depression. On the date of field observation (8/10/85), loose fill was the dominant tread surface in the upper subsections, and compacted fill with or without a stone mulch was found on the tread of the lower subsections.

The natural soil of the slope examined is identified as Manor loam from the Soil Survey of the District of Columbia (1976). This soil is highly erodable, especially on steep slopes, such as the one utilized for this path. Examination of this section of path prior to the application of the fill indicated that a minimum of 1.5 ft. of natural soil had been eroded.

Soil erosion rates for this section of the White Horse Path have been estimated with the aid of the Universal Soil Loss Equation (USLE), a technique developed by the U.S. Department of Agriculture, and described in USDA Agriculture Handbook 537 (1978). This equation was developed for the measurement of erosion sediment produced by sheetwash and rill erosion in agricultural fields, but it has proved useful for estimating the erosion rates occuring on a wide variety of non-agricultural land uses. The reader should be aware that the use of the USLE for some non-agricultural land uses or for some sites is controversial; paths and trails should be considered to be one of those uses.

The basic form of the equation is

$$A = RKLSCP$$

where

A is the computed soil loss expressed in tons per acre per year.

R is the rainfall-runoff factor; this factor has been computed for most of the U.S. and is available in map format in Agriculture Handbook 537; for the Washington D.C. area, the R factor is 200.

K is the soil erodability factor, which has been computed for all U.S. soil series; for loose fill the figure utilized is .40 and for compacted fill the figure utilized is .50 (these figures are arbitrary, as more accurate figures require laboratory analyses of the fill material, and these were unavailable).

L is the slope length factor, and it is either the total length in feet from a toeslope to corresponding crest or some component of that distance.*

S is the slope-steepness factor, expressed in percent slope, and is measured similarly to L.*

C is the cover and management factor, which includes the influence of vegetation, mulches, or other practices that affect erosion; an arbitrary figure of .85 is used in those subsections covered by a stone mulch.

P is the support practice factor, which covers the effect of conservation structures on erosion; for this analysis, a figure of .25 has been used for those subsections with a waterbar that effectively removes runoff from the tread, and a figure of 1.00 has been used for subsections with ineffective waterbars.

This equation does not measure sediment produced by gully erosion; therefore not all erosion occuring at a given site may be measured by the USLE. Reasoning would conclude that gullies would originate in this site, especially in subsections E, F, and G, but they were not present when the path was examined. Possibly they are destroyed by heavy hoof traffic. The presence of a stone mulch may play a part in discouraging the formation of gullies. For this reason, the figures of soil loss reported may represent less than the actual soil loss from this section of the path.

* L and S are considered as single topographic factor (LS) in the equation.

The analysis of the path was by subsections, divided by waterbars. The tread gradient was uniform between waterbars. The figures listed below are the computations from the USLE; figures in parentheses represent the actual annual loss from a 14' tread for a length of 592 feet, based on 1 inch = 150 tons/acre/year.

Section A: tread composed of 3.0 - 3.5 in. of uncompacted fill;waterbar effective
A = (200)(.50)(.802)(.25) = 20 tons/acre/year
= (0.13 inch/year)

Section B: tread composed of 3.0 - 3.5 in. of uncompacted fill; waterbar effective
A = (200)(.50)(1.22)(.65)(.25)= 20 tons/acre/year
= (0.13 inch/year)

Section C: tread composed of 1.0 - 2.0 in. of uncompacted fill; waterbar effective
A = (200)(.50)(1.50)(.65)(.25)= 24 tons/acre/year
= (0.16 inch/year)

Section D: tread composed of 1.0 - 2.0 in. of uncompacted fill; waterbar effective
A = (200)(.50)(1.60)(.65)(.25)= 104 tons/acre/year
= (0.68 inch/year)

Section E: tread composed of compact fill; waterbar ineffective
A = (200)(.40)(2.24) = 179 tons/acre/year
= (1.19 inch/year)

Section F: tread composed of compact fill with stone mulch; waterbar ineffective
A = (200)(.40)(2.98)(.85) = 203 tons/acre/year
= (1.36 inch/year)

Section G: tread composed on compact fill with stone mulch; no waterbar
A = (200)(.40)(3.54)(.85) = 231 tons/acre/year
= (1.54 inch/year)

TOTAL ESTIMATED SOIL LOSS = 781 tons/acre/year

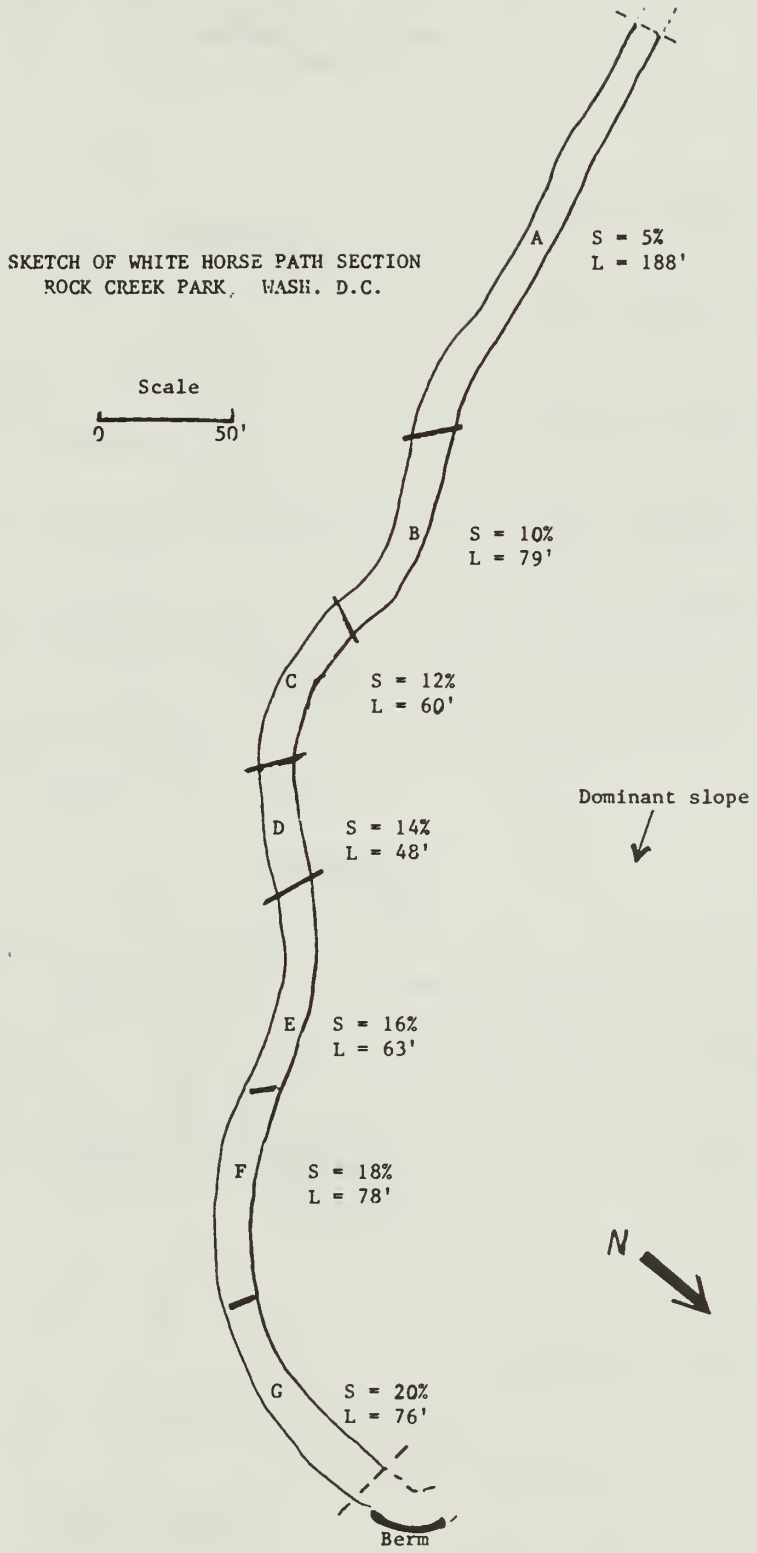
What is the significance of these figures? Soil erosion rates for other paths and trails are nonexistent (this report is considered a pioneering effort), but erosion rates for other land uses, slope gradients undisclosed, are listed for comparison.

Undisturbed forest soils (Southeast U.S.)	0.04-0.06 t/ac/yr
SCS recommended max. - agricultural land	5.0 t/ac/yr
Road shoulders (compacted fill)	16.4 t/ac/yr
Woodland roads (compacted fill)	21.9 t/ac/yr

Recommendations

There is little doubt that the erosion rate on this section of the White Horse path is excessive; maintenance costs are not available, but they must be very high compared with other sections. If the Park management staff chooses to eliminate or reduce this misuse of land, two alternatives are available: relocate this section of path well away from this particular site, beginning upslope from subsection A and avoiding natural slope gradients more than 12%; or relocate subsections D through G on this site with a new trail design. Using sidehill construction with switchbacks and a free use of waterbars, a new trail could be constructed on this site with a estimated minimum erosion rate in the range of 10 to 12 tons/acre/year in its steepest portion (0.66 to 0.80 inches/year loss from the tread), and the tread gradient would not exceed 10%. With either type of relocation, the present routing would require rehabilitation to prevent further erosion.

GDB: 8/26/85


SKETCH OF WHITE HORSE PATH SECTION
ROCK CREEK PARK, WASH. D.C.
Scale
0
50'
A
S = 5%
L = 188'
B
S = 10%
L = 79'
C
S = 12%
L = 60'
D
S = 14%
L = 48'
E
S = 16%
L = 63'
F
S = 18%
L = 78'
G
S = 20%
L = 76'
Dominant slope
N
Berm

APPENDIX B

CROSS TRAIL 7 BELOW ROSS DRIVE
EROSION ESTIMATE, (CROSS-TRAILS SECTION)
USING THE USLE EQUATION

Subsection A
A=(200)(4.40)(.50 = 440 tons/acre/yr (5.3 tons/yr)

Subsection B
A=(200)(3.43)(.50) = 343 tons/acre/yr (9.2 tons/yr)

Subsection C
A=(200)(3.72)(.50) = 372 tons/acre/yr (6.7 tons/yr)

Subsection D
A=(200)(1.15)(.50) = 115 tons/acre/yr (1.7 tons/yr)

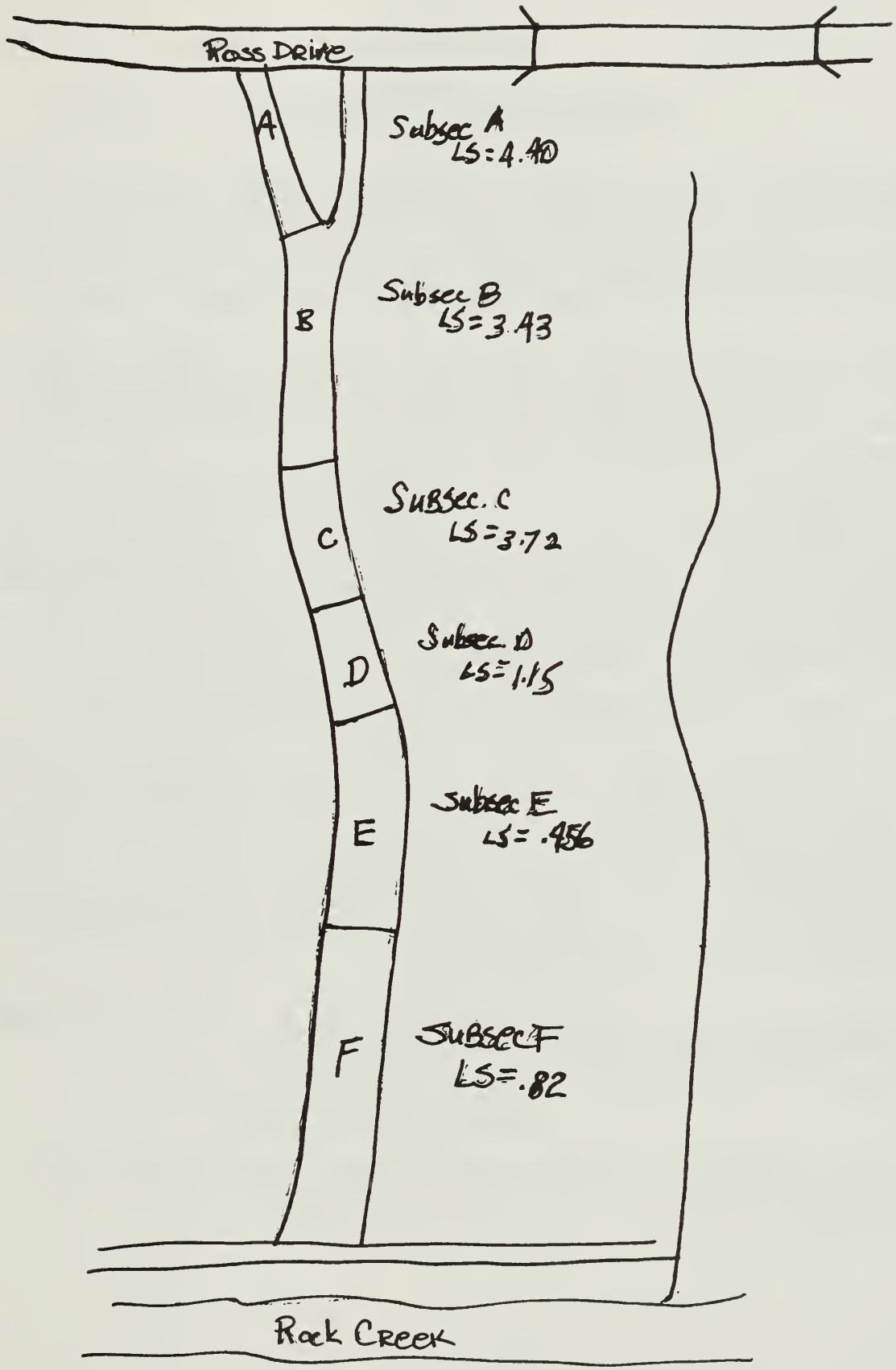
Subsection E
A=(200)(0.45)(.40) = 360 tons/acre/yr (7.5 tons/yr)

Subsection F
A=(200)(0.81)(.40) = 65 tons/acre/yr (1.7 tons/yr)

TOTAL (in excess of) 32.1 tons/yr

The loose fill on the surface of Subsections E and F is transitory; accumulating sediment from upslope during most of the year (with some contribution from the flooding of Rock Creek)), and having it erode away during severe storms. During these severe storms, the total sediment has nowhere to go but into Rock Creek. Since gullies were noted in most subsections and the USLE measures only sheetwash and rill erosion, the total soil eroded from this section of the White Horse Path must be in excess of 32.1 tons/year.

George D. Bailey
Soil Scientist, SCS.USDA
9/4/85


Ross Drive
A
Subsec A
LS=4.40
B
Subsec B
LS=3.43
C
SubSec. C
LS=3.72
D
Subsec. D
LS=1.15
E
Subsec E
LS=.456
F
SubSec F
LS=.82
Rock Creek

APPENDIX C

Calculation of Culvert Diameter For A Drainage Above the Black Horse Trail

Because of chronically clogged 12" diameter culverts on the Black Horse Trail between Boundary Bridge and Riley Spring Bridge, I worked with a civil engineer to calculate the peak-rates of run-off using the Rational Formula, for a drainage crossed by the Black Horse Trail. This data was used with Manning's Nomograph to determine optimal culvert diameters for discharge capacity adequate to withstand both the 10-year and 25-year flood return intervals.

The area is a 6.37 acre drainage about half of which is outside the Park boundary above Park Side Drive. There are no storm sewers along Park Side Drive. It is apparent from the terrain and water flow channels that substantial concentrations of storm run-off enter the Park below Park Side Drive and then clog culverts along the Black Horse Trail.

A long range solution might consist of working with the District of Columbia on an engineering study of this problem. Storm sewers and chutes built with pipe could convey storm run-off to Rock Creek at the West Beach Drive Bridge. This solution would relieve trail culverts of run-off from outside the Park.

All table references and page numbers refer to Design of Roadside Drainage Channels, U.S. Dept. of Commerce, 1965.

Rational Method for Calculating Peak Rate of Run-off in Cubic Feet per Second:

> $Q = CiA$ where **Q** is peak rate run-off; **C** is run-off coefficient; **i** is average rainfall intensity for Washington D.C. in inches/hour for both 10-year and 25-year flood return frequencies for duration equal to time of concentration (**Tc**); **A** is acreage which is 6.37 in this case.

Calculation of C, the run-off coefficient: I used Table 1 and picked **0.65** - moderately steep residential with 50% of area impervious (in all cases I like to err towards more extreme values.)

Calculation of **i**: Max. ft. of flow is approx. 1,000 ft. from NW corner south easterly then south south westerly to the B.H. Trail.

> Time of concentration **Tc** = $\frac{\text{maximum ft. of flow in watershed}}{\text{velocity (V) in ft./ sec.}}$

To calculate velocity, I calculated average slope = 13.1% and used an SCS table of run-off velocities to determine a run-off velocity of 1.7 ft./sec.

Velocity:

$$\frac{1{,}000\text{ft.}}{1.7\text{ ft./sec.}} = 588.23 \text{ sec./60} = \text{a } \mathbf{Tc} \text{ of } \mathbf{9.8\ min.}$$

From the Rainfall Intensity - Duration - Frequency curves for Washington D.C. (P. 10 - U.S. Weather Bureau data) I picked (for **Tc** = **9.8** min.):

(a.) **6.0** inches/hr. for 10 yr. return interval

(b.) **7.0** inches/hr. for 25 yr. return interval

Calculation of **Q**:

(a.) Q = 0.65 X 6.0 X 6.37 = 24.84 qubic ft. per sec. = approx. 16 millions of gal. per day (MGD)

(b.) Q = 0.65 X 7.0 X 6.37 = 28.98 " " " " = approx. 18.7 millions of gal. per day (MGD)

Calculation of Culvert Size Using Manning's Nomograph for a. & b.:
Using a 0.010 Manning Roughness Coefficient for the pipe, a minimum slope of 1% for the pipe and 16 and 18.7 MGD respectively, I come up with a minimum culvert diameter of 34 inches for the 10 year flood interval, and using (b.) Q = 18.7, I come up with a minimum culvert diameter of 36 inches for the 25 year flood interval.

The culvert should be 36" diameter to withstand floods in the 10 to 25 year range. This represents almost a 900% increase in the cross-sectional area over the existing 12" culvert.

Because of a lack of verticle elavation at the culvert site, a great deal of fill would be necessary to install a 36" diameter culvert. Two 24" diameter culverts provide about 90% of the discharge capacity of the 36" culvert and would be much easier to install.

Bob Proudman
October, 1985

MIRAFI® 140N, 700X Drainage Fabrics

Good drainage is essential for achieving and maintaining soil stability. Effective drainage structures — along highways, in embankments, under airfields, athletic fields or anywhere — require a properly designed protective filter to insure long life. While graded-aggregate filters have been traditionally used for drain protection, problems of design, cost, transportation, placement and testing of aggregate filters make Mirafi® drainage fabrics an attractive alternative. Mirafi nonwoven fabrics are a proven replacement for graded-aggregate filters. And they offer significant cost savings as well as improved performance.

Mirafi drainage fabrics eliminate the problems associated with:

- Determining the aggregate gradation required to match soil conditions.
- Finding a convenient and economical source of a specific aggregate gradation.
- Transporting and placing a graded aggregate.
- Quality assurance of the in-place aggregate gradation to insure filter performance.

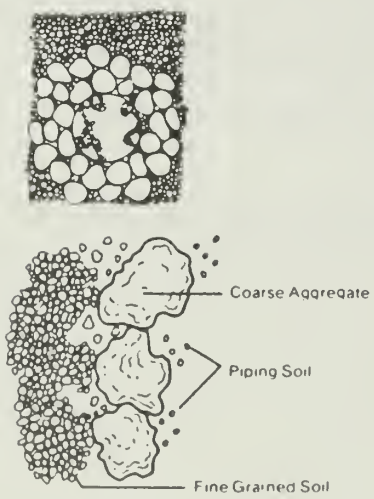
In addition, drain size can often be reduced when Mirafi fabric is installed because the thick graded-aggregate layer is eliminated. Consequently, less excavation and aggregate are required to construct the drain.

A filter medium is likewise required in armored embankments to prevent soil erosion due to wave or tidal action. Here again, the use of Mirafi fabric as a replacement for graded aggregate filters results in lower cost, quicker installation and elimination of possible filter "wash-out."

Whatever the use, Mirafi drainage fabric effectively retains soil particles while allowing for unimpeded flow of water through the fabric (see below).

Unprotected, Clogged Trench Drain

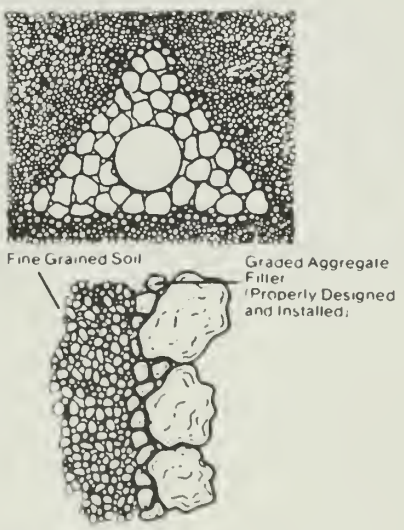
Low initial cost ineffective high maintenance costs



Soil piping results when soil particles cannot bridge large gaps between coarse aggregate particles at the soil/aggregate interface

Properly Designed And Installed Trench Drain

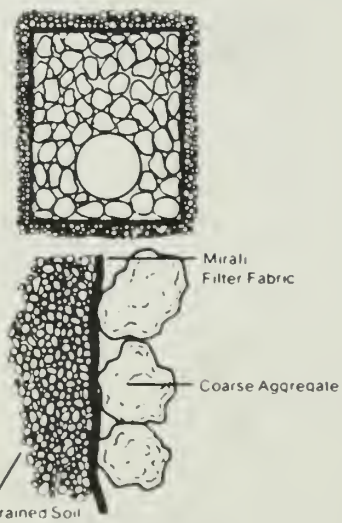
Effective very expensive long life



A properly designed graded aggregate filter provides adequate contact at the soil/filter interface to promote soil particle bridging and prevent significant particle movement

Mirafi Fabric Trench Drain (pipe optional*)

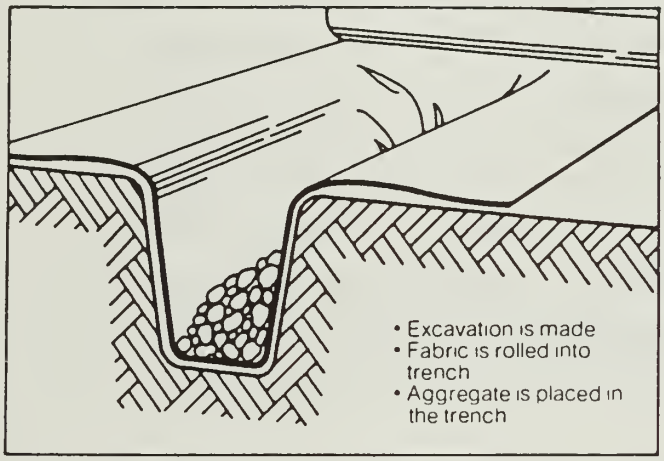
Effective inexpensive, long life

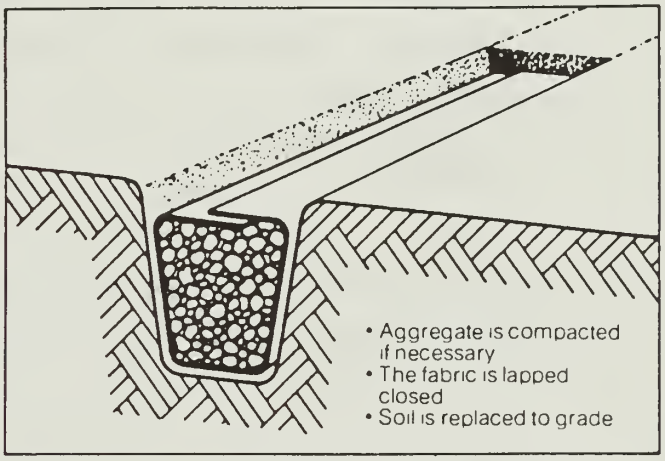


Mirafi fabric has a fiber/pore structure that promotes particle bridging at the soil/filter interface

Mirafi® fabrics can be readily incorporated as the filter medium in most subsurface drain designs. These designs require the normal investigations of hydrologic and soil conditions at a particular site. Drain size and location are based on the results of these surveys (soil type and permeability, source of water, etc.).

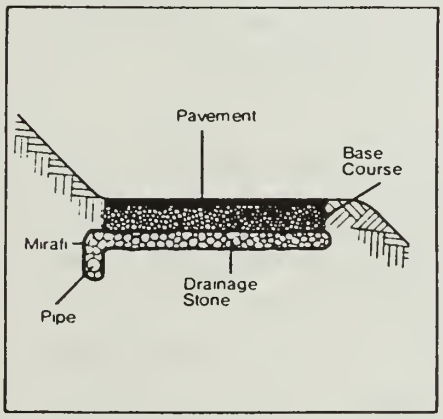
Installation of Mirafi fabric is straightforward; no special equipment or skills are required. Rolls may be cut with a saw to fit specific drain sizes. Installation of a simple French drain is shown below.



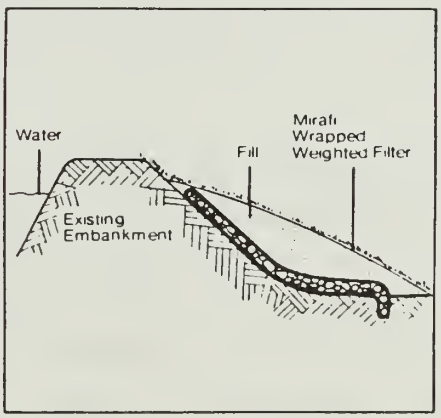


Diagrams of other typical Mirafi applications appear below.

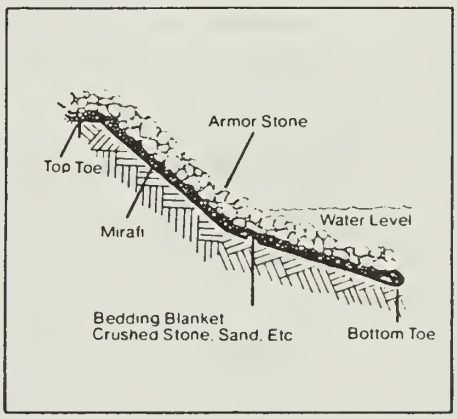
Mirafi Fabric Blanket/Trench Drain in Cut Area



Mirafi Fabric Weighted Filter



Mirafi Fabric in Armored Embankment



APPENDIX E

Trail Work Logs

During July, 1985, Bob Proudman and Ann Van Huizen evaluated the conditions of 7.23 miles of the horse trail system in Rock Creek Park, including major parts of the White Horse and Black Horse trails and cross trails 1, 2, 3, 4, 6, 7, 8 and 9. These written evaluations are detailed inventories of work in place and work needed; they were tabulated or "logged" to reference points measured with a measuring wheel or, when the wheel was broken, by pacing. These trail work logs can be used for scheduling maintenance, planning both short-term and long range projects, for budget preparation, prioritizing projects, and for guiding field personnel in general or specific work prescriptions and giving their location in the field.

The work logs propose work on the current location (7/85) of the park's trails. The park should analyze the relocation options in Part III of this report before making heavy reconstruction investments in the work recommended in the work logs. It is wasteful to install waterbars on a section which will be replaced one year hence (unless improved drainage is planned for rehabilitation of the section slated for replacement).

We recommend that work logs be adopted by the park staff as an administrative tool for maintaining written records of trail conditions. One group or individual should be responsible for maintaining the logs so that consistency is achieved. Despite seasonal variations in trail conditions, managers of other trail systems have found that work logs maintain their accuracy for four to six years. While a specific problem may vary in degree of seriousness, its location is permanent. Preparing work logs is well worth the park staff's time.

In addition to documenting trail conditions, accurate trail work logs can be used as inventories of all existing trail structures such as waterbars, culverts, geotextile drains, etc. The location, size, and condition of trail structures should be documented in light of the park's considerable financial investment in the trail system.

Maintenance reports should be prepared following trail projects. If these reports are keyed to reference points in the logs, trail condition records can be maintained in an up-to-date condition.

Preparing work logs requires an accurate and durable measuring wheel, 50' tape measure, and a "work log tally sheet". The wheels manufactured by the Cedarholm Mfg. Co. of Bastrop, TX 78602 are recommended. The all steel construction and internal calibrating mechanism of the Cedarholm wheels are rugged, a prerequisite for backwoods work.

Work logs are presented in the same order as the trail segment index: White Horse, Black Horse, both north to south, then the cross trails in numeric order.

Abbreviations used in the work logs: N, S, E, W = North, South, East, West. R, L. = Right and Left. (Keep the direction in which the trail was logged in mind.) WB = waterbar.

The trail logs were prepared separately for each trail segment to permit ease of photocopying for field crews.

NOTE: If major force account or contract trail work is planned, the estimates in the work logs should be refined with taped measurements of the work area(s) because some of the work prescribed represents "eyeball" estimates.

ROCK CREEK PARK
TRAIL WORK LOG

TRAIL: WHITE HORSE TRAIL

FROM: Cross Trail 2 (to Wise Rd. to Beach Dr.)

TO: Boundary Bridge Parking Area (S. to N.)

REFERENCE POINT (paced)	WORK DESCRIPTION
00	At point measuring wheel broke
30'	Slope = 19%
95'	Waterbar good. Need W.B. mid-slope
290'	Waterbar good
360'	Waterbar good
555'	Waterbar good
700'	Cross Trail 2 intersects White Horse. Go N.
980'	Load of dirt dumped for YCC crew (7/23/85)
1475'	Top of slope
1575'	Need waterbar on R.
1685'	Jct. with Wise Rd.
1905'	Waterbar needed
2035'	Waterbar needed
2125'	Waterbar needed
2505'	Large culvert O.K.
2750'	Mud hole in trail - suspect buried culvert
2820'	Gully with side trail. Suggest closing gully. Use side trail with waterbars.
3795'	Half-filled culvert
3940'	Waterbar needs cleaning. Suggest another W.B. at 3770'

WHITE HORSE TRAIL - Cross Trail 2 to Boundary Bridge Parking Lot (con't)

4015'	Waterbar drains into 12" culvert which needs cleaning
4090'	Culvert needs cleaning
4170'	Waterbar needs additional fill in uphill side
4320'	Intersect Beach Dr.

This section logged on July 23, 1985 by B. Proudman & A. Van Huizen

ROCK CREEK PARK

TRAIL WORK LOG

TRAIL: WHITE HORSE TRAIL

FROM: CROSS TRAIL 4 @ H-2 Stable Rd. (Park Police Rd.)

TO: Black Horse Trail junction (near Military Rd.)

REFERENCE POINT (measured)	WORK DESCRIPTION
Below field	Slope 7-10%. Need waterbars especially on L. turn descent
At 3' dia. culvert	Need waterbar above culvert. Culvert needs annual maintenance
0'	White Horse Trail Junction with Cross Trail 5
140'	Need 15' waterbar
282'	Pass foot trail on R.
319'	Existing waterbar good
379'	Existing waterbar needs to be lengthened 10'
390'	21% slope. Was soil imported here?
466'	Existing waterbar ok
490'	Need waterbar above slope
838'	Need waterbar above slope
949'	Big red oak on R.
1003'	Height of land
1077'	Green blazed trail on R.
1134'	Existing waterbar . . . could be longer on uphill end
1302'	8% slope. Need waterbar
1506'	Fort DeRussey Plaque on L.

White Horse Trail from Cross Trail 5 to Black Horse Trail (Con't)

1799'	Need waterbar to L. 15' long
1936'	Existing waterbar should be moved to steepen angle . . . help prevent premature filling up
1995'	Existing waterbar . . . same condition as 1936'
2066'	Replace bar . . . a lot of soil movement
2110'	Slope 10%. Existing waterbar. Too shallow an angle - filling up
2171'	Existing waterbar needs maintenance
2341'	Base of grade
2694'	Existing waterbar could use additional soil on low side
2713' - 2764'	Slope 27%. 15' wide. Horses widening further
2780'	Existing waterbar should be lengthened. This area may need relocation or reconstruction with wood cribs because of severe slopes and trail erosion
2880'	Existing waterbar too short
2928'	Existing waterbar needs longer ditch
3030' - 3050'	Trail below grade
3235' near Military Rd.	- measuring wheel broke. From this point to the junction with Black Horse Trail, there are 6 existing waterbars in relatively good condition.

This trail was logged on 7/23/85 by B. Proudman and Ann Van Huizen

TRAIL: WHITE HORSE AND BLACK HORSE CO-ALIGNED AT MILITARY RD.

There is a chronic wet spot where these two trails are co-aligned at the underpass of Military Rd. A spring saturates the treadway causing mud formation and deposition of sediments on the bike path which is parallel to the horse trail about 20' below. A subsurface geotextile drain should be installed under the horse trail to enhance drainage. A turnpike section over the drain will provide a raised dry tread. An open topped drain along the upper (south westerly) edge of the bike path could catch run-off from the horse trail. Then all runoff from both horse and bike paths can be channelled under the bike path with an 18" minimum diameter culvert.

ROCK CREEK PARK

TRAIL WORK LOG

WHITE HORSE TRAIL (S. of Military Rd.)

FROM: Gate at cross walk - Ross Dr.

TO: Stables (North Stables Spur)

REFERENCE POINT (measured)	WORK DESCRIPTION
00	Gate at cross walk
169'	Cross Ross Dr. then walk along chain fence on L. Propose waterbar from between the 3rd and 4th fence post to NE, into natural drain
360'	Trail 18' wide, 19% steep. Propose waterbar 25' long near a big tree.
424'	Existing waterbar too short (@ 17' 4"). Need 10' more on low end
504'	Existing waterbar 3' too short. Also needs cleaning
	In general, this situation is very serious. See main report for discussion of relocation options. Remove imported soils from root collars of trees adjacent to trail.
564'	Existing waterbar too short. Add 10' to low end
611'	Existing waterbar good
669'	Existing waterbar OK but needs additional length at upper end
738'	Existing waterbar good
Quite a few dead trees	(Horse Chestnut, Black Oak & Chestnut Oak) in this area. WHY?
1025'	Existing waterbar could be longer
1091'	Existing waterbar

White Horse Trail (S. of Military Rd.) (Con't)

1138'	Existing waterbar
1334'	Existing waterbar too short - low end needs 8' more
1413'	Existing waterbar
1940'	Existing waterbar in bad shape. Needs cleaning/lengthening
1996'	Existing waterbar needs to be longer
2075'	Existing waterbar " " " ". Needs longer ditch
2102'	Junction with side trail (North Stables Spur) on L. Existing waterbar needs lengthening
2132'	Existing waterbar is end of section measurement near stables.

This section logged on July 26, 1985 by B. Proudman & A. Van Huizen

ROCK CREEK PARK

TRAIL WORK LOG

WHITE HORSE TRAIL (S. of Military Rd.)

FROM: North Stables Spur

TO: Cross Trail 6

REFERENCE POINT (measured)	WORK DESCRIPTION
00	Uppermost waterbar on White Horse Trail @ junction with N. Spur
269'	Bird census trail on L. (Appears to be used by equestrians)
280'	Propose Waterbar to L. 16' long
383'	Propose 10' x 12' culvert at low point on trail
417'	Need 12' subsurface geotextile drain to eliminate mud
572'	Second bird census trail on L. (Appears to be used by equestrians)
607'	Propose Waterbar 20' long - at start of turn
712'	Propose Waterbar 16' long
739'	Propose Waterbar 12' long
816'	Existing 16" culvert in good condition
900'	Propose Waterbar 25' long!
952'	Propose Waterbar 20' long - upper end at dead tree. Water from C.T. 6 draining onto White Horse Trail
	End at C.T. 6

This section logged on July 26, 1985 by B. Proudman & A. Van Huizen

ROCK CREEK PARK

TRAIL WORK LOG

Prepared by Robert Proudman and Ann Van Huizen - July 25, 1985

Recommended work is described at reference point determined by pacing or measurement with a measuring wheel, as noted.

TRAIL: WHITE HORSE TRAIL

FROM: Park Hdqtrs. Entrance Road, South

TO: Cross Trail 7

This heavily used section is poorly drained, periodically flooded and muddy after storms. The trail should be hardened with raised turnpike with installation of permanent drains. Trail width may then be narrowed with brush barricades.

REFERENCE POINT (Measured)	WORK DESCRIPTION
00	Slope = approx. 5%
From Reference pt. @ 175' to Glover Rd. (at 471')	Trail very muddy . . . 18' wide, slope = 8% Recommend "turnpike", raised treadway bounded by timber tiles and filled with packed trail soil. Subsurface geotextile drains should be installed every 8' to 16' directed to east (See main report for specification).
At 310'	Existing 12" culvert clogged, lower end. Clean out ditch for 6'.
376'	Low point
S. of Glover Rd.	Continue Turnpiking and subsurface drainage on flat terrain for approx. 200'.

At approx. 720' abandoned trail leaves on R. (E.). From this point there are 3 options for correcting erosion: relocating either to the east or west or reconstruction of the existing route, which is gullied to 2.5' depth on the S. side of the knoll just before the 2nd crossing of Glover Rd. near Cross Trail 7. See main report for analysis of options.

IF EXISTING ROUTE IS RECONSTRUCTED:

Distances measured in feet

0' @ abandoned trail	8% slope, trail 11' wide; deposited soil from slope above.

Whitehorse Trail S. of Glover Rd. and N. of Cross Trail 7 (con't)

REFERENCE POINT	WORK DESCRIPTION
111'	Need waterbar - 16' long
147'	Trail 15.5' wide.
168'	Need waterbar - 20' long
261'	Need waterbar - 16' long
425'	Reach top of knoll
612'	Need waterbar - 20'
648'	Start of Gully - horses using western edge of gully.
840'	End of deep (2'4") gully. Could reconstruct with cribbing along W. edge of gully (total: 192'). See main report for specification.
890'	Sign post at Glover Rd. End of section.

We did not log the work needed on White Horse Trail from Cross Trail 7 to Cross Trail 8. However, there is an 18% gully and an informal "bootleg" by-pass trail near the junctions of Glover and Ross Rds. which should be corrected. Closure of one of the two alternate routes is advisable. A strategy similar to the wood cribs proposed on the White Horse Trail near Cross Trail 7 may be feasible in this gully.

ROCK CREEK PARK

TRAIL WORK LOG

TRAIL: WHITE HORSE TRAIL

FROM: Cross Trail 9 SW of Equitation Field

TO: Black Horse Trail at Broad Branch

REFERENCE POINT (measured)	WORK DESCRIPTION
0 (at White Horse sign)	Trail 15' wide
33'	Need 12' waterbar
93'	Gate
117'	Existing waterbar filled at upper end; undermined at low end. Needs "rip rap" to harden against erosion below waterbar.
217'	Slope starts descending at 15%
252'	Existing waterbar needs cleaning. Gully formation
383'	Existing waterbar too short. Extend ditch at both ends. Excavate ditch on R. downhill for 12'
419'	Hollow tree on R.
500'	Need waterbar
533'	Red-colored bank on L. Old Trail?
595'	Need waterbar
714'	Need waterbar
815'	Existing waterbar too angled . . . causing extensive deposition downslope
1014'	Old trail on L. ?

White Horse Trail from Cross-Trail 9 to Black Horse (con't)

REFERENCE POINT	WORK DESCRIPTION
1063'	Culvert at fence (one of three in sequence from storm drain on Glover Rd.) Outwash is eroding bank below trail (rip rap needed). Bottom of culvert is rusted out for 5'
1136'	Existing waterbar needs to be extended with locust log. Grade below this bar is 22% (!) yet erosion not too bad.
1328'	0% slope. Trail 8' wide
1402'	20' muddy section. Need turnpike or subsurface geotextile drains.
1546'	End of Black Horse Trail. 8% climb to road. Pipe barrier should be replaced.

Prepared by Robert Proudman and Ann Van Huizen - July 25, 1985

TRAIL WORK LOG

TRAIL: CROSS TRAIL I and BLACK HORSE TRAIL

FROM: Boundary Bridge (to underpass, W. Beach Dr.)

TO: Riley Spring Bridge

REFERENCE POINT (measured)	WORK DESCRIPTION
00	Center of Boundary Bridge. Railings damaged or missing.
322'	0% slope. Need 60'-70' turnpike with subsurface geotextile drains. 12" dia. culvert just cleaned, however, it looks as if it will fill again very soon.
619'	1 to 2 waterbars needed. Existing culvert just cleaned.
790'	Side Trail on left. End of Cross Trail 1. Start of Black Horse Trail. (No signs describing this junction).
846'	Existing 12" culvert, just cleaned. The headwalls should be built of stone to prevent lateral erosion.
1000' (estimated)	Wheel counter broke
1277' - 1500'	Low spots. Standing water on R. Need some geotextile drains to reduce puddling in treadway.
1585'	Man hole cover on R.
2438'	Jct. with high water trail
2530'	Mud spots - 15' long. Turnpike and geotextile drains needed
2618'	Mud spots near bridge - 10' long. Turnpike and geotextile drain
2675'	West Beach Dr. Pass under bridge. Railings missing.
2830'	10' mud spot. Need geotextile drain
3478'	Filled 2' dia. culvert. No slope at lower end. Need 5' dia. culvert or raise old culvert higher.

Black Horse Trail from Boundary Bridge to Riley Spring Bridge (con't)

3824'	Partly filled 8 x 10" square culvert. Mud on top indicates culvert not continuous under trail bench. Need subsurface geotextile drain.
3968'	Partly filled 8 x 10" square culvert.
4126'	Broken fence along steep sidehill. Fence should be repaired. If major area is contemplated, fence should be moved in from edge 1' to 2'. Waterbars are needed high on the slope to prevent sidehill washout from great amounts of water cascading down steepest part of the filled bank below trail.
4234'	Sidehill slippage - washout
4333'	Bad " " - Need waterbar at 4393'
4905'	Culvert rusted out - undermined. Tread OK though
5246'	Culvert full. Blocked by stone wall.
5764'	Trail jct. PATC (Potomac Appalachian Trail Club) sign: "Valley Trail/Riley Spring Bridge 0.3 km"
5961'	Need several waterbars to drain right.
6466'	Mud hole - 30'. Logs inhibiting drainage. Install subsurface drainage
6677'	Culvert: 8" x 10" square culvert buried - mud on top
6768'	PATC sign "Boundary Bridge 2.2 km."
6798'	Riley Spring Bridge

This section logged on July 23, 1985 by B. Proudman & A. Van Huizen

ROCK CREEK PARK

TRAIL WORK LOG

Prepared by R. Proudman and A. Van Huizen - July 23, 1985

TRAIL: BLACK HORSE TRAIL

FROM: Milk House Ford, north on the east side of Rock Creek

TO: Rolling Meadow Bridge and Cross Trail 3

REFERENCE POINT (paced est. feet)	WORK DESCRIPTION
00	Start on east side of ford
26	Heavy natural deposition of sandy sediments on trail tread under Beach Dr. Bridge: good tread, although lower fence rail is buried. Should be monitored.
43	High water trail
60 - 90	Slope = 0%. Trail so muddy during wet seasons that horsemen have made a by-pass trail. Need to relocate up hill to acquire 6" additional elevation, permitting drainage, or install approximately 100' of turnpike with subsurface geotextile drains (see work specifications in main report). This condition predominates along this section.
165	Existing wood bridge - good condition
188	Near loblolly pine: need ditch or half culvert to drain tread.
228	Muddy. Need geotextile drain and possibly 10' of turnpike.
246	8' mud hole needs subsurface geotextile drainage
254	" " " " " " "
264	View of Rock Creek
320	Old 12" cement culvert completely filled. Excess water flowing over tread, causing mud/poor trail tread conditions. Need more bigger diameter culverts with turnpike. Geotextile drains would help

Black Horse Trail, Milk House Ford to Rolling Meadow Bridge, cont.

338	Block culvert causing 25' mudhole. Same solution as above.
422	20' of mud. Use same solution as above with subsurface geotextile drains and possibly turnpike
428	at E. side of Rolling Meadow Bridge: long culvert blocked (intake under quartz rock wall). The 12" culvert should be replaced with 24" culvert and/or same solutions as above.
523	Cross-walk at Beach Dr.
539	Muddy area near road . . . draining from above. Need diversionary measures, perhaps culvert, uphill.
548	20' muddy area. Need subsurface geotextile drain
574	Junction with cross Trail 3

TRAIL: Black Horse Trail from White Horse to Milk House Ford

Bob Proudman and Ann Van Huizen didn't log this section; however, we have some recommendations.

There is a 3' dia. culvert near Milk House Ford that is totally filled up and contributing to deterioration of the treadway. There is a ledgy area near the Milk House Creek end of this section which is difficult to negotiate by horses. The ledge has been exposed because of annual flooding of Rock Creek. The W. bank of the river here is approximately 1.5' lower than the E. bank (measured with handheld level). An alternative would be to remove the ledge through portable jack hammer technique and splitting shims and wedges. (See Trail Building and Maintenance, page 71). Non-explosive blasting technique also holds promise (use a compound poured into drill holes). Surfacing with imported soils might work, but a hydrologist should advise the park, first on whether such an investment will withstand future flooding. Installation of gabions, wire baskets filled with rock, to a height equal with the opposite bank, would enable deposition of riverborne sediments to fill in the trail tread; however, this solution is probably not aesthetically acceptable to NPS.

ROCK CREEK PARK

TRAIL WORK LOG

TRAIL: BLACK HORSE TRAIL

FROM: White Horse Trail/Glover Rd. Near Broad Branch

TO: Cross Trail 9

REFERENCE POINT (measured)	WORK DESCRIPTION
0' - 208'	Pavement then Trail turns L.
472'	Fence. Enter woods. Slope 7%
723'	Need 15' waterbar
835'	Top of grade. Big red oak at 863' on R.
1022'	New trail surface starts . . . red soil
1129'	Existing log crib
1221'	Storm drain on L. built by YCC. Existing waterbar filled: clean out.
thru 1355'	Slope 19% yet pretty stable. Rill erosion starting
1362'	Existing waterbar. Needs rock rip rap below bar to slow flow.
1532'	Existing waterbar. Filling up . . . needs cleaning
1577'	Existing waterbar. Needs soil low end . . . undermined
1653'	Existing waterbar " " undermined
1718'	Existing waterbar

All these existing waterbars need rip rap below the bars to prevent off-trail erosion.

1720'	End of Cross Trail 9 at Black Horse Tr. sign

ROCK CREEK PARK

TRAIL WORK LOG

TRAIL: BLACK HORSE TRAIL

FROM: Cross Trail 8 to point 655' towards Cross Trail 9 (had to stop because of rain)

REFERENCE POINT (measured)	WORK DESCRIPTION
0'	Black Horse Trail sign
42'	23% slope! Need waterbar below large oak on L.
77'	Horses using L. bank. Would cribbing be a feasible solution?
202'	Need waterbar. Need to reestablish outslope with imported soil
655'	18" culvert. Retaining wall has broken and erosion is eating away trail tread. This is a hazardous condition because of very steep downslope grades. Need to rebuild rock retaining wall 10' long by 6'-8' high. Increase culvert diameter

Prepared by Robert Proudman and Ann Van Huizen - July 25, 1985

STOPPED BECAUSE OF RAIN

ROCK CREEK PARK

TRAIL WORK LOG

TRAIL: CROSS TRAIL 2

FROM: Black Horse @ Riley Spg. Bridge

TO: White Horse Trail

REFERENCE POINT (measured)	WORK DESCRIPTION
00	Riley Spg. Bridge
135'	Beach Dr.
208'	Culvert on R. (clear). Wet on L. Fill ditch with rocks and brush: it is feeding the wet area.
334'	Jct. w/Cross Trail 2 and Black Horse Trail: turn R.
414'	New waterbar: nice
476'	New waterbar: nice
520'	New waterbar: nice
594'	Culvert collapsed on lower side (R). Deposition on trail from above. Clean culvert.
682'	New waterbar: nice
922'	Culvert with rock blocking intake (On L).
944'	Waterbar good. Note: this section from 682' - 944' has severe erosion

End at junction with White Horse Trail. Measuring wheel broke again.

This section logged on July 23, 1985 by B. Proudman & A. Van Huizen

ROCK CREEK PARK

TRAIL WORK LOG

TRAIL: CROSS TRAIL 3

FROM: Beach Rd.

TO: Cross Trail 4

REFERENCE POINT (paced est. feet)	WORK DESCRIPTION
00	Start Cross Trail 3
55'	18% Slope. Bad Gully
135'	Waterbar needed above gully
135-380'	10% slope. 3 waterbars needed enroute
490'	Waterbar needed
660'	Top of grade - Tulip poplar on R.
760'	Intersection of Cross Trails 3 & 4 @ sign

This section logged on July 23, 1985 by B. Proudman & A. Van Huizen

TRAIL WORK LOG

TRAIL: CROSS TRAIL 4

FROM: Jct. with Cross Trail 3

TO: H-2 Police Stables

REFERENCE POINT (paced est. feet)	WORK DESCRIPTION
00	Start @ sign
565'	Good waterbar
610'	Waterbar too short
665'	Waterbar too short
700'	Waterbar OK
770'	Waterbar needs cleaning
795'	Waterbar OK
820'	Waterbar needs to be longer on uphill end
850'	Waterbar needs cleaning - uphill end
895'	Waterbar OK
1030'	Intersection with Bingham Dr.
1125'	5' dia. culvert needs to be cleaned of debris. Headwalls need to be rebuilt at both the inlet and outlet of the culvert. Replace fill behind headwalls.
1315'	Waterbar good
1385'	21% slope. Waterbar is good but needs cleaning
1490'	Waterbar good
1545'	Waterbar good
1610'	Waterbar good but needs cleaning
2650'	Reach #2 Stables

This section logged on July 23, 1985 by B. Proudman & A. Van Huizen

ROCK CREEK PARK

TRAIL WORK LOG

TRAIL: CROSS TRAIL 6

FROM: Stables (down)

TO: Cross Trail 7

REFERENCE POINT (measured)	WORK DESCRIPTION
00	Bent sign post with missing sign near stables
30'	Slope = 19%
95'	Existing waterbar good. Extend ditch and clean bar at center
174'	Existing waterbar need riprap at outlet
239'	Existing waterbar
295'	White Horse/Cross Trail 6 junction
300'-377'	Need drainage ditch on S. side of trail to collect run-off for 77' along trail from park headquarters parking lot. Run-off can then cross trail with waterbar or culvert at pt. 377'. (See p. 88 of Trail Building and Maintenance for illustration of this work.)
435'-656'	3-4 additional waterbars could be installed here; however, they may be disagreeable to horsemen.
827'	As at pt. 377', water from parking lot can be caught in a drainage ditch before crossing the trail, then funnelled across the trail with a culvert.
932'	Side road to maintenance storage area.
980'	Propose waterbar
1083'	Propose waterbar
1118'	Existing waterbar needs cleaning
1204'	Existing waterbar too steep: eroding. Need riprap or fill. Better yet, realign at more moderate grade.

TRAIL: CROSS TRAIL 6 (con't)

1294'	Existing waterbar
1386'	14% slope
1509'	Blowdown (probably removed by time this is read)
1580'	Trail turns R.; steepens
1610'	Propose waterbar to drain to L.
1667'	Existing waterbar
1741'	Existing waterbar clogged. In general, on these steeper grades, waterbars need more frequent maintenance.
1788'	130' long "S"-shaped gully, 2' below grade
1983'	4-5' cement culvert. Need riprap where trail drainage forming gully next to culvert. Surface muddy (turnpike or crown with soil).
2200'	End under center beam of Ross Drive Bridge near junction with Cross Trail 7

This section logged on July 26, 1985 by B. Proudman & A. Van Huizen

ROCK CREEK PARK

TRAIL WORK LOG

TRAIL: CROSS TRAIL 7

FROM: White Horse @ Glover Rd.

TO: Black Horse Trail

REFERENCE POINT (measured)	WORK DESCRIPTION
00	Start at Glover Rd.
22'	Need waterbar 20' to R into drain below stone culvert
54'	"This is a Nat. Park" sign on R.
74'	Pass gate
98'	Need waterbar 16' to R.
129'	Existing 12" culvert needs stone face on intakes and outtakes
145'	Puddling in trail. Knock down outside edge of trail
225'	Puddling. Need drainage - turnpike may be best with drains
252'	Need waterbar
400'	Need waterbar before dropping into cupped area
492'	Existing 12" culvert needs rock headwalls
564'	Puddling. Trail needs outsloping. If inadequate, use turnpike
656'	Same as 564'
872'	One foot below grade. 10% slope. Need 25' waterbar. Some excavation needed on R bank.
1000'	Trail meandering down fall line. Need large waterbar
1112'	Slope 7%. Need 16' waterbar to R

CROSS TRAIL 7 from Glover Rd. to Black Horse Trail (con't)

1282'	Need a series of waterbars
1350'	Need waterbar
1450'	Need waterbar
1497' - 1556'	Three existing waterbars above Rosss Dr. all need to be lengthened and cleaned.
1605'	Ross Dr.
1633'	Gate. Descent steep (24% !) slope

From Ross Dr. we flagged (in day-glo colored tape) a climbing turn to the south of the existing trail. This minor relocation could reduce the grade on the existing trail.

1650' - 1670'	Need waterbars if climbing turn is not constructed
1730'	Jct. of cross trails 6 & 7. Need 28' long waterbar
1788'	Need 28'-30' waterbar to cross very wide trail
1835'	Need 28'-30' waterbar to cross very wide trail
1885'	Need 28'-30' waterbar to cross very wide trail Junction with Black Horse Trail

This section logged on July 26, 1985 by B. Proudman & A. Van Huizen

ROCK CREEK PARK

TRAIL WORK LOG

TRAIL: CROSS TRAIL 8

FROM: Equitation Field

TO: Black Horse Trail

REFERENCE POINT (measured)	WORK DESCRIPTION
0' @ sign post	16% slope. Need waterbar
59'	Need waterbar
99'	Existing Waterbar. Needs cleaning, though working well.
175'	Existing Waterbar. Draining well but need to taper approach above bar.
343'	Existing Waterbar. Could use cleaning.
Approx. 430'	Need one or two long waterbars... trail wide.
465' - 524'	Wet area. Remove logs on low edge of trail (@505') ... inhibiting drainage. This spot needs a 12" culvert by 20' long, to provide drainage for watershed to north.
505'	Low point. Waterbar needed here as well as culvert.
550'	Need Waterbar.
573'	Grade steepens. Repair outslope so that trail sheds water. Running down trail now.
674'	24" culvert with roller equipment on R. (This equipment should be removed.) Ditch below outflow of culvert should be reexcavated for 20' to remove accumulated silt. Culvert should be lengthened 6' ... backwash eroding trail bed. An important culvert like this should have stone headwalls at inlet and outlet to prevent erosion next to culvert.
764'	End at Trail sign. A 30'+ waterbar would be installed here at the junction. This area should be narrowed with brush barricades.

Prepared by Robert Proudman and Ann Van Huizen - July 25, 1985

TRAIL: CROSS TRAIL 9

FROM: Black Horse Trail

TO: Equitation Field

REFERENCE POINT (measured)	WORK DESCRIPTION
0'	At Black Horse sign. Trail 15' wide, slope approx. 14%
143' or less	Need waterbar before grade
283'	Base of grade. Boggy area for 10'. Ditch at right angles to centerline of trail to drain water off sides
376'	Need waterbar
456'	Need waterbar
467'	Gate
503'	Glover Rd.
633'	Side Trail L.
645'	Gate
806'	End at cement steps in equitation field.

Prepared by Robert Proudman and Ann Van Huizen - July 25, 1985

APPENDIX F

SUMMARY OF CONCERNS

National Park Service
May 24, 1985

GREETINGS..:

As we promised, here is a summary of the concerns which we heard discussed at the May 7th meeting on horse trail maintenance and related issues in Rock Creek Park. Thanks again for attending and being such active and vocal participants. If you have any other concerns which are not reflected here, please let us know by phone or letter:

Ann Van Huizen, Park Planner
Bob Ford, Resource Manager (202)426-6834
National Park Service
Rock Creek Park
5000 Glover Road N.W.
Washington, D.C. 20015

SUMMARY OF CONCERNS...

Unleashed dogs, bicyclists, and joggers are major concerns because they scare horses and cause them to bolt. Signs should be installed at trail heads that advise park visitors about prohibited activities and trail etiquette.

Lights are badly needed between the red barn and parking lot. Many riders leave the barn after dark and are concerned for their personal safety.

The trail system needs more signs with trail names (other than Blackhorse and Whitehorse) or mile markers. Currently it is difficult to know where you are in the park and difficult to describe the location of an injured rider in cases of emergency.

A section of Cross Trail #8 is too steep and curves to the left at the top. Horses have a difficult time making it up the slope and around the corner1 without coming too close to a poorly placed sign at the top. Often, the result is the rider gets hit by the sign. Relocate sign.

Comments by Bob Douglas, Horse Center Concessioner:

The red clay placed on the Blackhorse trail above Grove 3 is holding well. The NPS should see what was done right there and duplicate it elsewhere. He feels the slope is not eroding and that there are no water bars there. He considers water bars a problem, not to boarders so much as to new riders who go on trail rides. Also, ruts and gullies form on both sides of water bars.

Equitation Field needs repairs badly. The NPS should fix it or close it down. The jumps are dangerous. The grounds are uneven and have holes. Riders will volunteer to fix it

if NPS will provide materials (lumber and soil @ $300). Once fixed, Equitation Field would receive lots of use by riders.

The fence with chains near Grove 22 is dangerous. Need to take points off posts before someone gets gored. Put wood crosspieces up to make it a railing. Get rid of the chains.

Large, loose rocks found along the trail south of Milkhouse Ford and other areas create hazardous footing for horses. This trail surface is especially a problem in the autumn and winter when leaves or snow cover the rocks, keeping them hidden from the horses.

A drainpipe on the path immediately behind the NCTR barn is hazardous. A horse could fall through it.

The fence near horseshoe bend is seriously dilapidated and the steep slope below it is suffering from erosion. Slope may need cribbing to stabilize.

Motorists often honk at riders at trail crossings. This scares the horses. Place signs to discourage honking.

A fence is needed to separate riders from traffic along Beach Drive just north of Rolling Meadow Bridge.

Depressions and holes develop at the ends of concrete bridges (Riley Spring and Rolling Meadow). The concrete also flakes. Check for steel rod exposure.

There is a large rock in trail bed west of Beach Drive near Groves 9 and 10.

Pruning is heeded on trails--lots of low branches.

Grove 10 restroom is a perfect place for a mugging. It should either be renovated or removed.

The best trail section is next to the rapids south of Military Road.

The worst section is the slope leading up to Fort DeRussey from Rock Creek parallel to Military Road.

Riders need a direct route from Ft. DeRussey trail across Military Road to stables. Presently, riders have to detour to Rock Creek to get under Military Road.

Riders would like to have trail access to the Potomac River, C&O Canal, and trails in Glover Archbold Park.

It would be desirable to have watering troughs at USPP stables and equitation field.

Experienced riders prefer a variety of trail types, including some with hazards such as downed trees. A possibility is to find a trail where there are no trail rides for beginners and leave deadfalls in place.

Horses and riders are hesitant to pass Grove 18 when occupied due to the noise, frisbees, volleyball games, and children. This activity forces riders off the trail and onto a parallel foot trail.

The main groups that use the horsetrails in RCP are those who board their horses at the RCP stables, those who go on guided trail rides, and students who are taking lessons. Some riders enter from Maryland and the Meadowbrook stables. This is a small proportion of the total ridership.

Horse trails are used throughout the year on weekdays and weekends. All of the trails are used and more are desirable. The trails closer to roads are preferred by some riding alone because of the greater safety factor.

U.S. Department of the Interior
Mission Statement

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