DEVELOPMENT OF A NATURE TRAIL AT KNOX SCOUT RESERVATION

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June 2015

Piedmont-Appalachian College of Commissioner Science

Ridgecrest Conference Center

Ridgecrest, NC

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To the Doctoral Candidate Review Board:

I am submitting herewith a Dissertation written by Paul S Korinko, entitled **Development of a Nature Trail at Knox Scout Reservation**. I have examined the final copy of this report and content and recommend that it be accepted in partial fulfillment of the requirements for the Degree of Doctor of Commissioner Science.

Dr. Elizabeth Stoner

We have read this Dissertation
and recommend its acceptance:

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Chairman
Doctoral Candidate Review Board
and Blue Ridge Council

ACKNOWLEDGEMENTS

I would like to acknowledge my wife for allowing and encouraging my participation in the Scouting movement. I would also like to acknowledge her financial support for my Scouting habit. In addition, I would like to acknowledge John Nichneidovitch and his role in the Georgia-Carolina Council Conservation Committee. The support of Ranger Greg Sewell at Knox Scout Reservation is also acknowledged. I would also like to acknowledge Jeff Schwab, the Georgia-Carolina Council Executive, for his support of my efforts to work with the camp and council to make facility improvements for the youth of the council, and the Scouting movement in general so we can bring a great program to youth who need it.

Finally, I would like to acknowledge my employer, Savannah River Nuclear Solutions. During my business travels, I have been able to arrange side visits to various national monuments, state parks, historically significant areas, and national forests. I have taken the opportunities to examine some of the trail characteristics and signage at places like Muir Woods National Monument, Craters of the Moon National Monument, Petroglyph National Park, Historic Albuquerque and Santa Fe, Nevada Test Site, Mount Rainier National Park, Cascade Mountain Range, Hoover Dam, Yellowstone National Park, and The Grand Tetons, to name a few of the more prominent locations.

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ABSTRACT

Trail design and planning can be a complex task, but with knowledge and review of guidelines the task can be tractable. A trail can be developed that meets the needs of end-users, landowners, land custodians, and animals. This document is comprised of rules and guidelines, definitions, and general information about the Piedmont area of the Georgia-Carolina Council so that a nature trail can be developed and constructed at Knox Scout Reservation (KSR). This study is based on review of the literature, consultation with experts, and consultation with Georgia-Carolina Council staff members.

Trails are developed for a variety reasons with the most important one being so that users can exercise, enjoy nature, and, unbeknownst to them, be educated. The information provided in this document provides the basis for the development of a nature trail for the Georgia-Carolina Council's Knox Scout Reservation. The Nature Trail at KSR will have signs and brochures to point out at least ten items of interest for the Scouts. Select geologic features, plants, and animal sign will be described in the nature trail brochure. Two draft brochures, included as appendices, were prepared with one appropriate for Cub Scouts and the other appropriate for Boy Scouts, Venturing and Team youths. The published brochures will include the actual species present after the forestry projects and trail location are finalized.

The information in this document will be used to define and characterize the trail. The trail will be a class 3 trail and will be about a half-mile long. The tread will be natural with no additional material or fill brought in. Signage, trail markers, and informational displays will be incorporated to improve the trail experience.

CHAPTER 1

INTRODUCTION

The topic of this dissertation is the design considerations and the basis for construction of a nature trail at Knox Scout Reservation, the Scout camp belonging to the Georgia-Carolina Council, which seems an odd topic for a roundtable commissioner. However, there were few topics related to roundtable that piqued my interest, but I am very interested in conservation of our natural resources and methods and means to convey this interest to our Scouts. I am a charter member of the GACA Council's conservation committee. It is important that we educate the youth and adults in Leave No Trace principles so that part of our legacy is having places in nature that can be enjoyed by future generations. Learning about the nature, flora, and fauna should foster that desire.

My interest in conservation comes from a long-standing influence of my father, who was an active hunter and fisherman and Christian, and who instilled in me a passion for God's creations. He was a member of the Isaac Walton League and established a recycling center in my hometown of Seward, Nebraska in the mid-1970s. I wish to pass along these interests to future generations and one way to do this is to engage the youth and their parents in learning to identify plants and animal trail sign. After consultation with the Ranger and Scout Executive, the final path will be designed for Knox Scout Reservation. I will lay out the nature trail and then I will lead the team that builds it. The Knox Season Rangers, under my supervision and support, will construct the trail as part of the monthly activities. I will also advocate its use by the Georgia-Carolina Council's Cub, Boy, Teams, and Venturing youth.

CHAPTER 2

REVIEW OF LITERATURE

Enjoying nature, being in the outdoors and learning "woodcraft" and about plants and animals was important to Robert Baden-Powell, the founder of "The Scouting Movement", as these concepts are referred to throughout "Scouting for Boys" (1). In addition, we see images of the importance of hiking to Baden-Powell in the Hiking merit badge pamphlet (2). Trail use and hiking can be done in urban areas, front country, and backcountry. Urban trails include culturally significant areas, "around town", in parks, etc. Front country trails are generally fully developed trails at city, state, and national parks. Front country trails are typically within a few minutes' walk from parking lots. Backcountry trails, on the other hand, are less developed and may take hikers miles from civilization. Backcountry trails include treks through areas like Philmont Scout Ranch, the Grand Canyon, the Appalachian Trail, etc. There are many interesting and educational opportunities that can be experienced while hiking. These include reading animal sign, respecting nature, learning about the geology, flora, and fauna, and meeting fellow hikers.

In this document the features and attributes of trails will be described. The types of trails based on level of development, the design for usage, and the location will also be described. General trail construction methods and techniques for layout and terminology will also be described. These general topics will be melded into suggestions for the development of an interpretive/nature trail at Knox Scout Reservation. An interesting item to note is that while there are guidelines and codes, there are generally no hard and fast rules for trail designs, and

most often there are rules of thumb that have evolved. This document will be used for the design and planning of the nature trail and draft pamphlets for Cub Scouts and Boy Scouts are included as Appendices A and B, respectively, for the nature trail at Knox Scout Reservation. The proposed layout, signage, and trail construction will be defined.

Trails exist for many reasons and purposes, and there are a wide variety of trails. There are pedestrian hiking, pedestrian walking, bike riding, horse riding, and multi-use trails in various combinations of the above; in addition, there are motorized vehicle trails for four wheelers, four wheel drive vehicles, and motorcycles. There are also snow and water trails. Each trail, although potentially of multiple use, should be characterized as a single trail class (3). In the arena of pedestrian walking trails, there can be historical, interpretive, and nature trails. This document will describe the development of walking trails, and this information will be applied to the nature trail at Knox Scout Reservation.

Trails, trails, trails, why do we care about trails? The Massachusetts Department of Conservation and Recreation lists the importance of trails and some reasons to care about them, while this list applies specifically to the Commonwealth of Massachusetts, the sentiments are universal (4):

> Importance of Trails
>
> Trails contribute significantly to the Commonwealth's health, economy, resource protection, and education.
>
> Trails connect people to the natural environment: place to place, person to person, and neighbor to neighbor. Trails connect us to scenic landscapes, natural wonders, and cultural resources.

> They make our communities more livable: improving the economy through tourism and civic improvement, and building support for land protection and stewardship.
>
> Trails provide opportunities for multiple-use recreation: promoting physical activity to improve fitness and mental health. They provide access for other recreational opportunities such as hunting or rock-climbing.
>
> They enhance educational opportunities: providing opportunities to improve and test skills, to be challenged, or to learn about our natural or cultural environment. Trails present opportunities for observation, enjoyment, and exploration.
>
> Trails strengthen each of us: offering opportunities for solitude, contemplation, and inspiration. To some, trails provide a sense of freedom, personal accomplishment, self-reliance, and self-discovery.
>
> Trails can even help protect rare habitats and sensitive resources: by concentrating use on designated sustainable pathways. (4)

Trails can also be used to control access to areas that are of environmental or social interest and can be used to protect sensitive areas. For instance, if there is interest in viewing a specific area, and no trail is present then "social" trails may be built. These uncontrolled trails can result in significantly more damage to the environment than a designated, designed trail. A formal trail may then be needed to better protect and control access to the sites of interest. In general, the social trails must be closed, the formal trail is designed and built, and the social trails are then recovered and vegetated (5).

Based on the above rationale for having trails, an understanding of trail design, purpose, and construction of trails is helpful. In the next sections trail types, uses, and some design parameters will be described and discussed. Some trail guidance is based on specific design parameters and requirements while others allow for "rules of thumb". The rules of thumb are generally based on design guidelines, science, history, and best and worst practices.

There are five classes of trail that are defined by the United States Forestry Service (USFS)

of the United States Department of Agriculture (USDA). These are from the least developed (Class 1 trail) to the most developed (Class 5 trail):

Trail Class 1: Minimally Developed

Trail Class 2: Moderately Developed

Trail Class 3: Developed

Trail Class 4: Highly Developed

Trail Class 5: Fully Developed

From these rather scant descriptions, it is a challenge to visualize what is meant. The meaning the trail descriptions and some features of each trail class, i.e., tread, obstacles, constructed features, signs and the expected experience, can be seen in the photos and text shown in Appendix C from the USFS (6). These images are helpful in defining the general characteristics of trails; however, they do not provide adequate design basis information to build trails, much less sustainable trails. To address the technical requirements of trails, design parameters are utilized. This information, listed in Table 1, more clearly defines the nominal dimensions, characteristics and design basis for trails (7). A comparison of the information in Table 1 reveals that there is some overlap of the trail classes. The accepted rule for trail characterization is that the majority characteristic of the trail be used to define the class; it is possible then to have a class two trail with some segments having either class one or class three characteristics. Trails should also be sustainable; sustainability indicates that the trail will be present and usable for a long time, trails with durable treads that won't be eroded away by water or use, trails that won't adversely affect water quality or the ecosystem, trails that meet the intended needs of the user

TABLE 1. Definitions of Trail Guidelines (3, 7)

Hiker/Pedestrian		**Trail Class 1**	**Trail Class 2**	**Trail Class 3**	**Trail Class 4**	**Trail Class 5**
Design Tread Width	**Wilderness (Single Lane)**	0 – 12”	6” – 18”	12” – 24” (May be 36” – 48” at steep side slopes)	18” – 24” (May be 36” – 48” at steep side slopes)	Not Applicable
	Non-Wilderness (Single Lane)	0 – 12”	6” – 18”	18” – 36”	24” – 60”	36” – 72”
	Non-Wilderness (Double Lane)	36”	36”	36” – 60”	48” – 72”	72” – 120”
	Structures	18”	18”	18”	36”	36"
Design Surfaces	**Type**	Native, ungraded May be continuously rough	Native, limited grading May be continuously rough	Native, with some on-site borrow or imported material where needed for stabilization and occasional grading Intermittently rough	Native with improved sections of borrow or imported material, and routine grading	Likely imported material, and routine grading Uniform, firm, and stable
	Protrusions	≤ 24” Likely common and continuous	≤ 6” May be common and continuous	≤ 3” May be common, not continuous	≤ 3 ” Uncommon, not continuous	No Protrusions
	Obstacles (max. height)	24”	14”	10”	8”	No Obstacles

TABLE 1 (cont.) (3, 7)

Hiker/Pedestrian		**Trail Class 1**	**Trail Class 2**	**Trail Class 3**	**Trail Class 4**	**Trail Class 5**
Design Grade	**Target Grade**	5% – 25%	5% – 18%	3% – 12%	2% – 10%	2% – 5%
	Short Pitch Maximum	40%	35%	25%	15%	5%
	Maximum Pitch Density	20% – 40% of trail	20% – 30% of trail	10% – 20% of trail	5% – 20% of trail	0% – 5% of trail
Design Cross Slope	**Target Cross Slope**	Natural side slope	5% – 20%	5% – 10%	3% – 7%	2% – 3% (or crowned)
	Maximum Cross Slope	Natural side slope	25%	15%	10%	3%
Design Clearing	**Height**	6’	6’ – 7’	7’ – 8’	8’ – 10’	8’ – 10’
	Width	≥ 24” Some vegetation may encroach into clearing area	24” – 48” Some light vegetation may encroach into clearing area	36” – 60”	48” – 72”	60” – 72”
	Shoulder Clearance	3” – 6”	6” – 12”	12” – 18”	12” – 18”	12” – 24”
Design Turn	**Radius**	No minimum	2’ – 3’	3’ – 6’	4’ – 8’	6’ – 8’

and provide a positive user experience. In short, sustainable trails are useful and durable and do little to minimal to no harm to the environment (3, 8).

In addition to sustainable trails, it is generally desired to have accessible trails. The development of accessible trails means that trail classes are by necessity increased for trail users with limited mobility. Trails that are fully accessible will typically be class 4 and 5. There may be sections of class 3 trails that are accessible. The accessibility of class three trails is generally limited to near and around the trailhead. Some characteristics of accessible trails are that they have hard durable treads, they are at least 60 inches wide, there are no steps, the grade is less than 10% and the cross grade is also less than 10%. Trail building guidelines that comply with American Disability Act (ADA) are presented in Reference 9.

In order to design and build a trial, it is important to know and review trail design parameters. Some of the design parameters and definitions from the USDA for trail building are listed in Appendix D.

Trail construction and the tools needed for it are also important to know about. Trails can be built using motorized or hand tools. Despite the nature trail being built in the front country, there will be little use of heavy-duty tools, tractors, blades, hydraulic equipment, etc. From more general principals, most trails will be built with and will require maintenance using hand tools. As our society moves from a familiarity of hand tools and manual labor, a brief description of hand tools and their safe using is recommended. While Scouts and Scouters are generally aware of the use of axes, hatchets, shovels and saws, more unique tools are often desired for constructing trails. A compendium of hand tools that are useful and suitable for trail building

and maintenance are available in references 18 and 19, also listed in these references are sources to procure the tools.

Safe tool use is based on three general principles, grip, maintenance, and proper use. A good grip will prevent the tool from slipping from your hands and causing incidental damage, either to you, a coworker, or plant. Wet or muddy gloves can be slippery and prevent good grip. Associated with grip is awareness of your surroundings. There should not be anyone within the working circle of the tool in question. A clear working area is also important so a full swing or partial swing can be used as appropriate. Tool maintenance is fairly obvious, but using a properly sharpened tool will minimize the level of effort needed to cut. A damaged handle can cause the working part of the tool to become a projectile and injure fellow trail workers. A brief inspection of the trail tools before use can save efforts later. Finally, using the right tool for the job makes is faster and safer. The final part of safe work practices, includes having the right personal protective equipment, gloves, safety glasses, closed toed shoes, hat, long sleeve shirt, long pants, etc. and a first aid kit to take care of those maladies that still occur despite our best efforts.

A brief description, paraphrased from *Tools for Trail Work* (19), of the less common hand tools that may be useful for constructing the KSR Nature Trail follows:

Weed cutters (Grass Whip/Swizzle Stick/Weed Whip) are useful to cut grasses and small woody shrubs and plants. They are not useful for branches larger than about a quarter inch (six millimeters). Periodic maintenance is needed to ensure that the screws that attach the blade to the handle are tight.

Machetes may also be used; the single blade works well to cut through dense vegetation. It works best when swung at a slight angle, and although it is a good cutter, it should not be used to chop off braches from trailside trees.

A Woodman's Pal Axe is a cutting blade that is about 16 inches long with a hand grip. It is easy to use and has two cutting edges.

A Swedish Safety Brush Axe (Sandvik) is a machete-like tool with a short replaceable blade and a longer handle. It is a little easier to control than a machete and offers the benefit of having a replaceable blade.

A Brush Hook has a heavier duty blade than a weed cutter and can be used to cut brush too heavy for a weed cutter and too light for an axe. It is swung like an axe.

A Bank Blade is useful for cutting briars and underbrush. With the long handle, it keeps you away from the vegetation that you are removing. It should not be used for overhead trimming.

To cut branches and limbs overhead, a pole saw should be used. These are pruning saw blades attached to a handle that can telescope to increase the height at which branches can be cut. To help keep the cut clean, it is best to make three cuts. The first is a cut on the underside of the branch to be removed to a depth of about the branch at a distance of about 4 to 6 inches, the second removes the branch and the third is a clean cut near the trunk. This method prevents the bark from being stripped along the trunk if a single top down cut is made. As a minimum, the underside cut followed by a topside cut technique should be used.

Grubbing tools will not generally be needed since the trail is not going through

completely undeveloped areas. A Mattock, which looks similar to a pick axe but has a number of different head styles and weights available may be useful to break small rocks and chop out roots. The head should be tight to the handle and may need to be shimmed to hold it in place.

The list of common hand tools that will be used include loppers, shovels, axes, hatchets, bow saws, pruning saws, hoes, rakes, forks (pitchforks), posthole diggers, hammers, sledge hammers, and wheelbarrows. A few common power tools that will be employed are chainsaws, power weed cutter, power weed cutters with saw blade attachments, string brush cutters, and the Ranger's golf cart.

CHAPTER 3

DESIGN DISCUSSION

Trail layout requires a significant amount of planning; planning is stupidity avoidance (5). Planning and design work hand-in-hand. Proper trail design starts with determining the trail management objective (TMO). The following list of questions should be addressed: Who is the trail designed for? What is the purpose of the trail? What is the layout? Where are the control points? Where does the trail need to go? Are there special areas to be avoided, such as water crossings, poor soil, endangered species of plants or animals, noxious weeds, critical habitats or sensitive habitats? Are there special areas for interpretation, historically significant areas, geological features, etc. (15, 16)?

Planning is also needed to ensure that the trail will have an acceptable impact on animals. Will the trail bisect animal habitat? Will it encroach on "resting areas"? Can it be routed to minimize impact? Will a developed trail serve additional purposes? A planned trail may be needed to control access to sensitive areas; as an example from reference 16, social trails evolved and were created to observe animals in a sensitive area. These social trails resulted in damage to the flora, destruction of habitat, and disruption to the breeding habits of the animals, in addition to causing erosion. In order to minimize all these effects, a planned trail was designed and constructed that allowed hikers to observe the animals, prevent the destruction of the flora and habitat, and was located to optimize the viewing of the animals with minimal impact on their behavior. In other words, by designing a trail, the overall impact was lessened compared to prohibiting observation. Ultimately, the social trails were blocked and rehabilitated with local

flora and the habitat was reestablished (16).

As indicated, the presence of trails can affect animals no matter how much we want to "take nothing but pictures and leave nothing but footprints." Simply by entering an area we can affect the ecology and environment. Sometimes the impacts are obvious and immediate while other times, they can be substantial and long lasting. An immediate impact is the change in behavior of an animal that is sharing "our" trail. The animal may stop doing what they were doing before our arrival, they may watch us, or they may run away. Long-term impacts of trails and use may include the destruction of habitat or the degradation of the habitat so that more edge-dwelling animals invade. Edge dwellers are animals that tolerate humans and tend to feed off our litter and debris, animals such as mice, raccoons, squirrels, and other smaller game. There are several concerns when working on trails with wildlife in mind. A checklist for considering animals for trail development is provided in Appendix E (16). Surprisingly, trails can be effective management tools to reduce the impacts of people on wildlife, but a trail must be planned in conjunction with its zone of influence so that it respects wildlife. Ultimately, a trail may be built with the intent of impacting animals and habitats but it should only be done with an understanding of the implications.

Informational trail signs are also important to improve trail use and enjoyment. The signs may be (1) "blaze" markers that indicate the trail location, (2) information signs for pointing out areas or items of interest, (3) warning or caution signs for safety, (4) information signs regarding distances, trail courtesy and etiquette. There are documents (15, 17) devoted to sign requirements for trail users. Signs can be painted markers on trees, zinc-plated can lids, etched

Bakelite (plastic), Bakelite directional arrows, etched metal signs, cast metal signs, painted wood, routed wood, etc. The signs should convey the information in the trail setting. The information signs should be constructed of materials that will withstand the atmosphere in which they are placed. A blaze should be apparent to the users, but it may be preferable to have it blend in somewhat. A warning sign should stand out so that it gets attention. Informational signs can be designed in the shape of plants or animals, they can be created to include plant parts, they can be laminated, or they can be hinged for questions and answers (15).

CHAPTER 4

APPLICATION

The Knox Scout Reservation nature trail will be located to the east of the area currently known as "Dining Hall Field" (20). Figure 1 shows the overall map of KSR. The location of the dining hall and proposed area for the trail is shown in the satellite image shown in Figure 2 and topographic maps of Knox are shown in Figure 3. From the topographic map, it is apparent that the selected trail area does not exhibit significant terrain changes; it is relatively flat. This fact means that bridges, walkways and other constructed features will not be required.

The design parameters from Table 1 will now be applied to the Knox nature trail. Since the trail needs to be user friendly to get maximum use, the trail will be designed to class 3 trail standards. While there are mobility limited Scouts and Scouters in the Georgia-Carolina Council, the cost to make the trail fully accessible, i.e., class 4 or 5, is too high and many of the individuals have access to heavy duty wheelchairs that are able to maneuver on a lesser established trail.

In order to minimize the impact of the trail on the environment and to enhance the trail users' experience, the trail will be designed as a class 3 trail. Using the information in Table 1 all of the design criteria will be considered item by item. The rationale for selecting class 3 as well as arguments against the other classes will be presented.

The tread width is intended as a double-lane trail so that users, i.e., Scouts as buddies, can walk two abreast. KSR is a "non-wilderness" location so the trail width needs to be a minimum of 36 inches. This width is also consistent with use of a weed eater type mower so that the trail

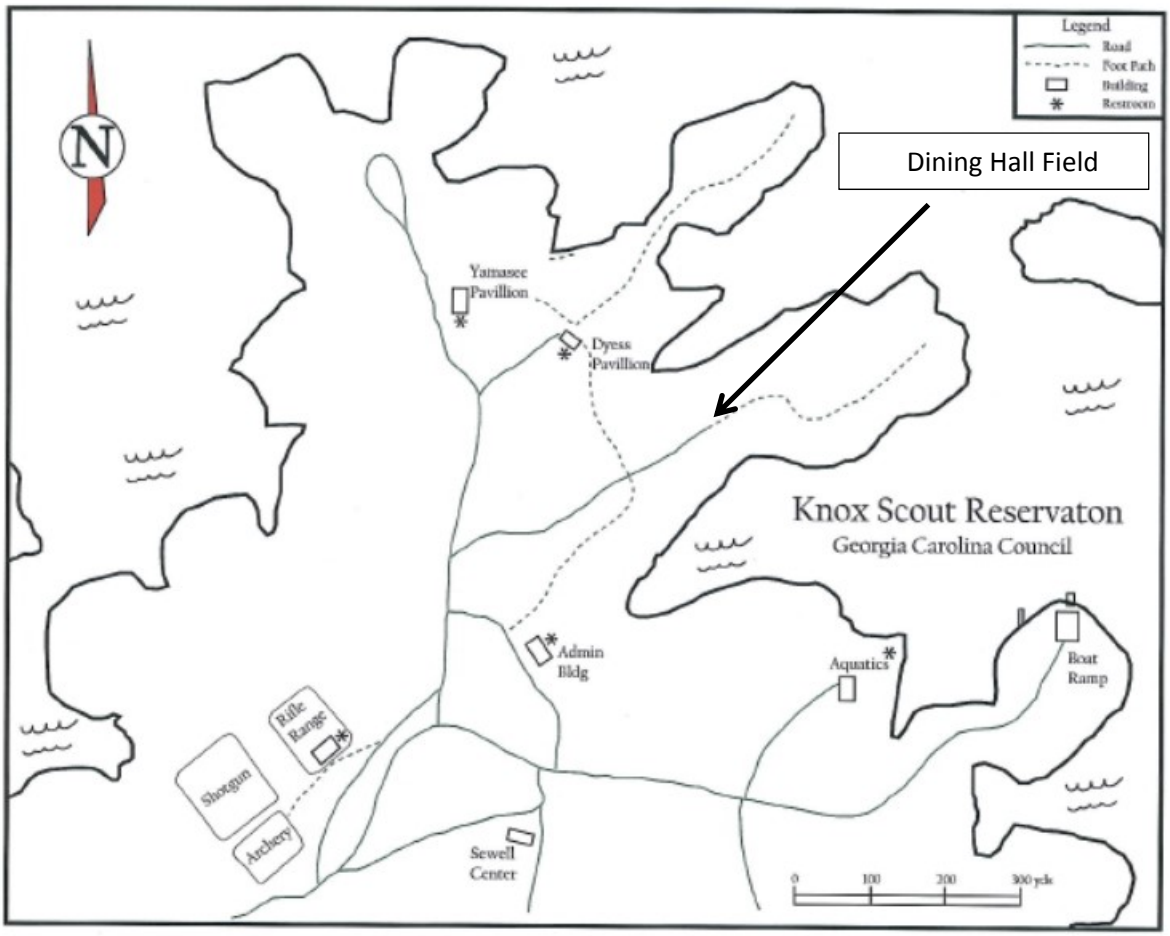

Figure 1. General map of Knox Scout Reservation (20).

can be maintained using mechanized devices. The clearing width may increase to 60 inches to accommodate the Ranger's heavy-duty golf cart so maintenance can be even more highly mechanized and the trail can be used not only as a nature trail but also as a utility trail along the point where it is to be located. Based on the topographic map shown in Figure 3, there are no steep side slopes anticipated so the width does not need to increase to allow for erosion

Figure 2. Satellite image showing the location of dining hall field and the general location of the Knox Nature Trail (20).

Figure 3a. Overall topographic map showing the location of Knox Scout Reservation, the circled area is shown in more detail in Figure 3b. (26).

Figure 3b. Circled area from Figure 3a, showing the elevation changes around the location of dining hall field. It is the same area shown in Figure 2 to more clearly define the terrain for the nature trail (26).

resistance. In addition to the lack of steep sloped ground, there are no streams, valleys or other characteristics for which a structure, such as a bridge or walkway, is required.

In keeping with minimal cost and disruption to the trail area, the design surface will be native materials. The most common material will be the grass that is present in the area. The trail will be graded to smooth the rough spots and the surface will be graded to reduce the likelihood of standing water in the trail. Low spots will be built up with locally borrowed material if needed.

Obstructions and protrusions will be limited in size and location. Loose quartz rocks and limbs and logs will be removed from the trail. These objects are tripping hazards and may adversely affect some of our Scouts and Scouters. Occasionally quartz rocks are unearthed during rain and erosion events, these obstacles will not be removed. Any trees that fall on the trail may be cut to the trail width and left to decompose or may be removed completely. Figure 4 shows two approaches for handing tree obstructions. In one case, a large redwood tree was cut to create a path through it since it fell on a trail in Muir Woods National Monument. In the second case, the tree was slightly elevated above the trail and the tree remained in place and hikers need to duck under it. It is unlikely that either of these conditions will occur on the Knox nature trail since the trees in the area do not compare to the giant redwoods of Muir Woods. The small trees and branches that interfere with the trail will be removed to limit the possibility of eye injuries. If the trees require significant trimming an assessment will be made to determine if they should be removed so that the situation shown in Figure 5 is avoided.

Figure 4. Trail obstructions observed by the Doctoral Candidate while hiking the trail at Muir Woods National Monument north of San Fransisco, CA.

Consistent with the topography shown in Figure 3, the grade will easily meet 3-13%. There are no hills that will be traversed and the slopes are generally gentle. The goal will be to not modify the cross slope consistent with a class 1 trail, but if there are areas where the trail will need to be cut along a side slope, the goal will be to keep it as low as possible to minimize erosion.

Figure 8—These trees should have been removed rather than pruned.

Figure 5. Improper tree trimming to meet shoulder clearance (10, 14).

The design clearing height will be about 7'. This height will allow most Scouters and Scouts to pass without being hit by trees. This height is taller than the height of the Ranger's golf cart so it will not be affected. The width will be between 36 and 60 inches, but some of the vegetation may be allowed to encroach since the trail will be minimally maintained, by design. Periodic maintenance will be performed to ensure the trail viability. The shoulder clearance will vary from none to 18 inches. The shoulder referred to here is consistent with the definition of the shoulder at the side of a road. It is the undeveloped space immediately adjacent to the edge of the trail (road).

Any of the turns in the trail will be very generous. Since the trail location is largely flat, there is no need for climbing turns switchbacks. Since the trail will be a circular trail, with an end near the trailhead, there will be some turns, but the radii of these turns will be on 10 to 12 feet or more, which is greater than turns referenced even class 5 trails.

Although not specifically referenced in the Trail Guidelines table, signage will also be addressed since it appears in the design pictures shown in Appendix C. The plants will be identified with routed wooden signs with numbers painted in green and the balance of the sign stained or finished with marine grade varnish for reasonable longevity. The signs will be mounted on the trees using zinc dipped or zinc-plated galvanized wood screws to support a wire on the sign. The signs will not be mounted directly on the tree since the trees can grow and break the signs. By mounting the signs loosely, the tree can overgrow the screw to maintain its health and not break the sign. Other plants will be identified by placing the numbered sign in front of the plant of interest. Simple directional signs and "blazes" will be mounted on prominent trees along the shoulder of the trail; the routed wood signs will be used to maintain consistency for the trail.

At least two informational/interpretive signs will be fabricated. One sign will be placed near the trailhead and it will be a fiberglass laminated sign that uses dried leaves from several of the indigenous trees to help Scouts identify the different trees. This sign will be prepared using a sheet of polycarbonate (Plexiglas) as a backing, laying a sheet of fiberglass on it, filling the fiberglass with epoxy, placing the desired dried leaves and labels on the epoxy, spreading another layer of epoxy over the leaves and labels, covering the epoxy with another layer of fiberglass and then infiltrating the fiberglass with epoxy. This sign will then be coated with an ultra-violet (UV) resistant coating like clear marine grade varnish. A second sign will be made identically to this sign but will contain representative animal footprints and photos of animal scat to help the Scouts identify "animal sign". This animal sign informational sign will be placed

near the middle of the trail.

In summary, the trail will be a class 3 trail with some areas of class 2 and some signage consistent with a class 4 trail. The trail will be about a half mile in length and should be traversed in 20 to 40 minutes depending on the length of time spent at each of the stations. The trail will have a natural walking surface. The base will likely be grass, soil, and duff. The trail will be nominally 36 inches in width and edge obstructions, trees, small shrubs, and dead branches will be removed. The trail will be designed and constructed for minimal maintenance.

The trailhead will be identified with a sign and a box filled with trail brochures. The box will be built from dimensional lumber with a Plexiglas front. The top will be hinged and have slope to keep the brochures from getting wet. The brochures will be printed using thermoset ink, e.g., a laser printer, rather than an ink-jet type printer so they will remain readable if they do get wet, since the thermal inks are permanent. The brochures will define the lay of the land, the geography, the indigenous plants and animals, and invasive plants and animals. The draft brochures in Appendices A & B are intended to be center-folded documents with the Cub Scout brochure having four pages, printed on both sides of one sheet of paper (8.5 x 11") and the Boy Scout/Venturing brochure being a total of eight pages printed on two sheets of paper stapled at the center.

Knox Scout Reservation is located in the Piedmont area of Georgia. This area is comprised of igneous and metamorphic rocks. The rocks typical of the piedmont are schist, amphibolite, gneiss, migmatite, quartz, and granite. The white quartz rocks are both subsurface and exposed at the surface (21). These rocks are widely used as firerings in the camp. The

piedmont tends to be hilly rather than mountainous and has lower elevations than the Blue Ridge area of Georgia (22).

The trees are consistent with a second-generation forest. There are both pine trees and hardwoods present in the area in addition to shrubs. There are slash pines, loblolly pines, and some long leaf pines. The most prevalent hardwood trees are dogwoods, black walnut, sweetgum, tulip tree, eastern black oak, southern red oak, post oak, maple, shagbark hickory, southern magnolia, and Carolina holly (23). The trees that are present on the trail will be identified using a numbering system with the identifying information published in the trail brochure. The invasive and noxious species of plants will also be identified. Poison ivy is prevalent in the area and will be identified and characterized.

Animals and animal sign that may be present in the trail area and the general KSR area will be described. Mammals indigenous to KSR include raccoons, beavers, eastern cottontail, fox squirrels, gray squirrels, big-eared bats, skunks, and white tail deer (24, 25). Animal sign, such as tracks and scat will be described in the trail brochure. Pictures of the tracks of several of these animals will be laminated with fiberglass and coated with varnish to show the types of animal sign to look for.

Reptiles that may be seen at KSR are the eastern hellbender, flatwood salamander, gopher frog, Carolina diamond backed terrapin, gopher tortoise, and striped newt. These animals will not likely be seen, with the exception of the green anole, which is quite prevalent. Snakes are also present at KSR, including both venomous and nonvenomous. Pygmy rattlesnake, timber (cane break) rattlesnake, cottonmouth, and eastern coral snakes are representative of the

venomous snakes that may be seen. The list of nonvenomous snakes is larger and includes; eastern green water snake, brown water snake, garter snake, corn snake, rat snake, and black king snake.

The birds that may be observed are the raven, crow, dove, bald eagle, red-cockaded woodpecker, southeastern American kestrel, wild turkey, and golden-winged warbler, as well as blue jays, sparrows, cardinals, and barn swallows. Evidence of these animals, such as scat, prints, nests, resting areas, feathers, etc. will be pointed out and signed as appropriate.

As described above, two brochures are envisioned for KSR, one that is written for Cub Scouts and one that is written for Boy Scouts, Teams, and Venturing. As can be seen in Appendices A and B, the Cub Scout brochure is written at about a third grade level while the other brochure is written at the eighth grade level.

CHAPTER 5

SUMMARY

To educate Scouts and Scouters in the Georgia-Carolina Council about the local flora, fauna, and geology, a nature trail will be constructed at KSR. The KSR nature trail will be constructed east of dining hall field. It will be approximately a half-mile long loop trail that will end near the trailhead. The trail will be constructed using the principles described in this document. In particular the trail will be a class three trail with a tread width of nominally 36 inches so that it will be double wide to allow for a Scout and his buddy to walk side by side. The design surface will be natural grass and soil. Most of the obstructions will be removed to facilitate use. The layout of the trail is on fairly flat land so the design grades will be readily achieved. The design clearing will be seven feet high and the clearing width will be 36 to 60 inches so that the Ranger's golf cart can access the trail. A printed brochure will be available in a box at the trailhead. Trail markers will be used to identify up to ten items of interest on the trail. Items to be identified include indigenous pine trees of the loblolly and longleaf species. Hardwood trees such as hickory, southern magnolia, and various species of oak trees will also be identified. The geology and select rocks will be described and identified in the trail guide brochure. Animal sign and indigenous birds, mammals and reptiles will also be identified. Two informational signs will be created to help Scouts identify trees and animals.

CHAPTER 6

AFTERWORD

I have had a lot of fun and learned a lot about trails. The knowledge I gained will be useful for constructing the trail at KSR. For instance, while hiking rim to rim at the Grand Canyon we traveled on a dual use, mule and pedestrian trail. It was designed for the mules so that when pedestrians used it, the trail step was spaced for the mules. For me, the spacing was about one and half strides. I ended up stepping consistently with one leg as we were going up. The group asked the question about the spacing. We discussed it and figured out why they were spaced that distance. Also, there were areas of erosion along the shoulder of the trail and the trail crew was building a water-diverting culvert. The interaction of the animals with the hikers made it clear that too many people have fed the animals. The squirrels would take food from your hand, if you let them. The deer were also very tame. I was within ten feet of a buck while waiting at one of the stops. The trail had a class five bridge to cross several gorges and the Colorado River. It was interesting also to note the switchbacks; the trail had a 5000-foot drop over about 15 miles, and then was flat on the bottom. The trails were reasonably well marked, even the trail to nowhere.

When I visited Muir Woods, I looked for the characteristics of trails that I learned about. While there, I saw the effect of social trails on the permanent trails. The real trail had steps, while the social trail was immediately adjacent to it and caused increased erosion. In addition, I noted that several of the trails that lead to the beach had been closed for rehabilitation. It was unfortunate since I wanted to take the trail to the beach. It was during my Muir Woods visit that

I saw the trees that were cut to allow passage of the path; it also had the tree that crossed the trail that required the user to duck underneath it. There were also areas of the trail that had continuous obstructions with tree roots and rock being the most common. In another area, a box culvert had been constructed to allow passage of water under the trail. The edge of the trail had been stabilized using the prescribed method of using logs ten inches in diameter or more with the bark stripped, and placed about 2/3 of the way in the ground.

As I said, it has been fun applying what I learned through the research for this project to my hiking experiences.

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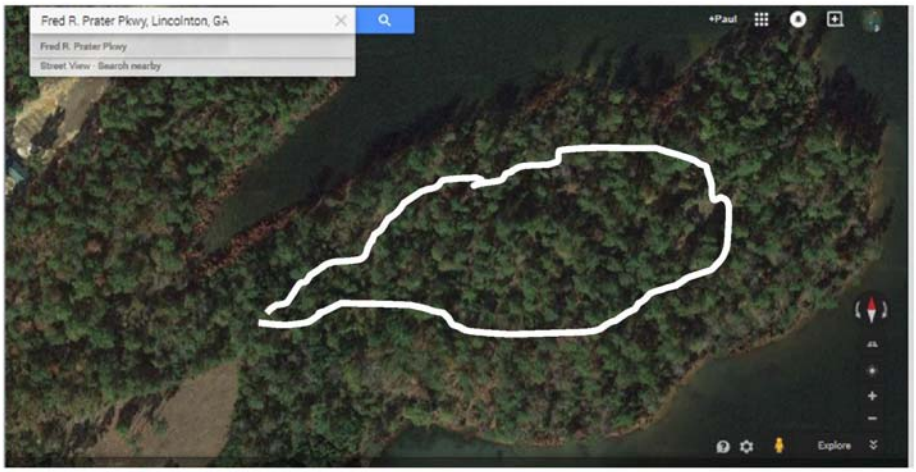
APPENDIX A

CUB SCOUT NATURE TRAIL BROCHURE

The actual version will be formatted as a booklet



KNOX NATURE TRAIL

A HALF-MILE WALK THROUGH THE WOODS

TO LOOK AT THE

PLANTS, ANIMALS, AND ROCKS OF KSR

PREPARED FOR THE COUNCIL CONSERVATION COMMITTEE

BY PAUL KORINKO

WELCOME TO KNOX SCOUT RESERVATION NATURE TRAIL. AS YOU WALK THE TRAIL, LOOK FOR THE FOLLOWING TREES, PLANTS, AND ANIMAL SIGN: LONGLEAF PINE, LOBLOLLY PINE, SOUTHERN MAGNOLIA, WHITE OAK, SWEETGUM, POISON IVY, SQUIRREL'S NEST, ANIMAL TRACKS. .

THERE ARE TWO PINE TREES NATIVE TO THIS AREA: LONGLEAF AND LOBLOLLY PINES. LOBLOLLY PINES HAVE SHORTER PINE NEEDLES COMPARED TO LONGLEAF PINES. LOBLOLLY PINES ALSO HAVE SMALLER PINECONES THAN LONGLEAF. (1, 2).

SEE THE MARKERS AT A AND B FOR THE LONGLEAF AND LOBLOLLY PINES.

THERE ARE ALSO HARDWOOD TREES PREVALENT ON KNOX. THE TREE AT C IS A SOUTHERN MAGNOLIA. MAGNOLIA TREES MAY BE DECIDUOUS OR EVERGREEN. THE SOUTHERN MAGNOLIA

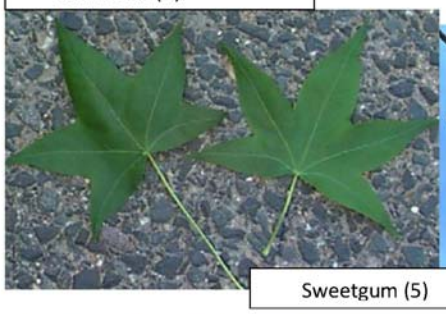
TREE IS AN EVERGREEN TREE AND DOESN'T LOSE ITS LEAVES. THE LEAVES ARE SHINY ON THE TOP AND HAIRY ON THE UNDERSIDE. THE MAGNOLIA TREE HAS SMOOTH BARK. SOUTHERN MAGNOLIAS HAVE WHITE FLOWERS AND LARGE SEEDPODS (3).

Southern magnolia bark, leaves, and flower (3)

White oak (4)

THERE ARE SEVERAL TYPES OF OAK TREES ON KNOX SCOUT RESERVATION. THESE TREES CAN BE IDENTIFIED BY THE SHAPE OF THE NUT AND THE SHAPE OF THE LEAVES. THE TREE AT "D" IS A WHITE OAK. (4).

SWEETGUM TREES CAN BE IDENTIFIED BY THEIR FIVE-POINTED LEAVES AND STRANGE SEEDPODS. THE TREE YOU SEE AT "E" IS A SWEETGUM (5).



Sweetgum (5)

A PLANT THAT IS VERY IMPORTANT TO KNOW ABOUT IS POISON IVY. THERE IS A NICE SPECIMEN AT TREE "G". THE VINE HAS HAIRY LEGS AND LEAVES OF THREE. IT MAY HAVE WHITE BERRIES. WHEN YOU TOUCH IT, IT MAY CAUSE A REACTION. THE REACTION WILL BE VERY ITCHY. IF YOU TOUCH IT, YOU SHOULD WASH WITH WARM SOAPY WATER. DON'T BURN THE DRY VINES. THE OILS CAN BE RELEASED AND MAKE YOUR LUNGS BURN (6).

WEEDS ARE ALSO PREVALENT ON KNOX. FIELD GOLDENROD IS A PRETTY YELLOW FLOWER WEED. THEY BLOOM IN THE FALL. THEY CAN GROW INTO A FOREST OF YELLOW. THEY SPREAD BY ROOTS THAT SHOOT OUT OF THE SIDE (7).

RATTLESNAKE FERNS MAY ALSO BE LOCATED IN THE SHADY AREAS OF THE FOREST. THE LEAVES ARE LIGHT GREEN IN COLOR. THEY ARE BROADLY TRIANGULAR, ABOUT TEN INCHES LONG AND TWELVE INCHES WIDE, AND ARE LACY (8).

Goldenrod (7)

LOOK AROUND ON THE GROUND. YOU MAY SEE SOME ANIMAL TRACKS. LOOK FOR SQUIRREL, RACCOON, RABBIT, AND DEER TRACKS. THE DISPLAY YOU SEE AT "E" SHOWS THE TRACKS OF THESE ANIMALS. KEEP YOUR EYES PEELED TO SEE IF YOU CAN FIND THESE TRACKS ALONG THE TRAIL AND IN OTHER AREAS OF THE CAMP. YOU MAY ALSO WANT TO KEEP AN EYE OUT FOR ANIMAL SCAT. RABBITS MAKE LITTLE PELLETS, DEER MAKE BIGGER PELLETS, AND RACCOON SCAT IS LONGER AND MAY HAVE SEEDS, ETC. PRESENT (9).

Deer tracks (9)

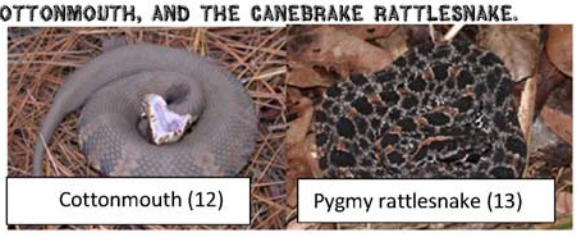
Rattlesnake Fern (8)

THE GRAY AND BLACK (A COLOR PHASE OF THE EASTERN GRAY (10)) SQUIRRELS MAKE NESTS IN THE TREES OUT OF LEAVES. IF YOU LOOK UP, YOU MAY SEE A SQUIRREL'S NEST. THE NESTS LOOK LIKE BIG BUNCHES OF LEAVES. YOU CAN SEE A NEST IN THE TREE AT "F" (11).

YOU MAY ALSO SEE HAWKS, EAGLES, DUCKS, GEESE, BLUE JAYS, BOBWHITE QUAIL, AND OTHER BIRDS FLYING. WHEN YOU LOOK DOWN YOU MIGHT SEE TRACKS FROM THE ANIMALS THAT WERE DESCRIBED ABOVE. LOOK AROUND TO SEE IF YOU CAN SEE ANY DEER TRACKS. THE PICTURE SHOWS HOW YOU CAN GUESS THE AGE OF THE DEER.

Squirrel nest (11)

YOU MAY ALSO SEE REPTILES AND AMPHIBIANS AROUND CAMP. THERE ARE BOTH VENOMOUS AND NON-VENOMOUS SNAKES AS WELL AS SKINKS, LIZARDS, FROGS AND TOADS. THE COMMON NON-VENOMOUS SNAKES YOU MAY SEE ARE THE SCARLET KING SNAKE, SOUTHERN HOGNOSE SNAKE, AND THE BROWN SNAKE. SOME OF THE VENOMOUS SNAKES THAT HAVE BEEN SEEN IN CAMP ARE THE PYGMY RATTLESNAKE, THE COTTONMOUTH, AND THE CANEBRAKE RATTLESNAKE.



Cottonmouth (12)

Pygmy rattlesnake (13)

Hognose (14)

THE GEORGIA PIEDMONT IS COMPRISED OF ROLLING HILLS; PIEDMONT MEANS FOOT OF THE MOUNTAINS. TWO OF THE ROCKS AND MINERALS THAT YOU MIGHT FIND IN THIS AREA ARE QUARTZ AND GRANITE. THE WHITE ROCKS THAT ARE USED FOR MANY OF THE CAMPFIRE RINGS ARE QUARTZ.

GRANITE (15)

QUARTZ (16)

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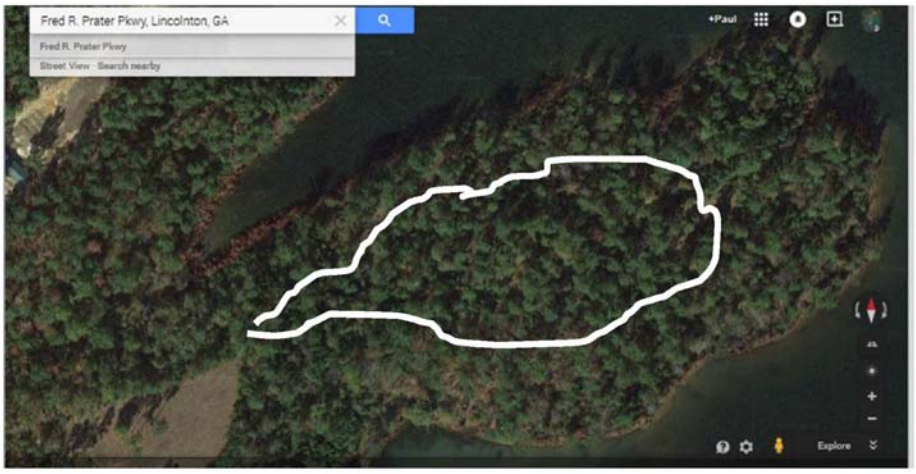
APPENDIX B

BOY SCOUT NATURE TRAIL BROCHURE

The actual version will be formatted as a booklet



KNOX NATURE TRAIL

A HALF-MILE TREK THROUGH THE WOODS

AN EXAMINATION OF THE

FLORA, FAUNA, AND GEOLOGY OF KSR

PREPARED FOR THE COUNCIL CONSERVATION COMMITTEE

BY PAUL KORINKO

1

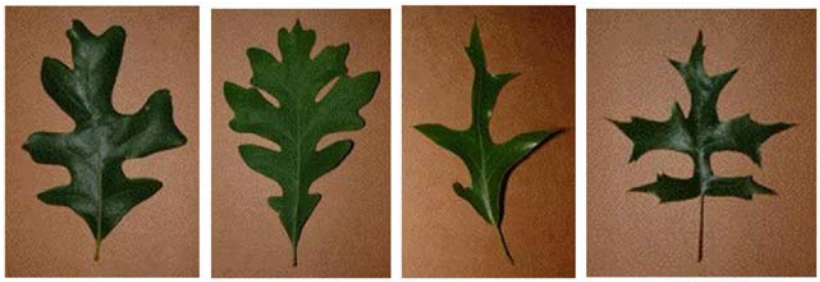
WELCOME TO KNOX SCOUT RESERVATION NATURE TRAIL. AS YOU WALK THE TRAIL, LOOK FOR THE FOLLOWING TREES, PLANTS, AND ANIMAL SIGN: LONGLEAF PINE, LOBLOLLY PINE, SOUTHERN MAGNOLIA, WHITE OAK, SWEETGUM, POISON IVY, SQUIRREL'S NEST, AND ANIMAL TRACKS.

YOU WILL SEE TWO DIFFERENT PINE TREES THAT ARE INDIGENOUS TO THIS AREA. THESE ARE THE LONGLEAF AND THE LOBLOLLY PINE TREES. A COMPARISON OF LONGLEAF AND LOBLOLLY PINES REVEALS SEVERAL DIFFERENCES. THE PINE NEEDLES OF LONGLEAF PINES ARE ABOUT 12 INCHES COMPARED TO 6-8 INCHES FOR THE LOBLOLLY. THE PINECONE SHAPES AND SIZE ARE ALSO DIFFERENT WITH LONGLEAF BEING LARGER THAN LOBLOLLY. IN ADDITION, THE LONGLEAF PINECONES HAVE SMOOTH EDGES BUT LOBLOLLY PINECONES ARE PRICKLY. FINALLY, THE BARK OF EACH TREE IS ALSO DIFFERENT WITH LONGLEAF HAVING A GRAY COLOR AND LONG STRIPS WHICH EXPOSE A BROWN UNDER-LAYER, AND LOBLOLLY BARK BEING GRAY AND HAVING A REGULAR NEARLY RECTANGULAR SHAPES (1, 2).

SEE THE MARKERS AT A AND B FOR THE LONGLEAF AND LOBLOLLY PINES.

THERE ARE ALSO HARDWOOD TREES PREVALENT ON KNOX. THE TREE AT C IS A SOUTHERN MAGNOLIA. MAGNOLIA TREES MAY BE DECIDUOUS OR EVERGREEN. THE SOUTHERN MAGNOLIA TREE IS AN EVERGREEN TREE AND DOESN'T LOSE ITS LEAVES. THE LEAVES ARE SHINY ON THE TOP AND HAIRY ON THE UNDERSIDE. THE MAGNOLIA TREE HAS SMOOTH BARK. SOUTHERN MAGNOLIAS HAVE WHITE FLOWERS AND LARGE SEEDPODS (3).

THERE ARE MANY TYPES OF OAK TREES ON KNOX SCOUT RESERVATION. THESE TREES CAN BE IDENTIFIED BY THE SHAPE OF THE NUT (ACORN) AND THE SHAPE OF THE LEAVES. SEE IF YOU CAN DETERMINE THE TYPE OF OAK TREE BASED ON THE LEAVES, NUTS, AND BARK. THE LEAVES ARE SHARP, THE NUTS HAVE CAPS ON THE TOP, AND THE BARK IS GRAY WITH DEEP GROOVES AND RIDGES. BASED ON THESE CHARACTERISTICS AND THE PICTURES OF THE LEAVES AND DESCRIPTION, WHAT IS THE TREE AT "D" (4)?



POST OAK WHITE OAK RED OAK PIN OAK

IF YOU GUESSED WHITE OAK, YOU ARE RIGHT.

SWEETGUM TREES CAN BE IDENTIFIED BY THEIR FIVE-POINTED LEAVES AND STRANGE SEEDPODS. THE TREE YOU SEE AT G IS A SWEETGUM (5).

A PLANT THAT IS VERY IMPORTANT TO KNOW ABOUT IS POISON IVY. THERE IS A NICE SPECIMEN AT TREE "G". THE VINE HAS HAIRY LEGS AND LEAVES OF THREE. IT CAN HAVE WHITE BERRIES. IT WILL GENERALLY CAUSE A SKIN REACTION WITH BUMPS AND PUSS PIMPLES. THE REACTION IS VERY ITCHY. IF YOU GET IT ON YOU, WASH WITH WARM SOAPY WATER IMMEDIATELY TO MINIMIZE THE REACTION. ALSO, DON'T BURN POISON IVY SINCE THE OILS CAN BE RELEASED AND CAUSE IRRITATION IN THE LUNGS (6).

WEEDS ARE ALSO PREVALENT ON KNOX AND SEVERAL OF THEM THAT ARE MORE COLORFUL ARE THE FIELD GOLDENROD. IT HAS DENSE YELLOW COLORED FLOWERS THAT ARE PLUME LIKE AND THEY BLOOM IN THE FALL. THEY CAN GROW INTO A FOREST OF YELLOW AND ARE RHIZOMATOUS; IT SPREADS BY ROOTS THAT SHOOT OUT OF THE SIDE TO CREATE NEW PLANTS (7).

3

Yellow Star

RATTLESNAKE FERNS MAY ALSO BE LOCATED IN THE SHADY AREAS OF THE FOREST. THE LEAVES ARE LIGHT GREEN IN COLOR. THEY ARE BROADLY TRIANGULAR, ABOUT TEN INCHES LONG AND TWE LVE INCHES WIDE, AND ARE LACY. THEY PROPAGATE BY FORMING A FERTILE FROND THAT ARISES FROM THE BASE OF THE LEAF AND IT HAS MANY SPHERICAL, BRIGHT YELLOW SPORES. THESE FRONDS APPEAR IN EARLY SUMMER AND WITHER AS SOON AS THE SPORES ARE RELEASED. FERNS DO WELL IN SHADY AREAS AND WILL WITHER AND DIE IN THE SUN (8).

Rattlesnake Fern

Deer scat

Rabbit scat

Golden Rod

YELLOW STAR GRASS IS ONE OF THE LONGEST BLOOMING WILDFLOWERS IN GEORGIA. IT SPREADS BY CORMS, OR BULBO-TUBER, A SHORT SWOLLEN UNDERGROUND PLANT STEM THAT SERVES AS A FOOD STORAGE ORGAN (9). IT ALSO SELF-SEEDS CLOSE TO THE PARENT PLANT AND MAKES A NICE GROUND COVER. IT HAS A HAIRY, GRASS-LIKE LEAF. THE FRUITS ARE ELLIPTIC CAPSULES WITH ROUND BLACK SEEDS (10).

LOOK AROUND ON THE GROUND. YOU MAY SEE SOME ANIMAL TRACKS. LOOK FOR SQUIRREL, RACCOON, RABBIT, AND DEER TRACKS. THE DISPLAY YOU SEE AT "E" SHOWS THE TRACKS OF THESE ANIMALS. KEEP YOUR EYES PEELED TO SEE IF YOU CAN FIND THESE TRACKS ALONG THE TRAIL AND IN OTHER AREAS OF THE CAMP. YOU MAY ALSO WANT TO KEEP AN

EYE OUT FOR ANIMAL SCAT. RABBITS MAKE LITTLE PELLETS, DEER MAKE BIGGER PELLETS, AND RACCOON SCAT IS LONGER AND MAY HAVE SEEDS, ETC. PRESENT.

RABBIT AND DEER SCAT ARE BOTH PELLETS. SEE IF YOU CAN IDENTIFY THEM BASED ON THESE PHOTOS. DEER SCAT TENDS TO BE NEARLY BLACK. THE RABBIT SCAT IS LIGHTER BROWN AND ROUNDER. RABBITS MAY ALSO PRODUCE GREEN SCAT. THIS IS MATERIALS THAT ARE ONLY PARTIALLY DIGESTED AND PRODUCED WHEN THE RABBITS MAY BE SPOOKED AND DO NOT HAVE ENOUGH TIME TO FINISH EATING SO THEY PRODUCE THE SCAT AND COME BACK AT A LATER TIME AND EAT IT (11).

OTHER SCAT THAT MAY BE FOUND IS BEAVER, RACCOON, AND SQUIRREL.

RACCOON (12)

SQUIRREL (13)

BEAVER (14)

THE GRAY AND BLACK (A COLOR PHASE OF THE EASTERN GRAY(15)) SQUIRRELS MAKE NESTS IN THE TREES OUT OF LEAVES. IF YOU LOOK UP, YOU MAY SEE A SQUIRREL'S NEST. THE NESTS LOOK LIKE BIG BUNCHES OF LEAVES. YOU CAN SEE A NEST IN THE TREE AT "F" (16).

YOU MAY ALSO SEE HAWKS, EAGLES, DUCKS, GEESE, BLUE JAYS, BOBWHITE QUAIL, AND OTHER BIRDS FLYING.

WHEN YOU LOOK DOWN YOU MIGHT SEE TRACKS FROM THE ANIMALS THAT WERE DESCRIBED ABOVE. LOOK AROUND TO SEE IF YOU CAN SEE TRACKS THAT LOOK LIKE ANY OF THE FOLLOWING:

DEER (17)

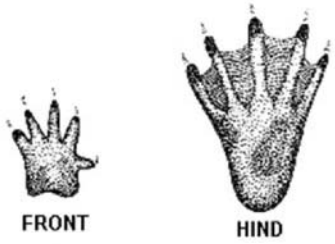
STRIPED SKUNK (18)

TURKEY (19)

COTTONTAIL RABBIT (20)

GRAY SQUIRREL (21)

BOBWHITE



BEAVER (22)

YOU MAY ALSO SEE REPTILES AND AMPHIBIANS AROUND CAMP. THERE ARE BOTH VENOMOUS AND NON-VENOMOUS SNAKES AS WELL AS SKINKS, LIZARDS, FROGS AND TOADS. THE COMMON NON-VENOMOUS SNAKES YOU MAY SEE ARE THE SCARLET KINGSNAKE, SOUTHERN HOGNOSE SNAKE, AND THE BROWN SNAKE. SOME OF THE VENOMOUS SNAKES THAT HAVE BEEN SEEN ON CAMP ARE THE PYGMY RATTLESNAKE, THE COTTONMOUTH, AND THE CANEBRAKE RATTLESNAKE.

Brown Snake (23)

Hognose Snake (24)

Pygmy Rattlesnake (25)

Canebrake Rattlesnake (26)

Cottonmouth (27)

Scarlet kingsnake (29)

THE GEORGIA PIEDMONT IS COMPRISED OF ROLLING HILLS; PIEDMONT MEANS FOOT OF THE MOUNTAINS. TWO OF THE ROCKS AND MINERALS THAT YOU MIGHT FIND IN THIS AREA ARE QUARTZ AND GRANITE. THE WHITE ROCKS THAT ARE USED FOR MANY OF THE CAMPFIRE RINGS ARE QUARTZ.

Granite (29)

Quartz (30)

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APPENDIX C

USFS TRAIL CLASSES PHOTOS

(from reference 6)

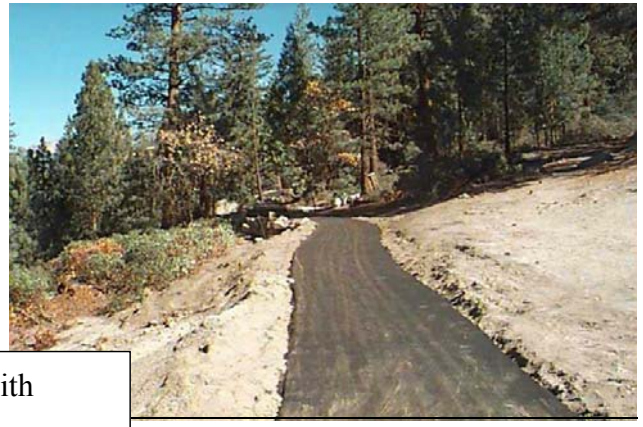
Tread

TC1 – Tread intermittent and indistinct.

TC2 – Tread discernible and continuous, but narrow and rough.

TC3 – Tread obvious and continuous.

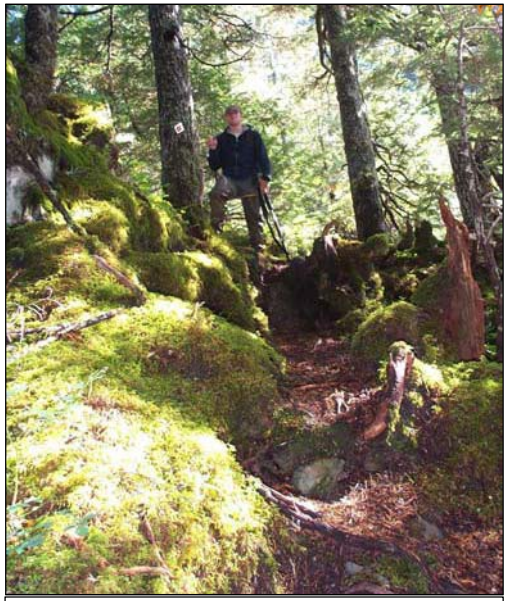
TC4 –Tread wide and relatively smooth with few irregularities.



TC5 – Tread commonly hardened with asphalt or other imported material.

Obstacles

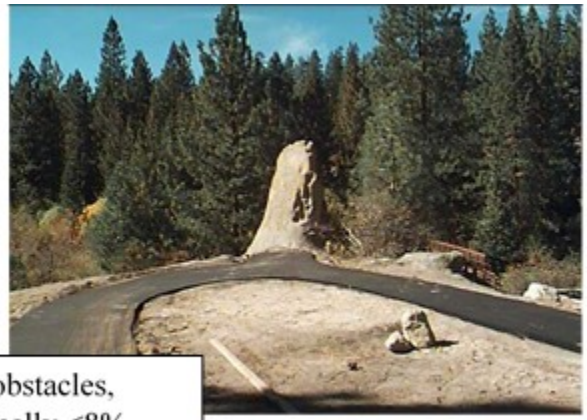
TC1 – Obstacles continuous



TC2 – Obstacles occasionally present. Blockages cleared to define route and protect resource.

TC3 – Obstacles infrequent. Vegetation cleared outside of trail way.

TC4 – Few or no obstacles exist, grades typically <12%, vegetation cleared outside of trailway.



TC5 – No obstacles, grades typically <8%.

Constructed Features:

TC1 –Constructed features minimal to non-existent unless safety or route finding.

TC2 – Structures are of limited size, scale, and numbers.

TC3 – Trail structures (walls, steps drainage, raised trail) may be common and substantial.

TC4 – Structures frequent and substantial. Substantial trail bridges are appropriate at water crossings.

TC5 –Structures frequent or continuous; may include curbs, handrails, trailside amenities, and boardwalks.

Signs

TC1 –No destination signs present, limited to regulation, junction, and resource protection, minimum required.

TC2 – Signs minimum required for basic direction, generally limited to regulation and resource protection.

TC3 – Directional signs at junctions or when confusion is likely.

TC4 – Wide variety of signs likely present, informational signs likely, interpretive signs possible.

TC5: – Wide variety of signage is present, information and interpretive signs likely.

Typical Rec. Environment / Experience

TC1 –Recreation environment natural, unmodified.

TC2 – Recreation environment natural, essentially unmodified.

TC3 –Recreation environment natural, primarily unmodified

TC4 –Recreation environment may be modified.

TC5 –Recreation environment can be highly modified.

APPENDIX D

DESIGN PARAMETERS AND DEFINITIONS

(From references 4, 7, 10, and 11)

Design Parameters (FSH 2309.18, sec. 14.5) (7, 10)
Technical guidelines for the survey, design, construction, maintenance, and assessment of a trail, based on its Designed Use and Trail Class.

Design Parameters reflect the design objectives for NFS trails and determine the dominant physical criteria that most define their geometric shape. These criteria include:

Design Tread Width: Design Tread Width is expressed in terms of single lane, double lane, and the minimum tread width on trail structures.

Design Surface: Design Surface is expressed in terms of surface type, protrusions, and obstacles.

Design Grade: Design Grade is expressed in terms of Target Grade, Short Pitch Maximum Grade, and Maximum Pitch Density.

Design Cross Slope: Design Cross Slope is expressed in terms of Target Cross Slope and Maximum Cross Slope.

Design Clearing: Design Clearing is expressed in terms of width, height, and shoulder clearance.

Design Turns: Design Turns are expressed in terms of the turning radius.

Design Parameter Terminology: A few sketches of trail design conditions, criteria, and concepts are shown in Figures 1-4 (10).

Clearing Limit: The area over and beside the trail tread that is cleared of trees, limbs, and other obstructions.

Clearing Height: The height of the clearing limit measured vertically from the trail tread.

Clearing Width: The width of the clearing limit measured perpendicular to the trail.

Cross Slope: The percentage of rise to length when measuring the trail tread from edge to edge perpendicular to the direction of travel.

Design Clearing: The clearing limit determined to be appropriate to accommodate the Managed Uses of a trail.

Design Clearing Height: The minimum clearing height determined to be appropriate to accommodate the Managed Uses of a trail.

Design Clearing Width: The minimum clearing width determined to be appropriate to accommodate the Managed Uses of a trail.

Design Shoulder Clearance: The minimum horizontal and vertical clearance of obstructions (for example, removal of bicycle pedal or motorcycle peg bumpers) immediately adjacent to the trail tread that is determined to be appropriate to accommodate the Managed Uses of a trail.

Design Cross Slope: The cross slope determined to be appropriate to accommodate the Managed Uses of a trail.

Target Cross Slope: The cross slope that is determined to be appropriate over most of a trail to accommodate its Managed Uses.

Maximum Cross Slope: The steepest cross slope that is determined to be appropriate based on the Managed Uses of a trail and that exceeds the target cross slope of the trail.

Design Grade: The trail grade determined to be appropriate to accommodate the Managed Uses of a trail.

Target Grade: The trail grade that is determined to be appropriate over most of a trail to accommodate its Managed Uses.

Short Pitch Maximum: The steepest grade that is determined to be appropriate based on the Managed Uses of a trail, that generally occurs for a distance of no more than 200 feet, and that does not exceed the maximum pitch density.

Maximum Pitch Density: The maximum percentage of a trail with grades that exceed the Target Grade and that are less than or equal to the short pitch maximum, which is determined to be appropriate based on the Managed Uses of the trail.

Design Surface: The trail tread surface, defined in terms of surface type, surface protrusions, and surface obstacles, that is determined to be appropriate to accommodate the Managed Uses of a trail.

Surface Type: A characteristic of the design surface expressed in terms of material type, grading, compaction, and roughness of the trail tread.

Native: A surface composed of soil, rock or other naturally occurring materials found on or near the trail.

Firm: A surface that is not noticeably distorted or compressed during the seasons for which it is managed, under normally occurring weather conditions, by the passage of a device that simulates a trail user in a wheelchair.

Stable: A surface that is not permanently affected by normally occurring weather conditions and able to sustain normal wear and tear caused by the uses for which the trail is managed between planned maintenance cycles.

Surface Protrusions: Trail tread imperfections, such as rock, roots, holes, stumps, steps, and

structures, that are within the acceptable range of tread roughness and challenge level for the trail and that do not obstruct the Managed Uses of the trail.

Surface Obstacles: Trail tread imperfections, such as rocks, roots, holes, stumps, steps, downed logs, and structures, that are beyond the acceptable range of tread roughness and challenge level for the trail and that obstruct one or more Managed Uses of the trail.

Design Tread Width: The tread width determined to be appropriate to accommodate the Managed Uses of a trail.

Design Turn Radius: The minimum horizontal radius required for a Managed Use to negotiate a curve (for example, a switchback, climbing turn, or horizontal turn) in a single maneuver.

Designed Use: The Managed Use of a trail that requires the most demanding design, construction, and maintenance parameters and that, in conjunction with the applicable Trail Class, determines which Design Parameters will apply to a trail.

Trail Grade: The ascent or descent of a trail segment expressed as a percentage of its length.

The impact of trails on soil and the tread are defined below:

Compaction (4): The downward force that compresses soil caused by trail use.

Heavier modes of travel and higher amounts of trail use cause greater compaction.
Some compaction is desirable to harden tread and reduce displacement, but
Highly compacted soils cause trail tread to sink, reducing natural infiltration and the ability for soils to drain.

Displacement: The sideways movement of soils caused by inevitable kicking, grinding, and acceleration of feet, hooves and wheels.

Amount of displacement is a function of grade and force exerted on tread.
The steeper the grade the faster soil particles move downhill.
Displacement tends to increase erosion by loosening soil particles.
Reduce displacement by limiting trail grade or modes of travel.

Erosion: The movement of soil caused by the forces of water or sometimes wind moving with enough force to transport soil particles. Erosion is a natural process, so expect it and learn how to accommodate it.

Grade: The slope of the trail. Measured as a percentage, it is the rise of the trail divided by the horizontal distance of that rise.

Percent grade formula = rise over run multiplied by 100.
The steeper the grade, the more likely it is to erode.
Avoid the shortest route down a hill (fall line) and flat areas that do not drain.
Generally, average trail grade of 10% or less is most sustainable.
Half rule – a trail's grade should not exceed half the grade of the side slope that the trail traverses. *For example if the side slope is 30% the trail grade should not exceed 15%.*

Trails (11): Trails are designated, marked and signed routes that people use recreationally for such activities as walking, running, hiking, biking, horseback riding, off-highway vehicle use, snowmobile riding, cross-country skiing and snowshoeing. Other special uses include wheelchairs or similar "mobility devices," carriages, dogsleds, and in-line skaters. Trails may or may not serve other, non-recreational forest purposes such as forest management, fire control, and emergency access. Other special types of trails include accessible trails, water trails, historic trails, educational, or interpretive trails.

Trail System: A Trail System is the sum of all of the recreationally used, designated, and marked routes in and connecting to a continuous area - park, forest, reservation or management unit. Trail systems are usually managed cohesively.

Trail Corridor: A Trail Corridor contains the traveled pathway (tread), and surrounding land that protects and enhances the trail experience. Trail Corridors are often associated with long-distance trails traveling through diverse landscapes and multiple landowners. For example, the Appalachian Trail, a long-distance trail of 2174 miles that traverses the peaks and valleys from Georgia to Maine, is protected by a corridor with an average of 500 feet on each side. This corridor protects the footpath as well as the natural setting of the trail experience.

Tread Watershed: The trail tread between a local high point (crest) and local low point (dip), plus the land area that drains into this tread segment.

Tread watershed is a function of topography and location of trail on the landscape.
The larger the tread watershed, the more water it collects from rain or snow and the greater potential for erosion.
Small tread watersheds help limit how much water reaches and stays on the trail.
Design trails to reduce the length of the tread watershed – take advantage of rolling contours and build in grade reversals.

Tread Texture: The composition of soil, rock and other tread materials.

Knowing tread texture helps you to predict how a tread accommodates physical forces in wet and dry conditions.
The most erosion-resistant treads have a well-compacted mix of all textures including gravel and larger particles.
The more soil separates (clay, silt, sand, loam, gravel, stones…) the tread has, the stronger it is.

Tread Width: The cleared traveled surface.

Varies depending on trail types and allowed uses.
On multi-use trails, clear tread for maximum width standard.
However, the wider the tread, the more surface exposure and potential to generate run-off and tread erosion.

The following definitions are drawn generally from the USDA Forest Service Trail Planning and Management Fundamentals (See Table 1 and Appendix C).

Trail Type: Is the fundamental trail category (only one per trail segment) that indicates the predominant trail surface or trail foundation, and the general mode of travel.

Four fundamental trail types within DCR include:

Standard Natural Surface Trail: The predominant surface is ground, and the trail is designed and managed for ground-based travel.

Paved Surface Trail: The surface is paved, and the trail design and managed for multiple uses including mechanized wheeled uses. (This type is added to the Forest Service definitions).

Snow Trail: The foundation is snow, and the trail is designed and managed for snow-based travel.

Water Trail: The foundation is water, and the trail is designed and managed for water-based trail use. There may be portage segments of water trails.

The DCR Road and Trail Inventory classified roads / trails along the following types:

Administrative Road: A road accessible to DCR administrative vehicles, but not open to the public.

Additional definitions of soils characteristics of soils for trails that may be built near waterways and wetlands follow (11)

Bedrock: The solid rock that lies under the soil or that is exposed at the surface as trail ledges.

Geotextile: Water permeable textile material (fabrics, etc.) used as an underlay to conserve gravel on trails and stabilize erodible surfaces. Textile allows for water to pass through it but keeps soil layers from mixing and breaking down.

Hardpan: A hardened or cemented soil layer that contains soil consisting of sand, loam, or clay and can be cemented by iron oxide, silica, calcium carbonate, or other substances. A hardpan layer prevents precipitation from draining through the soil layers.

Hydric Soil: Soil that is saturated or flooded during a sufficient portion of the growing season to develop anaerobic conditions in the upper soil layers.

Hydrology: The science dealing with the properties, distribution, and circulation of water on the surface of the land, in the soil, and below the ground surface in the underlying rocks, and in the atmosphere. Commonly used to describe the distribution and circulation of water in a particular area.

Peat: Unconsolidated material, largely undecomposed organic matter, mostly sphagnum mosses, that have accumulated due to continued saturation.

Rill: A steep-sided channel resulting from accelerated erosion in unstable soils.

Sheet erosion: The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff.

Vernal pool: A seasonal pool, usually occurring as a result of spring rains or snow melts, which provides crucial breeding habitat to some species of wildlife, such as wood frogs, spotted salamanders, fairy shrimp, and fingernail clams. Vernal pools dry up in the summer, but may still be identified as small topographical depressions with or without vegetation.

Channel: A waterway that contains moving water either periodically or continuously. A channel has a definite bed and banks that confine the water.

Riprap: A layer of large, durable materials (usually rocks) used to protect a stream bank or lake shore from erosion; may also refer to the materials used.

Runoff: The part of precipitation and snowmelt that reaches streams by flowing over the ground.

Sediment: Fragments of rock, soil, and organic material transported and deposited by water, wind, or other natural phenomena. The term can refer to any size of particles but often refers to fragments smaller than 6mm.

Angle of Repose: The maximum slope or angle at which a material, such as soil or loose rock, remains stable.

Berm: A low earth ledge constructed at the side of a road or trail to divert the direction of flowing water.

Trail Fundamentals: The five concepts that are the cornerstones of Forest Service trail management include Trail Type, Trail Class, Managed Use, Designed Use, and Design Parameters (12, 13).

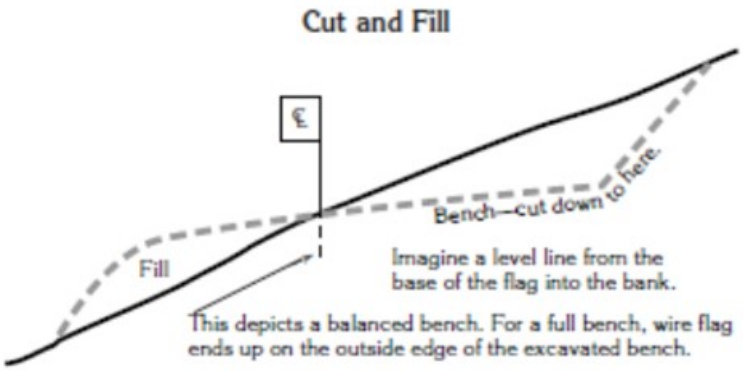


Figure 6. Design of a tread on a cross slope that requires cut-in and fill (10, 14).

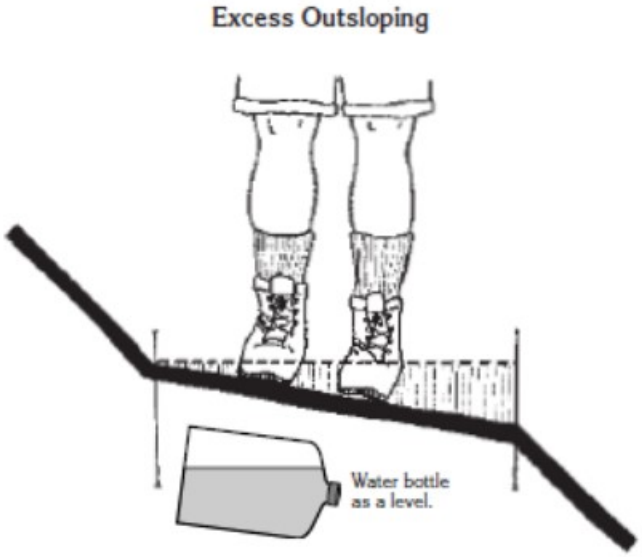


Figure 7. A tread that was improperlyexecuted with excess outsloping which promotes ankle rolling and excess erosion (10, 14).

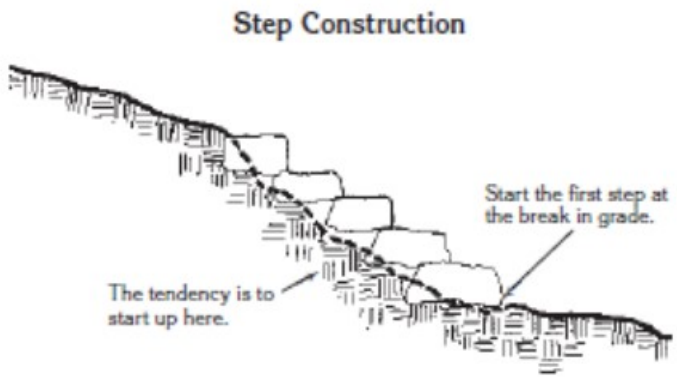


Figure 8. Step design for long durability (10, 14).

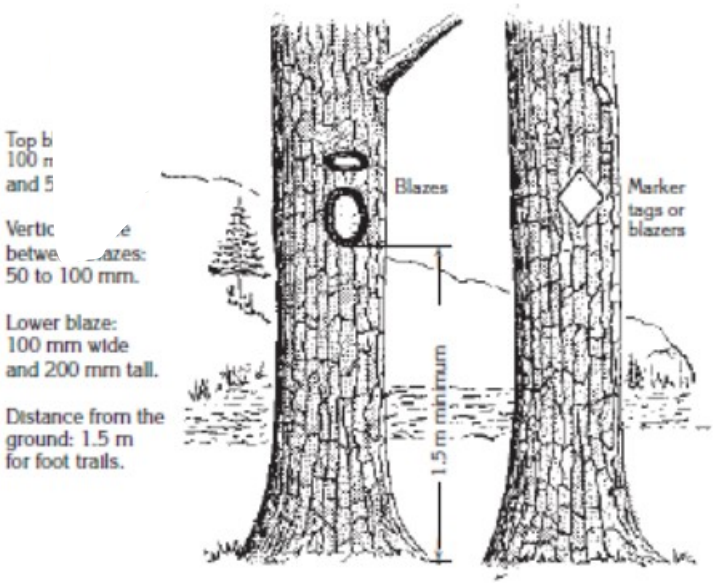


Figure 9. Methods for marking trails using blazes (10).

APPENDIX E

CONSIDERATIONS FOR DESIGNING TRAILS WITH ANIMALS IN MIND

(From reference 16)

Designing Trails with Animals in Mind Checklist
(Condensed from reference 16)

A. Getting the whole picture

1. Including wildlife in the trail vision

Look at the broader landscape. What opportunities or constraints are there for trails and wildlife in the broader landscape? What plans are there for other trails or wildlife across the landscape? In general, what kinds of landscapes would the trail pass through? Would any be areas that currently have no trails and little human modification? Do you foresee any cumulative trail impacts by adding a new trail?

2. Organizing & communicating

Create a profile of the kinds of users who are likely to use the trail. What are likely levels and seasons of use? Are there organizations that would be interested in the trail project? Would any help monitor the trail area for wildlife issues?

Identify the groups interested in wildlife in your trail area. What wildlife and conservation organizations would be interested to know of your trail project? Would any help monitor the trail area for wildlife issues?

3. Researching and inventorying

Determine the physical extent of the project. Over what area might the trail extend? What elevational ranges?

Conduct a preliminary biological inventory. What are the area's sensitive plants, animals, and wildlife habitats? Are there any special opportunities for wildlife education? How impacted already are wildlife in the area? How much modified is the area—is it urban, suburban, agricultural, pristine?

Determine the habitat/ecosystem types presents in the area of the proposed trail and the potential species or communities of special concern.

Identify important plants in the area. Are there any sensitive plant species or communities in the area? Are there ways to present these communities to trail users without disturbing sensitive species?

Evaluate the extent of existing impacts to wildlife and the landscape. What are the existing impacts to wildlife? How much have humans already modified the area? Is the area primarily natural, managed, cultivated, suburban, or urban? Will the trail provide access to backcountry or areas that have never had trails before? How can you minimize the trail's contribution to habitat fragmentation?

B. Considering alternative alignments

1. Preparing and evaluating alternatives

Create distinctive alternative plans. With this handbook's rules of thumb (Reference 19) as a guide, develop alternative plans that maximize the opportunities and minimize the constraints for wildlife. Especially look for opportunities to coordinate the restoration of degraded habitats.

Get professional help preparing and evaluating alternatives, if possible. Where an existing trail is to be improved, alternatives might include different management strategies.

2. Designing the trail

Refine the selected plan. Develop site designs, budgets, and timetables.

Develop management strategies. Consider how the trail will be managed, maintained, and monitored.

C. Building and managing the trail

1. Acquiring and constructing the trail

Look for opportunities for complementary conservation. In acquiring the land needed for the trail, look for additional areas that can be set aside for wildlife conservation at the same time and for the partners to implement such efforts.

Implement the plan. Be careful to impact wildlife as little as possible during construction.

2. Monitoring and managing the trail

Manage the trail. Implement the plan to manage the trail corridor and activities within it.

Monitor. Using staff or volunteers, monitor the important plants and wildlife of the alignment, looking for impacts. Adjust management plans as appropriate.