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Trail Design Issues in Environmentally Sensitive Areas

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Compaction of trail tread leads to trenching, erosion and root exposure over time.
-National Park Service Photo

Key Concepts

-Selecting the best route.
-The best types of soils.
-Structures employed to lessen impact.
-Types of recreation engaged in along the trail.
-Impact on wildlife and vegetation.
-Design in various environments.

Introduction

When constructing and designing trails, there are many issues that need to be addressed. To ensure that the design issues do not generate irreversible damage, contemplation of several key issues is imperative before construction begins. The type of recreation, season of use, size of user groups, wildlife needs, vegetation, rare and endangered species, acceptable grades, types of soils and selecting the best route must all be taken into consideration.

When designing a trail for recreational use, there are few universal standards to follow, resulting in a wide variety of trail construction methods. On the other hand, there are general guidelines and handbooks that discuss the best methods for trail building and maintenance. The problem that arises when following guidelines and handbooks is that each environment has specialized needs. The terrain each trail covers often requires certain materials and methods that are not appropriate elsewhere.

Design Issues

One of the first steps in designing a trail for recreational use is to consider the **landscape** the trail crosses. While surveying the landscape one should make note of any sensitive areas, special attributes, and resources that would be of interest to the user. Sensitive areas should be avoided when laying out the trail, if at all possible. The trail designers will want to create a trail that connects scenic overlooks, historic landmarks and other interesting aspects or features on the surrounding landscape. The resources of an area should also be taken into consideration, since the construction of any structures should feature the region's resources to blend into its surroundings.

Before planning a trail, an extensive survey of the area the trail will negotiate is necessary to determine whether any existing features or portions of trails can be used. This will cut down on the cost and work involved in designing a new trail segment. Once the trail has been layed out, consideration must be given to any fragile or environmentally sensitive area so that the environment and wildlife habitat is not disrupted by recreationists. When designing a trail one must always remember that various environments require distinct methods and resources when designing a trail and that the purpose for which the trail was intended should also be a factor in trail design.

Another point to consider is **pre-existing trails, trailheads and campsites**. To minimize additional impact to vegetation and wildlife habitats, trails should capitalize upon existing features, thus creating less disturbance. When existing structures and rights-of-way are not available, durable sites should be used to minimize on the destruction of fragile environments.

There are various environments that require different approaches in design issues in order to compensate for the lack of materials in the surrounding areas. When building trails in **desert regions**, the impact can be severe and long lasting because the trail tread is constantly shifting and erosion occurs regularly, causing difficulty in vegetative growth. Desert vegetation is sturdy, but once damaged, recovers slowly. Trail use should be concentrated on playas, because they are generally located at the bottom of desert basins and are sometimes temporarily covered with water, causing little vegetation to grow there. Trails are difficult to maintain because of the shifting sands and erosive quality of the soil. Boardwalks and treadways are two structures that may be used in desert regions, if the materials for construction are available. When hiking in desert areas, concentrate use on playas and slickrock and avoid traveling through vegetated areas whenever possible.

One of the least sensitive areas for recreationists is along the beaches of **seashores**, because of the constant revitalizing effect of the wind and waves. When traveling along seashores, remember to avoid dune areas and nesting birds, since exposure of eggs to heat or cold may result in chick mortality. If there is a fragile wetland area to be avoided, then bog bridges may be constructed to prevent the user from impacting the environment to a greater degree than necessary.

Winter use may adversely impact wildlife more than vegetation. Animals employ more energy in the winter than during all other seasons. When humans encounter wildlife, needless energy is taken up to flee and find a new food source, which may result in death. It is imperative for wildlife existence that humans not approach them too closely and that if they appear restless, to retreat immediately to avoid harassing them.

The most fragile of all environments is the **alpine and arctic tundra**. Cold climates sustain damaging impact (hence a longer recovery time), since the growing season is so short. The shortage of brush and tree cover makes backcountry travel easier, therefore, more users venture off trails, trampling precious vegetation. It is best to travel along streambeds to avoid causing the maximum amount of damage due to trampling. Damage to alpine areas is often irreversible and the cost of trail repair is very expensive. Instituting well blazed trails and educating the public about the importance of remaining along marked trails by placing information at the trailheads are some precautionary methods to reduce impact in environmentally sensitive areas.

Impact to vegetation caused by human use in an alpine zone.

-William E. Hammitt
(Wildland Recreation, p. 58)

Wildlife habitats should also play an important role in design issues, especially when trails are constructed through feeding and nesting sites. The removal of small shrubs and hazardous trees for the convenience of the user often obliterates sources of food and shelter for birds and other small animals. It has been documented that eagles and waterfowl will not return to feeding sites until several hours after all humans have left the area (if they return at all).

Selecting the best route for a trail involves the incorporation of various elements to enable a trail to sustain the amount of use anticipated without causing any undue strain to the trail or its resources. The trail should blend into its natural surroundings to provide an aesthetic value for the user and minimize adverse impacts. A trail should avoid areas in which the environment and wildlife will be threatened by continual use from recreationists.

The **texture of soils** is important in preventing erosion of the trail tread and for allowing minimal amounts of compaction to occur. Soils in which there is a mixture of sands, clays, and silt will withstand compaction and erosion effectively. It is important for soils to consist of a variety of different grain sizes to impede the effects of trail erosion. Moderately sandy soils are generally the best for trails, while clays are considered the worst

Soil compaction causes an inhibition of root penetration, which will lead to the absence of germination of new plants and no new growth. Compaction often leads to the exposure of tree roots, which is a common occurrence on trails. Once the tree roots are exposed, trees become more vulnerable to wind throw.

When selecting a location for a future trail, **soil composition** should be a major factor in determining the path and, consequently, the durability of a trail. Soil wetness, texture, structure and depth are all important components in ascertaining the best site for a trail. Because most areas do not offer the perfect balance of soil moisture, texture and depth, soils consisting of a mixture of soil types and those that are not easily compacted are the most desirable.

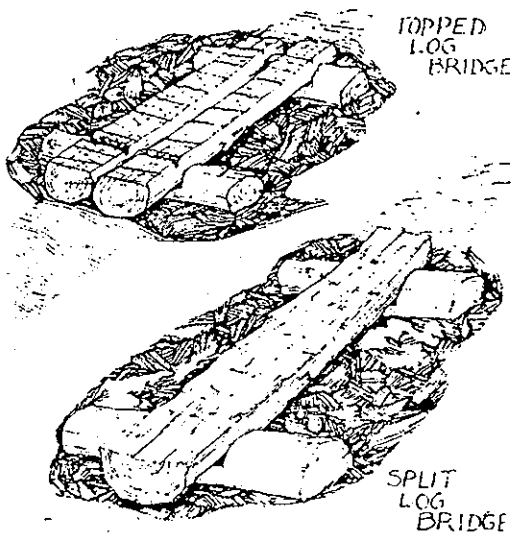
Soil wetness is generally caused by poor drainage and/or a high organic content and is a poor indication of a suitable site. A surveyor should look for homogeneous coloring throughout the subsurface soil, this is a good indication that drainage conditions are present. Another aspect of good drainage can be noted in reddish-brown soils, which are composed of a high mineral content and generally indicative of a proficient amount of porosity in the soil, allowing water and air to move freely.

Even with a durable trail tread, erosion and compaction will occur on frequently used trails over time. **Hikers** tend to widen trails, as well as create braided trails while attempting to avoid muddy areas and by not hiking single file. Hiking also causes compaction of the trail and can lead to the formation of trenches, that might expose roots. Many of these problems can be alleviated by being conscientious about where you hike and remaining on the trail.

Compaction is not the only threat to root exposure, **stock use** along trails is also a menace to root exposure as well as erosion. Shod hooves have a tendency to loosen soil, causing it to become more prone to erosion. Poorly built equestrian trails can develop into deep and narrow trenches which widen over time. Users should refrain from riding on trails when they are wet or muddy to help prevent erosion that may develop into trenches. The surrounding vegetation is also effected by stock use, because of their need to graze. Recreationists sometimes tie their stock to a nearby tree off the trail causing the hooves to expose roots and eventually erode them to the point that the tree is susceptible to wind fall.

Mountain biking often causes similar impacts as those resulting from hiking and stock use. Biking trails have different guidelines than those for hiking. Switchbacks, steps, and wood and rock waterbars are generally not employed because they tend to promote off-trail use. Mountain bikes, like stock, loosen the soil causing erosion to occur. Over time biking trails may also develop into trenches causing the deterioration of the surrounding vegetation.

Once a path has been marked, environmentally sensitive areas must be noted so that they can be dealt with using a variety of solutions, including bridges, stepping stones, waterbars and switchbacks. Most of these solutions are helpful in eliminating wet areas along the trail and also help in the prevention of erosion along sensitive areas.



(Trail Building and Maintenance, p. 117)

The type of bridge being employed is dependent on the type of traffic the trail will support. **Bog bridges**, used primarily for foot traffic, are constructed in areas where there is a limited amount of rock and are used to form a stable treadway to cross small streams and gullies. There are three types of bridges commonly used for foot traffic; topped log, split log, and bridge stringers. **Topped log** bridges are the most durable and therefore are more unaffected by water and rot. The drawback to topped log bridges is that they usually require two full trees and are difficult to transport because of the extra weight. **Split log** bridges should be used in areas in which timber is scarce, because they require only one log. They are much easier to transport but

necessitate a substantially larger log. **Bridge stringers** are used sparingly because of the difficulty in construction. Stringers are made by sawing a log in half with a chainsaw, which involves a substantial amount of wear on the chainsaw and the operator during construction.

There are a wide variety of bridges that are used for mountain biking, stock use and occasionally snowmobiles and cross country skiing. These include, but are not limited to, tension bridges, laminated timber bridges, steel girder bridges, suspension bridges and the use of crowns and curbs. These bridges are generally expensive, because of the amount of materials used and the cost of engineers and builders accrued during construction.

Another device used in avoiding wet areas are, **stepping stones**, whose function is to ford small wetland areas if the rockwork is available for construction. Any size or shape may be used, but larger rocks far exceed smaller ones because they provide a more stable surface on which to walk. Remember when selecting rocks to chose ones with a large enough depth to sink into the mud and a fairly flat surface on one face to use as the treadway.

Another technique used to reduce erosion is the mobilization of **waterbars**. Waterbars, when employed correctly, divert water towards the down-hill side of a trail. Waterbars can be constructed of either wood or rock and should be angled at 15 to 45 degrees from the trail. On trails with a higher grade, a backup waterbar may be applied to control heavy runoff. The backup waterbar is simply a retaining bar installed perpendicular to the trail several feet below the original waterbar. The area between the two bars should then be filled with crushed rock, fill or trail tread to the level of the waterbars to impede the excess water caused by heavy runoff and steep terrain. Waterbars that are employed on biking trails are constructed of a synthetic material so that they are easily crossed by mountain bikers, while still functioning as a deterrent of run-off water.

One element that is often employed on steep slopes in certain areas is the **switchback**. Switchbacks are customarily used to climb long stretches of steep grade on a mountain or to add variety to the users experience. The main point to remember is to not build many switchbacks too close together so that hikers are not tempted to create shortcuts, by hiking off the intended trail. The best switchbacks are those which incorporate both fairly lengthy hikes and wide turns between switchbacks.

Once the trail corridor has been completed, it should not be neglected or misused. Trail staff and volunteer organizations need to periodically monitor the trail to pinpoint problem areas that require further maintenance. During this assessment to look at alternatives and assess impacts, designers should note which areas will require official clearances and approvals from the appropriate state or federal agency.

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