

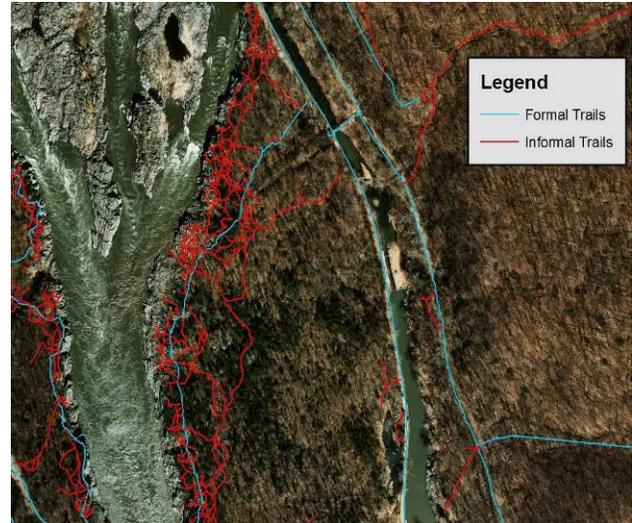


# Guidance for Managing Informal Trails

Jeff Marion, USGS Research Scientist

([jmarion@vt.edu](mailto:jmarion@vt.edu), 540-231-6603)

The development, deterioration and proliferation of visitor-created informal trails in protected areas can be a vexing management issue for land managers. Formal trail systems never provide access to all locations required by visitors seeking to engage in a variety of appropriate recreational activities. Traveling off-trail is necessary to engage in activities such as nature study, fishing, or camping. Unfortunately management experience reveals that informal trail systems are frequently poorly designed, including “shortest distance” routing with steep grades and alignments parallel to the slope. Such routes are rarely sustainable under heavy traffic and subsequent resource degradation is often severe. Vegetation impacts include trampling damage leading to changes in species composition, potential introduction and dispersal of non-native plants, and the loss of vegetation cover. Soil impacts include the pulverization and loss of organic litter, and exposure, compaction, and erosion of soil. Soil deposition in streams, disturbance to wildlife, and damage to historic resources are also possible. Creation of multiple routes to common destinations is another frequent problem, resulting in “avoidable” impacts such as unnecessary vegetation/soil loss and fragmentation of flora/fauna habitats.



This guidance is provided to assist land managers and volunteer trail organizations in evaluating informal trail impacts and selecting the most appropriate and effective management responses.

## Adopt a Decision-Making Process

The management of informal trail networks can benefit from application of a planning and decision-making process or framework that includes public dialogue and input. Decisions regarding impact acceptability and the selection of actions needed to prevent recreation-related resource impacts fall into the domain of carrying capacity decision-making. The NPS defines carrying capacity as “the type and level of visitor use that can be accommodated while sustaining the desired resource and visitor experience conditions in the park” (NPS 2006). The NPS applies the Visitor Experience and Resource Protection (VERP) decision-making framework (NPS 1997), while the U.S. Forest Service applies the Limits of Acceptable Change (LAC) framework (Stankey *et al.* 1985).

These formal frameworks direct managers to prescribe objectives for biophysical and social conditions they intend to achieve for specific park zones. Numerical standards of quality are established for each indicator and zone to define the critical boundary line between acceptable and unacceptable conditions, establishing a measurable reference point against which future conditions can be compared through periodic monitoring. These frameworks incorporate an adaptive management decision process, whereby managers can apply actions, evaluate their

success, and when needed, apply alternative actions as a follow-up until management objectives are achieved. A simplified framework known as Protected Area Visitor Impact Management (PAVIM) employs an expert panel and problem analysis process (Table 1) that requires less data (Farrell and Marion 2002). The problem analysis process, which is particularly applicable and useful in informal trail management decision-making, is described below.

### **Problem Analysis Process**

Assemble a team of knowledgeable and experienced individuals with expertise in recreation resources management, visitor management, social science, site and trail management, natural resource management, and interpretation. Visit the site where the impacts or problems are occurring and apply this problem analysis process to guide discussions.

#### ***Identify and Evaluate the Problem***

The problem analysis begins by developing the group's collective knowledge of the area, amounts and types of recreational uses, and the resource and social problems currently present. Group members most knowledgeable about these topics are asked to share their knowledge with the group. The sharing of differing perspectives, land management agency, trail club, recreation representatives, is encouraged. The significance of the problems and degree to which current conditions are unacceptable are considered when deciding whether management actions are needed. Next, participants with the longest experience in the area are asked to relate the history of the problems or impacts. Previous management actions are described and their effectiveness discussed and evaluated, including why implemented actions were or were not effective.

The core of a good problem analysis is a thorough evaluation of a problem's underlying causes and identification of factors that influence impact severity. For example, substantial off-trail traffic may be the cause for excessive vegetation loss but fragile ground vegetation and poorly marked or maintained formal trails may significantly contribute to the creation of unacceptably extensive or impacted informal trails. The relative influence of three groupings of factors: use-related, environmental, and managerial, should be examined. An improved understanding of these causes and factors are essential to evaluating alternative actions and selecting effective actions.

#### ***Identify and Evaluate Strategies and Actions***

Step two involves brainstorming by team members to list and then evaluate a diverse array of management strategies and actions. Following list development, study team discussions should focus on careful evaluations of the advantages and disadvantages of each action. A number of important attributes should be considered, including potential effectiveness, management feasibility, costs to visitor freedom and satisfaction, expected visitor compliance, and others as appropriate.

The final step is selecting one or more preferred actions recommended for implementation. Careful consideration of the history of impacts and their management, the desired resource and social conditions for the area, and factors which either cause or influence impacts can help guide more objective and effective decision-making. Management objectives or desired condition statements will suggest the appropriateness of alternative actions relative to the natural, social, and managerial settings of the zone the area is situated within.

Generally, initial actions are feasible, have a low “cost” to visitors, and are judged to have a good chance at effecting the desired change in conditions. For example, indirect actions such as education or site maintenance should be considered before regulatory or site development actions as they are less obtrusive and do not compromise visitor freedom. More restrictive, expensive, and/or obtrusive actions are generally deferred until justified by the failure of one or more preceding actions. However, severe or unacceptable impacts may warrant bypassing such light-handed efforts in favor of actions necessary to achieve more effective or immediate results. Alternative actions should be identified for potential implementation in the event that initial actions are ineffective.

For each action, identify likely individuals or organizations responsible for implementing the action and describe the necessary resources they will require. An implementation schedule should also be developed and efforts to obtain funding and staff initiated. At this time it is also useful to consider how a planned action should be monitored for evaluating effectiveness. For example, an accurate GPS survey of informal trail networks with condition class assessments provides a baseline for future comparison and should be conducted prior to implementing corrective actions.

Table 1. Problem analysis for managing resource and social impacts related to visitation.

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| <p><b>I. Identify and Evaluate the Problem</b></p> <ul style="list-style-type: none"> <li>➤ <b>Describe area and use(s)</b> - provide background information about the area, facilities, and visitor use.</li> <li>➤ <b>Describe problem(s)</b> - briefly describe the facility, resource and social impact problems that are occurring.</li> <li>➤ <b>Problem significance</b> - consider if and why the impacts are significant or unacceptable to land managers and protected area visitors</li> <li>➤ <b>Previous management actions</b> - describe the history of the problems and previous actions; discuss the effectiveness of these actions and why they did or didn't work.</li> <li>➤ <b>Causes and influential factors</b> - discuss the underlying causes for the impacts and the role of non-causal but influential factors that may intensify impacts. Consider use-related factors (type and amount of visitor use, visitor behavior and motives, use density), environmental factors (soil and vegetation type, environmental sensitivity, topography), and managerial factors (siting, design, construction, and maintenance of facilities, visitor management).</li> </ul> <p><b>II. Identify and Evaluate Strategies and Actions</b></p> <ul style="list-style-type: none"> <li>➤ <b>List potential strategies and actions</b> - create a comprehensive list of appropriate and potentially effective management strategies and actions. Strategies are broad approaches (e.g., modify visitor behavior, manage sites and facilities) and actions are the specific means used to implement a strategy (e.g., educate visitors, relocate campsites).</li> <li>➤ <b>Evaluate strategies and actions</b> - discuss and evaluate the following attributes for each strategy and action: potential effectiveness, management feasibility (cost, staffing, long-term maintenance), advantages/disadvantages (e.g., costs to visitor freedom), expected visitor compliance, etc.</li> <li>➤ <b>Formulate recommendations</b> - through group discussion, develop and write recommendations that reflect the group's consensus views. Describe the recommended action or group of actions to implement first and what might be tried next if these are ineffective.</li> </ul> |
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***Problem Definition:*** For informal trail management decision-making, an inventory of the informal trail network within an area of management concern is particularly useful. If GPS devices and expertise is available, a simple inventory technique is to conduct a walking GPS survey, provided the terrain and forest canopy permit accurate GPS use. GIS software can input, map and analyze the data, providing a visual display of the informal trail network relative to designated trails, roads and other resource features. Computation of the lineal extent of the informal trail network is also possible. If GPS devices cannot be used then an inventory can be made by hand-sketching informal trails onto large-scale maps with lengths assessed by pacing or a measuring wheel.

Where possible, managers may also wish to consider various options for assessing the condition of the informal trails. Many options, ranging from simple condition class evaluations, to trail width and depth measurements, or detailed assessments of soil and vegetation loss are possible. Guidance for assessing trail conditions may be found in the scientific literature (Cole 1983, Leung & Marion 2000, Marion & Leung 2001). Some rapid assessment “condition class” options are included at the end of this document or contact the author for examples of alternative monitoring protocols and manuals. An objective assessment of informal trail conditions can produce quantitative data for indicator variables that can be summarized to characterize current trail conditions, or when replicated, to monitor changes in trail conditions over time. Such data can be used in the previously described formal or informal adaptive management decision-making frameworks.

***Evaluate Impact Acceptability:*** The acceptability of informal trail impacts should be evaluated according to park or management zone objectives. Informal trails located in pristine areas where preservation values are paramount are less acceptable than when located in areas that are intensively developed and managed for recreation use. Trails in areas with sensitive cultural and archaeological resources are particularly unacceptable if they threaten such irreplaceable resources.

**Environmental factors:** Informal trails located in sensitive or fragile plant/soil types, near rare plants and animals, or in critical wildlife habitats are less acceptable than when located in areas that are resistant to trampling damage and lack rare species. Informal trails that directly ascend steep slopes and/or will easily erode are less acceptable than trails with a side-hill design. Informal trails prone to muddiness and widening are less acceptable, as are trails that may contribute soils to water resources.

**Use-related factors:** Why is a trail in a particular location and what are the visitors trying to access? Which recreation activities are most responsible for creating informal trails? What are the motives responsible for off-trail hiking? Are some impacts avoidable? For example, informal trail impacts related to a poorly marked formal trail or that result from visitors trying to circumvent muddiness or severe erosion are more easily avoided and should be targeted first. It is not uncommon to find several “duplicative” informal trails in close proximity to each other accessing a common destination. Impacts caused by visitors seeking to shortcut a longer, more resistant route are unacceptable, as are impacts caused by visitors who could alternately access their intended destination by staying on resistant durable surfaces (e.g., rocks or gravel) ([www.LNT.org](http://www.LNT.org)). Informal trails resulting from illegal or inappropriate types of uses are less acceptable than if they are caused by permitted uses.

A careful consideration of these and other relevant factors (e.g., visitor safety) can assist managers in making value-laden decisions regarding the acceptability of informal trail impacts. The acceptability of these impacts, in turn, guides decisions about which trails should be left open, rerouted, or closed, and selection of appropriate and effective management interventions.

***Selection of Management Strategies:*** The problem analysis process can assist managers in considering and evaluating a diverse array of potential management strategies and actions. Note that some degree of degradation to natural resources is an inevitable consequence of recreation use, requiring managers to balance recreation provision and resource protection mandates. Roads and formal trails can never provide complete access to the locations visitors wish to see, hence, some degree of informal trail development is inevitable and must be tolerated. The challenge for managers is to evaluate the impacts in light of recreation provision and resource protection objectives, and apply professional judgment to determine which impacts are unacceptable and require management action.

The following section describes four general strategies for managing informal trail impacts: 1) Improve management of formal trails, 2) Ignore or formalize informal trails, 3) Maintain informal trails, and 4) Close and restore unacceptable trails,.

### Improve Management of Formal Trails

If formal trail problems are contributing to the development of informal trails, then addressing such problems is generally one of the more effective and efficient options available to managers. Four problems are common. Make sure that formal trails are well-marked in some distinctive fashion so that visitors can clearly distinguish between formal and informal trails – this is often very confusing to most visitors. In rocky areas, paint blazes may be needed on rocks rather than trees because the terrain demands constant attention to the immediate trail tread. “Overblazing” or clearly defined trail borders (e.g., spaced rocks, logs, or scree walls) may be necessary in some tricky areas. Boardwalks, low symbolic fencing, or higher rustic fencing are more effective but more visually obtrusive and costly. The treads of formal trails should be the most attractive location for walking, maintained to be free of muddiness or deeply eroded ruts with exposed roots and rocks. When braided or multiple parallel treads occur managers should define a single intended tread throughout.

### Ignore or Formalize Informal Trails

Some informal trails may have reasonably sustainable design attributes and access locations, such as vistas or campsites (hikers), water resources (fishermen), or cliffs (climbers) that are acceptable to land managers. When visitor access to these locations is appropriate, such trails should generally be left open as informal trails or even designated and managed as formal trails. They serve an important resource protection function by concentrating visitor traffic on a narrow tread and protecting adjacent vegetation from trampling damage. Recreation ecology studies have consistently found a curvilinear relationship between the amount of traffic and trampling impacts (Leung and Marion 2000). The majority of trampling impact occurs with relatively low levels of trampling; once a trail is established, further trampling impact is greatly minimized by a “concentration” strategy that focuses all further traffic to its barren tread. An alternate “dispersal” strategy is only effective under conditions of very low use and/or when traffic can be confined to durable substrates (e.g., rock, gravel) or vegetation (grasses/sedges).

Sometimes a portion of such informal trails may require a reroute to improve the sustainability of an alignment, such as a very steep section aligned with the fall-line (parallel to the landform

slope). An experienced trails professional should conduct a review and provide recommendations for informal trails left open to use. Generally trail alignments should favor side-hill over fall-line alignments, avoid grades over 15%, and favor rocky substrates and non-vegetated or grassy groundcover. As with formal trails, leaving an informal trail with a poor “impact susceptible” alignment is rarely a preferred long-term solution. Site development actions, such as graveling or installation of water bars and rock steps, could be applied but these are generally less appropriate on informal trails and would be unnecessary on a well-designed alignment. In most instances, relocation to an improved alignment will be a more cost-effective and sustainable long-term solution, even though pristine terrain is affected.

Due to the relatively poor trail design skills of visitors, it may even be necessary to replace several non-sustainable informal trails with a new well-designed informal or formal trail (with appropriate environmental reviews). An objective evaluation of the aggregate or cumulative impacts, including the total area of trampling disturbance and soil loss, will generally support such a decision. However, this option should only be attempted when managers are relatively certain of their ability to effectively close the pre-existing informal trails.

### Maintain Informal Trails

Historically, most park managers have not maintained informal trail networks. However, extending maintenance work to those trails with reasonably sustainable designs left open to use can substantially reduce impacts. For example, managers can piece together a single sustainable route in an area with numerous braided trails and trim obstructing vegetation, subtly enhance tread drainage, or install natural-appearing rockwork on steep slopes. These actions will effectively encourage use and reduce impacts on the sustainable route while reducing use and encouraging natural recovery on alternate informal trail segments. Additional actions, discussed in the following section, can be applied to discourage their continued use.

### Close and Restore Unacceptable Trails

Informal trails with poor, non-sustainable design attributes, trails that threaten sensitive resources, or unnecessary trails with duplicative routings should generally be closed and rehabilitated. Managers should recognize that successful trail closures and restoration are rare and require substantial and sustained management effort. The principal reason for low success rates is that while trampling impacts occur rapidly with low levels of use, vegetative and soil recovery occurs very slowly and complete recovery is prevented unless nearly all traffic is removed from treads for several consecutive years. A substantial restoration program involving the addition of soil and plantings of native species, with watering as needed to ensure survival, can hasten natural recovery. However, care must be taken to apply such intensive work only when managers are reasonably certain that effective measures are in place to prevent further trampling of the restoration work.

***Selection of Management Actions:*** An adaptive management program involving education and site management actions is recommended when implementing strategies. Management experience and research have demonstrated that integrating site management and educational actions consistently achieve the highest rates of success. Site management actions are needed to mark and keep visitors on formal trails or to block or hide informal trails; educational actions are needed to inform visitors of the impacts associated with off-trail traffic and what managers would like them to do to protect natural and cultural resources. Visitors frequently misunderstand site management actions that lack signs placed to convey information about impacts of concern and management intent. In the absence of site management actions, visitors may choose to

disregard a prompter sign if a well-used informal trail branches off to what looks like an appealing vista.

### Educational Actions

An educational component is often critical to communicate a clear rationale for an action – for example, that significant resource impacts can occur in some areas if visitors travel off designated trails. A message with a rationale should be followed by a plea for visitors to remain on formal trails, which need to be clearly designated through site management actions (e.g., blazing, symbolic markers, cairns) to distinguish them from informal trails. Social science research and theory has found that signs with a compelling rationale and clear behavioral plea are more effective than simple “do” and “do not” messages (e.g., “Please Stay on Designated Trails to Preserve Sensitive Vegetation”) (Cialdini 1996, Cialdini *et al.* 2006, Johnson & Swearingen 1992, Marion & Reid 2007, Vande Kamp *et al.* 1994, Winter 2006). Such literature should be consulted to improve the efficacy of educational messaging.

Some principal goals that educational efforts seek to communicate include: 1) trampling impacts represent a significant threat to resource protection in some areas, 2) that off-trail traffic has created informal trails that managers would like to close and restore, 3) remaining on formal trails avoids these impacts, 3) formal trails can be distinguished from informal (visitor-created) trails by distinctive markings, and 4) even small amounts of continued traffic prevents the recovery of informal trails that managers are seeking to close and restore. Unfortunately, as you might expect, this is a lengthy and complex educational message that is challenging to communicate effectively. Research suggests that more complex messages are more effectively communicated personally, rather than on signed or in brochures. Regardless, examples of signs that seek to accomplish these objectives and that have received NPS approval for use are depicted in Figure 1. Note the inclusion of the “no-step” icons that communicate the message with just a glance and are understandable by children and non-English speaking visitors. Generally the larger informative signs are placed in conspicuous locations near trailheads and the more numerous “prompter” signs are placed just beyond junctions with informal trails.

### Site Management Actions

A variety of site management actions are available for closing informal trails. Close lightly used trails by actions that naturalize and hide their tread disturbance, particularly along initial visible sections where visitors make the decision to venture down them. Effective actions include raking organic debris such as leaves onto the tread, along with randomly placed local rocks, gravel, and woody debris designed to naturalize and hide the tread. These actions also lessen soil erosion and speed natural recovery. On trails that have been effectively closed, transplanting plugs of vegetation at the beginning of wet seasons can hasten natural recovery. Revegetation work conducted before successful closure is achieved can be a frustrating waste of time and materials if visitors continue use of the trail and trample the transplanted vegetation.

For well-used trails, such work generally cannot fully disguise the disturbed substrates and vegetation so additional measures are necessary for effective closures. Construct a visually obvious border along the main trail, such as a row of rocks or a log, to communicate an implied blockage for those seeking to access the closed trail. Alternately, embed large rocks or place large woody materials or fencing to obstruct access at the entrance to closed trails to fully clarify management intent. Even temporary 2 ft tall post and cord symbolic fences can communicate the importance of closures and effectively deter traffic (Figure 2) (Park *et al.* 2006). Taller plastic

fencing (preferably in green or brown) is also easy to transport and install to discourage traffic on trails that prove more difficult to close. However, fencing is generally perceived as visually obtrusive and inappropriate in more primitive settings.

Placing rocks or woody debris that physically obstructs traffic beyond the beginning of closed trails may be ineffective if visitors are able to circumvent these by walking around them. This can result in new trampling and trails parallel to the “closed” trail – a significant problem in areas with sensitive or rare vegetation. In such areas it is better for hikers who ignore closures to remain on the “closed” tread than to create new treads on each side (Johnson *et al.* 1987). If the trail is in sloping terrain its closure may require the addition of soil to fill ruts and reestablish the original surface contour, and organic litter and vegetation to keep the soil from eroding. Finally, integrating site management work with temporary educational signs may be necessary to obtain a level of compliance that allows vegetative recovery. Also, consider signs to communicate the location of a preferred alternate route when visitors are seeking to reach a particular destination and their only visible access trail is closed.

**Conclusions:** Informal trail management actions should be implemented as part of an ongoing adaptive management program. Experimentation will be necessary to refine site management procedures that are appropriate in each management zone or location. Some form of periodic monitoring is critical to program success. A 5-year interval could be sufficient for monitoring with quantitative procedures, but annual informal evaluations are needed to effectively guide the application of management actions.

Objective monitoring will be needed if any potentially controversial management actions may be needed (e.g., use restrictions or high fencing). In exceptionally high use areas with sensitive resources there is a good probability that such actions will be necessary. For example, a combination of signs and restoration work may be able to keep 95% of visitors on a designated



Figure 1. Examples of informative trailhead sign (left) and trailside prompter signs that can assist management efforts in closing informal trails.

trail but 5% of 2000 visitors/day is 100 visitors/day, a level of trampling that is sufficient to both create and maintain informal trails. Tall fencing or a regulatory sign that prohibits use of the closed trail and threatens fines may be necessary on trails that are particularly difficult to close. Such situations also indicate a need for further dialogue with trail users to discover their motives and a review of whether the formal trail system should be extended or modified.



Figure 2. Low symbolic post and rope fencing (left) and high fencing designed to physically obstruct access (right).

Regardless, periodic monitoring provides feedback for gauging the success of management interventions in keeping conditions within acceptable limits. A documented failure of one intervention can be used to justify the use of a more obtrusive or expensive intervention.

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## Trail Indicators

The number, lineal extent and condition of informal trails are attributes that can be assessed as indicators of impact for informal trail systems.

**Number:** Count the number of informal trails that branch off of a designated trail.

**Lineal Extent:** Push a measuring wheel or run a GPS device along every informal trail within a defined area to determine their aggregate lineal extent.

**Condition:** Assess the condition of social trails with a “condition class” method (see below) or with quantitative measurements (contact the author). Condition class methods provide a quick summary of general trail condition and can be applied to just the visible section of social trails at their junctions with a designated trail or to entire trails or trail segments when a measuring wheel or GPS device is used. Quantitative methods involve measures of separate indicators (e.g., trail width, depth, soil loss, muddiness) generally taken at transects sampled along the trail with a standard interval (e.g., every 300 ft).

## Trail Condition Class Systems

Trail condition class systems can be applied to an entire trail (if in uniform condition) or to segments. For the latter you would use a GPS or push a measuring wheel down the trail and record a condition class rating to segments of the trail in uniform condition. A minimum distance rule, like 30 ft as the smallest segment that can be labeled as a new condition class, is helpful.

### Numerical

Class 1: >10% vegetation cover on trail

Class 2: <10% vegetation cover and less than 20 inches (0.5m) wide

Class 3: <10% vegetation cover and > 20 inches wide

*Comments:* Only 3 categories, though that's easy to apply and should be fine for most areas (additional categories could be added). The criteria (10% and 20 inches) could be modified if needed. Judging the 10% vegetation cover might be somewhat difficult in some places due to patchy vegetation.

### Descriptive

Class 0: Trail barely distinguishable; no or minimal disturbance of vegetation and/or organic litter.

Class 1: Trail distinguishable; slight loss of vegetation cover and/or minimal disturbance of organic litter.

Class 2: Trail obvious; vegetation cover lost and/or organic litter pulverized in primary use areas.

Class 3: Vegetation cover lost and/or organic litter pulverized within the center of the tread, some bare soil exposed.

Class 4: Nearly complete or total loss of vegetation cover and organic litter within the tread, bare soil widespread.

Class 5: Soil erosion obvious, as indicated by exposed roots and rocks and/or gullying

*Comments:* More categories but less quantitative. Potentially has a greater possibility for subjectivity in application or differences in interpreting findings.