Identifying and Monitoring Indicators of Visitor Experience and Resource Quality:

A Handbook for Recreation Resource Managers

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Definitions

Carrying Capacity. The amount and type of use that can be accommodated in a particular area over time while sustaining desired biophysical resources and opportunities for quality visitor experiences. Statements of appropriate biophysical and experiential conditions must be compatible with a park's purpose and interpretive themes.

Goals. (see management objectives)

Indicators of quality. Indicators are specific, measurable variables that reflect the conditions of an overall park resource or management zone. Resource indicators measure visitor-caused impacts to biophysical and cultural resources; social indicators measure visitor-caused impacts to visitor experiences. Managers increasingly look to the use of *indicators* and *monitoring* to assess how the quality of biophysical resources and visitor experiences change in response to human activity and to act as an early warning mechanism to predict future conditions.

Management objectives. Management objectives define, as specifically as possible, the kind of biophysical and recreation opportunities and benefits an area should provide. At least two types of management objectives can be differentiated. First, broad objectives are dictated or controlled by enabling legislation and general administrative policies of the managing agency. Broad objectives address what activities might be provided in a park, whether consideration will be give to protection of natural resources, and whether the park should serve as many people as possible or be limited to specific kinds of uses and users. Second, more explicit objectives delineate the appropriate setting or conditions to be sustained and the visitor opportunities or benefits to preserve. Explicit objectives are more difficult to define because they must identify the kinds of opportunities to be provided, as well as how and where these opportunities will be managed and sustained.

Management zone. Management zones represent areas in which management direction is fairly homogeneous in terms of such characteristics as level of development, visitor activities allowed, types of resource management, and park operations. As such, a specific zone within a park would have a unique set of resource and social conditions that would differentiate it from other zones in the park (e.g., backcountry, frontcountry, and vehicle-access campgrounds in frontcountry). Further, each zone would have consistent management prescriptions that are easily understood by managers and stakeholders.

Minimally acceptable conditions. Minimally acceptable conditions (MACs) are standards or thresholds of acceptability for biophysical and experiential indicator variables. If a condition (indicator variable) is not violated, the condition is considered to be within an acceptable limit. When the condition is violated, the condition is deemed unacceptable and management intervention is required to bring the condition back within the acceptable limit. Minimally acceptable conditions are not management goals, targets, or desired future conditions.

Monitoring. Monitoring represents a systematic and periodic measuring of human activity that impacts biophysical and visitor experience conditions in a given area (e.g., park, management zone, and specific site). Measurements, in affect, evaluate quantifiably whether existing conditions are acceptable (i.e., within minimally acceptable conditions).

Resource conditions. Resources include biophysical, historic, archaeological, architectural, and ethnographic features found in a park. In combination they shape the park's purpose, significance, and interpretive themes.

Social conditions. Social conditions represent elements of a park visit that influences the quality of the experience. Detractors to the quality of park experiences include information and interpretive services, visitor crowding, visitor facilities, park management activities, visitor behavior and activities, resource impacts of visitors, and quality and condition of natural features.

Standards of quality. Standards define the minimally acceptable condition of indicator variables. (See *minimally acceptable conditions.*)

Introduction

In the scenario below, a framework is followed that results in park managers generating a defensible basis for addressing a perceived problem that compromised their responsibility to protect and conserve biophysical resources and opportunities for quality visitor experiences. Broadly speaking, the framework follows a rationale developed for resource managers that seeks to keep parks and other protected areas from exceeding their *carrying capacity*.

Problem scenario

One of Minnesota's larger state parks had witnessed rapidly growing visitor use during the last two decades. Trail use, primarily day-use hiking, was a main activity and over the past several years managers observed accelerated visitor-caused impacts to some trail resources—especially a general widening of the trail path and soil erosion. Off-trail travel increasingly was observed as well. No set patterns of social trails were apparent, but the number of such trails and their expansion was very noticeable and unacceptable to park professionals.

Conventional wisdom among park managers suggested the problem of increased social trails was caused primarily by a few park visitors—mostly children accompanied by adults and groups of unsupervised teenagers. Also, most of the off-trail activity was thought to occur on weekends. To address the perceived problem, a consensus of the managers argued to increase ranger patrols during weekends on affected trails in an effort to improve visitor education about staying on trails and to issue warnings or formal citations to observed offenders.

Further discussions among managers, however, raised questions about the extent and nature of the problem and appropriate actions to ameliorate continued impacts. How "bad" was the off-trail problem? How many visitors actually were going off-trail? Who were the offenders? When were the actions occurring? What activities were offenders doing off-trail? Do trail users know there is a general park policy to stay on designated trails? It was decided that answers to these and related questions could aid greatly in a more informed decision on what to do about off-trail travel in the park.

During the peak use season of mid-June to Labor Day, park staff decided to conduct an experiment or informal study and observe several stretches of the highest-used trails in both frontcountry and backcountry areas that were experiencing growing numbers of social trails. Five trail stretches of about 1/8 mile in length that could be seen by an observer were selected for monitoring. Three of the five trail stretches were within 20 feet of lakes or streams and paralleled the shoreline. Each stretch was observed on three randomly selected weekend days and three randomly selected weekdays.

Observations occurred for about two hours on each randomly selected day, and observers recorded their observations on prepared data forms.

To the surprise of some management staff, off-trail activity was frequent and sometimes prolonged, and the occurrences were equally pronounced on weekdays and on weekend days. During observation periods off-trail activity among 1,700 people observed ranged from 35 percent to 70 percent on individual trails, and averaged 55 percent. That is, on average, one of every two people walked off the trail at one or more places along the 1/8-mile stretch of the trail. Tabulating as best they could, observers found that those hikers leaving the trail most often were: (1) children accompanied by parents or other adults, (2) groups of teenagers, (3) people with pets, and (4) large groups (groups of more than seven people). The most frequently observed activities of off-trail hikers were: (1) taking photographs, (2) looking after pets (almost exclusively dogs), (3) looking at or for some feature such as birds, flowers, or other vegetation, and (4) conversation among group members, often to allow other hikers to more easily pass by.

Findings from the experiment helped park managers better define the nature and extent of the problem concerning off-trail traffic. The problem was "worse" than managers thought and more widespread with respect to who was involved. What was learned helped park staff grapple with several important questions about how much and what types of off-trail activity could be tolerated before management intervention was necessary to address the problem. What were the goals or management objectives associated with off-trail use? What would be a good indicator or indicators that could be monitored over time to help assess if minimally acceptable conditions were being approached or exceeded? What management strategies and tactics might be implemented to address unacceptable amounts of off-trail travel? Could a monitoring plan be developed and implemented to assess the effects of management—to determine if the management actions worked successfully?

The experiment and further dialogue among park staff and others led to decisions to address the problem of social trails. Monitoring the number of people, representing several activity or social groups (e.g., people with pets, groups with children, and groups of teenagers), going off the existing trail by more than three feet on 1/8-mile trail stretches was selected as the indicator of "impact" concerning off-trail travel. It was further decided that the observed off-trail occurrences were much too high and the park should achieve a situation in which less than 25 percent of hikers walked off the trail. This situation would be seen not as a goal but rather a minimally acceptable condition the park would strive to achieve within a four-year period. Of

course, park staff would be pleased if the occurrences of off-trail activity could be much lower than 25 percent, and in less than four years!

Armed with knowledge about the nature and extent of off-trail activity on some trails and decisions about minimally acceptable off-trail activity, management strategies and tactics were reviewed and provisional actions implemented. On affected trails, ranger patrols were increased with the goal of more aggressively informing visitors about the environmental and aesthetic consequences of walking off-trail. Anecdotal findings from ranger discussions with hikers suggested more information on where to find toilet facilities would help reduce some off-trail travel. More emphasis was put on educating visitors with dogs that it is required to leash them and to keep their pets on the trail. A focus also was made in park-wide information and education to address the specific need to curtail off-trail travel in some or all park areas. An inexpensive, one-page handout printed on chartreuse paper (for visual emphasis) was distributed to all park visitors upon entering the park. It illustrated the importance of staying on park trails except at attraction sites and other designated areas.

Following implementation of the several management activities, a long-term monitoring strategy was developed, implemented, and endorsed by park staff. Monitoring the agreed upon indicator variable over time proved to be effective in serving three important roles. First, monitoring off-trail behavior documented the status of the activity and would show trends. Second, monitoring allowed managers to assess the effectiveness of the management actions that were implemented—did the management action taken result in less off-trail activity. Third, monitoring data, coupled with the assessment of the effectiveness of management activity, provided a defensible basis for the management taken.

The outcome of the management strategy to reduce off-trail activity was successful given the specification of management goals and objectives, the minimally acceptable conditions the park sought to sustain, and the indicator to assess if minimally acceptable conditions were exceeded. Over a two-summer period of monitoring, the park saw the incidence of off-trail activity drop to less than 20 percent—fewer than one in five hikers walked off the trail. And, the management actions implemented were deemed instrumental in achieving the desired results.

Framework for solving the problem

While several definitions of carrying capacity have been offered over the past four decades, they are more similar than different. Carrying capacity refers to the amount and type of use that can be accommodated in a particular area over time while sustaining desired biophysical resource conditions and

opportunities for quality visitor experiences. All such definitions are grounded in the notion that carrying capacity can only be addressed:

- within an agency's management goals and objectives,
- only if managers are able to identify unacceptable impacts to resources and visitors, and
- only if managers are dedicated to mitigating unwanted impacts.

Carrying capacity is the conceptual underpinning for all of the major recreation resource management frameworks in use today:

- Recreation Opportunity Spectrum (ROS) (Brown et al. 1978, Clark and Stankey 1979)
- Limits of Acceptable Change (LAC) (Stankey et al. 1985)
- Visitor Experience and Resource Protection (VERP) (USDI, National Park Service 1997)
- Visitor Impact Management (VIM) (Graefe et al. 1990)
- Visitor Activity Management Process (VAMP) (Environment Canada and Park Service 1991), and
- Benefits Based Management (BBM) (Driver et al. 1991).

The carrying capacity framework is a widely accepted and useful management tool to use when trying to identify, select, and monitor indicators of resource and visitor experience quality. It is useful because it addresses how much and what kind of use occurs on the land as well as the resource's ability to sustain a variety of recreational uses over time. Carrying capacity is a guiding framework for managers in that it forces managers to focus and think about the impacts of recreational use on both biophysical resource and social resource conditions.

To put carrying capacity into practice, managers must be able to identify *indicators* of quality visitor experiences and quality resource conditions. Indicators *indicate* what is important to providing quality resources and visitor experience opportunities and are often worded so they point to the kinds of impacts that may detract from the quality and the ability to sustain the integrity of these conditions over time. For example, in the scenario at the beginning of this section, monitoring an indicator that describes the number of visitors going off-trail helps to understand the "general health" of the trail corridor and characterizes impacts to soil, vegetation, and aesthetics. As such, indicators are critical to the sustainability of resource uses and visitor experiences over time.

This handbook is meant to serve as a companion to an earlier handbook titled: *Maintaining the Quality of Park Resources and Visitor Experiences: A*

Handbook for Managers (Anderson et al.1998). That handbook offers a step-by-step, easy to use, process for public land managers who have identified seemingly unacceptable impacts to biophysical resources and/or visitor experiences and want to act to eliminate them. Although the handbook was prepared for the National Park Service, it will aid any state, federal, county or local land management organization responsible for managing recreation resources and visitor use. It is intended that users of this companion handbook will be familiar with the earlier effort and will use it as an important reference. For those unfamiliar with the earlier handbook, it can be accessed at the following website: http://www.cnr.umn.edu/CPSP/. Appendix A of this document provides a step-by-step outline for Minnesota Department of Natural Resources planners and managers about how to use the earlier handbook to gather material needed to successfully implement the process outlined in this handbook.

The focus of this companion handbook is on indicators of quality and the monitoring of indicator variables. To accomplish this purpose the handbook will: (1) identify and describe biophysical and social indicators of resource and visitor experience quality; (2) provide a framework for identifying, selecting, and evaluating indicators of interest for a specified resource area; (3) provide a framework for monitoring over time selected indicators of biophysical and social quality; and, (5) illustrate the use of the handbook in selecting indicators of quality for the visitor experience with an example from Tettegouche State Park in northern Minnesota.

Using This Handbook

This handbook was commissioned and funded by the Parks and Trails Council of Minnesota and the Minnesota Department of Natural Resources' Division of Parks and Recreation. The handbook is a companion work to an earlier handbook (Anderson et al.1998), which focused on identifying visitor-caused impacts to resources and visitor experiences and appropriate management strategies and tactics to address impacts. Like the earlier handbook, this handbook can be used in conjunction with park planning frameworks such as or similar to Visitor Experience Resource Protection (VERP) and Limits of Acceptable Change (LAC). It also can be used where no particular planning framework is in place but where managing within the conceptual bounds of carrying capacity is important.

This handbook is divided into five parts. The first part is an introduction that provides the overview and rationale for using the handbook. In particular it stresses the critical importance of basing the activities in the handbook in the context of the agency's goals and objectives. This context is fundamental to the success of using this management tool. The handbook further addresses the need for problem awareness and clear problem specification as well as determining whether existing impacts are acceptable, unacceptable, or approaching unacceptable levels. Further activity focuses on identifying and establishing indicators of resource and visitor experience quality and monitoring selected indicator variables over time. Once the extent and nature of visitor-caused impacts have been identified and their root cause(s) specified, appropriate strategies and tactics are selected to address the impacts. Further monitoring is an ongoing process and provides managers with important information and feedback about the consequences of implementing specific management actions. For those who have read or used the earlier handbook by Anderson, et al. (1998), much of the material in this section (especially identification of management strategies and tactics) is covered in greater detail therein.

Part Two of the handbook discusses indicators of quality in general, why they are used, what they do, what they do not do, what makes a good indicator, and why a manager would want to use them. This section also outlines the steps a manager would go through to identify and select indicators to monitor resource and visitor experience quality as well as who would be involved and how they would be involved in the process. Several worksheets are provided as a means for managers and the public they serve to better visualize the decision-making process around the identification and use of indicators.

Part Three addresses the essential role of minimally acceptable conditions or standards in applying the carrying capacity framework. While this topic is not a focus of this handbook, it is important to reinforce the notion that some level of thinking is necessary to decide when indicator variables are reaching or

have exceeded the point that the essential meaning expressed in the indicators of quality is no longer acceptable. At what point is an indicator of quality no longer acceptable?

Part Four of the handbook focuses on the critical need to monitor indicator variables over time and provides guidance on doing monitoring as part of ongoing management activities or as specially designed studies.

Part Five briefly illustrates how the handbook could be used in selecting indicators of quality for the visitor experience for a specific park or other outdoor recreation area. In this case, Tettegouche State Park along Lake Superior's north shore in Minnesota is used as the example.

As the primary focus, this handbook is intended to assist managers in thinking about and selecting a range of potential indicator conditions to sustain quality biophysical resources and opportunities for visitor experiences. The worksheets included in the handbook are intended to stimulate critical thinking about the purpose and value of indicators as a way to guide monitoring of biophysical and social conditions of a park or management zone within a park. They also are intended as a means for managers to record their thinking and decision-making processes related to selecting indicators that reflect park purposes, interpretative themes, and other management objectives. Keeping a record of decisions is important to science-based management of natural resources, especially when the science is relatively young. While good records will aid in future identification and selection of indicators as well as means to monitor them, they also will inform managers and researchers of differences in indicator performance across a range of landscapes.

As with any handbook, this handbook cannot make decisions for the manager. Despite the best science, in the end practitioner experience and knowledge about visitor-caused impacts to resources and visitor experiences is the key to selecting indicators that reflect the values of those involved. Using this handbook should help managers reduce some of the uncertainty surrounding their decisions. It also should help managers better weigh and balance the scientific, legal, administrative, political, and budgetary constraints associated with land management decision-making.

This handbook *can*:

- Address selection of biophysical and social indicators to monitor the quality of the resource and visitor experiences.
- Provide a method for identifying and documenting the selection of indicators.
- Provide guidance to developing and implementing a monitoring strategy to track indictor variables.

This handbook *cannot*:

- Provide quick and easy solutions to management problems related to visitor use.
- Solve problems unrelated to visitor use.
- Guarantee 100 percent scientific accuracy of any indicator to adequately address change over time in resource conditions or visitor experiences.

The intended audience for this handbook is state park managers, federal land managers with recreation resource management responsibilities, and non-government organizations and community groups with an interest in sustaining recreation resources.

Context and Rationale for the Handbook

Public land managers increasingly are challenged to meet a dual and seemingly conflicting mission—to protect and sustain natural and cultural resources for future generations as well so to provide high quality experiences for people. More specifically these resource professionals are charged to: (1) prevent abuse and misuse of public lands, (2) study and understand the resource's potential to provide an array of benefits to people and society, (3) anticipate and prevent unwanted impacts to resources and visitor experiences, and (4) provide optimum use of resources while sustaining them ecologically, economically, and socially. Many resource areas, public and private, are threatened by a variety of visitor-caused impacts. For some practitioners the problems have reached crisis proportions. The biophysical environment is being damaged beyond acceptable limits and visitors to these areas no longer attain the enjoyable experiences and benefits they seek.

Resource professionals, planners, and researchers have long wrestled with ways to address visitor-caused unacceptable impacts such as trail and campsite deterioration, crowding, visitor conflicts, noncompliant visitor behavior, and impacts to wildlife, vegetation, and water resources. An extensive and growing body of literature exists that addresses organizational frameworks to guide decision-making concerning recreation use and impacts as well as ways to eliminate or reduce unacceptable visitor-caused impacts (e.g., Wagar 1964, 1974; Lime and Stankey 1971; Stankey and Lime 1973; Lime 1977, 1979, 1996; Driver and Brown 1978; Peterson and Lime 1979; Clark and Stankey 1979; Graefe et al. 1984, 1990; Stankey et al. 1985; Shelby and Heberlein 1986; Cole et al. 1987; Brown et al. 1987; Cole 1989; Kuss et al. 1990; Manning and Lime 1996, 2000; Manning et al. 1996; McCool and Christensen 1996; Vander Stoep and Roggenbuck 1996; USDI, National Park Service 1997; McCool and Cole 1997; Anderson et al. 1998; Hammitt and Cole 1998; Manning 1999; Stein et al. 1999; Anderson et al. 2000; McCool and Lime 2001).

Over the past twenty-five years, carrying capacity has become a useful and guiding conceptual framework to address problems of overused and unacceptably impacted areas. From a park management perspective, carrying capacity provides a way of thinking about how to plan and manage a particular resource. The capacity framework is driven by the notion that *management objectives* define, as specifically as possible, the kind of recreational opportunities or benefits an area is to provide. Fairly broad, narrative statements help define the types of activities that might be provided in the area (e.g., camping, fishing, boating, wildlife watching, and nature study), whether strong consideration will be given to natural feature protection, and whether the area will be developed to serve as many people as possible or to focus on certain kinds of uses such as backcountry camping, horseback riding, hiking, ATV riding and angling. These broad objectives provide an introductory

description of *desired future conditions* for a parks' resources and opportunities for visitor experiences.

Indicators *of quality* are more explicit management objectives that provide a measure reflecting the meaning of the broader objectives. Indicators reflect the types of conditions meant to be provided, such as general use intensity (or appropriate level of solitude) or general degree of naturalness desired. In wilderness, for example, legislative guidance is given that directs managers to provide visitors with outstanding opportunities for solitude.

Minimally acceptable conditions (MACs), often referred to as *standards of quality* in the literature, are increasingly explicit statements of management objectives and reflect the quantitative and measurable conditions of indicator variables. An indicator might be expressed as the number of other parties per day a person could expect to encounter while hiking in the backcountry and not adversely impact the quality of the visitor experience or the percentage of soil surface in a backcountry campsite that is bare ground.

Monitoring of indicator variables at periodic intervals is a critical component in the carrying capacity framework because it aids in determining whether existing resource and social conditions have been violated. Conceptually, when minimally acceptable conditions (MACs) have been reached or exceeded, carrying capacity has been reached.

Building on the carrying capacity framework, the earlier handbook by the authors (Anderson et al. 1998) outlined a decision process to assist managers in analyzing resource and visitor experience problems related to visitor experiences. The process addresses five separate but interrelated stages: (1) problem awareness, (2) problem specification, (3) strategy and tactic selection, (4) plan implementation, and (5) monitoring (Figure 1). Problems are defined as *unacceptable* visitor-caused impacts to biophysical resources and visitor experiences. They include impacts to resources such as trail and campsite deterioration, water and air pollution, wildlife and fishery impacts, and soil compaction (Figure 2). Visitor experience impacts include crowding, visitor conflicts, and noncompliant behavior.

The earlier handbook outlines five general management strategies to address unacceptable impacts:

- Increase the supply of recreation opportunities, areas, and facilities to accommodate demand.
- Reduce use in the entire area, within management zones, or specific sites.
- Modify the character of visitor use by controlling where use occurs, when use occurs, what type of use occurs, and how visitors behave.

Stages in the Decision Process	Potential Resources for Decision-making
1. Problem Awareness • Recognize that unacceptable impacts exist and must be addressed	• Statements of park purposes, significance, primary interpretive themes, and specific resource conditions and visitor experiences to be achieved and maintained over time • Observations of park staff • Indicators and standards of quality • Public input
2. Problem Specification • Identify impact • Describe acceptable impact • Describe existing impact • Determine if existing impact is unacceptable • Identify root cause of impact	• Resource condition and visitor experience data available from: - research - resource use monitoring - public input • Comparison of existing condition with predetermined standard of quality • Public input
3. Strategy and Tactic Selection • Select appropriate strategy • Identify potential tactics • Evaluate and select appropriate tactics	• This handbook • Public input
4. Plan Implementation • Develop implementation plan for selected management tactics - identify specific management actions - identify person responsible for carrying out management actions • Implement actions	• Supervisors, office staff, and field staff determine appropriate tasks and workloads
5. Monitoring • Monitor effectiveness of actions • If problem arises, return to problem specification stage	• Resource condition and visitor experience data available from: - research - resource use data - public input • Comparison of existing condition with predetermined standard of quality • Public input • VERP handbook (USDI NPS, 1997)

Figure 1: Stages in the decision process for maintaining quality park resources and visitor experiences. (*Source:* Anderson, et. al 1998)

Resource Impacts

Trail deterioration, trail erosion, excessive trail muddiness, excessive trail width, excessive trail depth/development of tread ruts or grooves; development of undesired trails.

Campsite deterioration, excessive campsite size, loss of vegetation, erosion of campsite soils, proliferation of tent sites, depletion of dead and downed wood for campfires, proliferation of fire rings; proliferation of campsites.

Cultural resource deterioration, defacement of cultural resources, theft of cultural resources.

Improper disposal of *human waste*, unacceptable amounts of human waste at site.

Water pollution, contamination of water body with fecal material, soap residue, chemical substances, or food and animal remains.

Unacceptable levels or types of *litter*, improper disposal of garbage, unacceptable evidence of humans (e.g., trail markers, cairns).

Trampling of *vegetation*, loss of herbaceous vegetation or seedlings, change in species composition, introduction of exotic species, improper collection of specimens, deterioration of grazing areas, trampling of tree roots, nails in trees, peeling of bark, carving initials/words into bark, felling of live trees.

Soil compaction, erosion of organic litter and soil, excessive muddiness, disturbance of cryptobiotic crusts.

Wildlife and fishery impacts, destruction or loss of habitat, change in species composition, introduction of exotic fauna, harassment or disturbance of wildlife, competition for food sources, attraction of wildlife, illegal hunting or fishing.

Visitor Experience Impacts

Unacceptable levels of *crowding* at attraction sites; unacceptable number of encounters at trailheads, in visitor centers, on trails, or at campsites; congestion, unacceptable traffic conditions on park roads, lack of available parking spaces.

Visitor conflicts due to incompatible uses, encounters with large groups or parties dissimilar to one's own, or rowdiness by itself or in combination with excessive consumption of alcohol, visitor displacement (spatial, temporal, or total).

Noncompliant behavior, vandalism, resource destructive behavior.

Inadequate or inappropriate levels of access to facilities, natural areas, or cultural resources; facility design that fails to accommodate the needs of the broadest possible spectrum of people, including persons with disabilities.

Threats to *visitor safety*, behavior that jeopardizes the safety of the individual or of other visitors, failure to maintain a safe environment through facility design, maintenance, or other means.

Figure 2: Examples of resource and visitor experience impacts. (*Source:* Anderson, et. al., 1998)

- Modify visitor attitudes and expectations.
- Modify the resource base by increasing resource durability or maintaining/rehabilitating the resource.

To address the five strategies, there are numerous management actions or tactics that can be employed depending upon the situation. The handbook suggests five categories of tactics and twenty-nine specific tactics to resolve or diminish existing impacts related to biophysical and social conditions (Figure 3). It also suggests a series of questions the manager should ask when deciding on and selecting appropriate tactics to address visitor-caused impacts (Figure 4).

This companion handbook is targeted toward *preventing* impacts from reaching unacceptable levels or exceeding carrying capacity. Specifically, this handbook focuses on identifying, selecting, and monitoring indicators of quality for biophysical and social resource conditions. Many, if not all, of the strategies and tactics outlined in the 1998 handbook are appropriate and useful management tools to use when initially selecting indicators or when monitoring indicators over time. The need for this type of handbook is best understood when thinking about the continued loss of natural areas to burgeoning populations and development pressures. Public lands continue to experience ever increasing numbers of people engaged in ever changing recreation activities whose short and long-term impacts on the resource and visitor experiences are often not known or are best guesses.

To identify indicators managers must be able to identify potential and/or existing visitor-caused impacts to biophysical and social resource conditions. For indicators to be of use to managers, they also must be able to specify when an impact is *unacceptable* and *significant.* Impacts are unacceptable and significant when the resource condition and/or visitor experience is threatened and may not be sustained *or* when the resource condition and/or visitor experience cannot be sustained.

Some of the most common types of visitor-caused impacts include trail deterioration, trail erosion, campsite deterioration, proliferation of campsites in backcountry areas, water pollution, trampled vegetation, change in species numbers and composition, introduction of exotic species, soil compaction, destruction or loss of wildlife habitat, noncompliant visitor behavior, unacceptable numbers of people on trails, near campsites, and scenic attractions, and incompatible visitor uses (for other examples, see Figure 2). Many of these impacts are linked to one another. For example, trail erosion is often linked to numbers of people using the trail, people walking off the trail, trail widening, trampled vegetation along the trail, loss of plant and animal biodiversity in and near the trail, and increased runoff, which may impact

Tactic Category	Tactics
Site Management	• facility design/redesign • use of vegetation • barriers • increase number of/improve facilities or eliminate • strengthen/harden sites • remove litter and other problems • close area or facilities
Rationing and Allocation	• reservations • queuing • lottery • merit-based application • pricing
Regulation	• location • facility • activity • equipment • mode of transportation • time • number of people/stock/pets • environmental condition • behavior
Deterrence and Enforcement	• signs • sanctions • personnel
Visitor Education	• explain management actions/concerns • distribution of visitor use • encourage/discourage use spatially within area • encourage discourage use temporally within an area • encourage/discourage specific uses

Figure 3: Management tactic categories and associated tactics. (*Source:* Anderson, et. al. 1998)

- Does the tactic adequately address the root cause of the visitor use problem?
- Is the tactic direct or indirect in terms of how it operates on visitor behavior?
- Is the tactic subtle or obtrusive in terms of visitor awareness of being managed?
- Does the tactic preserve visitor freedom of choice?
- Does the tactic affect visitors offsite during the planning stages of their trip? Or does the tactic affect visitors onsite while they are engaged in their recreational experience?
- Does the tactic affect a large or small number of visitors? Are those affected primarily conscientious visitors who are generally not responsible for the impact(s) in question?
- Does the tactic affect an activity to which some visitors attach a great deal of importance?
- Are visitors likely to resist the management action?
- What are the costs to managers in terms of tactic implementation and administration, including facility construction, operation, and maintenance, staff workload, and communication and enforcement costs? Are any of these limiting factors?
- How effective is the tactic likely to be at solving the visitor use problem in question?
- Is the tactic likely to lead to the creation of a new problem?

Figure 4. Selection criteria for management tactics. (*Source:* Anderson, et. al. 1998)

water quality. In some ways it is similar to a chain reaction where one impact sparks another impact.

Addressing impacts independently of one another shows little or no awareness of this chain reaction phenomenon and does little to sustain biophysical conditions or social conditions. Hardening a trail may address trail erosion. But, if the erosion was unchecked for a period of time prior to trail hardening, then trail hardening will do little to avert unacceptable changes in species biodiversity or loss of vegetation along the trail resulting from the number of people using the trail at one time. Indicators should take into account existing impacts, the significance of those impacts, and the relationship of those impacts to one another. If indicators are to be of use to managers, managers must be aware of the linkages among impacts and develop indicators to address all of these impacts. Where little visitor-caused impact has occurred, indicators should be selected to monitor the biophysical or social condition that is most likely to be impacted first.

Identifying and Selecting Indicators of Resource and Experience Quality

Indicators are proxies or measures for management goals and objectives. They reflect the meaning of broader management objectives and are specific, measurable variables that reflect the condition of a resource. Indicators are key to being able to systematically monitor resources and visitor experiences to see whether a park or management zone within a park is being managed for the goals specified in management plans or other guiding documents. The indicators, and their extended minimally acceptable conditions, set the bar of responsibility for management by identifying the amount of change allowed for resource and visitor experience conditions before significant harm is done and management intervention is necessary. For example, what constitutes "opportunities for solitude" or "primarily natural conditions," and how is "solitude" and "primarily natural" measured?

To illustrate these definitions, management might decide that the number of encounters per day visitors have with other parties along trails is a good measure of the "opportunity for solitude." Management's way of quantifying solitude becomes one of perhaps several experiential indicators for a park, management zone, or trail. Research in the park that queries visitors or research from pertinent literature might suggest that once hikers encounter more than five parties per day along trails they no longer experience solitude and the quality of their experience is unacceptable. Therefore, the minimally acceptable condition (MAC) for experiencing solitude could be set at five parties encountered per day on trails or within selected trail management zones.

It should be understood that specifying minimally acceptable conditions is a subjective process. There is no "right" minimally acceptable condition. Such decisions are best made by understanding the tradeoffs and implications of the stated minimally acceptable condition and by using several sources information, including: (1) scientific literature, (2) scientific research, (3) the public through unscientific public involvement, and (4) management judgment (USDI, National Park Service 1997).

Characteristics of good indicators of quality

There are at least eight characteristics that make a good indicator and could serve as primary elements to evaluate potential indicators. They are summarized from the 1997 National Park Service handbook for operationalizing the Visitor Experience and Resource Protection (VERP) management framework (USDI, National Park Service 1997) and Manning (1999).

Specific. Indicators should be specific enough that when monitored they measure whether management objectives (specified, if possible, as minimally acceptable conditions) are within an acceptable condition or exceeded. Soil

erosion would not be a good indicator for the condition of the resource—it is too general. The percentage of the soil surface at a campsite with bare soil is a better indicator because it is specific and could be measured over time.

Objective and measurable. Indicators need to be objective, absolute, and not open to interpretation—thus, not subjective. The number of severely impacted campsites or miles of severely impacted hiking trails are not objective statements and are open to broad interpretation. The indicator needs to be stated in a way so the condition can be quantified and measured consistently by different individuals over time.

Reliable and repeatable. Indicators should be able to be measured repeatedly and should generate similar results when collected by more than one individual.

Sensitive. Indicators should be sensitive to visitor use during relatively short periods of time. As such, indicators should be sensitive to change in a way that serves as an early warning mechanism for visitor-caused impacts. Indicators need to provide warnings of problems before they deteriorate to unacceptable conditions or reach the point where management intervention is impossible or nearly so. For example, disturbance to ground cover vegetation in campsites and other attraction sites usually occurs with relatively small amounts of visitor use, and it has been promoted as an effective indicator for understanding ecological recreation impacts (e.g., Marion 1991).

Related to visitor use. Indicators should have a close association to one or more aspects of visitor use (e.g., amount of use, types of use, location of use, timing of use, and behavior of visitors) if they are to aid in determining when management intervention is necessary to prevent visitor-caused impacts.

Manageable. Indicators should be helpful in determining the effectiveness of management strategies and tactics.

Efficient and effective to measure. Indicators should be relatively easy and cost-efficient to monitor, especially when they need to be monitored frequently and by different field personnel. Care should be taken to select indicators that do not require complex sampling techniques and/or considerable time, equipment, and staff to conduct measurements.

Significant. Indicators need to address the most critical variables that define the quality of biophysical and visitor experience conditions. Indicators should address major issues that will detect changes that help define resource or visitor experience quality. For example, if park visitors engaged in wildlife viewing value solitude or being with few people as more important than the

number of wildlife seen, then an indicator that addresses number of encounters with other visitors may be an especially good indicator to monitor (Vaske et al. 2002).

Selecting indicator variables

An infinite number of potential indicator variables could be identified to address unacceptable visitor-caused impacts. It is not the purpose of this handbook to generate an all-inclusive list of indicators. Such an exhaustive list is neither possible nor productive. It is possible and useful to show a few indicators to illustrate the breadth of potential variables that address both resource and experience quality (Figures 5 and 6).

Indicators can be stated in numerous ways with increasingly specific conditions (Lime 1991). An encounter indicator variable could be expressed in general, such as "number of people per day encountered on trails." Encounters also could be specified for certain trail settings or locations (e.g., frontcountry trails, backcountry trails, and remote backcountry trails), by visitor groups (e.g., large groups and small groups, hiker and ATV rider groups, and groups with pets and groups without pets), and/or with respect to management zones (e.g., frontcountry, campgrounds in frontcountry, and backcountry).

In discussing and selecting indicators of quality, it is useful to initially identify a large number or range of potential indicators. The purpose, for example, would be to review their important influence on visitor experiences and to suggest ways they might be specified. Presenting a type of condition (e.g., meeting other groups) in more that one way (e.g., actual number or groups encountered or dissatisfaction with encounters) allows the analysts to discuss which expression of the indicator is most important and relevant to their management situation. For example, two possible ways to express "meeting other groups on trails" and "meeting other groups at campsites" as an indicator are:

- Number of groups encountered per day while hiking on a trail by mode of travel (hikers, motorized groups) for individual trails or groups of trails (management zones).
- Percentage of groups (by mode of travel or other categories) dissatisfied with their encounters with other groups while hiking on a trail for individual trails or groups of trails (management zones).
- Percentage of groups finding it difficult to find a vacant campsite for individual camping areas or groups of campsites (management zones).
- Median (or mean) time of day that groups set up camp for individual camping areas or groups of campsites (management zones).

- Percentage of occupied campsites within sight or sound of other occupied campsites for individual camping areas or groups of campsites (management zones).
- Percentage of groups finding it difficult to find a high quality campsite for individual camping areas or groups of campsites (management zones).

A variety of criteria can be used to evaluate and select indicators, but focusing on the eight characteristics of good indicators noted above can aid in comparing possible candidates. One useful way to evaluate and prioritize possible indicators would be to develop a matrix in which a combined score is assigned for potential indicators in response to indicator characteristics (Worksheet 1). As many potential indicators could be evaluated as deemed necessary by analysts.

Total park area
- Percent of park area disturbed by facilities and development (buildings, campgrounds, roads, etc.)
- Exotic/nonnative plant species distribution and density over the entire park

Soil impacts
- Degree of soil compaction measured a certain distance from a trail centerline
- Average soil crust index value for a 100-meter transect
- Percentage of the soil surface at a picnic or campsite with bare ground (bare mineral soil)
- Cross-sectional area of net soil loss on trails
- Percent of park trail system with severe erosion

Vegetation impacts
- Number of exposed tree roots exceeding a certain diameter within a picnic site or campsite
- Presence and distribution of exotic species along trails and at facilities

Water impacts
- Average concentration of selected nutrients in water (e.g., nitrates, phosphates, sulfates)
- Fecal coliform count (streptococci ratio) in water
- Presence of herbicides and pesticides in water

Air quality impacts
- Ambient concentration of selected chemicals in the air in developed facilities (e.g., sulfur dioxide, nitrogen dioxide, ozone)
- Air visibility affected by presence of particulate matter, photochemical oxidants, etc.

Wildlife impacts
- Distribution of selected wildlife & fish species sensitive to the presence of humans
- Absence of selected wildlife and fish species sensitive to the presence of humans
- Population trend for wildlife species associated with probable human causes

Figure 5. Potential indicators of quality for biophysical conditions in parks.

Site impacts

Type or amount of litter seen on a trail (or at other locations)
Type/amount of graffiti or other evidence of depreciative behavior by people
Type/amount of vegetation loss and bare ground around a picnic site or campsite
Number of trees around a picnic site or campsite damaged by people
Percent/number of trees within sight of the campsite damaged by people
Number/size/appearance of campfire rings made by visitors
Number of occurrences of unburied human or pet feces
Amount/type of social trails along developed trails, walking areas, waterways, roads
Evidence of motorized vehicle use on nonmotorized trails

Encountering wildlife

Number or type of wildlife seen

Sound and air quality impacts

Type or amount of noise experienced from people within the area
Type or amount of noise experienced that originated outside the area
Visibility of lights origination outside the area
Visibility of the dark night sky
Number of airplanes seen flying overhead per day

Encountering people

Total number of people seen on the trail per day (or specified time period)
Total number of people present at one time (PAOT) at an attraction site
Number of visitor groups seen at attraction sites related to time present there
Number of hiker (or other types) groups seen on the trail per day
Number of large groups (8 or more people) seen on the trail per day
Number of hiker groups with pets seen on the trail per day
Percent of the time other people are in sight while hiking on the trail per day
Total hours of the day other people are in sight while hiking on the trail
Number of hiker groups camped within sight or sound of my campsite each night
Percent or number of nights on trip that other groups were camped within sight or sound
Number of hiker groups that walk past the campsite per day while I am there
Number of visitor groups leaving or returning to trailhead or launch site
Minutes waiting to leave the trailhead or launch site
Number of vehicles seen at the trailhead or launch site
Minutes waiting to view an attraction site, enter a facility or the park
Percent of camper parties having difficulty finding vacant campsites
Percent of visitors who lack outdoor activity skills

Encountering vehicles, horses, development, management activity

Total number of ATVs (or other types of motorized vehicles) seen per day
Number of ATVs (or other types of motorized vehicles) seen on the trail per day
Number of ATV groups camped within sight or sound of my campsite each night
Total number of horse groups seen per day on the trail
Number of signs per mile on trails
Number of regulatory signs posted beyond trailheads
Number of manager-created structures seen per day
Number or frequency of park rangers seen in the area per day
Level or quality of trail maintenance seen per day

Figure 6. Potential indicators of quality for visitor experience conditions in parks.

Worksheet 1: Scoring potential indicators

Indicator	Characteristics of Good Indicators								Summary Score[c]	Rank[d]
	Specific *(N/Y)*[a]	**Objective and measurable** *(N/Y)*[a]	**Reliable and repeatable** *(N/Y)*[a]	**Sensitive** *(L/M/H)*[b]	**Related to visitor use** *(N/Y)*[a]	**Manageable** *(N/Y)*[a]	**Efficient and effective to measure** *(N/Y)*[a]	**Significant** *(L/M/H)*[b]		
Biophysical										
e.g. ,Trampled vegetation at Palisade Head staging area										
Social										
e.g., Encounters with hiker groups on frontcountry trails										

[a] (N/Y) = No / Yes. Score "no" = 1. Score "yes" = 2.
[b] (L/M/H) = Low / Medium / High. Score "low" = 1. Score "medium" = 2. Score "high" = 3.
[c] Sum of values entered in columns 2 through 9 for each row. The range of scores possible for each indicator is 8 to 18. The higher the score the "better" the indicator.
[d] Once a summary score is found for each indicator, rank order the biophysical indicators from highest to lowest and the social indicators from highest to lowest.

The Role of Minimally Acceptable Conditions in the Carrying Capacity Planning and Management Framework

Although the focus on this handbook is on indicators of quality and monitoring indicator variables, it is important to reinforce the notion that some level of critical thinking is necessary to decide when indicator variables are approaching or have exceeded the essential meaning expressed in the indicators of quality. At what point is the condition expressed in the indicator of quality no longer acceptable?

Minimally acceptable conditions (MACs), often referred to as *standards of quality* in the literature, are increasingly explicit statements of management objectives. They reflect the quantitative and measurable conditions of indicator variables, such as the number of other parties a person could expect to encounter while hiking each day in the frontcountry and not adversely impact the quality of their experience—or the percentage of soil surface in a backcountry campsite that is bare ground.

As applied in the carrying capacity literature, MACs are specific, quantified measures of indicator variables that specify when conditions have been reached or exceeded. They define minimally acceptable conditions in unambiguous terms and are meant to be easily understood and interpreted by resource administrators and stakeholders. Figure 7 illustrates several biophysical and experiential indicators of quality and MACs and how the specificity increases from indicators to MACs.

Managers frequently want maximum flexibility in deciding when "unacceptability" is reached or exceeded. How specific MACs are and how they are used is dependent on the management philosophy for the agency or functional unit using the carrying capacity framework. To implement the capacity framework, the park staff needs clarity. For MACs to be useful they must at a minimum be a written expression, even if somewhat ambiguous, concerning when the condition associated with an indicator is no longer acceptable and management intervention is required. Without this minimum specification, management staff cannot implement the carrying capacity framework and have no means by which to identify unacceptable impacts to visitor experiences and biophysical resources.

It is simply not appropriate when using a carrying capacity framework (e.g.,VERP or LAC) to: (1) state an indictor, such as "number of other parties encountered on a hiking trail per day," (2) monitor numbers of encounters hikers have on trails, and (3) upon reviewing the data, arbitrarily decide if the reported encounter rates are acceptable or unacceptable. In this scenario, while some specificity of management objectives has occurred concerning what opportunities for solitude will be provided for hikers on trails, no quantifiable measure has been developed that can be monitored to determine if the condition lies within acceptable limits. Further decisions about

Examples of Indicators and MACs for Resource Conditions

Indicator	The percentage of the soil surface at a campsite with bare ground
MAC	60% of the soil surface at a campsite is bare ground
Indicator	The degree of soil compaction measured 5 feet from a trail center line
MAC	80% of the soil surface samples exhibit 50% of the porosity of a relatively undisturbed site
Indicator	The average soil crust index crust value for a 100 meter transect
MAC	The average soil crust index for a transect is 4
Indicator	The number of exposed tree roots exceeding 2 inches in diameter, measured within 6 feet of a trail edge for 100 feet of a trail
MAC	20% of tree roots are exposed relative to a control area

Examples of Indicators and MACs for Social Conditions

Indicator	The percentage of parites that can camp out of the sight or sound of other parties in the backcountry
MAC	70% of parties report that they could cam out of the sight and sound of other parties
Indicator	Number of people seen at one time at Shovel Point
MAC	90% of visitor over the course of a year see no more than 50 people at one time
Indicator	The number of people encountered along a trail per day over the course of a year
MAC	80% of visitors over the course of a year encounter no more than 10 people per day along the trail
Indicator	The traffic congestion during peak visitor use days
MAC	Roadways do not exceed level D service for more than 10% of peak use days
Indicator	The waiting period required to see an attraction during peak use days
MAC	No more than 10% of visitors wait 10 or more minutes to see the attraction

Figure 7. Examples of indicators and minimally acceptable conditions (MACs). (Modified from USDI, National Park Service 1997.)

management to reduce or not reduce hiker use on trails to preserve quality visitor experiences would be met with skepticism and probing questions about the context and basis for management actions—or a lack thereof.

In cases where managers are reluctant to specify minimally acceptable conditions in very specific, definitive ways, a MAC might be stated in fairly general ways—such as "in a backcountry setting, hikers would meet few other groups of hikers while traveling on the trail per day" or "few camper parties had difficulty finding vacant campsites." Managers could assess camper reports in various management zones concerning visitors' ability to camp "alone." Data generated from such monitoring could allow managers to discuss whether conditions are acceptable and to decide if greater specificity of minimally acceptable conditions is appropriate.

Another approach to the example above would be to express MACs as a *range* of acceptable conditions rather than as a very general statement or a single, definitive number. For instance, the MAC might be stated as: "in a backcountry setting, hikers would meet no more than 6-10 other parties while traveling on the trail per day." While it is not clear what the MAC is for backcountry, it does present a much clearer statement than "few." It also provides managers with flexibility in deciding when a site or management zone is experiencing an unacceptable situation. Staff discussions, and possibly more stakeholder dialogue, should aid in exploring plans for dealing with conditions if, through further monitoring, they worsen.

To aid discussion concerning minimally acceptable conditions for indicator variables, Worksheet 2 would allow analysts to write down MACs for each indicator variable. Space allows for several MAC entries for each indicator variable and facilitates the notion of generating a range of narrative statements or specific, quantitative statements. Displaying potential ways to express the meaning of minimally acceptable conditions should aid managers in selecting a MAC that park staff can "live with" and one that can be implemented managerially and can be presented successfully to stakeholders.

Worksheet 2. Selecting minimally acceptable conditions (MACs) for indicator variables.

Indicator variable	Narrative and quantitative statements of Minimally Acceptable Conditions (MACs) for each indicator variable

Monitoring Indicators of Resource and Experience Quality

Monitoring represents a system to measure various aspects of human activity that impacts both biophysical resource and visitor experience conditions in a given area (e.g., park, management zone, and specific site). This component of the carrying capacity framework is decisively critical in that it fulfills the essential responsibility of management to find out if management objectives and goals are being met or have deteriorated. Such measurements, in affect, evaluate quantifiably whether existing conditions are acceptable (i.e., within minimally acceptable conditions). If conditions are deteriorating, and close to, or have reached an unacceptable situation, monitoring will aid in directing decision-makers to take ameliorative actions.

In addition to allowing managers to document the status of resource and experiential conditions, monitoring provides important feedback on the effectiveness of management actions to address unacceptable conditions. Monitoring also provides managers with defensible information regarding actions taken to ameliorate impacts. Without such measurements, and especially without trend data, practitioners have limited data to defend what they do.

Arguably perhaps, monitoring is the most underestimated component of the carrying capacity framework. Monitoring is *not* an add-on! It is not an extracurricular activity that is separate from the overall process. Experience has shown that monitoring needs to be thoughtfully considered *during the formulation* of indicators and discussions about minimally acceptable conditions, *not after* they are agreed upon (Hof and Lime 1997). Monitoring is very dependent on the way in which indicators, for example, are defined. Monitoring cannot occur without a clear understanding of what needs to be measured and in what context (Lime and Lewis 1996).

Monitoring strategies and plans need to be of sufficient breadth to permit periodic and systematic replication. Procedures need to specify location, frequency, and timing of measurements as well as other specific instructions. How to analyze and display monitoring data also is critical. What to do with the data collected is dictated by the nature and context of the indicators and minimally acceptable conditions outlined in the carrying capacity planning document(s). Estimated costs of accomplishing the monitoring activities are critical as well. Further, plans should specify the individuals responsible for data collection, analysis, and reporting activities.

Institutional support is critical in all aspects of conducting carrying capacity planning and management, but it is especially important in monitoring to achieve buy-in from all levels of the management system that are responsible for dealing with visitor-caused impacts. Implementation of such frameworks can require substantial investments in employee training as well as data

collection and analysis. And monitoring, by its very nature, necessitates long term commitments for success. If an agency or area manager does not have the commitment and resources to monitor indicators and to take action when conditions are not within acceptable limits, then why engage in the carrying capacity framework in the first place (Hof and Lime 1997)?

There is a need to prioritize where and when monitoring occurs. A variety of limitations will necessitate that monitoring indicators of quality cannot be conducted everywhere in the park. And, all indicator variables selected for monitoring cannot be monitored at each location selected for monitoring. In general specific monitoring activities occur in management zones or specific locations where visitor-caused impacts are of greatest concern. As general guidance, monitoring should occur where: (1) indicator variables are at or violate minimally acceptable conditions, (2) conditions are changing rapidly, (3) specific and critically important park values are threatened by visitation, and (4) the effects of management actions are unknown (USDI, National Park Service 1997).

How to monitor indicators of quality

It is not the intent of this handbook to offer specific procedures on monitoring resource and experiential indicators of quality. The intent is to help readers become aware of the breadth of experience and published literature on monitoring and offer some suggestions concerning the development and implementation of monitoring programs.

The indicator variable being monitored, the site, the nature of the use to be monitored largely dictate how to monitor indicators of quality as well as the financial, equipment, time, and personnel resources directed to the effort. Numerous methods for monitoring exist and often more than one source is necessary to accomplish objectives. These methods include: (1) original research with scientific rigor, representativeness, and hypothesis testing—both biophysical and social research; (2) public involvement; (3) permit systems; (4) self-registration systems; (5) counting and observation equipment such as traffic counters, cameras, aerial photography, and remote sensing; (6) visual observations by managers, volunteers, or visitors; and (7) informal dialogue between agency staff and stakeholders.

There are numerous publications that provide general guidance as well as detailed instructions on how to monitor indicators (USDI, National Park Service 1997). More has been written on inventorying and monitoring ecological impacts of visitor use (e.g., Cole 1983, 1987, 1989; Cole and Marion 1988; Merigliano1990a; Marion 1991, 1995; Belnap 1998; Farrell and Marion 1998; Leung and Marion 2000) than on monitoring social and visitor use conditions (e.g., Martin 1990; Merigliano 1990b; Lime 1991; Roggenbuck

et al. 1993; Lime and Lewis 1996; Ashor 2000; Manning and Lime 2000). Readers are encouraged to obtain some or all of the above publications and use them to help structure a monitoring program that addresses their specific needs.

Selecting a monitoring strategy that fulfills the needs for a park can be accomplished by individuals or staff groups with responsibilities for monitoring or through more interactive activities that include collaboration from several functions or disciplines at a park. Seeking input from monitoring experts to discuss options, review plans, or conduct the monitoring per se should be considered as well. A team approach was used successfully at Arches National Park in southeast Utah during the past decade to develop a carrying capacity plan (VERP) and implement a monitoring program (USDI, National Park Service 1995). Arguably perhaps, the best monitoring plans will be developed and implemented through a process in which an interdisciplinary team convenes to review the scope and intent of the carrying capacity effort and to sculpture monitoring activities based on the combined experience found in the literature and the expertise of field personnel.

Given the trend toward reduced park staffing and budgets, the idea of implementing monitoring programs is indeed challenging. In addition to seeking new funding sources, parks will need to find ways to leverage assistance from new and current programs, use volunteers, seek matching funds, and forgo expenditures or activities on new plans. For many parks it makes sense to begin by monitoring a very limited number of indicators and to use the simplest and most economical monitoring procedures available. Furthermore, more or better indicators may evolve following additional monitoring.

The literature to conduct evaluation and monitoring of ecological impacts of visitor use has provided standardized procedures to measure a variety of impacts including trampling and subsequent loss of ground vegetation, shrubs, tree seedlings, and felling of saplings; erosion of surface litter and humus; exposure, erosion, and compaction of mineral soil; and, exposure of tree roots and damage to tree trunks. Procedures for conducting resource inventory and monitoring include photographs from permanently referenced photo points, condition class assessments, and measurement-based assessments of impact indicators (Cole 1989b; Marion 1991). These and other techniques have been field-tested and can be easily implemented or modified to fit most resource impact problems. Most of the methods have been applied to both frontcountry and backcountry campsite and trail situations.

Observation, comment cards, and informal dialogue with visitors can be very effective methods to monitor numerous social indicator variables. And they

can be very inexpensive to implement. Observation has been used successfully to monitor visitor behavior regarding a variety of issues including depreciative behavior, encounters with other visitors, and travel patterns of visitors moving along trails or waterways. Observing how visitors react spatially and verbally to being in various human density situations in park settings has provided useful data concerning congestion and visitor encounters. Comments cards can be used for informal or formal feedback from visitors, and they can cover numerous topics (e.g., Vogel and Titre 1997). They can be especially useful in identifying issues and concerns of visitors about park resources and in assessing the quality of services provided in the park. Comments cards can be formal and serve as a scientific survey, handed out following a systematic sampling plan (e.g., Lime and Lewis 1996). They also can be distributed through a purposive rather than random sampling procedure at entrance stations, visitor centers, or by park staff. With formal or informal approaches, visitors can return the cards in person to staff, deposit them in collection receptacles in the park, or mail them back.

Dialogue with visitors also can be informal or formal. Informal dialogue between park staff and visitors allows staff to probe visitors about salient issues of concern to park management and to seek feedback on indicator variables. It can be especially helpful in highlighting problems and can act as an early warning to predict future conditions. Dialogue with visitors also has been used successfully in visitor centers in which staff query a sample of daily visitors about their visit to the park and probe on certain questions affecting the quality of their experience.

To extend limited resources, monitoring can be implemented in different parts of a park using a rotation or tiered system. More monitoring, for example, could be scheduled for areas or sites where conditions were at or rapidly approaching minimally acceptable conditions. Less critical areas could be monitored on a less frequent basis. Or, as another alternative, approximately twenty percent of all trails or trailheads in a park could be monitored each year. With this schedule each location would be monitored about every five years. The point is that monitoring protocols can be tailored to the indicator variables to be monitored and the apparent level of impact or degree of change they are thought to be receiving.

Worksheet 3 can be used to assist in determining if the park has the resources to monitor selected indicators. Here the analyst lists various indicators from Worksheet 1 (i.e., in ascending order from highest to lowest rank) in column one of Worksheet 3. The analyst then determines the feasibility of monitoring each indicator based on costs, time, and staff expertise and enters these data in the appropriately marked columns. The last column provides a space for the analyst to document how data was determined for cost, time, and staff

Worksheet 3: Selecting the indicators to monitor.

Instructions: In the first column list the indicators from Worksheet 1 according to rank order.

	Feasibility of monitoring					
Indicator variables	**Cost to monitor / time period**	**Time required to monitor**			**Staff Expertise**	**Notes**
		Getting to the site	**On site**	**Survey [a]**		
Biophysical						
e.g. Trampled vegetation at Palisade Head staging area						
Social						
e.g. Encounters with other groups						

[a] Relevant only to social indicators where surveys are used to collect data. The time required should include the time needed to conduct mailings and follow-up mailings, enter the data, and analyze and interpret results.

columns. While exact data probably are not realistic, informed judgment and experience should permit the inclusion of acceptable figures to see data patterns and make decisions. Highest-rated evaluations, in combination with ratings from Worksheet 1, should aid greatly in deciding which indicators to use for monitoring over time.

Tettegouche State Park, Minnesota: An Illustration of How the Handbook Can be Used to Select Indicators of Quality

In 2003, a team of Minnesota Department of Natural Resources staff and research colleagues explored the Visitor Experience and Resource Protection (VERP) planning framework for application in the Minnesota State Park System. The test case for this effort was Tettegouche State Park in northeastern Minnesota. Much of the direction was to recommend monitoring and management activities directed at five major resource areas and four visitor experience zones that characterize the park.

In the Tettegouche pilot project, the VERP framework was used to identify and prioritize visitor-caused impacts. It was further used to help select management strategies to mitigate leading impacts. The project concluded with a workplan—a workplan that is expected to be carried out—for targeting further effort on leading impacts. In short, VERP was used to help organize thinking around the topic of visitor-caused impacts to resources and visitor experiences.

The VERP framework was not used, however, to develop standards (minimally accepted conditions) and monitoring systems to evaluate compliance with those standards. The development of standards and monitoring systems is more time-consuming and costly than simply using VERP to identify indicators of visitor-caused impacts to resources and visitor experiences. It requires that the implementing organization make firm commitments to the maintenance of standards and to the maintenance of the monitoring systems to judge compliance with standards. The DNR Parks and Recreation Division was hesitant to make such financial and organizational commitments, and decided instead to use VERP as a planning tool for identifying indicators of quality. This decision was made at the start of the project by both the project work group and the Division Management Team, and the decision is reflected in the initial workplan written to carry out the project. Clearly, the Division has interest in the use of VERP as a planning tool, but is ambivalent about a more extensive use of VERP at this time.

Meetings with park staff were used to identify resource areas in the park: (1) cliffs, (2) wetland and aquatic habitats, (3) old forests, (4) cultural sites, and (5) developed areas where vegetation is heavily managed to accommodate high visitor use. Once the zones were developed, staff identified specific impacts to each of the resource areas, potential indicators (Worksheets 1 and 2), and actions to take if minimally acceptable resource conditions are not met (Worksheet 3) (see T. Kelly. 2003. *Tettegouche State Park VERP Pilot Project: Summary Report*). Two significant types of impacts related to visitor use were identified for four of the resource zones (i.e., cliffs, wetland and aquatic habitats, old forests, and developed areas). They were: (1) impacts caused by trampling of vegetation and (2) impacts caused by the introduction of aggressive non-native plant species. Methods to measure, mitigate, and

monitor these significant impacts were identified. Ways to mitigate unacceptable conditions were identified using the companion handbook, *Maintaining the Quality of Park Resources and Visitor Experiences* (Anderson et. al. 1998). Staff time and expertise as well as the costs involved will determine the level and type of mitigation and monitoring that is undertaken (Worksheet 3).

Impacts related to cultural resources included damage to structures and artifact theft. Neither of these impacts was considered significant at this time. However, methods to measure, mitigate, and monitor change in cultural resources also were identified. If overtime, changes become significant, park staff will have a place to begin in deciding what actions to take to maintain acceptable conditions.

Visitor surveys were used to identify visitor perceptions of impacts to visitor experiences and resources. The surveys were conducted during the high-use summer season in 2003 and provided useful input to identifying potential indicators of quality of the visitor experience (Worksheet 1). Visitor surveys were conducted in each of the four park areas or possible visitor experience management zones: (1) frontcountry, (2) campgrounds within the frontcountry, (3) backcountry, and (4) Tettegouche Camp. Three frontcountry attractions were targeted in the frontcountry survey—High Falls, Shovel Point, and Palisade Head. Frontcountry campgrounds included drive-in, walk-in, and cart-in sites. Tettegouche Camp is located in the backcountry and is an illustration of the rustic log architecture popular of Minnesota's early twentieth century resorts (see T. Kelly and R. Sushak. 2003. *Tettegouche VERP Related Visitor Survey Results* for more on survey methods and results—sample sizes, response rates, etc.)

Survey results provided useful input into the identification of indicators of quality of the visitor experience. Especially useful was one question that probed the perceptions of park visitors on visitor-caused impacts (biophysical and social) that detracted from their experience. Respondents were asked how much (if at all) a list of 25-35 items detracted from quality of their experience to Tettegouche. The number of items in the survey was dependent on the visitor group contacted/management zone.

Park conditions and issues that visitors felt detracted from the quality of the park experience focused on several broad categories of issues including: (1) impacts due to trampling in backcountry and frontcountry—visitor-caused erosion in cliff areas, along water, trail deterioration and widening, hiker-created nondesignated trails (social trails), and ATV-created nondesignated trails and erosion in backcountry, (2) number of encounters among visitors at attractions in frontcountry, (3) number of encounters between hikers and motorized vehicles in backcountry, (4) evidence of motorized vehicles on

nonmotorized trails in backcountry, (5) number of RVs and other large camping units encountered by tent campers in campgrounds, (6) level of noise in campgrounds experienced by tent campers, and (7) length of the walk into Tettegouche from parking areas. Note that the detractors varied among management zones and among visitor types, and the nature of detractors spanned a variety to biophysical and social park conditions and issues.

Dialogue among members of the study team prioritized the various conditions and issues that were important visitor-caused impacts to visitor experiences and selected three types of impacts that suggest the "most significant" impacts. Further dialogue can focus on developing specific indicators of quality for each impact type and specifying minimally acceptable conditions for each indicator, as well. The "most significant" types of impacts are: (1) trampling in the frontcountry and backcountry, (2) number of people encountered in the frontcountry, and (3) number and evidence of motorized vehicles in the backcountry. As with impacts to resource zones, ways to measure, mitigate, and monitor significant impacts to these social indicators were developed (Worksheets 1and 2). Staff time, expertise, and costs will determine the level and type of mitigation and monitoring undertaken (Worksheet 3).

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Appendix A:

Identifying Visitor Caused Impacts to Park Resources and Visitor Experiences

Prior to developing indicators of quality for park resources and visitor experience opportunities, the park manager needs to think through and identify the visitor caused impacts to resources and/or visitor experiences that currently affect park management. Once these impacts are identified and understood, the process of identifying indicators can begin.

The material in this appendix is designed to do two things:

- Guide the process of identifying visitor caused impacts to resources and visitor experiences, and
- Inform the process of identifying indicators of quality resources and visitor experiences

This appendix is organized around the problem identification and strategies and tactics to address visitor caused problems to resources and visitor experiences process outlined out in *Maintaining the Quality of Park Resources and Visitor Experiences* (Anderson et al. 1998) and borrows heavily from it. This publication can be found on the following website: http://www.cnr.umn.edu/CPSP.

This appendix is specifically designed for Minnesota Department of Natural Resources Division of Parks and Recreation planning and park management staff. It is intended as an aid to:

- explicitly stating park values,
- providing an agreed upon sense of direction,
- prioritizing work,
- standardizing and formalizing a planning and management approach across parks/regions,
- documenting actions, and
- learning from one another.

The result of using the process outlined should be data relevant to developing annual work plans and resource plans for parks. The busier the planner or manager, the more likely they will have something to gain from using the material in this appendix. However, the process described should be useful to any natural resource area planner or manager addressing visitor caused problems to resources and visitor experiences.

Identifying visitor-caused problems

Does the park have problems with visitor-caused impacts to resources or visitor experiences? If not, this process will not help you. If yes, then this process is intended to help prioritize what visitor-caused impacts are most important in a park and what management actions can be taken to address them.

Thinking about resources:
Identify where high quality resources occur:

- Natural communities
- Cultural sites
- Restoration sites
- Listed species

Thinking about people:
Identify where people go and what experiences they have and/or seek:

- What areas of the park or facilities are they using?
- What experiences are they seeking?
- Did their experience match their expectations?

Experience zones of the park
Looking at the park from the perspective of visitor experiences—general division into frontcountry and backcountry areas of a park.

Sub-zones for some parks:

- Frontcountry—motorized and nonmotorized
- Backcountry—high encounter and low encounter

Division of the park into the two zones is based on several things including encounters with others, type of access (motorized or nonmotorized), and facilities present (few or many). At Tettogouche State Park, Minnesota, wher this process was developed and piloted, the resulting discussion set out four zones:

- Frontcountry—motorized (high number of encounters, motorized access, and many facilities provided)
- Frontcountry—nonmotorized (relatively high encounters, no motorized access, and fewer facilities provided)
- Backcountry—high encounter (expect to encounter groups, no motorized access, and few or no facilities provided)
- Backcountry—low encounter (encounter few or no other people, no motorized access, and few or no facilities provided)

Keep these zones in mind for later discussions of impacts and potential management objectives—what are we trying to achieve for resource values, what should people expect to see/do here, what management actions are appropriate for this part of the park? These questions along with other questions are relevant when selecting management actions (Worksheet A3).

Using the worksheets

In this section, four worksheets are identified to help planners and managers organize their thinking around visitor caused problems. Worksheets A1, A3, and A4 are borrowed from *Maintaining the Quality of Park Resources and*

Visitor Experiences (Anderson et al. 1998). Worksheet A2 was created to assist the planner or manager in thinking through the significance of problems and their impacts identified in Worksheet A1. Realistically all impacts cannot be addressed and agency resources probably should not be spent on those that are insignificant. Worksheet A2 focuses the planner or manager's attention on significant impacts that must be addressed if quality resources and visitor experience opportunities are to be provided.

Worksheet A1– Problem Identification

Identifying situations where visitors are impacting park resources or the experiences of other park visitors. *(A park may have multiples of Worksheet A1—one worksheet for each identified problem area.)*

Statement of the Problem (top of page):

This is broad topic that may show up in multiple ways throughout the park (several impacts to resources or experience).

Example from Tettegouche pilot project: *Trampling of vegetation*

Specific impacts related to the problem (first column):

Examples from Tettegouche pilot: *Loss of ground cover vegetation, braided trails, widened trails*

Existing impacts (second column):

Are these impacts widespread, related to certain areas or facilities, are they seasonal, etc.?

Is existing impact acceptable, approaching unacceptable, or unacceptable—mark one.

This is the first step in prioritizing visitor-caused impacts.

Root cause:

Ideas here form the basis for discussion of management actions (Worksheet A3). Examples of root causes could include: too many people visiting a site, no signage guiding visitors (e.g., *fragile plant communities—please stay on trails* or *overlook ahead—please follow trail*.)

Past or current efforts:

Recognizing past and current work priorities and the success or failure of these efforts helps to guide selection of management actions (Worksheet A3). Is what we are doing now working and we just need to continue/do more of it? Have our past efforts helped some but have other problems cropped up somewhere else? Have the past efforts not worked and do we need to try something different?

Worksheet A2 – Prioritizing Impacts

The purpose of this worksheet is to prioritize the all the visitor-caused impacts identified for the park. Impacts are separated from the associated problem statements and all impacts are ranked together. A park will use only one Worksheet A2.

Which impacts are prioritized?

Significant impacts or those identified as "unacceptable" on Worksheet A1 should be brought forward. Forwarding those marked "approaching unacceptable" should be also considered depending on the number of total impacts identified in all Worksheet A1's for the park. The selected impacts from Worksheet A1 are transferred to the two impact columns at the left side of the worksheet.

Each impact is ranked twice—one based on the importance of the resource or experience impacted, and one based on the feasibility of addressing the impact.

Prioritizing impacts—importance of resource/experience impact:

A ranking of 1 to N is assigned to the impacts. Criteria for this ranking can include:

- Quality of resource impacted (natural community, listed species)
- Extent of resource impact (throughout park, extensive in limited area)
- Impacts large number of visitors' experiences
- Impacts key experience park is managing to provide

Prioritizing impacts—feasibility of addressing impact:

Two criteria are included in this ranking:

- Cost to address/monitor (based on cost and resources needed to address the impact)— "can we afford it?" (columns 2-5)
- Staff expertise/knowledge —"do we know how do it?"

A ranking of 1 to N is assigned for the impact based on the two criteria.

Which impacts are the highest priorities?

The two rankings—importance of impact and feasibility of addressing impact—measure different things and are not easily converted for a numeric or other like comparison. The potential tradeoffs between importance of the impact and feasibility of addressing are unavoidable. Park planning and management staff will need to determine how to balance the two rankings when determining which impacts are the highest priority for this specific park. Staff then rank the impacts from 1 to N based on all the input from Worksheet A2.

Worksheet A3 – Choosing Management Actions

Having identified and ranked the visitor-caused impacts, management actions are now chosen to address the significant impacts identified in Worksheet A2. Even though, budgets, time, and personnel may limit the park's ability to address all significant impacts, management actions for all significant impacts should be identified. Doing so may identify links between management actions for several impacts, which may be identified during this process. As a result, knowledge gained by addressing one impact may benefit knowledge of another impact and allow for design of management actions to address multiple impacts in cost-effective ways.

The zoning discussions from the beginning of the process play an important part in choosing strategies and management actions for addressing visitor-caused impacts. Visitors will have different expectations (and staff will be comfortable with different solutions to problems) depending on the recreation opportunities (activities and experiences) provided and the capability of the resource to sustain those opportunities. Think about choosing management actions that support the type of setting and experiences being provided (e.g., remote or easy access, solitude or high use, primarily natural surroundings, or areas with park facilities and other improvements.)

One Worksheet A3 is completed for each impact ranked in Worksheet A2.

Statement of Problem (from Worksheet A1):

Re-establishes the link between the overarching problem and impact.

Impact (from Worksheet A2):

Transferred from Worksheet A2—one per Worksheet A3.

Check the strategies you believe are the most likely to resolve the problem:

Choosing a strategy or strategies is part of recognizing the overall philosophy of the agency in addressing certain types of problems. Several strategies may be appropriate to address different aspects of the problem. Keeping these strategies in mind will help staff in the next step to identify acceptable management actions for those park units or specific areas within a park.

Check management actions:

Staff identifies which management actions will be used to address the problem. Several management actions can be used together, for example visitor education strategies can be used to complement many of the other strategies. Staff should select all of those tactics that will be combined to address the problem, as well as provide comments on those currently used or used in the past.

Worksheet A4—Implementation and Evaluation

This worksheet has two parts:

- documenting an implementation outline for addressing the impact, and
- evaluating the success or failure of the chosen actions to address the impact.

Worksheet A4 helps staff document the results of the VERP process and being planning for projects or other efforts to address visitor-caused impacts. The second half of the worksheet provides staff with a tool for evaluating how well the management actions chosen and implemented worked in addressing the problem. This worksheet can be completed soon after the project implementation or as part of the process of preparing the annual work plans or resource plans for the following year.

Implementation:

Management actions selected: Actions selected on Worksheet A3 should be transferred into this column on the far left of the worksheet.

Person responsible: Who will be leading the project or will be responsible to see that actions are implemented? More than one person could be identified if several different people will be collaborating on the design or implementation of the project.

Timeframe/frequency to implement: If it is project-type action, when will it be put in place? Other actions may need to be conducted throughout the year, as needed or on a regular schedule.

Evaluation:

Problem resolved? Yes or no, or is this an ongoing issue that needs to be monitored?

More time, more effort, or new action needed? Is this the correct management action but is a longer time period needed to fully address the issue? Is the action correct but do not effort/resources need to be put toward it to fully resolve the issue? Did this action fail and does a different or additional management action need to be implemented to resolve the problem?

How will this information be used?

As part of the annual work plans and resource plans:
Information from this process is intended to plug directly into the process for developing annual work plans and resource plans. This process only addresses one part of the work plan and resource plan process. The intent of the VERP process is to help formulate and document visitor-caused impacts and how they can be addressed. The impact rankings and management actions will be brought into the work plan and resource plan as another piece of information for prioritizing staff time and resources allocation at a park.

Monitoring and evaluation:
Progress on visitor-related impacts can be monitored and evaluated in the same way other work projects are reviewed during the development of succeeding annual work plans and resource plans. New strategies can be selected if the previously chosen ones are ineffective. Staff can include additional visitor-related impacts in future work plans as higher priority ones are successfully addressed. Starting over with the VERP process is not necessary unless staff identify new visitor-caused impacts not considered in the previous process.

Process—how do we get this done?

Workshop format

The process can be conducted in a workshop format, with two meetings of the group to complete the worksheets and prepare the outcomes to be included in the annual work plans and resource plans:

- First meeting—introduce the process. Begin identifying problems and impacts (Worksheet A1), prioritizing impacts (Worksheet A2), and selecting management actions (Worksheet A3).
- Second meeting—review worksheets and discuss integration of results into work plans.

A third meeting could be scheduled to evaluate the VERP process, specifically how well it fit into the other work plans and what results were achieved. This meeting would be conducted before beginning the following season's work plan and resource plan discussions.

If several parks are beginning the process at one time, the first meeting could be conducted as a multiple-park session. Also, if several parks within a region are starting, these parks could go through the process together.

Who is involved in the process?

Staff from Central Office, the region and the park will be involved in the process. Possible staff include:

- Central Office—a planner to serve as guide/facilitator
- Region—RPOS, resource specialist (or area resource specialist), and regional naturalist.
  - Involving the RPOS will aid in linking the results to annual work plans.
  - Involving resource staff will provide important resource information and a link to resource plans.
  - Involving the regional naturalist would link to visitor education efforts.
- Park—park manager, assistant manager, park resource specialist, park naturalist

Timing—when should it be done?

The VERP process should be completed in time for its results to be included at the beginning annual work plan and resource plan processes.

Worksheet A1: Problem Identification

Statement of the Problem:

Specific impacts related to the problem	Existing impact (include when and where it occurs and how much of it occurs)	Is existing impact:			Root cause of unacceptable impact or why impact is approaching unacceptable	Past or current efforts to address impacts
		acceptable	approaching unacceptable	unacceptable		

Adapted from Anderson, Lime & Wang. 1998. *Maintaining the Quality of Park Resources and Visitor Experiences: A Handbook for Managers.*

Worksheet A2: Prioritizing Impacts

Prioritizing Impacts: importance of resource/experience impact

Impact (biophysical or social)	Rank	Notes

Prioritizing Impacts: feasibility of addressing impact

Impact (biophysical or social)	Cost to address /monitor	Time required to monitor			Staff expertise/ knowledge	Rank	Notes
		Getting to the site	On site	Survey*			

* Relevant only to social indicators where surveys are used to collect data. The time required should include the time needed to conduct mailings and follow-up mailings, enter the data, and analyze and interpret results.

Adapted from Anderson & Lime. 2004. *Identifying and Monitoring Indicators of Visitor Experience and Resource Quality: A Handbook for Recreation Managers, Minnesota Department of Natural Resources.*

Worksheet A3: Choosing Management Actions

Statement of Problem (Worksheet A1):

Impact (Worksheet A2):

Check the strategies you believe are the most likely to resolve the problem:

_____ Modify the character of use by controlling where use occurs, when use occurs, what type of use occurs, and how visitors behave.
_____ Modify the resource base by increasing resource durability, maintain/rehabilitating the resource.
_____ Increase the supply of recreation opportunities.
_____ Reduce use in the entire area, or in problem areas only.
_____ Modify visitor attitudes and expectations.

Check management actions you believe are related to the strategies you selected above and you think are most likely to resolve the problem:
(For detailed explanation of each tactic, see Anderson, Lime & Wang *Maintaining the Quality of Park Resources and Visitor Experiences, pgs 29 to 120)*

Management Actions	**Comments/Notes**
Site Management (Handbook pgs 29 to 50) _____ provide facilities and structures _____ use vegetation to rehabilitate, shield, or screen area _____ use physical barriers _____ increase (decrease), improve (not improve), or eliminate facilities _____ strengthen/harden sites _____ remove litter and other problems _____ close area or facilities	
Rationing and Allocation (Handbook pgs 51 to 72) _____ limit access using reservations _____ limit access using a first-come-first-serve (queuing) system _____ limit access using lotteries _____ limit access using merit/eligibility system _____ charge fees	

Check management actions you believe are related to the strategies you selected about and you think are most likely to resolve the problem (continued):

Management Actions	Comments/Notes
Regulation (Handbook pgs 73 to 100) _____ restrict access to specific locations (zoning) _____ restrict use/behavior at facilities _____ restrict/prohibit activities _____ restrict/prohibit equipment _____ restrict/prohibit modes of travel _____ limit length of stay _____ limit group size/stock/pets _____ restrict/prohibit use to protect environmental conditions	
Deterrence and Enforcement (Handbook pgs 101 to 110) _____ provide signs _____ sanction visitors who engage in noncompliant behavior _____ provide personnel and law enforcement	
Visitor Education (Handbook pgs 111 to 120) _____ educate visitors about appropriate behaviors _____ educate visitors to alter use patterns _____ educate visitors to alter expectations*	

* Not discussed in Handbook - refers to efforts made during trip planning and at park to inform visitors of conditions that may affect their experiences (ambient noise, number of people to be encountered, available facilities or amenities, trail conditions, other trail uses, etc.)

Adapted from Anderson, Lime & Wang. 1998. *Maintaining the Quality of Park Resources and Visitor Experiences: A Handbook for Managers.*

Worksheet A4: Implementation and Evaluation

Statement of Problem (Worksheet A1):

Impact (Worksheet A2):

Implementation			**Evaluation**		
Management actions selected	**Person responsible**	**Timeframe/ frequency to implement**	**Problem resolved?**	**More time, more effort, or new action needed?**	**Comments**

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