

FIRE ECOLOGY AND MONITORING

1 Introduction

This chapter provides policy direction for monitoring of wildland fires, fire effects, and fuels treatments. In addition, this chapter provides direction and guidance relating to adaptive management and general programmatic requirements for the fire ecology program. The information contained within this chapter will evolve as changes in national direction are defined and as new scientific information becomes available.

The National Park Service's fire management program has grown in scope and complexity over the past decade. Changes in federal policy, new political initiatives, and increased planning requirements have all resulted in a greater need for scientific information that supports fire management activities. In recognition of this need, the NPS has made the commitment to fund (within the existing budgetary allocation) national, regional and field-level fire ecologists and fire effects monitors. These fire ecologists and fire effects monitors provide scientific capabilities for collecting, analyzing, and interpreting fire effects monitoring data so that fire ecology information and monitoring results can be used for adaptive management.

The goals and objectives for wildland fire (wildfire and prescribed fire) and non-fire fuels treatments can vary widely from park to park as well as from project to project within a park. Monitoring provides an avenue for evaluating whether management goals and objectives are being met and whether undesired effects are occurring. When goals and objectives are not being met, monitoring data can be used to facilitate management changes. This practice is part of the adaptive management cycle that the NPS fire management program uses to improve land management practices. A primary role of the NPS fire ecology program is to support fuels and fire management by using monitoring data, in conjunction with professional knowledge and judgment, to provide scientific guidance and feedback that supports adaptive management and the assessment of treatment effectiveness.

2 Responsibilities

2.1 National Level

The national office will:

- Provide leadership in the NPS and interagency fire community on policy and practices, budget, and fire ecology issues.

- Support the development and implementation of the NPS Wildland Fire Strategic Plan.
- Provide assistance to regions and parks on fire ecology related matters, including policy and budget interpretation, position management, planning, monitoring, and program reviews.
- Promote the effective use and sharing of fire effects data.
- Facilitate communication and coordination between wildland fire and resource management programs.

2.2 Regional Level

The regional office will:

- Provide assistance on fire ecology related matters, including policy and budget interpretation, standard operating procedures, position management, planning, and monitoring.
- Review and approve fire monitoring plans and new monitoring protocols for parks and networks.
- Review and approve park [National Fire Plan Operations and Reporting System \(NFORS\)](#) monitoring request entries.
- Facilitate communication and coordination between NPS wildland fire and resource management programs at the park and regional level.
- Assist parks with shared resources, contracts, and agreements.
- Schedule and perform reviews of park fuels and ecology programs.
- Work with other NPS regions, the national office, and other agencies and organizations to develop and implement policy and practices.

2.3 Park Level

The park will:

- Support land management decisions and practices with science-based expertise.
- Articulate ecologically sound objectives to strengthen and facilitate the land management planning process.
- Collect, analyze, report, and interpret fire effects data for managers.
- Utilize fire ecology information for adaptive management.
- Facilitate communication and coordination between the park-level wildland fire and resource management programs.
- Complete [NFORS](#) monitoring request entries.

2.4 Fire Ecology Program Personnel Roles and Responsibilities

(See [Exhibit 1](#) in the NPS Integrated Resource Management Applications (IRMA) Data Store)

Fire ecology program personnel consistently collaborate with many other program personnel, not only in planning, but also in project development, implementation, and evaluation. Specific descriptions of responsibilities by position are listed in [Exhibit 1 - Roles and Responsibilities](#) found on the NPS Integrated Resource Management Applications (IRMA) Data Store. The lists are not exhaustive but are intended to clarify roles and responsibilities in relation to the requirements outlined in this chapter. Responsibilities will vary among parks, and unit-level fire management plans that address local definitions of roles and responsibilities should be the first place to seek out clarification. Fire ecologists and fire effects crews typically provide their services to a number of parks. The group of parks for which a fire management officer is responsible may not coincide completely with the areas covered by the fire ecology program personnel, although overlap is common.

3 Monitoring For Adaptive Management

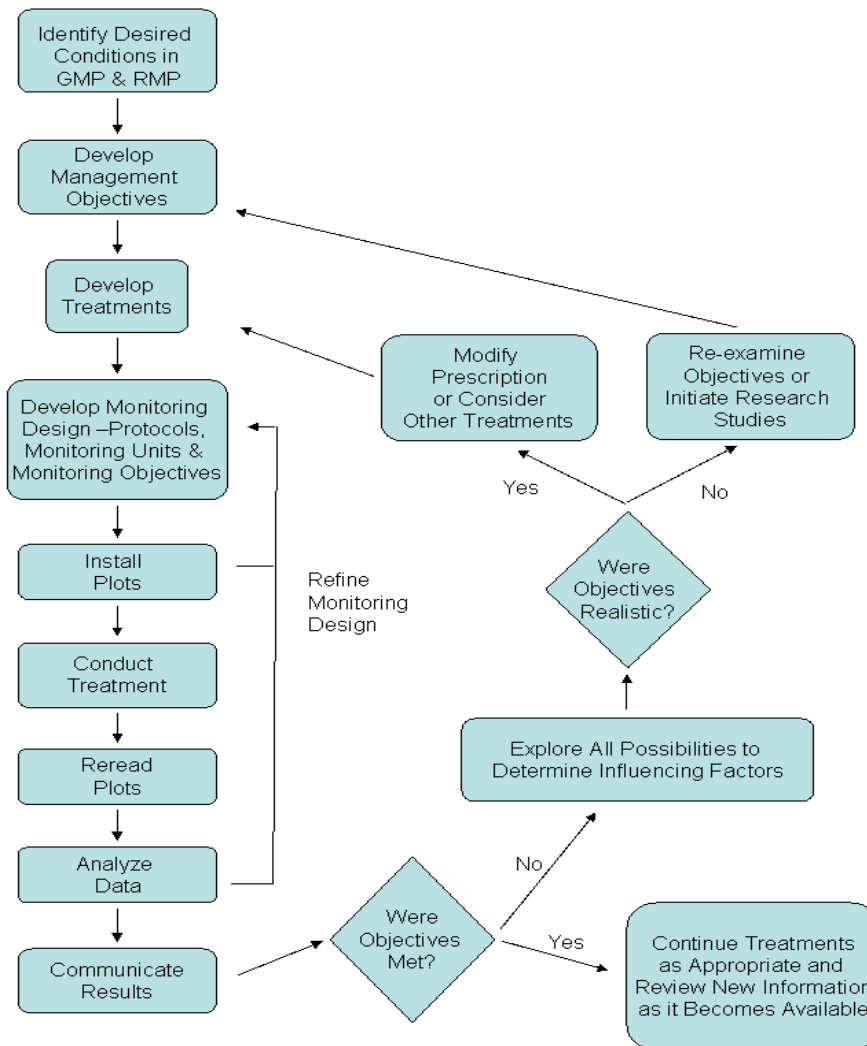
3.1 Adaptive Management

Adaptive management is a system of management practices based on clearly identified objectives in conjunction with monitoring to determine if management actions are meeting those objectives. In cases where objectives are not being met, adaptive management is intended to facilitate management changes that will ensure that desired outcomes are met or to facilitate re-evaluation of the desired outcomes. As described in the Fuels Management chapter in *RM 18*, adaptive management is an iterative process requiring continual evaluation of results to determine whether the ongoing treatments are appropriate or whether they need modification. Monitoring data provide the basis for adaptive management by allowing managers to determine whether objectives are being met or whether undesired effects are occurring.

Figure 1, elaborates on the role of monitoring in the adaptive management process. Quantitative and measurable management objectives and proposed treatments with specific prescriptions are developed in fire management plans (FMPs) and/or associated documents. These prescriptions are based on desired conditions described in higher level planning documents. A monitoring design derived from the management objectives is developed and includes defined monitoring units (what is being monitored and where), monitoring protocols (how and when monitoring is conducted), and monitoring objectives (why). The monitoring design is implemented prior to the proposed treatment through the establishment of plots, or through other appropriate monitoring techniques (such

as photo point documentation). Monitoring continues following the treatment. Analysis of monitoring data compares the post-treatment conditions with the pre-treatment conditions to assess whether the management objectives of the treatments are being met. Results from the analyzed monitoring data must be communicated to park resource and fire management staff so they can examine the results and evaluate the progress being made towards meeting objectives.

FIGURE 1. Monitoring for Adaptive Management



If management objectives are being met, then treatments may continue as appropriate to achieve desired conditions. If management objectives are not being met, the following questions should be addressed:

- Are the objectives realistic?

- Should there be changes made to the treatment prescriptions?
- Are there other management actions that should be taken in conjunction with the prescribed fire or treatment?
- Could other management actions be more effective at meeting objectives?
- Is additional research needed?

Adaptive management requires continual evaluation. As the monitoring is conducted and data are analyzed, refinements to the monitoring design may need to be made. Results from data analysis should be incorporated into planning documents. Objectives and treatments must also be re-evaluated as new information from research and other sources becomes available.

There are several elements that are critical to successful implementation of adaptive management.

1. Goals and Objectives: Clear goals and objectives are the foundation of adaptive management, and their creation takes critical thinking and analysis. Well-written goals and objectives can provide long-term guidance to park managers and staff, help integrate science, and improve management practices.

Guidance on definitions and development of goals and objectives can be found in [Adaptive Management: US Department of the Interior Technical Guide](#), the NPS [Fire Monitoring Handbook](#), and [U.S. Fish and Wildlife Service website](#).

2. Monitoring Design: A monitoring program must be designed around objectives, and the monitoring design must be able to determine whether the short-term, long-term, and desired conditions are being met. The design should be multi-faceted, statistically valid, and able to produce results in a timely manner.
3. Data Analysis and Quality Control: Monitoring data should be analyzed in a timely manner with an appropriate level of quality control.
4. Communication: Monitoring results and any applicable new research should be communicated on a pre-determined periodic basis to all internal and external stakeholders and more frequently to fire and resource management staff. Formal presentations are encouraged to initiate a discussion of “closing the loop.”
5. Evaluation: Based on these communicated results, fire and resource managers should closely examine the program and evaluate how

management should be adjusted or determine whether further research is needed.

3.2 Communication

Communication is crucial for adaptive management to work effectively. An important function of the Fire Ecology Program is to communicate with NPS fire staff, other NPS staff, the interagency community, and the general public. Analysis of monitoring data and its communication through reports, presentations, and informal discussion is a primary goal of the fire ecology program.

Fire ecologists should work with NPS fire communication and education staff to assist with communication of results and success stories. Articles may be submitted to fire ecology and fire management newsletters, scientific journals, and popular publications. Communication should not be limited to written reports and articles, however, but should include utilization of intranet and internet websites and presentations at scientific meetings or more informal gatherings.

3.3 Reporting

Official fire monitoring reports are critical not only for adaptive management, but also for a number of other purposes including the following:

- Communicating results to park fire and resource staff
- Providing accountability to regional and national offices
- Communicating results to the scientific community
- Presenting success stories and failures to NPS staff, the interagency community, non-governmental organizations (NGOs), and the general public

Two types of annual reports are required for each fire ecology program: park reports and national reports.

Park fire ecologists should prepare and present an annual monitoring report for each park that they support. The format and timing for such reports is flexible and should be geared towards the needs of the parks. However, the reports should include a summary of monitoring activities from the year, results from data analysis, interpretation of data in the context of adaptive management, and discussion of the degree to which prescribed fire, wildfire, and non-fire treatment objectives are being met. The report should also document the results from any meetings where feedback was provided. In addition to these written reports, annual presentations should be made to park staff to facilitate open discussion of the results and possible changes in management based on the data.

A second annual report should be prepared for the regional and national offices. The objective of this report is to provide accountability for funds expended and to inform the regional staff of programmatic accomplishments. The annual reports are due by the end of January. The regional/national reports may be identical to the park reports, or they may include additional information as requested by regional staff. Regional/national annual reports are posted to and stored on the [Integrated Resource Management Applications \(IRMA\) Portal](#).

In addition to annual reports, ecology program staff are encouraged to create informal reports throughout the year summarizing site visits and/or describing and evaluating individual project implementation.

3.4 Internal and External Reviews

Internal and external reviews should be conducted periodically to ensure that fire ecology programs are efficient and effective, and that all aspects of the adaptive management model are functional. There are three types of reviews that are conducted: fire management program reviews, fire ecology/fire effects monitoring program reviews, and regional fire management program reviews.

When fire management program reviews are conducted on a park's program, at least one ecologist should be a member of the review team, and the fire ecology/fire effects monitoring programs should be evaluated along with all other aspects of the fire management program.

In between fire management program reviews, the regional fire ecologist should conduct periodic reviews of fire ecology/fire effects monitoring programs. This review should focus more closely on collection of monitoring data, data management, monitoring results, and communication of results. A review team consisting of other specialists may be appropriate for these reviews. The review team should rely on the [Park Level Fire Program Review Template](#).

Regional fire ecology programs should be reviewed every five to seven years. These reviews are part of the regional fire management program review and will be led by the fire ecologist from the Fire Management Program Center (FMPC) with an interdisciplinary review team that may consist of at least one of the following: resource manager, fire management officer, fuels specialist, superintendent, park fire ecologist, regional fire ecologist, or fire researcher.

Park and regional level fire program review templates can be found in the [NPS Wildland Fire Program Review Guide](#).

4 **Fire Monitoring**

Monitoring of wildland fires and non-fire fuels treatments is the primary way of assessing whether the fire program is meeting management goals and objectives for hazardous fuels reduction, ecosystem restoration, and maintenance of ecosystem integrity. Information gathered during fire monitoring is essential for decision making, and it provides documentation and an administrative record of fire activities. The information gained through monitoring serves to increase the knowledge of fire effects and fire behavior on park lands. Additionally, monitoring provides a feedback loop for adaptive management that allows fire managers to improve prescriptions and fire plans based on the new knowledge gained from field measurements. For effective adaptive management, monitoring must be based on and designed to assess both short- and long-term objectives.

The NPS [Fire Monitoring Handbook](#) provides the core background information for fire effects monitoring program design, sampling, and implementation. Formal handbook updates are approved by the NPS Regional/National Fire Ecologists and posted to the website as needed. Park units starting new fire monitoring programs are encouraged to first consider the NPS [Fire Monitoring Handbook](#) standard protocols to see if these protocols meet the needs of the new program before a decision is made to pursue other protocols.

4.1 **Fire Monitoring Level Definitions**

The NPS [Fire Monitoring Handbook](#) provides a recommended guideline for monitoring fire or treatment effects within a framework of four monitoring levels:

- Environmental (Level 1)
- Fire Observation (Level 2)
- Short-Term Change (Level 3)
- Long-Term Change (Level 4)

The first two monitoring levels provide information to guide fire management strategies for wildland fire and fuels management. Information collected on environmental conditions and fire observations are generally required for pre-suppression planning and fire reporting, and are usually collected by fire operations or fuels management personnel. This information also provides baseline data necessary to understand fire effects.

Monitoring for short- and long-term change is generally confined to fuels and vegetation monitoring but can be expanded to address other natural or cultural resource concerns.

The need for timely short-term fuels-treatment monitoring results to guide management may call for project-level monitoring designs in addition to those based on park-wide vegetation/fuels complexes.

General definitions and overview of the monitoring levels are provided below. Section 4.4 outlines the recommended level of monitoring based on fire management activities.

4.1.1 Level 1: Environmental Monitoring

This level of monitoring provides baseline data that is collected in preparation for the fire season or prescribed fire projects. Environmental monitoring data provide the background information needed to make fire management decisions. The following are examples of environmental data that may be collected by fire management:

- Local weather data
- Fire danger rating
- Fuel conditions (i.e. fuel type, fuel load, plant phenology, fuel moisture)
- Values-at-Risk

4.1.2 Level 2: Fire Observations

Fire observation monitoring provides a basic overview of the physical aspects of a fire event or fuels management activity. The following are examples of monitoring variables; the level of data collection may vary with the fire management activity:

- Fire cause, fire location, fire date
- Fire or project size
- Fuels and vegetation description
- Fire regime and condition class
- Current and predicted fire behavior
- Current and forecasted weather
- Smoke volume and movement

4.1.3 Level 3: Short-Term Change

Monitoring for short-term changes provides information on the immediate or short-term effects of a fire or fire management activity, at a level sufficient to evaluate whether stated project or program-level management objectives are achieved. For example, management objectives may be reducing the fuel load by 20 tons per acre, maintaining mean overstory tree density to within 10% of pre-burn conditions, or reducing the average

total non-native species cover by 50-75%. Monitoring provides information on identified variables of interest either in a specific predefined vegetation and fuel complex (monitoring type or monitoring unit) or for a specific project. Data are collected through sampling of permanent monitoring plots, temporary plots, Composite Burn Index (CBI) plots (see section 4.3, Burn Severity Assessments, for more information), or photo points. Monitoring is implemented at varying intervals—pre-burn, during the burn, and immediately post-burn—and continues for up to two years post-burn. Level 3 monitoring data must be managed appropriately for effective long-term storage and use (see section 4.9, Data Management, for more information).

4.1.4 Level 4: Long-Term Change

Monitoring for long-term change involves identifying the long-term effects of management activities that can be used to guide management decisions. Long-term monitoring of prescribed fire in pre-defined vegetation/fuel complexes is required to document that overall programmatic objectives are being met and undesired effects are not occurring. It may entail the continuation of Level 3 monitoring over a longer period. Monitoring frequency is based on a predefined interval appropriate to both the vegetation and fuels complex and the anticipated duration of treatment impacts. Level 4 monitoring data must be managed appropriately for effective long-term storage and use (see section 4.9, Data Management, for more information).

4.2 Fire Regime and Condition Class Assessments

Current National Park Service guidance stipulates that each fuels project entered into the [National Fire Plan Operations and Reporting System](#) (NFPORS) have a Fire Regime and Condition Class (FRCC) assessment completed prior to implementation ([LANDFIRE FRCC](#)). A post-treatment assessment must also be completed to document any change in FRCC resulting from project implementation.

4.3 Burn Severity Assessments

Initial and extended burn severity assessments are a nationally approved NPS fire effects monitoring protocol. The information these assessments provide can meet the criteria defined by levels 2, 3, or 4 monitoring depending upon the extent to which the assessments are conducted.

National Park Service (NPS) units in which a single fire has exceeded 500 acres should request an assessment of burn severity through the U.S. Geological

Survey (USGS) EROS National Burn Severity Mapping Project website. NPS units should also consider requesting burn severity assessments for single fires 300 to 500 acres in size, or multiple fires that exceed 500 acres. USGS EROS has developed an online request form to facilitate this process. For instructions on how to complete a request, go to Exhibit 2 and on the [NPS Data Store](#). Remote sensing and field methods for burn severity and a general overview of burn severity mapping are available at the <https://mtbs.gov>. The requesting unit does not have to pay for the burn severity assessment.

Fires greater than 500 acres in the East and 1000 acres in the West are automatically mapped by Monitoring Trends in Burn Severity (MTBS). Mapping of these fires are expedited by completing a request through the National Burn Severity Mapping Project website. The request helps Monitoring Trends in Burn Severity/USGS EROS mapping staff by providing a fire perimeter and a NPS point of contact that can address any questions that may come up during the mapping process.

MTBS addresses the need to quantify fire effects on public lands in order to develop an archive of fire history. The goal of MTBS is to monitor fire effects using standardized geographic databases employing consistent measures of burn severity, which is defined as the magnitude of ecological change caused by fire.

4.4 Fire Monitoring Requirements by Fire Management Activity

The following section describes the specific monitoring requirements for all fire management activities. Table 1 outlines the minimum required monitoring level for each fire management activity.

TABLE 1. Minimum required monitoring level for each fire management activity.

Management Activity	<i>Minimum Required Monitoring Level and Activities</i>
Wildfire	Levels 1, 2 Request burn severity assessments for fires > 500 acres
Prescribed Fire	Levels 1, 2, 3, 4 ¹ Request burn severity assessments for fires > 500 acres
Non-Fire Treatments	Documentation of treatment prescription, location, objectives, and evaluation of results (see section 4.4.3)

¹ Long-term monitoring is required if monitoring addresses prescribed fire programmatic objectives.

4.4.1 Wildfire

Requirements

Levels 1 and 2

- Data necessary to satisfactorily complete a Wildland Fire Report for wildfires.
- Data necessary for decision support tools.
- Burn Severity Assessments for single fires exceeding 500 acres.
Consider requesting a burn severity assessment for forested and shrub-dominated areas with fires between 300 and 500 acres.

Recommendations

- CBI plots for field validation of burn severity mapping.
- Post-burn survey to inspect for exotic plant species invasion or expansion.
- Post-burn short- or long-term monitoring plots in areas of sensitive species, rare/unique vegetation types, or vegetation types where the effects of fire are not well known.
- Consultation with cultural resources staff evaluating the need for post-burn surveys.
- Determination of whether any non-fire (research, resource management, Inventory and Monitoring, etc.) program plots or projects were impacted; consider re-measurement of any previously established plots.

4.4.2 Prescribed Fire

Requirements

Levels 1 and 2

- Data necessary to satisfactorily complete a Wildland Fire Report for prescribed fires.
- Data necessary to satisfactorily complete a Prescribed Fire Plan and immediate Post-Burn Report.
- Burn Severity Assessments for single fires exceeding 500 acres;
consider requesting burn severity for forested and shrub dominated areas with fires between 300 and 500 acres.
- Data necessary to satisfactorily complete pre- and post-burn FRCC assessment.

Level 3

- Data necessary to determine the immediate or short-term effects of a fire or fire management activity, at a level sufficient to evaluate whether stated management objectives were achieved.
 - These data are collected through sampling of permanent monitoring plots, temporary plots, or photo points using protocols defined in the NPS [Fire Monitoring Handbook](#) or other protocols approved at the regional level (see section 4.5, Protocol Development and Approval, for further information).
 - **Note:** Plots are not required in each specific project, but the monitoring program should include representative data for each key vegetation and fuel complex with specific objectives (monitoring type) in the park prescribed fire program.

Level 4

- Data necessary to determine the long-term effects of fire management activities that can be used to guide management decisions. Long-term monitoring is required if monitoring addresses prescribed fire programmatic objectives.
 - These data are collected through sampling of permanent plots. This may entail a continuation of Level 3 monitoring activities at a frequency appropriate to both the vegetation and fuels complex and the anticipated duration of treatment impacts.

Recommendations

- Post-burn survey to inspect for exotic species invasion or expansion.
- CBI plots for field validation of burn severity mapping.

4.4.3 Non-Fire Treatments

Increased emphasis on risk reduction in the wildland urban interface (WUI) has resulted in an increasing number of non-fire treatment projects within the NPS. Non-fire treatments include manual, mechanical, chemical, and biological controls to manipulate vegetation and/or remove fuels to change fire behavior and/or reduce the likelihood of ignition or fire spread. The Fuels Management chapter in *RM 18* describes the process for planning and implementing non-fire treatments. Documentation of non-fire treatment activities is required in [National Fire Plan Operations and Reporting System \(NFORS\)](#). Currently, the minimum required data for monitoring non-fire treatments needed for NFORS are completion of required fields, Management Objectives Tool questions, and Fire Regime and Condition Class (FRCC) pre- and post-treatment.

Non-fire fuels treatments must be monitored for pre- and post-treatment conditions at a level sufficient to determine whether the objectives of the treatment were met (see requirements below). Examples include photo point documentation or establishment of pre- and post-treatment monitoring plots. The fuels specialist or fire management officer (FMO), fire ecologist, and resource staff should determine the level and type of monitoring needed based on the scope, complexity, and size of each treatment or combination of treatments. Non-fire treatment monitoring must be included in the park fire monitoring plan.

Requirements

- Documentation of treatment prescription.
- Documentation of treatment location using geographic information system (GIS) layers or maps.
- Data necessary to fill out [NFPORS](#) documentation, including FRCC for the project area pre- and post-treatment.
- Pre-and post-treatment monitoring to determine if the management objectives were met (e.g., photo points, monitoring plots).

Recommendations

- Post-treatment survey to inspect for exotic plant species invasion or expansion.
- Fire behavior modeling to demonstrate treatment effectiveness in reducing risk.

4.5 Protocol Development and Approval

Monitoring protocols document the sampling design, methods, frequency, and analysis for a monitoring program. Descriptions of all monitoring protocols in a park are documented in the park's fire monitoring plan and may include a single protocol or sets of protocols. Currently, the only nationally approved NPS fire ecology program protocols are those described in the NPS [Fire Monitoring Handbook](#) and those developed for burn severity mapping. Additionally, the NPS Inventory and Monitoring Program is developing standard protocols for monitoring, which may include protocols for monitoring fire effects. However, the NPS Fire Ecology Steering Committee has not approved these protocols to be used nationally.

There are two levels of approval for new protocols: regional and national. At the regional level, the regional fire ecologist approves the written protocol proposal. Approval at this level signifies acceptance of the protocol for use at the park,

network, or regional level. Once a protocol is approved, the monitoring plan should be updated to include the new protocol.

At the national level, protocols are approved through the NPS Fire Ecology Steering Committee. The committee may approve the protocols themselves or may form task groups that include outside reviewers to provide recommendations to the committee.

Park units should use monitoring protocols and monitoring designs that best measure whether short- and long-term objectives are being met. They should first consider the NPS [Fire Monitoring Handbook](#) standard protocols, because these protocols were developed for use in many vegetation types and to address a wide range of fire and resource management objectives. However, other protocols and designs may be developed and utilized if they better meet the program's objectives. Determination of appropriate protocols or the use of new protocols should be included in the development or revision of the fire monitoring plan.

Parks that choose to develop or use protocols not found in the NPS [Fire Monitoring Handbook](#) need to document the protocol and receive approval at the regional level. The decision to use other documented monitoring protocols or to develop new protocols should be conducted with input from park fire and resource managers, park scientists, the regional fire ecologist, the regional vegetation specialist, interagency or academic scientists, and other local experts. Pilot sampling should be considered to ensure the efficacy of the protocols and monitoring design. A written protocol proposal is required as outlined below and must be submitted to the regional fire ecologist for approval. When regional approval is received, the monitoring plan must be updated to include the new protocol. Protocol requests should include the following:

- Justification of the need for the new protocol and description of how the new protocol meets monitoring objectives.
- List of the target variables identified that directly measure objectives described in park fire and/or resource management plans.
- Detailed description of field methods to be used.
- Description of statistical tests to be used to analyze the data and determine minimum sample size needed to measure whether objectives are being met.
- Description of the repeatable plot location process and location documentation for permanent plots.

The NPS [Inventory and Monitoring Program Protocol Tracking](#) website also maintains a list of protocols and is a useful reference.

4.6 Project Monitoring

The monitoring methodology outlined in the NPS [Fire Monitoring Handbook](#) is based on the monitoring of vegetation across *Monitoring Types*. Monitoring Types are areas of the landscape defined by similar vegetation, fuels, treatments, and objectives that often encompass multiple prescribed fire units. A limitation of this methodology is that it is not designed to discern whether the short-term management objectives identified in a prescribed fire plan were achieved by a single treatment.

In instances where immediate results are needed to evaluate the effectiveness of a treatment, monitoring protocols may be developed that specifically address whether treatment objectives are being achieved. Because time and energy spent assessing the short-term effects of treatments may detract from addressing longer-term park-wide objectives, the fire ecologist will work with fire management staff to determine the appropriateness of project-specific monitoring.

4.7 Coordination with Park and Network Monitoring Efforts

Fire effects monitoring is one of numerous monitoring activities that may occur within a park. The NPS Inventory and Monitoring (I&M) Program consists of networks of parks that monitor a wide range of natural resources within parks. Moreover, resource management staff in individual parks may conduct specific types of monitoring.

Fire ecologists must coordinate with park and network staffs who are conducting monitoring. The degree of coordination will vary by program, but at a minimum the various monitoring programs should communicate with one another to ensure that there are no potential conflicts in their monitoring activities or treatments. More intensive coordination may entail the sharing of data or the sharing of personnel and resources.

Coordination is also necessary to avoid potential conflicts with treatments. For example, fire ecologists should work with exotic plant management teams to coordinate timing of prescribed fire and mechanical treatments to maximize effectiveness of treatments.

4.8 Fire Monitoring Plans (see [Exhibit 2](#) in the NPS Integrated Resource Management Applications (IRMA) Data Store)

Monitoring is a critical component of fire management because it is the primary means of assessing whether the fire program is meeting management goals and

objectives. All NPS units applying prescribed fire, managing wildfire for multiple benefits, or altering the arrangement of wildland fuels for the purpose of modifying fire behavior must prepare a fire monitoring plan or plans. The fire monitoring plan describes in detail how monitoring will be conducted. It identifies the reasons for monitoring, and it specifies the objectives, methods, locations, and frequency of monitoring. The fire monitoring plan is an appendix to the fire management plan. Fire monitoring plan(s) can be developed concurrently with the fire management plan or independently; in either case, it needs to be completed prior to managing fire for multiple benefits, or the initiation of prescribed fire or non-fire fuels treatments.

For units without prescribed fire programs or who are not planning to manage wildfires for multiple objectives, the decision regarding whether a fire monitoring plan is necessary should be made collaboratively by the regional office fire staff, the unit fire staff, and the unit resource management staff. This decision should be revisited over time as the program evolves. In lieu of a separate fire monitoring plan, parks that use only protection as a management strategy and suppression or aggressive perimeter control as a tactic may follow the guidance for monitoring and evaluation found in their respective fire management plans and in the descriptions of Level 1 and 2 monitoring in the NPS [Fire Monitoring Handbook](#). The fire monitoring plan should work in concert with monitoring plans that are developed by the NPS Inventory and Monitoring (I&M) Program, as well as with any other monitoring occurring in the park and with park neighbors. Some examples of fire monitoring plans can be found on the [Fire Ecology SharePoint](#) site.

In the event of Burned Area Emergency Response activities, the BAER plan will incorporate monitoring strategies specific to the BAER treatments. These may be, but are not required to be, incorporated into the monitoring plan.

There are several different fire monitoring plan format options: park monitoring, community monitoring, and project monitoring (see [Exhibit 2](#) for the elements of the different monitoring plans which can be found on the NPS Integrated Resource Management Applications (IRMA) Data Store). The decision of what type of plan or plans to develop and maintain will be made by the park/network fire ecologist and the FMO and/or Fuels Specialist, with guidance and approval from the Regional Fire Ecologist. Park/network fire management staff should collaborate with park resource managers, local network Inventory and Monitoring Program personnel, and adjacent parks and land management agencies, as appropriate, to develop monitoring plans. Peer review of fire monitoring plans by the NPS, other agencies, NGOs, and academic scientists in the disciplines of vegetation, fire ecology, and monitoring is strongly recommended. The fire monitoring plan should be viewed as a living document. It should be updated regularly as new information becomes available through analysis of data and

research. If possible, these updates should coincide with the annual update of the fire management plan.

4.8.1 Park Monitoring Plan

The park fire monitoring plan is a single plan that contains information about all fire effects monitoring being conducted in the park—all the monitoring units and protocols are described in one place within the park fire monitoring plan document. Park, project, and community plans may be incorporated into the main document or may be addenda to the plan. Parks with only one or a few monitoring projects may find that a park fire monitoring plan is not necessary, and that one or several project plans may be sufficient. Park plans should be submitted by the fire ecologist, at a minimum reviewed by the chief of resource management and the fire management officer, and approved by the regional fire ecologist.

4.8.2 Community Monitoring Plan

Community monitoring is defined as monitoring the effects of treatments on a single monitoring unit across the park or on a landscape scale, usually in several project areas. The monitoring unit is relatively homogeneous in ecological or fuels-defined attribute(s) and treatment objectives. Treatments are often similar across the monitoring unit. The NPS [Fire Monitoring Handbook](#) describes the stratification of ecological- or fuels-based monitoring types as the appropriate method for defining monitoring units when objectives relate to restoring or maintaining a vegetation community at a landscape scale. Review requirements for community plans are at the discretion of the regional fire ecologist.

4.8.3 Project Monitoring Plan

Project monitoring is defined as monitoring the effects of treatments in a single project area, such as a burn unit, with sufficient intensity to enable the evaluation of treatment objectives. This type of monitoring is not restricted by time frame or similarity of treatment(s). The monitoring unit is spatially defined by the project and characterized ecologically or through fuels objectives. Examples of objectives include mechanical hazardous fuels reduction, maintenance of a historic scene, and reduction of an invasive species. Project monitoring can be used to determine whether the objectives of an individual treatment were met, and it can provide specific feedback for adaptive management in a relatively short time frame and/or over the long term. Review requirements for project plans are at the discretion of the regional fire ecologist.

4.9 Data Management

NPS fire ecologists and fire effects monitors will primarily use the [FEAT/FIREMON Integrated](#) (FFI) software to collect, store, and analyze fire effects monitoring plot data. Data will meet Federal Geographic Data Committee (FGDC) minimum metadata standards for biological data and will be posted to the [NPS Integrated Resource Management Applications \(IRMA\) Data Store](#) annually along with the park/network Fire Ecology Annual Report.

Park-level fire ecologists are responsible for appropriately managing fire effects plot data (Level 3 and 4 monitoring data). Data management protocols will be included in the fire monitoring plan. The chapter on Information and Technology Management in *RM 18* should be consulted when developing data management protocols because it provides guidance on stewardship, standards, documentation, sharing, and archiving of data. In addition, the NPS [I&M Program](#) website is an excellent reference for data management guidance.

Level 1 and 2 monitoring data (i.e., smoke, fire weather, fire behavior) are included in the wildland fire report, and the prescribed burn summary report. At a minimum, on-site fire weather and behavior data should be archived (electronically or as a hard copy) with the other information pertaining to the fire (i.e., wildland fire report and prescribed burn report). Fire management staff must make sure adequate mechanisms are in place to ensure long-term protection of this data. To ensure long-term protection and use of burn severity assessments completed by the [Monitoring Trends in Burn Severity Program](#) all assessments are archived and available on its website.

5 Fire Ecology Program Safety

Employee and public safety is the first priority in every fire management activity. The chapter on Standards for Operations and Safety in *Reference Manual 18* deals specifically with safety and health related to wildland fire activities but does not address fire monitoring activities explicitly.

The Safety chapter in [Interagency Standards for Fire and Fire Aviation Operations](#) identifies safety items that should be considered for safe fire monitoring activities. Two of the primary sections in this chapter are risk management and job hazard analysis (JHA). The risk management process ensures that critical factors and risks associated with operations are considered during decision making. This process must be applied to all fire operations prior to taking action. The process includes gathering information, estimating or identifying hazards, identifying controls for hazards, and evaluating personnel.

Job hazard analysis information is available at the Occupational Safety and Health Administration ([OSHA](#)) website.

Parks and fire effects monitoring teams should review the documents posted on the Forest Service and OSHA websites listed above to determine if they meet their local programmatic needs. For those job aspects unique to local fire ecology programs, each fire effects monitoring crew should develop JHAs for their monitoring activities. The JHAs may apply to an individual park or a network of parks.

6 Fire Ecology Program Funding

Funding for the fire ecology program is included under the overall NPS Fuels Management Program budget. Permanent and seasonal staffing levels are determined by the regional fire management staff. Project level and supplemental travel funding is requested through [National Fire Plan Operations and Reporting System \(NFPORS\)](#). Fire ecologists should play an active role in developing and overseeing the budget of their program. Fire ecology program staff should work with park and regional fire budget analysts and other regional fire staff to ensure fire ecology program needs are represented in the annual budget planning efforts. Specific information on the appropriate use of Fuels funding can be found in the [NPS Wildland Fire & Aviation Budget Rules](#) which is updated annually.

6.1 Supplemental Travel Funds

Programmatic support funding should be used for general program functions, including supplies and equipment and travel for fire ecology training, workshops, and conferences.

Fire ecologists need to track [NFPORS](#) project-entry deadlines for requesting funds for travel support for fuels monitoring projects. These additional travel funding requests should be coordinated with regional ecologists. See [NPS Wildland Fire & Aviation Financial Management Guide](#) for guidance on using support funding and requesting additional travel funding.

6.2 Additional Funding and Staffing Sources

In addition to wildland fire funding for staffing and projects, other sources of funding may be available to enhance or supplement existing fire ecology programs. These sources include:

- Interagency positions and partnerships
- Student Conservation Association positions

- Collaborative partnerships with the NPS Inventory and Monitoring program

Proposals to create these types of positions should be coordinated with the regional fire ecologist and regional fire management officer.