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HANDBOOK TRANSMITTAL SHEET

Subject:

H1740 – 2 INTEGRATED VEGETATION MANAGEMENT

1. Explanation of Material Transmitted: This Handbook release has been issued to guide implementation of vegetation management planning and treatment activities to achieve the objectives set forth for the updated manual, 1740 Renewable Resource Improvements and Treatments. These objectives include adding policy on maintaining and restoring native plant community diversity, resiliency, and productivity. The Handbook includes 5 Appendices.

2. Reports Required: None

3. Material Superseded: None

4. Filing Instructions: File as directed below

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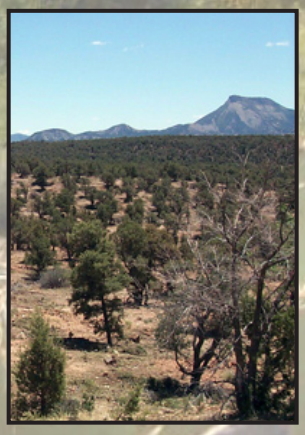
NONE	H-1740 -2
(Total: 0 sheets)	(Total: 192 sheets)

Assistant Director, Renewable Resources and Planning

BLM

Integrated Vegetation Management Handbook

(Public)



Bureau of Land Management
Handbook H-1740-2
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Contents

Chapter 1 - Introduction

I. Defining an Integrated Vegetation Management Strategy

Vegetation is perhaps the one uniting feature of all the 258 million acres cared for by the Bureau of Land Management (BLM). Yet history shows how quickly this core resource can be changed by invasive weeds, wildfire, drought, grazing, recreational use and other activities.

BLM recognizes the importance of vegetation management. That recognition is symbolized in the 150-plus different authorities or guidelines that exist for vegetation management within the agency. But that huge number also illustrates the central problem: A common approach for managing vegetation, one that can be embraced by a variety of disciplines across the agency, has been lacking.

This is not new territory for BLM. In the late 1980s, BLM embarked on what was called the "Vegetation Management Initiative, or VMI." At the core of VMI was establishing clearly stated and ecologically attainable objectives for the vegetation on public land. While VMI began as a grazing management program concept, it quickly became apparent that this concept offered "an improved, more effective way to deal with vegetation management across a wide spectrum of renewable resource programs, facilitating improved objective setting and interdisciplinary coordination."

Many of the ideas developed under the "Vegetation Management Initiative" are still applicable today. At the core of VMI was establishing clearly stated and ecologically attainable objectives for the vegetation on public land.

In 1995, BLM implemented regulations (Title 43 CFR 4180) requiring state directors to develop standards and guidelines to improve the health of public rangelands. These revised regulations were the result of an effort called "Rangeland Reform '94." The objective of these regulations was to promote healthy, sustainable rangelands. By 1998, state directors had developed—in consultation with Resource Advisory Councils—state or regional rangeland health standards that applied to most BLM lands. These land-health standards addressed the four fundamentals of rangeland health: (1) watershed function, including upland, riparian-wetland, and aquatic components; (2) ecological processes, including the hydrologic cycle, nutrient cycling, and energy flow; (3) water quality; and (4) habitat quality for threatened and endangered and special status species.

The ideas and concepts contained in this handbook continue to build on those from VMI and Rangeland Reform '94, especially in that a unified approach to vegetation management represents the best opportunity to address the many challenges we face today. Policies and concepts contained within this handbook are intended to build upon previous initiatives, recognizing that healthy native plant communities alone do not define healthy watersheds and landscapes. But without them, there is little hope of achieving broader land-health objectives and providing for sustainable use that the public has come to expect from the public lands.

The term "integrate" means to unite different components toward a common purpose. In the case of this Integrated Vegetation Management Handbook, the aim is to unite the various programs within BLM toward achieving a common goal of protecting, maintaining and restoring ecologically diverse and properly functioning native plant communities on public land.

This handbook is organized with a definite purpose. The first few chapters set the overall stage for vegetation management and address broad topics. As the handbook progresses, the topic and guidance in it becomes more specific to field-level needs.

II. The Approach to Vegetation Management Across Renewable Resources Programs

The approach fostered throughout this handbook is one where the various programs within the BLM use an interdisciplinary and collaborative process to plan and implement a set of actions that improve biological diversity and ecosystem function and that promote and maintain native plant communities that are resilient to disturbance and invasive species. Healthy, functioning plant communities will enhance the ability to attain a sustainable level of social and economic benefits on public land. An interdisciplinary approach ensures that proponents of actions not only understand the potential impact their activities may have on achieving other program objectives, but also helps in identifying ways to design projects so that they improve conditions and help achieve objectives for a variety of BLM programs.

A. Guiding Principles

The following principles will guide further development of this strategy and an implementation action plan.

- Diverse, healthy, and resilient native plant communities provide the greatest opportunity to be successful in meeting multiple-use objectives for all programs within BLM.
- Plant communities integrate at a landscape scale; they react to biological and physical conditions and disturbances that affect large areas. Therefore, the goal should not be to have native plant communities on every acre of public land. Rather, the goal is to manage for a mix of plant communities comprised primarily of native species across the landscape, thus allowing for a number of uses to co-exist with these broader landscape plant communities.
- Decisions concerning the desired mix of plant communities and uses will be made at the local level, through the land-use planning and implementation process, with involvement of local communities, stakeholders, other landowners, tribes and other agencies. This approach will help avoid duplication of efforts, ensure consistency and improve public acceptance of vegetation management activities.
- Renewable resource programs and processes within BLM will be structured to promote working toward common goals and objectives that will maximize the effectiveness of management actions, as well as improve overall program efficiency. This can be accomplished through a collaborative, interdisciplinary process, based on the best available science.
- The Land Health Standards developed in conjunction with Resource Advisory Councils will serve as a management goal and framework within which vegetation condition is assessed and described. BLM has made significant progress in defining and gaining consensus on land-health issues using the Land Health Standards development process. This effort will seek to build upon this progress. Programs will continue to have specific objectives, such as use objectives, that will be consistent with the overarching shared goals and objectives described in this strategy.
- An integrated, interdisciplinary approach in planning, implementing and monitoring management actions, regardless of which program is funding the work, will improve efficiency and help achieve the multiple-use and sustained-yield mission.
- An interdisciplinary approach to integrated vegetation management will be established at all levels of BLM, from the national office to field offices.

III. Linkages to Strategic Plans

A. Department of the Interior (DOI) and BLM Strategic Plans

Resource protection and sustaining healthy landscapes are a cornerstone of the Department of the Interior and BLM missions. Both the Department and BLM recognize that multiple-use and sustained-yield

principles are best served by healthy and productive land, of which vegetation is a key component. By focusing programs on maintaining and restoring native plant communities on public land, BLM can be more successful at fulfilling a vital part of the agency and DOI mission.

Activities guided by this handbook fall under several DOI strategic goals. For example, DOI is charged with protecting the nation's natural, cultural, scenic, and heritage resources. DOI is specifically responsible for restoring and maintaining properly functioning landscapes and watersheds, as well as creating habitat conditions for biological communities to flourish. BLM's Operating Plan is tiered to these Departmental goals. That makes proper management of vegetation by BLM vital to achieving these two broad goals.

In short, the mission, goals and operating plans of the Department and BLM are closely linked. Vegetation management is at the center of what both the Department and BLM seek to accomplish.

B. The Relationship Between this Handbook and the BLM Vegetation Treatments Programmatic EIS and Programmatic Environmental Report

As stated in the Final BLM Vegetation Treatments Using Herbicides Programmatic Environmental Impact Statement (PEIS), (USDI, BLM, 2007), and Programmatic Environmental Report (PER) (USDI, BLM, 2007a), vegetation management on public land is a vital function of the agency. The Final PEIS and PER analyzed a potentially significant increase in the amount of vegetation that could be treated to respond to Presidential and Congressional mandates to reduce the risk of wildfire, restore fire-adapted ecosystems and repair land damaged by fire.

The Final PEIS, PER, and PEIS Record of Decision (USDI, BLM, 2007b) provide the rationale for such an increase and disclose the potential environmental effects of such a program. The Record of Decision describes the types of treatments that can be used, standard operating procedures and mitigation measures to be applied. These three documents provide analysis and documentation to which BLM field offices can tier and/or reference when making decisions to implement vegetative treatments.

Chapter 2 - Purpose of this Handbook

I. Summary of Manual 1740 – Renewable Resource Improvements and Treatments Policies and Objectives

Manual 1740 – Renewable Resource Improvements and Treatments, to which this handbook is tiered, provides overarching policies, objectives and standards common to all renewable resource programs, including forestry, range management, soil, water, air, fish and wildlife, and wild horse and burro programs. The policies, objectives and standards outlined in the manual focus primarily on planning, analyzing, constructing, maintaining, replacing, or modifying renewable resource improvements and treatments.

The policy contained in the 1985 release of Manual 1740 states:

> It is the policy of the Bureau to manage public lands in a manner that will conserve, protect, and improve the condition and productivity of renewable resources. Bureau managers will consider for use all improvement and treatment practices that research data or prior experience indicate will efficiently and effectively achieve identified management objectives, and will maintain resource values at a level sufficient to meet expected multiple-use and commodity production needs.

Objectives contained in Manual 1740 include the following:

1. Improve or maintain the condition and productivity of renewable resources on public lands for multiple-use.
2. Ensure that funds appropriated or contributed for resource improvements and treatments are used in a manner consistent with the intent of applicable law and regulation.
3. Create realistic Bureau and public expectations regarding the flexibility, timing, and magnitude of investments in resource improvements and treatments.
4. Plan, install, and report improvement and treatment actions as efficiently and effectively as possible.

In 2008, Manual 1740 was revised to include the hazardous fuels reduction, emergency stabilization, and burned area rehabilitation programs due to their involvement in managing vegetation (alive and dead). The manual was also amended to include the following shared policy on native plant communities:

> It is the policy of the Bureau of Land Management to manage for biologically diverse, resilient and productive native plant communities to sustain the health and productivity of the public lands. This policy recognizes that, for a variety of reasons, not every acre of public land will contain native plants and that, in certain circumstances to prevent further site degradation and improve functionality, non-native plants may be used as part of post-fire stabilization and rehabilitation activities as well as in restoration to achieve short-term site stabilization objectives. However, where practical, uses and activities will be conducted to favor the health and persistence of native plant communities where they currently exist and rehabilitation or restoration actions will be undertaken to improve their diversity, resiliency and productivity.

This policy is intended to be the focal point for bringing the renewable resource programs within the BLM together to work as partners in maintaining and restoring the vegetative resources on the public land. By focusing on the diversity (both species composition and structure), the resilience, and the productivity of the vegetation at a plant community scale, the programs outlined in the beginning of this chapter will be more likely to find common goals, use common assessment and monitoring protocols, and combine their expertise and their financial resources toward improving the condition of the vegetation.

This policy is also important because it links the condition of the vegetation with the sustainability of the many uses of these lands that are part of BLM's multiple-use mission. Producing forage, timber, recreation opportunities, protecting scenery settings and wildlife habitat are all dependent upon the ability of the vegetation to respond to use or other disturbance in a way that will allow for sustainable use into the future. The vegetation must be in a condition to renew itself, in composition, structure, and productivity, following disturbance if sustainable use is to be a reality.

II. Handbooks Associated With Manual 1740

A number of handbooks were reserved in the 1985 release of Manual 1740. The 2008 release amended the list to include this handbook and update the status of others. Handbooks associated with Manual 1740 include the following (date of actual release):

- H-1740-1 – Renewable Resource Improvement and Treatment Guidelines and Procedures (1987)
- H-1740-2 – Integrated Vegetation Management (2008)
- H-1741-1 – Fencing (1989)
- H-1741-2 – Land Treatments (Reserved)
- H-1741-3 – Water Developments (1990)
- H-1741-4 – Management Facilities (Reserved)
- H-1741-5 – Prescribed Fire (Moved to Manual 9214)
- H-1742-1 – Burned Area Emergency Stabilization and Rehabilitation (2007)
- H-1743-1 – Resource Investment Analysis: User Handbook for the SageRam Computer Program (Deleted)
- H-1744-1 – Data Management Handbook for Job Documentation Reports (Deleted)

III. Handbook H-1740-2 – Integrated Vegetation Management Purpose and Objectives

This handbook describes and clarifies agency expectations for a more consistent and unified approach to managing vegetation on public land. It further clarifies multi-program goals, objectives and priorities relative to maintaining and restoring ecologically diverse, resilient and productive native plant communities.

A well-integrated vegetation management program requires that staff at all levels of the organization who are involved in activities that modify vegetation on public land, whether directly through vegetation treatments or indirectly through land use, work closely together to achieve a common outcome for the vegetative resource. This common outcome should initially manifest itself in common vegetation goals and objectives within the renewable resource and fuels programs at both the national and state office levels, as well as in land-use plan decisions. As a result of having common objectives for vegetation management, activity plans and project plans should be able to better focus on achieving multi-program vegetation goals and objectives. That, in turn, better facilitates more effective multi-program funding and accomplishment reporting.

In addition, this handbook describes procedures for preparing budget requests and reporting accomplishments for programs that manage vegetation, provides best management practices to be used in all programs, as appropriate, to mitigate impacts and achieve overarching vegetation objectives, and describes the native plant materials and pest management programs within BLM.

IV. Relationship to Other Handbooks

Objectives, policies and standards applicable to individual resource programs can be found in other program-specific manuals and handbooks. Guidance in this handbook does not override program-specific guidance contained in those handbooks. Rather, it provides additional guidance that facilitates more uniform and unified planning to achieve multiple-resource objectives through all vegetation management activities. It also provides updated information, where older manuals and handbooks have not been updated, to include newer concepts relative to managing for ecologically diverse and resilient native plant communities. Where inconsistencies between this handbook and programmatic handbooks are discovered, programmatic handbooks will be modified to be more consistent with the unified approach outlined in this handbook.

Chapter 3 - Common Terminology

I. Introduction

This chapter provides definitions for terms commonly used in vegetation management to improve communication and understanding among programs as integrated vegetation management projects are developed and implemented. These terms also serve as a glossary for this handbook.

The terminology, which spans the multiple vegetation management programs in BLM, is focused on those terms used in understanding and describing vegetation conditions and designing and monitoring vegetation treatments. The definitions may differ from those used within a specific program's manuals and handbooks. They are not intended to replace those definitions, but rather, to be used when discussing vegetation condition, goals, and objectives that cross program lines and therefore require integrated definitions.

Where possible, definitions previously published by BLM were used. Terms used from outside BLM are from entities that have established accepted definitions or other agencies/offices responsible for setting national direction on vegetation management.

II. Terms

Assessment: The estimation or judgment of the status of ecosystem structures, functions, or processes, within a specified geographic area (preferably a watershed or group of contiguous watersheds) at a specific time. An assessment is conducted by gathering, synthesizing, and interpreting information, from observations or data from inventories and monitoring. An assessment characterizes the status of resource conditions so that the status can be evaluated relative to land health standards (United States Department of the Interior (USDI), BLM, 2001a).

Adaptive Management: A system of management practices based on clearly defined outcomes, monitoring to determine if management actions are meeting outcomes, and, if not, facilitating management changes that will best ensure that outcomes are met or re-evaluated. (USDI, 2004).

Best Management Practices (BMPs): A suite of techniques that guide, or may be applied to management actions, to aid in achieving desired outcomes (USDI, BLM, 2005). The term, "standard operating procedures" (SOP) is sometimes used instead of BMPs.

Biophysical Setting: A LANDFIRE data layer that represents the vegetation that may have been dominant on the landscape prior to Euro-American settlement and is based on both the current biophysical environment and an approximation of the historical disturbance. The biophysical setting concept is similar to the concept of potential natural vegetation groups used in mapping and modeling efforts related to fire regime condition class (http://www.landfire.gov).

Control: The means, as appropriate, to eradicate, suppress, reduce, or manage invasive species populations, preventing spread of invasive species from areas where they are present, and taking steps such as restoration of native species and habitats to reduce the effects of invasive species and to prevent further invasions (Executive Order 13112, 1999).

Desired Future Condition (DFC) or Desired Outcomes: Land or resource conditions that are expected to result if goals and objectives are fully achieved (United States Department of Agriculture (USDA) Forest Service, no date); a type of land-use plan decision expressed as a goal or objective (USDI, BLM, 2005).

Disturbance: Refers to events that alter the structure, composition, or function of terrestrial or aquatic habitats. Natural disturbances include, among others, drought, floods, wind, fires, wildlife grazing, and insects and pathogens. Human-caused disturbances include actions such as timber harvest, livestock grazing, road construction and use, and the introduction of exotic species (USDI, BLM, 2007b).

Diversity: (1) The absolute number of species in a community or species richness; and (2) a measure of the number of species and their relative abundance in a community; low diversity refers to a few species or unequal abundances, high diversity refers to many species or equal abundances (USDI, BLM,1997).

Ecological Processes or Ecosystem Functions: The dynamic attributes of ecosystems, including interactions among organisms and interactions between organisms and their environment. Ecological processes are the basis for self-maintenance in an ecosystem. Ecosystem functions and processes, along with the reproduction and growth of organisms, are what cause an ecosystem to be self-renewing. A common goal for the restoration of any natural ecosystem is to recover self-renewing processes to the point where assistance is no longer needed (Society for Ecological Restoration, 2002).

Ecological Reference Area: A landscape unit in which ecological processes are functioning within a normal range of variability and the plant community has adequate resistance to and resiliency from most disturbances. Ecological reference areas are lands that best represent the potential of a specific ecological site in both physical function and biological health (USDI, BLM 2001a).

Ecological Site Description: Description of the soils, uses, and potential of a kind of land with specific physical characteristics to produce distinctive kinds and amounts of vegetation (USDA, Agricultural Research Service (ARS), 2005).

Ecosystem Health (forest health, rangeland health, aquatic system health): The state or condition of an ecosystem in which its dynamic attributes are expressed within "normal" ranges of activity relative to its ecological stage of development. A restored ecosystem expresses health if it functions normally relative to its reference (ecosystem), or to an appropriate set of restored ecosystem attributes (Society for Ecological Restoration, 2002).

Emergency Stabilization: Planned actions to stabilize and prevent unacceptable degradation to natural and cultural resources, to minimize threats to life or property resulting from the effects of a fire, or to repair/replace/construct physical improvements necessary to prevent degradation of land or resources (National Wildfire Coordinating Group (NWCG), 2006).

Evaluation: An examination and judgment concerning the worth, quality, significance, amount, degree, or condition of something; or the systematic process for determining the effectiveness of on-the-ground management actions and assessing progress toward meeting management objectives (USDI, BLM, 1984).

Exotic Species: Includes species introduced into an area that may have adapted to the area and compete with resident native (indigenous) species (USDI, BLM, 2007b).

Fire Dependent: Plants and vegetation communities that have evolved adaptations such as a reliance on fire as a disturbance agent, protection as a species against the effects of wildland fire, or even a strengthening or enhancement by it (NWCG, 2006).

Fire Regime: Description of the patterns of fire occurrences, frequency, size, severity, and sometimes vegetation and fire effects as well, in a given area or ecosystem. A fire regime is a generalization based on fire histories at individual sites. Fire regimes can often be described as cycles because some parts of the histories usually get repeated, and the repetitions can be counted and measured, such as fire return interval (NWCG, 2006).

Fire Regime Condition Class: A classification of the amount of departure of conditions at a given time period from the ecological reference conditions that typically result in alterations of native ecosystem components such as species composition, structural stage, stand age, canopy closure, and fuel loadings (adapted from Interagency FRCC Guidebook, 2005; and NWCG, 2006).

Fire Regime Groups: A classification of fire regimes into a discrete number of categories based on frequency and severity. The national, coarse-scale classification of fire regime groups commonly used includes five groups: I - frequent (0-35 years), low severity; II - frequent (0-35 years), stand replacement severity; III - 35-100+ years, mixed severity; IV - 35-100+ years, stand replacement severity; and V - 200+ years, all severities (adapted from NWCG, 2006; and Interagency FRCC Guidebook, 2005).

Forest Land: Land where the potential natural plant community contains 10% or more tree canopy cover. (Society of American Foresters (SAF), 1998).

Fragmentation: The process of dividing habitats into smaller and smaller units until their utility as habitat is lost (USDI, BLM, 1997).

Functioning: (1) Refers to the rangeland health attributes where the majority of the associated indicators are rated as having little or no deviation from that described in the Reference Sheet for the ecological site; (2) Refers to the presence and integrity of ecological processes (energy flow, water cycling, and nutrient cycling) being within the range of expectations for the ecological site (USDA ARS et al, 2005).

Habitat: A place where an animal or plant normally lives for a substantial part of its life, often characterized by dominant plant forms and/or physical characteristics (USDI, BLM, 1990).

Hazardous Fuels: A fuel complex defined by kind, arrangement, volume, condition and location that presents a threat of ignition and resistance to control (NWCG, 2006).

Herbicide: A chemical pesticide used to control, suppress, or kill vegetation, or severely interrupt normal growth processes (USDI, BLM, 2007b).

Implementation Plan: An area of a site-specific plan written to implement decisions made in a land-use plan. Implementation plans include both activity plans and project plans, both of which are types of implementation plans (USDI, BLM, 2005).

Indicator: Components of a system whose characteristics (e.g., presence or absence, quantity, distribution) are used as an index of an attribute (e.g. land health) that are too difficult, inconvenient, or expensive to measure (USDA et al, 2005).

Integrated Pest Management: A sustainable approach to managing pests by combining biological, cultural, physical and chemical tools in a way that minimizes economic, health and environmental risks (7 USC 136r-1).

Integrated Vegetation Management: To unite the various programs within BLM toward achieving a common goal of protecting, maintaining and restoring ecologically diverse and properly functioning native plant communities on public land.

Integrated Program of Work: A plan for a specific area that includes the planned activities, treatments, staffing, funding and accomplishments for a set period of time, usually three to five years.

Interdisciplinary Process: The act of drawing from two or more academic disciplines and integrating their insights to work together in pursuit of a common goal, in contrast to a multidisciplinary approach where input from two or more disciplines is combined without integration or pursuit of a common goal (http://www.Wikipedia.org, 2007).

Invasive plants: Plants that are not part of (if exotic), or are a minor component of (if native), the original plant community or communities that have the potential to become a dominant or co-dominant species on the site if their future establishment and growth is not actively controlled by management interventions, or are classified as exotic or noxious plants under state or federal law. Species that become dominant for only one to several years (e.g. short-term response to drought or wildfire) are not invasive plants (USDI, BLM, 2007b).

Introduction: The intentional or unintentional escape, release, dissemination, or placement of a species into an ecosystem as a result of human activity (Executive Order 13112, 1999).

Inventory: Gathering of baseline information (including quantitative data, cultural knowledge, and qualitative observations) about condition of resources (USDI, BLM, 2001a).

LANDFIRE: (Landscape Fire and Resource Management Planning Tools Project) is an interagency project designed to produce comprehensive maps and data describing vegetation, wildland fuel, and fire regimes across the United States (USDA website http://www.landfire.gov).

Landscape: All the natural features such as grasslands, hills, forest and water, that distinguish one part of the earth's surface from another part; usually that portion of land that the eye can comprehend at a single view, including all its natural characteristics (ICEBMP, 2000).

Land Health: Degree to which the integrity of the soil and the ecological processes of ecosystems are sustained (USDI, BLM, 2001a).

Land-use Plan: A set of decisions that establishes management direction for land within an administrative area, as prescribed under the planning provisions of FLPMA; an assimilation of land-use-plan-level decisions developed through the planning process outlined in 43 CFR 1600, regardless of the scale at which the decisions were developed. The term includes both resource management plans (RMPs) and management framework plan (MFPs) (USDI, BLM, 2007).

Maintain: To keep in an existing state (http://www.dictionary.com).

Monitoring: The regular collection of data over time to evaluate: (1) whether objectives or land health standards are being achieved; (2) effectiveness of management actions (USDI, BLM, 2001a).

Native Species: Species that historically occurred or currently occur in a particular ecosystem and were not introduced (USDI, BLM, 2007b).

Natural Community: An assemblage of organisms indigenous to an area that is characterized by distinct combinations of species occupying a common ecological zone and interacting with one another (USDI, BLM, 2007b).

Normal Variability or Normal Range of Variability: The deviation of characteristics of biotic communities and their environment that can be expected given natural variability in climate and disturbance regimes (USDA, ARS et al, 2005).

Noxious Weed: A plant species designated by federal or state law as generally possessing one or more of the following characteristics: aggressive and difficult to manage; parasitic; a carrier or host of serious insects or disease; or non-native, new, or not common to the United States (USDI, BLM, 2007b).

Objective: A concise, time-specific statement of measurable planned results that responds to pre-established goals. An objective forms the basis for further planning to define the precise steps to be taken and the resources to be used to achieve identified goals (USDI, BLM, 2007b).

Pesticides: Any substance used for controlling, preventing, destroying, repelling, or mitigating any pest. Includes fungicides, herbicides, insecticides, nematicides, rodenticides, dessicants, defoliants, plant growth regulators, and the like (USDI, BLM, 1988).

Plant Community: A vegetation complex, unique in its combination of plants, which occurs in particular locations under particular influences. A plant community is a reflection of integrated environmental influences on the site, such as soils, temperature, elevation, solar radiation, slope, aspect and precipitation (USDI, BLM, 2007b).

The following are commonly used ways of describing plant communities:

Desired Plant Community - The kind, proportion and amount of vegetation necessary for achieving the objectives established for an area.

Diverse Plant Community - A large assemblage of plants with adequate representation from all the species groups found in a non-degraded environment of that type.

Native Plant Communities - Plant communities having the proper mix of native species, structures, and landscape mosaic consistent with the natural disturbance regime.

Potential Natural Community - The stable biotic community that would occur on an ecological site if present environmental conditions and natural succession continued without human interference.

Resilient Plant Community - A plant community with the ability or capacity to renew its composition, structure and function following disturbance.

Plant Community Structure: The physiognomy or architecture of the plant community with respect to the density, horizontal stratification, and frequency distribution of species-populations, and the sizes and life forms of the organisms that comprise those communities (Society for Ecological Restoration (SER), 2002).

Potential Natural Vegetation Groups: A site classification based on Kuchler's Potential Natural Vegetation referring to vegetation that would exist without human interference and if plant succession were projected to its climax condition while allowing for natural disturbance processes such as fire (Kuchler, 1964).

Prescribed Fire: Any fire ignited by management actions to meet specific objectives. A written, approved prescribed fire plan must exist, and National Environmental Protection Act (NEPA) requirements (where applicable) must be met, prior to ignition (NWCG, 2006).

Prevention: To detect or ameliorate conditions that cause or favor the introduction, establishment or spread of invasive plants (USDA, Forest Service, 2005).

Productivity: The ability of a site to produce vegetation. This term can be used to describe plant vigor, meaning total plant production, seed and seed stalk production, cover, etc. is adequate to enable reproduction and recruitment of plants. It usually relates to the above-ground growth of plants. It can be measured by weight for any species in a plant community (USDI, BLM, 1997).

Properly Functioning Condition: (1) Condition in which vegetation and ground cover maintain soil conditions that can sustain natural biotic communities; (2) Riparian-wetland areas are functioning properly when adequate vegetation, landform, or large woody debris is present to dissipate stream energy associated with high water-flows, thereby reducing erosion and improving water quality; filter sediment, and capture bedload, aid floodplain development; improve flood-water retention and ground-water recharge; develop root masses that stabilize streambanks against cutting action; develop diverse ponding and channel characteristics to provide the habitat and the water depth, duration, and temperature necessary for fish production, waterfowl breeding, and other uses; and support greater biodiversity (USDI BLM, 2001a).

Rangeland: Land on which the native vegetation, climax or natural potential consists predominantly of grasses, grass-like plants, forbs, or shrubs. The term includes lands revegetated naturally or artificially to provide a non-crop plant cover that is managed like native vegetation. Rangeland may consist of natural grasslands, savannahs, shrublands, most deserts, tundra, alpine communities, coastal marshes and wet meadows (USDI, BLM, 2001a).

Rehabilitation: The “repair” of a wildland fire area using native and or nonnative plant species to obtain a stable plant community that will protect the burned area from erosion and invasion by weeds (NWCG, 2006).

Renewable Resource Programs: BLM programs that have as part of their management focus the biological resources that occupy public land, for example, forestry, rangeland, wildlife, weeds, botany, recreation and hazardous fuels management.

Resilience: The capacity of ecological processes to recover following a disturbance. Resilience can be defined in terms of the rate of recovery, the extent of recovery during a particular period of time, or both (USDA, ARS et al, 2005).

Resistance: The capacity of ecological processes to continue to function without change following a disturbance (USDA, ARS et al, 2005).

Restoration: Implementation of a set of actions that promotes plant community diversity and structure that allows plant communities to be more resilient to disturbance and invasive species over the long term (USDI, BLM, 1999).

Revegetation: Establishing or re-establishing desirable plants in areas where desirable plants are absent or of inadequate density, by management alone (natural revegetation) or by seeding or transplanting (artificial revegetation) (USDI, BLM, 2007b).

Special Status Species: Plant and animal species that are federally listed as threatened or endangered; proposed threatened or endangered; candidate species; state listed as threatened or endangered or listed by a BLM state director as sensitive (USDI, BLM, 2001b).

Species Composition: The proportions of various plant species in relation to the total on a given area. Species composition may be expressed in terms of relative cover, relative density, or relative weight (Habich, 2001).

Structure (Vegetative): The arrangement of vegetation in terms of density, basal area, cover, and vertical arrangement (NWCG, 2006).

Sustainable Cultural Practices: Traditional human land uses that maintain biodiversity and productivity. In this context, the biota is valued as much for its importance to ecosystem stability as it is for its short term worth as commodities (SER, 2002).

Vegetation Management: Purposeful actions that are a result of an assessment of vegetation conditions and that meet land-use plan objectives.

Visual Resource Management (VRM): The inventory and planning actions taken to identify visual values and to establish objectives for managing those values; and the management actions taken to achieve the visual management objectives (USDI, BLM, 1984a).

Watershed: The total area of land above a given point on a waterway that contributes runoff water to the flow at that point; a major subdivision of a drainage basin (Habich, 2001).

Wildfire: An unplanned, unwanted wildland fire including unauthorized human-caused fires, escaped wildland fire use events, escaped prescribed fire projects, and all other wildland fires where the objective is to put the fire out (NWCG, 2006).

Wildland: An area in which development is essentially non-existent, except for roads, railroads, power lines, and similar transportation facilities. Structures, if any, are widely scattered (NWCG, 2006).

Wildland Fire: Any non-structure fire that occurs in the wildland. Three distinct types of wildland fire have been defined and include wildfire, wildland fire use, and prescribed fire (NWCG, 2006).

Wildland Fire Use: The application of the appropriate management response to naturally ignited wildland fires to accomplish specific resource management objectives in pre-defined designated areas outlined in Fire Management Plans. Operational management is described in the Wildland Fire Implementation Plan (WFIP) (NWCG, 2006).

Wildland Urban Interface (WUI): The line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels (NWCG, 2006).

Woodland: A forest in which the trees are often small, characteristically short-bolded relative to their crown depth, and forming only an open canopy with the intervening area being occupied by lower vegetation, commonly grass (SAF, 1998).

Chapter 4: Assessing Vegetation Condition

I. Introduction—Why Does BLM Assess Vegetation Condition?

Assessment is the estimation or judgment of the status of ecosystem structures, functions, or processes, within a specified geographic area at a specific time. An assessment is conducted by gathering, synthesizing, and interpreting information from observations or data from inventories and monitoring. Assessments are used to describe attributes related to the composition, structure, abundance and habitat quality of vegetation. Because there are unique management challenges and requirements within various BLM programs, several different assessment techniques are currently being used. This chapter of the handbook describes assessment principles and techniques, completing and using assessments at different scales, timing considerations, and opportunities to integrate assessments between programs.

Assessments are conducted for a variety of reasons, including:

- Understand current conditions: Assessments are used to determine the current status of vegetative resources, factors that may affect those resources and opportunities for managing them. In the land-use planning process, these are outlined in the Analysis of the Management Situation. For implementation actions, this information is often portrayed in the affected environment section of associated National Environmental Policy Act (NEPA) documents.
- Establish management goals and objectives: Assessments provide the foundation for goals and objectives (that is, desired future conditions) in land-use plans, implementation plans and project-level plans.
- Provide information for decisions: Assessments themselves are not decisions. However, they provide the information to support decisions for virtually all BLM programs.
- Establish priorities: Assessments are used at a local, regional and national scale to establish program priorities. For example, improving the health of sagebrush ecosystems may be identified as a regional priority to enhance habitat conditions for sagebrush obligate species.
- Determine the status of conditions relative to land-health standards: Assessments determine the status of conditions and set the stage for evaluations that are used to determine achievement or non-achievement of land-health standards.
- Determine if decisions are meeting objectives: Assessments utilize information and monitoring data to determine if implemented actions are achieving desired objectives. They provide the basis for modifying decisions, if necessary.
- Reporting: BLM uses assessments to interpret information and data in order to report periodically on the condition of public lands.

Because BLM programs are responding to different needs and requirements, a single assessment technique is not feasible. However, there are opportunities to integrate assessments so that the needs of several programs can be achieved and integrated vegetation management objectives can be developed. This integration can eliminate redundancy, reduce personnel time and expense in measuring vegetation condition, and reduce confusion concerning the overall desired future condition of the vegetation. Integration opportunities are discussed further in Section IV.

II. Temporal Issues Associated with the Techniques

How assessments of vegetation are conducted depends on the management objectives defined as well as the scale of the project. Once a method has been established and the scale defined, the next step is to determine when and

for how long vegetation should be assessed. This can include such considerations as seasonality of data, duration, frequency, and available resources.

Considering seasonality is very important when assessing vegetative conditions. Depending on when the vegetative data were collected (e.g. dormant vs. growing season) may determine the species composition, diversity, and other factors correlated from the data. A good example of this is assessing diversity and density of an herbaceous layer. In many ecosystems it is not possible to obtain an accurate assessment of the herbaceous layer in the dormant season. Another example is with remotely sensed data. In some ecosystems it is best to have remotely sensed data that are collected during "leaf-off" or the dormant season so as to get a better view of sub-canopy and understory layers.

Another consideration for assessing vegetation is duration. This consideration is as much dependent on the objectives as it is the method chosen. If the objective of the assessment is to determine species composition in a photographic approach than the assessment period will be very short (e.g. a single visit). However, if there is interest in topics such as migration of species, disturbance regimes, etc., which may require more than one or two field visits to a site, then the assessment may need to be of a longer duration or made from data collected through a long-term study.

The final consideration is frequency. How often the vegetative condition of an area or several areas is assessed is dependent on the objectives of the assessment. If a project concern is the invasion of an invasive species at all stages of implementation then vegetative condition may need to be assessed several times. However, if the only concern regarding vegetative condition is before and after the implementation of a strategy then condition may only need to be assessed twice.

In summary, the timing and scheduling of vegetation assessments is dependent on the management objectives, assessment method chosen, and the limitations of that method. Furthermore, scheduling and timing are dependent on funding and resources. How often and when a project is able to assess vegetation is dependent on when staff are available or present (i.e. seasonal technicians). Therefore, when developing a strategy to assess vegetative conditions, managers must take into account their resources as well as their objectives and methodologies.

III. Techniques BLM Uses to Assess Vegetation Condition

A. The Similarity Index of Ecological Site Inventory

The similarity index is a calculation based on a comparison of the plant species composition of a presently existing plant community to the plant species composition of a reference condition. The reference condition is a plant community identified for each ecological site as either a historic climax plant community, or a potential natural community. An ecological site is a distinctive kind of land with specific physical characteristics that differs from other kinds of land in its ability to produce a distinctive kind and amount of vegetation. An ecological site is essentially a landscape stratification unit that responds similarly to land management.

When the similarity index is computed in this way, a successional status category is derived that signals how far away or how close the presently existing plant community is successionally to the historic climax plant community or the potential natural community for that ecological site. A similarity index of 0 to 25% represents an early seral plant community. A similarity index of 26 to 50% represents a mid-seral plant community. A similarity index of 51 to 75% represents a late seral plant community. A similarity index of 76 to 100% represents the potential natural community.

Vegetation objectives that are developed using successional status (seral status) categories are not always focused on achieving the reference condition(s). Another way of saying this is that the potential natural community or the historic climax plant community is not always the target endpoint of vegetation management.

BLM Technical Reference 1734-7, titled Ecological Site Inventory, http://www.blm.gov/nstc/library/1734-7direct.html (Habich, 2001), provides the detailed technical aspects of the technique. Examples of ecological site descriptions, which provide the characteristics of ecological sites, and are useful for reference when reading this section, can be found at http://esis.sc.egov.usda.gov/ESIS.

1. The Reference that Vegetation Condition is Gauged Against

   A potential natural community or historic climax plant community is identified for each ecological site. The plant species composition of the potential natural community or the historic climax plant community is the reference condition that is gauged against. Typically the plant species composition is represented as a range in production (pounds per acre), which is derived from a range of aboveground annual production (air-dry weight) for each plant species in the community. Cover of plant species can be used instead of aboveground annual production, but in most instances aboveground annual production is used because many ecological site descriptions do not yet provide a range of cover values for each plant species in the reference condition.

   A potential natural community is the biotic community that would become established on an ecological site if all successional sequences were completed without interference by humans under the present environmental conditions. The plant species composition of the potential natural community reflects past influences by humans, including past use and introduced species of plants and animals. The influence of humans on the plant species composition is excluded from the present onward to eliminate the complexities of future management and to set a baseline plant species composition for the potential natural community. The plant species composition of the potential natural community explicitly recognizes that naturalized exotic species can persist in the final stage of secondary succession and that succession after disturbance does not always reestablish the historic climax vegetation existing before European immigration and settlement.

   A historic climax plant community is the plant community that existed on an ecological site before European immigration and settlement. The historic climax plant community was best adapted to the unique combination of environmental factors associated with the ecological site. Natural disturbances such as drought, fire, unusually wet periods, and herbivory were inherent in the development and maintenance of the historic climax plant community. The effects of these disturbances are a part of the range of characteristics of the ecological site that contribute to a dynamic equilibrium. Fluctuations in plant community structure and function caused by the effects of these natural disturbances establish the boundaries of dynamic equilibrium. Plant communities that are subjected to abnormal disturbances and physical site deterioration or that are protected from natural disturbances—such as herbivory—for long periods, seldom typify the historic climax plant community. The historic climax plant community is not a precise assemblage of plant species for which the proportions are the same from place to place or from year to year. Variability is apparent in productivity, cover, and occurrence of individual plant species and that is why the plant species composition is presented as a percent range for each plant species.

   BLM managers and resource specialists have the option of using a potential natural community or a historic climax plant community as a reference condition.

2. Indicators Used

   The reference indicators are the range in production (pounds per acre) of each plant species' annual aboveground production (air-dry weight), or less frequently, cover, for the potential natural community or the historic climax plant community. Sometimes the range in production or range in cover is also converted to a range in percent of plant species composition. Existing plant species composition is compared against the reference indicators to estimate successional or seral status.

3. Primary Uses of Data

   a. Reporting: The similarity index generates seral status categories of early seral, mid- seral, late seral, and potential natural community. The seral status categories are reported annually in BLM's "Public Land Statistics," http://www.blm.gov/natacq/pls05/, for each administrative state to satisfy the range condition and trend in range condition reporting requirement in the Public Rangelands Improvement Act of 1978. The goal of BLM with ecological site inventory is to inventory all BLM surface lands to classify them into ecological sites, and to ascertain seral status on the ecological sites on a periodic basis. In reality, the inventory focus to date has been on lands contained within grazing allotments (roughly 158 million acres of the 258 million acres, as of 2006).
   b. Developing vegetation objectives: The plant species composition data of the potential natural community, historic climax plant community, or existing plant community serves as base data used for developing vegetation objectives in land-use plans or other planning documents. For example, it is common to see vegetation management objectives in land-use plans or other planning documents that focus on shifting plant species composition of select plant communities from one seral status category to another over a span of time to achieve a desired plant community, or that focus on shifting the abundance of certain plant species (often referred to as key species) over a span of time.
   c. Effectiveness monitoring (tracking management progress): Periodic collection of plant species composition data as monitoring data, is often used to ascertain degree of achievement of vegetation management objectives in land-use plans and other planning documents. This type of monitoring is often called trend monitoring (found in BLM Rangeland Monitoring and Evaluation Manual Handbook H-4400-1, Release 4-98, 11/28/1989; not accessible on-line).
   d. Ascertaining livestock forage condition, and setting/adjusting livestock stocking rates: The total aboveground annual production of plant species in the potential natural community, the historic climax plant community, and the various seral stages, has been used to ascertain livestock forage condition and set baseline livestock stocking rates (animal unit months per acre). The periodic collection of plant species composition data based on aboveground annual production can be used to adjust livestock stocking rates.
   e. Ascertaining achievement of some land-health standards: The plant species composition data are an indicator that can be used to ascertain if some land-health standards are being achieved. Land-health standards are to be incorporated into land-use plans as goals and the indicators associated with each land-health standard are recommended to be used in the development of objectives in land-use plans and other planning documents. See BLM Land Use Planning Handbook H-1601-1, http://www.blm.gov/style/medialib/blm/wo/Information_Resources_Management/policy/blm_handbook.Par.38665.File.dat/h1601-1.pdf. and BLM Rangeland Health Standards Handbook H-4180-1, http://www.blm.gov/style/medialib/blm/wo/Information_Resources_Management/policy/blm_manual.Par.23764.File.dat/4180.pdf as references.
   f. Assessing the relative value of vegetation communities for certain wildlife species: The ecological site itself, accompanied by the plant communities associated with each ecological site,

are often described in relation to habitat values for certain wildlife species. In many instances the description of each plant community includes a listing of certain wildlife species that are known to have strong affinities to the plant community.

4. How Data are Aggregated or Reported

Seral status category data in acres are compiled by each field office and submitted to the administrative state office. The state range lead in each administrative state office calculates and reports the percent of acres in each seral status category for the administrative state for the acres that were actually categorized to seral status, rather than for the entire surface BLM acreage in the administrative state. The seral status data are collected annually with a BLM-wide (except Alaska and Eastern States) data call administered out of the BLM National Operations Center. The percent of acres in each seral status category for each administrative state are reported annually in BLM's "Public Land Statistics," http://www.blm.gov/natacq/pls05/, as BLM's way of satisfying the range condition and trend in condition reporting requirement in the "Public Rangelands Improvement Act of 1978."

5. Advantages and Limitations

Advantages

a. If data are collected periodically, it shows how plant communities change over time as a response to natural disturbances (both short-term such as weather and wildfire, and long-term such as climate), land-uses (such as livestock grazing, off-highway vehicle recreation, timber harvest), and treatment applications. Tracking how plant communities change over time, and establishing correlation of these changes with these events, confers predictive power to land managers and resource specialists, which is essential in land-use planning.
b. The aboveground annual production data of plant community(ies) and the plant species composition is associated with what the ecological site should be capable of producing and with the livestock stocking rates that can be sustained. Monitoring the plant species composition and aboveground annual production over time can provide a needed check and balance system to set appropriate livestock stocking rates or appropriate management levels for wild horses and burros, and adjust those when necessary. This same information can be useful for determining some aspects of wildlife habitat suitability and to manage for appropriate population levels, particularly for managed species such as deer and elk. However, for wildlife habitat suitability for most species, additional information is needed which is not provided by the similarity index and plant species composition data (see Limitation c below).
c. The similarity index and its derived, quantitative seral status categories have provided an easily understood framework for land managers and resource specialists to develop vegetation management objectives in land-use plans and other planning documents.

Limitations

a. The data are collected at an ecological site spatial scale and predictions of how natural disturbances, land-uses, and treatment applications will affect plant communities are only applicable at the ecological site scale. Because there are large areas remaining that have yet to be inventoried, and because areas that have been inventoried were not inventoried at the same time, predictions across large spatial scales have not been possible. This hinders cumulative effects analysis at spatial scales larger than ecological site.

b. Where plant cover information is a necessary attribute in understanding vegetation condition, such as in forest and some woodland plant communities, ecological site descriptions do not typically provide a range of cover values for each plant species in the reference condition.
c. The legacy of plant species composition data, derived primarily from aboveground annual production (air-dry weight) of plant species, has not been extremely useful in understanding vegetation condition in forests or in understanding wildlife habitat condition where plant structural features, both vertically and horizontally, are a core attribute of habitat quality and habitat suitability measures. Plant aboveground production in weight cannot be easily translated into structural features required to describe and understand forest canopy layers, fire severity potential, and wildlife habitat quality. Canopy cover for trees and shrubs, and basal cover for herbaceous species, is much more useful to assess structural habitat features, especially if measured within vertical strata and measured by horizontal length.
d. Although seral status categories are easily understood by land managers and resource specialists in BLM, using them as the basis for reporting range condition to Congress and the general public in BLM's "Public Land Statistics," http://www.blm.gov/natacq/pls05/, has not been successful. One reason for the lack of success is because BLM no longer has justification from science to link the seral status categories of potential natural community, late seral, mid-seral, and early seral, to range condition categories of excellent, good, fair, and poor. The range condition categories of excellent, good, fair, and poor were developed to connote forage condition of the rangeland for livestock types (for example cattle and sheep). Forage condition categories for livestock do not necessarily correlate to seral status categories based on plant species composition. In addition, scientists have provided evidence that condition of rangelands is much more inclusive than just plant species composition. Hence, seral status categories by themselves are not comprehensive enough to reflect range condition.
e. To report range condition and trend in that condition BLM-wide to satisfy the "Public Rangelands Improvement Act's" (1978) reporting requirement, the inventory must be completed once to set the baseline, and then must be repeated periodically. The completion of the inventory has not been achieved across all BLM-administered surface lands nor have most of the inventoried acres been re-inventoried. The labor and cost to complete a baseline inventory and re-inventory has proven prohibitive to date.

B. Fire Regime Condition Class (FRCC)

"Fire Regime Condition Class" (FRCC) is a classification of the amount of departure from the natural regime (Hann and Bunnell 2001) based upon landscape conditions. Determination of amount of departure is based upon a comparison of current vegetation and fire regime conditions, with those of a reference state. The vegetation attributes measured include species composition, structural stage, stand age, canopy closure and mosaic pattern. The fire regime attributes measured include fire severity, fire frequency, and fire pattern.

The FRCC assessment protocols place all wildland vegetation communities into one of three classes: FRCC1, FRCC2, and FRCC3, indicating the departure from the natural (historical) regime (Hann and Bunnell 2001, Hardy et al. 2001, Schmidt et al. 2002). The central tendency (FRCC1) is a composite estimate of vegetation characteristics (species composition, structural stages, stand age, canopy closure, and mosaic pattern); fuel composition; fire frequency, severity, and pattern; and other associated natural disturbances. Low departure (FRCC1) is considered to be within the natural (historical) range of variability, while moderate (FRCC2) and high (FRCC3) departures are outside.

In FRCC classification, a landscape is defined as the contiguous area within a delineation that is large enough to include the variation in vegetation-fuel conditions of the natural fire regimes. When a landscape is being assessed, which must occur prior to identifying stand or patch level condition, it becomes a Project Area. A Project Area can be further divided into Strata, which are subdivisions of the landscape based on biophysical or land management criteria. FRCC is determined for each strata within a Project Area using "approved" national assessment techniques (IM-2008-037).

1. The Reference that Vegetation Condition is Gauged Against

   To determine FRCC, first, a Biophysical Setting (BpS) or Potential Natural Vegetation Group (PNVG) is assigned to each ecological site/system to determine reference conditions.

   For the purpose of FRCC assessment, BpS and PNVG Reference condition models were created through a series of expert workshops and a peer-review process as a part of "Landscape Fire and Resource Management Planning Tools Project" (LANDFIRE). For the purposes of determining FRCC, either PNVG or BpS reference models can be used. Each BpS/PNVG model description includes comprehensive documentation that describes the vegetation, geography, biophysical characteristics, succession stages, and disturbance regimes of each BpS/PNVG. Descriptions also document the assumptions behind, the outstanding questions about, the contributors to, the resources used for, and the evolution of each model. In addition, model descriptions include the results of the Vegetation Dynamics Development Tool (VDDT). The VDDT software was used to estimate vegetation proportions described in terms of successional classes (see Appendix 1 for LANDFIRE Biophysical Setting Model example). More specifically, VDDT modeling determines the proportion of seral stages which would be found across the landscape within a given BpS/PNVG, given the most typical historic fire size, severity and frequency (Historic Fire Regime) within the ecological site. Typically the successional classes are described in terms of dominant life form (that is, grasses, forbs, shrubs, trees) and plant species. The results of VDDT modeling (percent of each successional stage) done for each BpS/PNVG are used as reference conditions in an FRCC assessment.

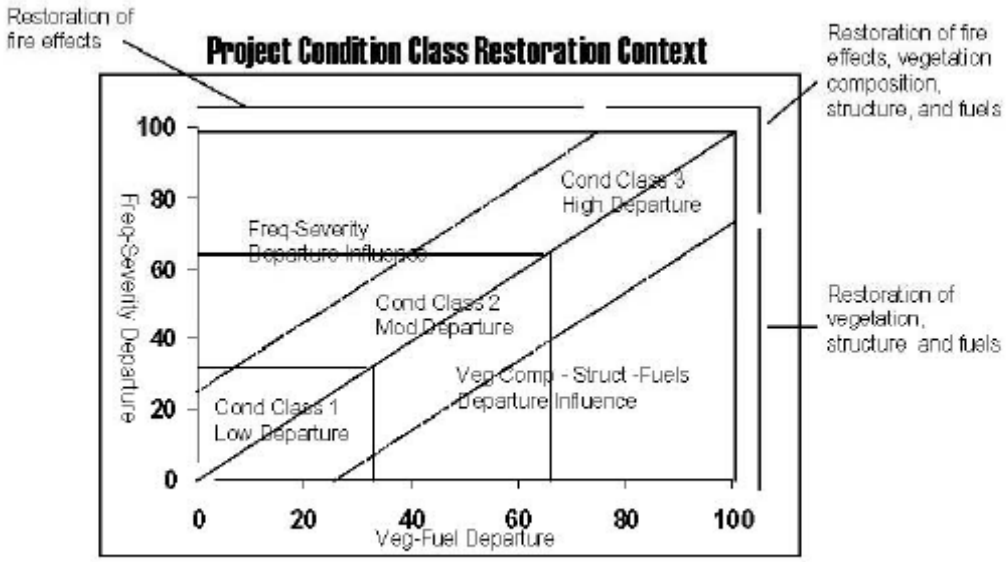
   The amount in percent of the BpS or PNVG that historically existed in each successional stage is the reference condition that is gauged against in an FRCC assessment, as well as historic or reference fire frequency and severity. These reference model values provided in the BpS/PNVG model descriptions are assigned to appropriate ecological classifications on the landscape and serve as the reference for comparison with current conditions to determine departure of vegetation condition and disturbance regimes that ultimately determine FRCC.

   For spatial mapping of FRCC, BLM managers and resource specialists have the option of using BpS, PNVG or successional class spatial layers provided by LANDFIRE or creating BpS, PNVG or successional class layers using local data such as soils, surveys or aerial photos. For manual, non-spatial calculation of FRCC, field forms and software versions are available.

2. Indicators Used

   To determine FRCC, a similarity index is calculated based on a comparison of successional class proportions presently existing compared with the proportion of successional classes described in the BpS or PNVG reference condition models. Additionally, fire occurrence data are used to compare existing fire frequency and severity to estimates of historic frequency and severity. When the similarity index is computed in this way, a FRCC is derived that signals how far away or how close the presently existing vegetation is successionally to the historic for that ecological site.

When calculating FRCC for an entire BpS or PNVG, vegetation-fuel similarity and fire frequency and severity similarity are considered. Vegetation-fuel similarity is averaged across all successional classes and fire frequency and severity similarity is averaged as well. For each, a similarity of 0 to +33% represents FRCC1, from +34% to +66% represents FRCC2, and from +67% to +100% represents FRCC3. The BpS or PNVG is assigned an overall FRCC rating based on the graph below:



BLM managers and resource specialists have the option of calculating FRCC by successional class, for the entire BpS or PNVG, or for the entire project area which may involve several BpS/PNVG groups.

When calculating FRCC for each successional class within a BpS or PNVG, vegetation-fuel similarity is calculated and fire frequency and severity similarity is not considered. A vegetation-fuel similarity index of -66% to +33%, indicating the successional class is either trace, under-represented or similar in proportion to historic represents FRCC1. A similarity index of +34% to +66%, indicating the successional class is over-represented on the landscape when compared with historic represents FRCC2. A similarity index of +67% to +100%, indicating the successional class is abundant on the landscape when compared with historic represents FRCC3. Typically, areas dominated by species or life forms not described in the PNVG or BpS reference models are considered “uncharacteristic.”

FRCC assessment can be used to set vegetation objectives for either the entire BpS/PNVG or by successional class proportions across the landscape. However, BpS or PNVG reference models as described are not always the target endpoint of vegetation management.

Although BLM has no Technical References available describing BpS and PNVG development, more information on FRCC regarding “approved” FRCC determination methodologies can be found in H-9211-1 Fire Planning Handbook (in progress) and/or at http://www.frcc.gov and http://www.landfire.gov.

3. Primary Uses of Data

   a. Developing vegetation management objectives: The vegetation-fuel, fire frequency and fire severity similarity indicators, and the subsequent FRCC determinations, serve as base data used for developing vegetation management objectives in RMPs or other planning documents. For example, it is common to see vegetation management objectives in RMPs or other planning documents that focus on shifting plant species composition of select plant communities which would result in shifting a proportion of the landscape from one successional class category to another over a span of time to achieve a desired vegetation-fuel condition. Another example would be to focus on shifting the abundance of certain plant species (often referred to as key species) over a span of time, also resulting in a shift from one successional class to another.
   b. Reporting: Acres treated within each FRCC are required to be reported annually for all vegetation treatments meeting National Fire Plan objectives in the National Fire Plan Operating and Reporting System (NFPORS) in the Hazardous Fuels Module, annually, by field offices receiving either hazardous fuels (2823) or wildland urban interface (2824) funding. The goal of BLM with FRCC is to improve FRCC2 and FRCC3 acres, or maintain FRCC1 in priority areas as indicated in RMPs and Fire Management Plans (FMPs). Site-specific projects, implemented annually, are to be designed to meet the overarching vegetation management/FRCC objectives outlined in RMPs. BLM aims to treat 400,000 acres annually (2002-2007 average annual) with the intent to improve FRCC and to reduce hazard within the Wildland Urban Interface.
   c. Ascertaining vegetation-fuel condition and setting appropriate fuels treatment levels: The determination of the need to reduce or increase a certain successional class within a BpS or PNVG has been used to ascertain fuels treatment levels and set baseline fuels management budgets. The periodic collection of life form and plant species composition data and the determination of the geographic location and distribution of successional classes across the landscape can be used to determine whether FRCC is being improved and should not only be used to adjust fuels treatment priorities within field offices, but also between states.
   d. Ascertaining the effectiveness of treatments at achieving National Fire Plan, RMP, and Fire Management Plan (FMP) Objectives: The FRCC indicators can be used to ascertain if certain fire management plan objectives are being achieved. It is BLM policy to incorporate National Fire Plan objectives into RMPs and FMPs as fire management goals and as an indicator of treatment effectiveness. See "BLM Land Use Planning Handbook H-1601-1," http://www.blm.gov/style/medialib/blm/wo/Information_Resources_Management/policy/blm_handbook.Par.38665.File.dat/h1601-1.pdf, "Fire Planning Handbook H-9211-1" (not currently accessible on-line), the "Cohesive Fuels Treatment Strategy" (USDI and USDA, Forest Service, 2006b), and the "10-Year Comprehensive Strategy Implementation Plan" (USDI and USDA, Forest Service, 2006a) as references.

4. How Data are Aggregated or Reported

   Current FRCC data in acres are compiled by field offices, in RMPs and FMPs, and used when prioritizing and planning annual implementation acres. Annually, vegetation treatments accomplished that meet National Fire Plan objectives are reported in NFPORS by the field office accomplishing the treatment. NFPORS allows the reporting of FRCC change for each treatment that has occurred. State office and national office leads can summarize the data to report acres of FRCC improved.

5. Advantages and Limitations

Advantages

a. As a landscape scale metric, FRCC classifies large areas at one time, providing context for management decisions, including designing hazardous fuel reduction and other land-health treatments.
b. The FRCC descriptions have provided a relatively easily understood measure for land managers and resource specialists to develop fire-related vegetation management objectives in land-use plans and other planning documents.
c. Once the FRCC Standard Landscape has been assessed, FRCC can be mapped at various finer scales, allowing for a better understanding of the ecological risks within areas of high management concern, such as in threatened and endangered (T&E) species habitats or municipal watersheds.
d. Because FRCC reflects the composite effects of changes from the natural or native systems at multiple scales, it may be useful as a foundation for a coarse-filter land management strategy for land-use planning within and across land ownerships (Hann et al., 2003).
e. Tracking FRCC over time can help determine where wildfire acres and treatments are either improving or degrading overall vegetation-fuel conditions. Measuring successional class proportions across the landscape by ecological site/BpS/PNVG is associated with how the ecological site responds to disturbance. Monitoring FRCC changes can provide a needed check-and-balance system to discover where priorities should be changed for wildfire protection, wildland fire use, and fuels/vegetation treatments.

Limitations

a. FRCC is not a classification of fire hazard or risk, which has traditionally been used to characterize fire condition. Thus, it is often misused to represent fire severity or resistance to control. In cases where determining fire severity or resistance to control is the objective, FRCC is not the appropriate measure.
b. As a landscape-scale metric that uses remotely sensed information for mapping current and historic conditions, FRCC often does not reflect site-specific conditions, and therefore must be field validated or updated prior to designing and implementing treatments.
c. The time and cost of completing baseline FRCC assessments and re-assessment over time to monitor plan effectiveness may be prohibitive.
d. Landscape-level changes, such as from one condition class to another, may be more appropriately viewed as longer-term outcomes, rather than treatment outcomes or annual outputs. In many cases, significant levels of treatment are required before a condition class change is detectable, reducing the effectiveness of FRCC as a site level or short-term metric of success. Thus, other indicators/measures, such as number of acres of thinning accomplished, acres of cheatgrass reduced, or percent increase in sagebrush cover, may be more easily understood measures of success by resource specialists, managers, and the public.
e. LANDFIRE data are one source that can be used to portray BpS, PNVG, successional classes, and ultimately, FRCC. However, LANDFIRE data need to be validated and potentially improved at the local level, using inventory, soils data, aerial photos, or other sources. Crosswalking FRCC determinations with ecological site inventory is difficult because of the differences in scale (FRCC, landscape scale; ESI, site scale) and the data that are used at each scale. Additionally, the accurate estimation and spatial depiction of successional classes in grass plant communities is difficult at best using remote sensed data. In these cases, field inventories, in combination with GIS layers depicting locations of land treatment and large wildfire history, are necessary to

determine successional class distribution and proportion. Many field units do not have these data, technology, or personnel available and are not able to acquire these data which hinders accurate determination of FRCC.

C. Assessments of Vegetation-Focused Land Health Standards

Land-health standards are ecologically based goal statements that are to conform to Fundamentals of Rangeland Health as per "43 Code of Federal Regulations (CFR) §4180.2." Fundamentals of Rangeland Health include watershed function, ecological processes, water quality, and habitat quality for threatened and endangered and special status species (see 43 CFR §4180.1). Land-health standards were developed by BLM in consultation with Resource Advisory Councils (RACs) and were submitted by BLM state directors to the Secretary of the Interior for approval. Land-health standards are grouped into sets. The sets of land-health standards are based on administrative state or on RAC geographic areas, which themselves are based typically on Major Land Resource Area boundaries developed and administered by the Natural Resources Conservation Service. The number of land-health standards in each set varies between state and RAC area. For example, Idaho has a set of eight land-health standards and the California (Northeast) and Nevada (Northwest) RAC area has a set of five land-health standards.

Each set of land-health standards contains at least one standard that requires assessment of vegetation condition in order to determine whether it is being achieved. These land-health standards are typically focused on riparian vegetation species and riparian plant communities, or terrestrial vegetation, primarily native plant communities and native plant species. Idaho has two atypical land-health standards that require assessment of condition of introduced vegetation seedings, and exotic plant communities. Threatened and endangered or special status plant species are typically assessed in land-health standards that deal with habitat quality and each set of land-health standards contains at least one habitat quality standard.

Each land-health standard has an associated list of indicators that can be measured qualitatively or quantitatively, depending on the indicator, in order to ascertain achievement of the standard. For the vegetation-focused land-health standards many of the indicators are vegetation-specific.

The variety of plant species-based and plant community-based indicators that can be selected to be measured allows for a variety of measurement techniques to be used. Many plant population measurement techniques can be found in "BLM Technical Reference 1730-1," titled "Measuring & Monitoring Plant Populations," http://www.blm.gov/nstc/library/pdf/MeasAndMon.pdf. Other vegetation measurement techniques the BLM uses can be found in BLM Technical Reference 1734-4 "Sampling Vegetation Attributes," http://www.blm.gov/nstc/library/pdf/samplveg.pdf. Additional vegetation measurement techniques supported by BLM can be found in Herrick et al.'s (2005) "Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems." Regarding measurement of vegetation-based indicators useful in assessing wildlife habitat, several references are available including: (1) Cooperrider (1986) for wildlife habitat in general; (2) Karl and Sadowski's (2005) BLM Technical Note 417, http://www.blm.gov/nstc/library/pdf/SagebrushTN417.pdf, for multiple spatial scale big sagebrush habitat; (3) several recently completed ecoregional-scale assessments funded partially by BLM (for example Wisdom et al. 2005) but yet to be published as BLM technical documents; and (4) on-going assessment techniques such as the greater sage-grouse habitat assessment framework (USDI, BLM and WAFWA, in prep.).

BLM has a few assessment techniques that incorporate vegetation-based indicators. In some cases the measurement techniques to be used in association with the assessment technique are explicitly identified. In other cases a list of measurement techniques are merely recommended. Assessment techniques used

by BLM to aid in ascertaining achievement of vegetation-focused land-health standards include: (1) the similarity index of ecological site inventory, particularly where plant species composition is an indicator, which has been discussed in section A of this chapter; (2) the FRCC assessment technique discussed in section B of this chapter, which has not yet been used often, partially because fire/fuel-focused indicators were not readily incorporated into the land-health standards during their development in the 1990s and early 2000s; (3) the Interpreting Indicators of Rangeland Health assessment technique, "BLM Technical Reference 1734-6," http://www.blm.gov/nstc/library/pdf/1734-6rev05.pdf, discussed below; (4) the Proper Functioning Condition Lentic and Lotic Riparian assessment techniques, "BLM Technical References 1737-9, 1737-11, 1737-15, and 1737-16," http://www.blm.gov/nstc/library/techref.htm, discussed in section E of this chapter; and (5) the multiscale big sagebrush assessment technique in "BLM Technical Note 417," http://www.blm.gov/nstc/library/pdf/SagebrushTN417.pdf, discussed in section F of this chapter.

Interpreting Indicators of Rangeland Health Assessment

The detailed technical aspects of this technique can be found in BLM Technical Reference 1734-6, Version 4, http://www.blm.gov/nstc/library/pdf/1734-6rev05.pdf.

1. The Reference that Vegetation Condition is Gauged Against

   There are 17 indicators in this assessment technique, six of which are vegetation-focused. More detail on these vegetation-focused indicators can be found in the Indicators Used section below. The reference that is gauged against is done so for all 17 indicators, not just the vegetation-focused indicators. The reference is preferred to be the indicator conditions associated with the reference state in state-and-transition succession-disturbance diagrams in ecological site descriptions. A reference sheet containing the range of reference conditions for each indicator is required to be used and is a required feature in future ecological site descriptions. If not present in existing ecological site descriptions, the reference sheet must be developed. There is an up-front commitment with this assessment technique to utilize the ecological site as the assessment unit on-the-ground.

If a reference sheet in an ecological site description is not available, here is guidance for developing one. The steps below are either required or optional:

a. Assemble a diverse group of experts with extensive knowledge of the ecological site (required).
b. Provide this group of experts with all available sources of information (required).
c. Define the functional/structural groups for the ecological site (or equivalent) (required). Plant species are grouped into life-form, functional, or structural categories, for example warm season bunchgrasses, or perennial taprooted forbs. The potential abundance of these groups on the ecological site is estimated, and compared with the actual abundance of these groups on the ecological site. This is also one of the 17 indicators and many of the other 16 indicators rely on knowledge of this indicator for their estimation. There is a special functional/structural groups sheet that must be completed.
d. Visit one or more ecological reference areas (optional). An ecological reference area is defined as: a landscape unit in which ecological processes are functioning within a normal range of variability and the plant communities have adequate resistance to and resiliency from most disturbances. An ecological reference area is the visual representation of the characteristics and variability of the components found in the ecological site description. Ecological reference areas do not need to be pristine, historically unused lands (for example, climax plant communities or relict areas). Guidance is provided to seek out these sources of information to assist in the

selection of ecological reference areas:

- Ecological site descriptions
- Soil surveys
- Topographic maps
- Vegetation inventories
- Maps showing locations of Research Natural Areas, Wilderness Study Areas, or other protected (large exclosures)/special management areas
- Historical records and photographs
- Records of well-managed rangelands where grazing use has maintained ecological processes and the plant community in a proper functioning state; grazing use pattern maps are helpful in identifying these areas.

The intent of the above-provided criteria is to guide practitioners to find well-managed rangelands and appropriate relict areas to use as reference areas.

e. Describe the status of each indicator in the reference state (required). This corresponds to a none-to-slight departure category (see number 4 below, "How Data Are Aggregated or Reported," for more detail on the qualitative rating categories used in this assessment technique).

2. Indicators Used

The six vegetation-focused indicators are: functional/structural groups; plant mortality/decadence; litter amount; annual production; invasive plants; and reproductive capability of perennial plants. These six indicators are not independently used to assess vegetation condition in the assessment technique. Rather, the assessment technique uses these six indicators plus three other non-vegetation-focused indicators as a group, and gauges them against the reference condition, in order to rate a biotic integrity attribute of rangeland-health. Other combinations of the 17 indicators are used similarly to rate two other attributes of rangeland-health called soil/site stability and hydrologic function. Although this assessment technique does not use these vegetation-focused indicators independently to assess vegetation condition, BLM field offices often use the ratings of the vegetation-focused indicators as a basis for assessing vegetation condition. See the following section on primary uses of data for more explanation.

3. Primary Uses of Data

a. Assess achievement/non-achievement of upland vegetation-focused land-health standards: This assessment technique produces a qualitative rating assessment of the vegetation-focused indicators in comparison with the reference condition. This technique has been used by many BLM field offices as a primary (but not only) way of ascertaining achievement or non-achievement of the upland vegetation-focused land-health standards.

b. Provides criteria useful in selecting monitoring sites: The ratings of the indicators are useful in helping land managers identify areas that are potentially at risk of degradation or where resource problems currently exist. These types of areas are good candidate areas for monitoring sites.

4. How Data are Aggregated or Reported

The current status of each indicator is assessed against a reference condition for each indicator contained with a reference worksheet. From this comparison, the current status is rated into one of five qualitative ratings. The qualitative rating categories are: none to slight; slight to moderate; moderate; moderate to extreme; and extreme to total. They refer to departure from the reference condition. The qualitative rating categories for indicators are then translated into a qualitative rating

category for each of three rangeland-health attributes using a preponderance of evidence approach, with each attribute having a different combination of indicators nested within it. The six vegetation-focused indicators are nested within the biotic integrity attribute.

5. Advantages and Limitations

Advantages

a. Using ecological sites as the base landscape unit for assessment, and the reference state in state-and-transition diagrams associated with the ecological site description, allows for the site potential to be estimated for each vegetation-focused indicator. In this way the current status of the vegetation-focused indicators can be objectively estimated (to a greater degree than if site potential was not described). Vegetation condition at the ecological site spatial scale is assessed at a maximum level of objectivity.
b. The qualitative comparison of current indicator status to that of the reference condition is a relatively rapid approach that can facilitate relatively rapid assessments of vegetation condition.

Limitations

a. The vegetation-focused indicators are not designed to deal comprehensively with habitat features useful in assessing habitat quality/condition. Habitat features such as cover of plant species or species groups by vertical strata, cover of plant species or species groups in comparison with horizontal gaps in vegetation, and fragmentation of vegetation types compared with site potential or compared with site potentials across broad spatial landscapes, are not a focus of the vegetation-focused indicators. Therefore, the assessment technique is not adequate by itself to assess habitat quality-focused land-health standards.
b. The ecological site spatial scale of assessment does not lend itself easily to broader spatial scales of assessment (for example, an entire allotment, or a watershed [5th level Hydrologic Unit Code] or a subbasin [4th level Hydrologic Unit Code]). A proper study design must be developed that consists of a fairly labor-intensive assessment schedule across the spectrum of ecological sites within the broader landscape unit chosen for assessment.

Assessing Big Sagebrush Habitat at Multiple Spatial Scales

This assessment technique is published as "BLM Technical Note 417," http://www.blm.gov/nstc/library/pdf/SagebrushTN417.pdf, and further details not provided in this Handbook can be found there. Although the assessment technique was used to assess Oregon's habitat quality Land Health Standard at the pasture scale, it is more appropriately discussed in Section F, "Wildlife and Wildlife Habitat," because it assesses big sagebrush habitats for sagebrush-obligate wildlife species across multiple spatial scales and for various objectives not just restricted to land-health standards. Refer to Section F for more detail on this assessment technique.

D. The Habitat Type Classification

The habitat type classification is a method of site classification that uses the complete floristic composition (for example, trees, shrubs, grasses, forbs) of a forest community as an integrated indicator of environmental factors that affect species reproduction, growth, competition, and therefore, community development. Through sampling across a complete environmental gradient of a region, floristic patterns are identified that reflect different positions on the gradient. For example, dry, nutrient-poor; dry-mesic, moderate nutrient; mesic, nutrient-rich. In practice, indicator plant species are used to classify forest stands into habitat types.

Habitat type classifications have been developed and used extensively in the western United States. They differ from some potential natural vegetation classifications in that habitat type classifications have two components, vegetation and abiotic. The vegetation component is defined by potential natural vegetation (that is, climax plant association), thus the vegetation component is a potential natural vegetation classification. The abiotic component is represented by indicator species rather than actual quantification of the climatic, terrain, landform or edaphic conditions. Together, the potential natural vegetation community and the abiotic components define the environmental setting or the habitat type.

1. The Reference that Vegetation Condition is Gauged Against

   Climax plant association as used in habitat type and potential natural vegetation classifications is used to represent a benchmark stage of secondary succession to communicate an understanding of successional changes over time (Brewer and Pfister 2006 draft). It does not equate to the desired plant community.

2. Indicators Used

   Environment is indicated for each habitat type by the combination of the potential dominant overstory species and select indicator understory species (shrub, grass or forb). For example, Douglas-fir/ninebark habitat type would be dominated by Douglas-fir at climax and has a certain amount of Douglas-fir in the understory or overstory and ninebark in the understory at all seral stages. The persistence of these species through all seral stages is a result of climatic and edaphic conditions for that site.

3. Primary Uses of Data

   Habitat type is used primarily by forest managers to predict, understand and communicate current and post-disturbance conditions and the associated management implications. For example, in many areas, the amount and type of forage, timber growth and yield, and associated insect or disease risk have been described for each of the sub-climax seral stages, called phases.

   Habitat type is also used in assessment and research to assist in sampling stratification and to extrapolate findings to other areas having similar environmental conditions as reflected by their habitat type.

4. How Data are Aggregated or Reported

   Habitat types have been grouped in various ways to understand larger landscape patterns and to form larger land units. Due to the limitation listed below, habitat type classification is not currently used to report on vegetation or land-health condition at any scale.

5. Advantages and Limitations

   Advantages
   a. Habitat type classification provides a means for predicting outcomes from a variety of silvicultural treatments, land-uses, and passive management.
   b. Designed to reduce the complexity inherent in the natural system by providing a logical framework from which to study natural succession, habitat type can be used to improve

communication among various disciplines.

c. They have broader application and allow better predictions than classifications designed for a specific use.

Limitations

a. Habitat type classification does not contain all the seral stages that would exist in a frequent disturbance ecosystem, such as many of the western forest environments. Therefore, in themselves, habitat types do not suggest preference for a particular seral stage in the absence of site-specific management objectives, nor do they indicate what mix of stand structures are characteristic of a properly functioning native disturbance regime.

   Habitat type classification is identified and mapped at the site or stand spatial scale and predictions of how natural disturbances, land-uses, and treatment applications will affect plant communities are only applicable at that scale.

b. Habitat type mapping has only been completed for a small percentage of BLM forests and woodlands.

E. Riparian Area Proper Functioning Condition Assessments

Proper functioning condition (PFC) assessments are conducted on riparian areas and are qualitative assessments that can be supported with quantitative data. BLM Manual 1737, "Riparian-Wetland Area Management" (USDI, BLM, 1992) defines riparian areas as a form of wetland transition between permanently saturated wetlands and upland areas. These areas exhibit vegetation or physical characteristics reflective of permanent surface or subsurface water influence. Lands along, adjacent to, or contiguous with perennially and intermittently flowing rivers and streams, glacial potholes, and the shores of lakes and reservoirs with stable water levels are typical riparian areas. Excluded are such sites as ephemeral streams or washes that do not exhibit the presence of vegetation dependent upon free water in the soil.

Riparian-wetland areas are grouped into two major categories: (1) lentic, which is standing water habitat such as lakes, ponds, seeps, bogs, and meadows; and (2) lotic, which is running water habitat such as rivers, streams, and springs. BLM has Technical References focused on lentic riparian-wetland areas (1737-11 and 1737-16, http://www.blm.gov/nstc/library/techref.htm), and lotic riparian-wetland areas (1737-9 and 1737-15, http://www.blm.gov/nstc/library/techref.htm). Detailed information on PFC assessments is found in these Technical References.

Proper functioning condition riparian area assessments consist of assessments of the interaction of vegetation, landform/soils, and hydrology and are therefore not vegetation-specific. However, because this is a vegetation management handbook, an attempt is made to focus on the vegetation portion of the assessment.

1. The Reference that Vegetation Condition is Gauged Against

   The interaction of vegetation, landform/soils, and hydrology is gauged against the capability of the riparian-wetland area, or gauged against the potential of the riparian-wetland area. Capability is defined as the highest ecological status a riparian-wetland area can attain given political, social, or economical constraints, also referred to as limiting factors. Potential is defined as the highest ecological status a riparian-wetland area can attain given no political, social, or economical

constraints. The potential is often referred to as the potential natural community (PNC). The PNC is a plant community. Riparian-wetland areas on BLM-administered lands in Alaska can be gauged against potential because most are in their natural state. Riparian-wetland areas on BLM-administered lands outside of Alaska have typically been human-altered in some way and are better gauged against capability.

The PFC assessment states that riparian-wetland areas can function properly before they achieve the potential plant community (PPC) or the potential natural community (PNC). So it is not always the goal or target to achieve the capability or the potential of the riparian-wetland area (the reference conditions).

A set of criteria is presented as guidance for determining a riparian-wetland area's capability and potential. Some of the criteria below are vegetation-focused and marked with an asterisk. The criteria are:

a. *Look for relict areas (exclosures, preserves, etc.).
b. Seek out historic photos, survey notes, and/or documents that indicate historic condition.

c. *Search out species lists (animals and plants—historic and present).
d. *Determine species habitat needs (animals and plants) related to species that are/were present.
e. Examine the soils and determine if they were saturated at one time and are now well drained.
f. Examine the hydrology, establish cross sections if necessary to determine frequency and duration of flooding.
g. *Identify vegetation that currently exists. Are they the same species that occurred historically?
h. Determine the entire watershed's general condition and identify its major landform(s).
i. Look for limiting factors, both human-caused and natural, and determine if they can be corrected.

2. Indicators Used

If a qualitative PFC assessment is deemed acceptable, the minimum national standards include these vegetation-focused indicators, which are highlighted as to whether they are applicable for lotic riparian-wetland areas, lentic riparian-wetland areas, or both.

a. Diverse age-class distribution (recruitment for maintenance/recovery) (Both).
b. Diverse composition of vegetation (for maintenance/recovery) (Both).
c. Species present indicate maintenance of riparian-wetland soil moisture characteristics (Both).
d. Streambank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high streamflow events (Lotic).
e. Vegetation is comprised of those plants or plant communities that have root masses capable of withstanding wind events, wave flow events, or overland flows (for example, storm events, snowmelt) (Lentic).
f. Riparian plants exhibit high vigor (Both).
g. Adequate vegetative cover present to protect banks and dissipate energy during high flows (Lotic).
h. Adequate vegetative cover present to protect shorelines/soil surface and dissipate energy during high wind and wave events or overland flows (Lentic).
i. Plant communities in the riparian area are an adequate source of coarse and/or large woody debris (Lotic).

j. Frost or abnormal hydrologic heaving is not present (Lentic).
k. Favorable microsite condition (that is, woody debris, water temperature, etc.) is maintained by adjacent site characteristics (Lentic).

For riparian-wetland areas in which status is hard to discern, a quantitative ecological site inventory is recommended for use as the basis for a PFC assessment, to establish capability and potential and to assess functionality (see "BLM Technical Reference 1737-7, Procedures for Ecological Site Inventory—With Special Reference to Riparian-Wetland Sites, "Leonard et al. 1992, http://www.blm.gov/nstc/library/techref.htm.

3. Primary Uses of Data

a. Reporting functioning condition status: The functioning condition status of lotic and lentic riparian-wetland areas is reported annually in BLM's "Public Land Statistics," http://www.blm.gov/natacq/pls05/, by administrative state. Lotic and lentic riparian-wetland areas are reported separately. This reporting is done to satisfy inventory requirements of "The Federal Land Policy and Management Act (FLPMA) of 1976," and to report on progress toward goals and objectives of the Riparian-Wetland Initiative for the 1990s (USDI, BLM, 1991).
b. Assessing achievement and non-achievement of riparian-focused land-health standards: The lotic and lentic riparian-wetland PFC assessment techniques are often the primary techniques used by BLM field offices to ascertain achievement or non-achievement of riparian-focused land-health standards.
c. Developing riparian management objectives: The focus of some riparian management objectives is a functioning condition category(ies) (see section 4 below for functioning condition categories) that is(are) desired to be sustained or achieved through management.
d. Effectiveness monitoring/ascertaining progress toward or away from riparian management objectives in land-use plans and other planning documents: Monitoring data and re-assessment of functioning condition status through time can be used to ascertain progress toward or away from (trend) riparian management objectives.

4. How Data are Aggregated or Reported

For the qualitative PFC assessment, a checklist containing minimum national standards of hydrologic, vegetative, and soils-erosion deposition indicators is filled out by an interdisciplinary team. Each indicator is checked: (1) yes, it is present; (2) no, it is not present; or (3) N/A (it is not applicable). For those indicators checked as no, the severity of the condition must be explained in a Remarks section. Remarks are encouraged but not required for indicators checked as yes. An interdisciplinary team discussion of the ratings for each indicator is the means by which a functional rating category is decided upon.

Lotic riparian-wetland areas are reported by miles. Lentic riparian-wetland areas are reported by acres. Lotic in miles and lentic in acres are reported separately in these functional rating reporting categories:

a. Proper Functioning Condition
b. Functional—At Risk
   i. Trend Up
   ii. Trend Not Apparent

iii. Trend Down

c. Non-Functional

d. Unknown

5. Advantages and Limitations

Advantages

a. Most riparian-wetland areas can be assessed using the qualitative assessment technique which is a relatively rapid assessment, yet is science-based. Its rapidity makes it an operational way to assess functionality of riparian-wetland areas across all of BLM.
b. Can be used to assess riparian vegetation condition to help in ascertaining achievement or non-achievement for riparian-focused land-health standards.

Limitations

a. PFC assessments are focused on physical functioning. Biological habitat quality as part of the overall functioning of riparian-wetland areas is not a focus—vegetation-focused indicators are not focused on habitat quality. To obtain a complete picture of riparian-wetland area health, biological habitat quality must be assessed in addition to physical functioning.

F. Wildlife and Wildlife Habitat

BLM manages lands that constitute either year-round or seasonal habitats for more than 3,000 species of terrestrial, aquatic, and amphibious vertebrates, including mammals, birds, reptiles, fish and amphibians, all collectively referred to as "wildlife." In addition, BLM also manages habitats for hundreds more special-status species of invertebrates ("wildlife") and plants. With respect to aquatic species, it is important to understand how the condition of upland and riparian plant communities influences water quality and quantity, and hence, suitability for aquatic species. Because of such diversity on BLM lands and elsewhere, wildlife habitat assessment and evaluation, and related management decisions, are almost always contextual to the species under consideration, and many methods exist for assessing "wildlife habitat." The species being addressed, the questions to be answered, and the scale(s) of assessment will determine the method(s) to be used.

Anderson and Gutzwiller (2005) provide an in-depth review of wildlife habitat evaluation considerations that includes relating animal fitness, density, and diversity to habitat features; which habitat features should be measured; measurement of habitat variables (macro and micro features); and, standardized techniques of habitat evaluation. They note that in examining the quantity and quality of available habitat for a particular species, "… (managers) must be able to measure features of the habitat that relate specifically to the presence and number of animals." Discussing which habitat features should be used to assess animal-habitat relationships, they state that general habitat characteristics can help identify which broad animal taxa might be present, and also note that "frequently, general habitat studies are not helpful in identifying habitat features associated with a particular species."

Single Species Considerations

For species such as sage-grouse, pygmy rabbit, northern spotted owl, and marbled murrelet, habitat and/or population assessment protocols have been developed and should be followed. These may or may not be reflected in state species management plans, such as sage-grouse conservation plans developed by Local Working Groups, or in State Wildlife Action Plans.

Individual states may also have information systems and established protocols for wildlife, vegetation, and/or special status plants. As a result, state goals and objectives for wildlife and wildlife habitat may also have been developed that will be important in developing integrated vegetation management objectives. For example, the California Wildlife Habitat Relationships (CWHR) information system contains life history, geographic range, habitat relationships, and management information on 692 species of amphibians, reptiles, birds, and mammals known to occur in California. The CWHR is operated and maintained by the California Department of Fish and Game in cooperation with "the California Interagency Wildlife Task Group," of which BLM is a member. The California Native Plant Society Vegetation Rapid Assessment Protocol is a reconnaissance-level method of vegetation and habitat sampling used to quickly assess and map the extent of all vegetation types in relatively large, ecologically defined regions.

Individual species considerations that can affect assessment technique selection include:

- Is the species under consideration wide-ranging? Does it utilize large spatial areas either seasonally or daily? Is it migratory or non-migratory? Is it a short or long-distance migrant? Examples include elk, pronghorn, sage-grouse, golden eagle, wolf.
- Is the species under consideration widely distributed? If so, is it also wide-ranging, or does it have limited home ranges? Does it inhabit only small areas of suitable habitat within much larger landscapes (pygmy rabbits), or is it more generally distributed across landscapes (cottontail rabbits)?
- Is the species a narrow endemic, restricted to a comparatively small geographic area and having very specific habitat requirements?
- Are there behavioral considerations that must be accounted for in assessing habitat quality, such as some species either avoiding or being adversely affected by anthropogenic features including roads, power lines, or industrial noise?

Multi-species Considerations

Managing for single-species conservation will likely remain an obligation well into the future because of considerations such as Endangered Species Act requirements. However, there is increasing acknowledgement of the need to move away from single-species management and toward multi-species management. Vegetation management that favors the retention or restoration of one or more particular types of habitat will benefit most those species showing close affinities with those habitats.

Identifying multi-species needs in a broader habitat-oriented context can facilitate development of vegetation management objectives which provide broader wildlife benefits, and are usually most applicable at the landscape and larger spatial scales. A useful concept in that regard is grouping species according to their use of different types of habitats. Wisdom et al. (2005), in assessing the potential cheatgrass and pinyon-juniper displacement of sagebrush habitats in the Great Basin and resultant impacts to wildlife, assigned 40 sagebrush-associated species of conservation concern to one of five groupings for analysis (see Table 4-1). Their analysis used habitat abundance and habitat risk to characterize the composite habitat conditions for each watershed and group, providing information that can have a significant role in developing vegetation management objectives.

Table 4-1. Species grouping for sagebrush-associated species.

Species Grouping	Habitat(s) Used	Example Species
Sagebrush obligate	sagebrush nearly exclusively	Greater sage-grouse Pygmy rabbit Brewer's sparrow
Arid shrubland	sagebrush and salt-desert scrub	Desert collared lizard Longnose snake Merriam's kangaroo rat
Sagebrush-grassland	sagebrush and grasslands	Western burrowing owl Kit fox Pronghorn antelope
Sagebrush-woodland	sagebrush and pinyon-juniper	Gray flycatcher Merriam's shrew White-tailed jackrabbit
Sagebrush generalist	sagebrush and many other habitats	Great Basin spadefoot Striped whipsnake Swainson's hawk

In considering the utility of greater sage-grouse as an umbrella species, Wisdom et al. (2005) wrote, "Our results suggest that sage-grouse function best as an umbrella species for those taxa strongly associated with sagebrush as their primary habitat, i.e., members of the sagebrush and sagebrush-woodland groups." In considering the other species of concern in their analysis, i.e., those species not strongly associated with sagebrush as their primary habitat, they note, "Even if extensive habitat management and restoration occur within the range of sage-grouse, much of the high risk habitat for other species of concern will not be targeted, especially for non-sagebrush obligate species."

Integration of Single Species and Multi-species Evaluations

In evaluating source habitats for individual species as well as for groups of species in the interior Columbia Basin, Wisdom et al. (2000) nested evaluations of individual species hierarchically within evaluations conducted for groups of species and for multiple groups. They state:

> "Use of hierarchically nested single- and multi-species evaluations, conducted at multiple spatial scales, is considered a requirement for managers who need information at different levels of resolution and complexity. Our use of both single- and multi-species evaluations was designed to provide maximum flexibility in how managers address different issues of habitat management. Our rationale for using both single- and multi-species evaluations, each nested hierarchically within one another, was that each habitat issue requires a different level of detail and knowledge for effective management."

The continuing evolution of techniques and technology make it important to seek the most current information for conducting assessments, whether for single or multi-species applications. Examples include the Sage-grouse Habitat Assessment Framework (USDI, BLM, and WAFWA, in prep.), ecoregional assessments, connectivity analyses, and advances in remote sensing and GIS. Where published or formal protocols do not exist, technical references such as the following should be consulted:

- "Techniques for Wildlife Investigations and Management" (Braun, 2005);
- "Inventory and Monitoring of Wildlife Habitat" (Cooperrider et al., 1986);
- "Assessing Big Sagebrush at Multiple Spatial Scales" (Karl and Sadowski, 2005), http://www.blm.gov/nstc/library/pdf/SagebrushTN417.pdf; and,

- "Measuring and Monitoring Plant Populations" (Elzinga et al., 2003), http://www.blm.gov/nstc/library/pdf/MeasAndMon.pdf.

1. The Reference that Vegetation Condition is Gauged Against

   Simplified habitat assessments consider the four fundamental requirements for wildlife; food, water, shelter and space. Because different species have different habitat requirements, reference conditions for gauging habitats vary with the species under consideration and the protocols used. Consequently, vegetation "condition," such as habitat structure and other measures, some of which may be qualitative rather than quantitative, are also scale-dependent.

   Habitat management guidelines for particular species frequently contain specific metrics that either: (a) characterize desirable habitat conditions at scales coarser than ecological sites; or (b) may apply to spatial areas that encompass multiple ecological sites. Wide-ranging and migratory species may have significantly different needs than non-migratory species. Widely distributed species may, in one portion of their range, inhabit landscapes whose characteristics are markedly different than landscapes in another portion of their range, and it is essential to understand species requirements in the context of local and regional settings.

2. Indicators Used

   In discussing vegetation sampling and measurement, Higgins et al. (2005) write:

   "After listing the objectives of the study and primary habitat requirements of the wildlife species under study, one may then identify which aspects of the vegetation to sample. Some or all of the following may be important in describing primary wildlife habitat requirements:
   (1) species composition;
   (2) vertical and/or horizontal spatial distribution;
   (3) temporal variation in structure;
   (4) biomass;
   (5) overall stand structure; and
   (6) surrounding environment (landscape structure)."

   Stated another way, also simplified, basic habitat assessment considerations should answer the following questions. Examples of one or more examples or indicators for each question are shown, and the metrics can vary depending on species under consideration.

   a. What is it?
      Indicator: cover type
   b. Where is it?
      Indicator: spatial location on the landscape
   c. How much of it is there?
      Indicator or example: habitat abundance (usually expressed in acres or hectares)
   d. How is it arranged?
      Indicators or examples: habitat distribution, degree of interspersion (edge), patchiness
   e. What is its qualitative value for the species under consideration?
      Indicators or examples: species composition, floristic diversity, cover density, vertical structure (height, age classes present), degree of fragmentation, water quality and availability (type, proximity, seasonality, quantity, competition)

f. What are the threats to the habitat (including non-vegetal)?
Indicators or examples: disturbances resulting from human presence or other anthropogenic activities (roads, off-highway vehicle activity, transmission lines, compressor stations, wind turbines, fences, mining, development sprawl), invasive species, undesired fire (including arson)

In addition to vegetation and associated considerations (such as water availability), actual use of the habitat by the species under consideration also provides indicators, and should be considered in assessing habitat(s):

a. What species of interest or concern are present or absent?
b. What is the relative abundance of the species under consideration?
c. How does species abundance in the assessment area(s) compare with abundance at larger scales?
d. What are the local and larger-scale population trends of the species under consideration?
e. Do the observed population levels represent normal, cyclical population variations, or are they associated with longer-term population increases or declines?

3. Primary Uses of Data

Data collected through the assessment process enable BLM to meet a variety of needs, including, but not limited to:

a. Monitoring trends in specific habitat and/or population parameters to determine the effects of management on those trends;
b. Assessing habitat suitability or condition, including connectivity, to better understand the existing and potential role of BLM lands in sustaining species of interest or concern;
c. Providing information for the development and monitoring of Habitat Management Plans developed under Manual Section 6780;
d. Prioritizing vegetation (habitat) management actions, such as habitat improvement or restoration projects;
e. Developing habitat-related stipulations in conjunction with land-use authorizations;
f. Providing information for land-use plan revisions or amendments; and,
g. Periodic reporting required by law or policy, such as to provide status information for threatened and endangered or other special status species.

4. How Data are Aggregated or Reported

Fish and wildlife habitat data are aggregated or reported in a variety of applications and/or documents. Aggregation (or compilation) often is more applicable to analytical needs, such as scientific or other analyses, which may include NEPA processes, than is reporting. Examples include:

a. Preparation of cumulative effects analyses for NEPA applications
b. Development of strategic planning documents
c. Development of habitat management or recovery plans
d. Preparation of ecoregional assessments
e. Preparation of biological clearances for various projects
f. Development of wildlife or fisheries objectives for land-use plans, and subsequent implementation plans
g. Preparation of mandatory annual reports to Congress or other federal agencies (for example, U.S. Fish and Wildlife Service, NOAA Fisheries Service)

5. Advantages and Limitations

Advantages

a. Better management may result for species of conservation concern (some of which may be mandated by recovery plans) or of economic concern (for example, big game, Pacific Northwest salmonids)
b. Coordinated management across jurisdictional boundaries may be facilitated.

Limitations

a. Because the historical focus of habitat assessments has been on individual species habitat management (for example, deer, elk, spotted owl, sage-grouse), individual species-focused objectives for habitat condition or habitat quality have been developed. These objectives often cannot be satisfactorily achieved on a given management area where other important species with substantially different habitat requirements are present. There are too many conflicting species habitat needs to accommodate. Managing for a single species may depress or cause declines in populations of other species.
b. Site-specific target metrics for some species may not be able to be achieved on some ecological sites.
c. The specifics of habitat requirements at larger spatial scales are largely unknown for many wildlife species.
d. It is difficult to definitively establish cause-and-effect relationships between individual habitat improvement projects and population trends, especially at larger spatial and temporal scales. Population fluctuations may be attributable to causes other than local habitat conditions, including supernatural population cycles, habitat changes in distant parts of migratory species habitats, newly introduced pathogens (for example, West Nile virus), macroscale environmental factors (for example, climate change, ozone layer thinning), or shorter-term environmental factors (for example, episodic drought, or above-normal precipitation).
e. The dynamic nature of vegetation communities and their responses to natural and/or uncharacteristic disturbance events, including fire, may not be considered in many traditional wildlife habitat assessments.

Assessing Big Sagebrush Habitat at Multiple Spatial Scales

This assessment technique is published as "BLM Technical Note 417," http://www.blm.gov/nstc/library/pdf/SagebrushTN417.pdf, and further details not provided in this handbook can be found there. This assessment technique describes how big sagebrush habitats are being assessed and managed at multiple spatial scales within the Jordan Resource Area of the Vale District in southeast Oregon. The assessment included information at the broad-scale (Interior Columbia Basin Ecosystem Management Project area; 145 million acres), mid-scale (Southeast Oregon Resource Management Plan-Final Environmental Impact Statement, 4.6 million acres; and Louse Canyon Geographic Management Area, 0.52 million acres), fine-scale (pasture, ranging in size between less than 2,000 to 88,000 acres), and site- or local-scale (ecological site, variable in size but typically smaller than pasture) levels.

This assessment technique was developed for a few major reasons. First, BLM faces a challenge in assessing issues that operate across different spatial scales. A case in point is sagebrush habitat because the risk factors for sagebrush-obligate wildlife species operate across different spatial scales and the habitat needs of some species such as sage-grouse encompass multiple spatial scales, so an assessment at any single spatial scale does not fully characterize habitat conditions. This challenge is not just restricted to sagebrush habitat.

Second, in regard to wildlife habitat, the BLM has developed and continues to develop broad-scale habitat assessments, such as the Interior Columbia Basin (Wisdom et al. 2000) and the Great Basin (Wisdom et al. 2003). Broad-scale information provides a valuable context for planning and managing the public land. However, because land-use plans are the mechanism by which BLM makes legally binding decisions about natural resource management, and such decisions in turn require NEPA processes that involve the public at the local level, broad-scale findings cannot and do not replace local BLM decisions. A bridge between broad-scale natural resource assessments and local-scale decisions regarding public land must first be established. This assessment technique provides a bridge.

Third, BLM's land-health standards are typically assessed using fine-scale (for example, pasture) to site-scale (local, for example, ecological site) landscape units. In addition, although each BLM administrative state or Resource Advisory Council area has at least one land-health standard that addresses native plants or native plant communities, which would encompass sagebrush, BLM has struggled to develop ways to assess sagebrush for these land-health standards. Some of the struggle is related to the lack of measurable indicators associated with these land-health standards that are focused on spatial patterns of sagebrush (or any other type of vegetation) across the landscape and the structural complexity of sagebrush (or any other type of vegetation). The challenge here is that fine-scale to site-scale assessments are not adequate in all cases for assessing habitat-focused land-health standards, and the currently available habitat-specific indicators associated with habitat-focused land-health standards are not always adequate. This assessment technique addresses this challenge.

a. The Reference that Vegetation Condition is Gauged Against

   The reference that vegetation condition—in this instance habitat condition, based on vegetation condition—is gauged against varies by spatial scale.

   Range surveys from the Vale District included data on percent composition of plant communities estimated by weight of vegetation. These data were summarized to show how many of the acres within the Southeast Oregon Resource Management Plan (SEORMP) area either support or have the potential to support big sagebrush vegetation. This represented a baseline reference from which a mid-scale SEORMP objective was developed. The long-term mid-scale SEORMP objective is to maintain 70 percent or more of acreage that either supports or has the potential to support big sagebrush vegetation, in big sagebrush canopy cover classes 3, 4, or 5 (shrubland aspect classes; see section 2 below, "Indicators Used" for explanation of canopy cover classes).

   The currently existing spatial extent of big sagebrush canopy cover classes 3, 4, and 5 on acreage that either support or has the potential to support big sagebrush vegetation, was the baseline reference in the Jordan Resource Area portion of the SEORMP. This represented the baseline from which mid-scale Geographic Management Area (GMA) objectives were developed. The Jordan Resource Area was subdivided into eight Geographic Management Areas, or GMAs, (ranging in size from 184,000 to 531,000 acres, or roughly the size of subbasins (4th level of the Hydrologic Unit Code)) to facilitate landscape-scale assessment. The spatial extent of big sagebrush canopy cover classes 3, 4, or 5 within objectives for each GMA, if achieved, would achieve the mid-scale SEORMP objective.

   The spatial extent of big sagebrush canopy cover classes 3, 4, or 5 within objectives for each GMA, was the baseline reference from which fine-scale pasture objectives were developed. In addition, understory herbaceous vegetation species composition representative of mid-seral, late

seral, or potential natural community conditions was a baseline reference from which fine-scale pasture objectives were developed. The spatial extent of big sagebrush canopy cover classes 3, 4, or 5, and understory herbaceous species composition representative of mid seral, late seral, or potential natural community within objectives for each pasture, if achieved, would meet the mid-scale GMA objectives and Oregon's habitat quality land-health standard.

b. Indicators Used

The spatial extent and patterning of big sagebrush canopy cover classes is the primary indicator used. Big sagebrush (which included the subspecies of Wyoming, basin, and mountain) canopy cover was subdivided into five classes. Canopy cover classes were: (1) no sagebrush canopy cover, which represented a grassland aspect; (2) trace to five percent sagebrush canopy cover, which represented a grassland aspect; (3) greater than five percent to 15 percent sagebrush canopy cover, which represented a shrubland aspect; (4) greater than 15 percent to 25 percent sagebrush canopy cover, which represented a shrubland aspect; and (5) greater than 25 percent sagebrush canopy cover, which represented a shrubland aspect.

A secondary indicator (used only at the fine-scale pasture level) is the understory herbaceous vegetation species composition. Although not used in the assessment technique per se, a placeholder indicator was developed for the local (ecological site) scale—canopy cover subclasses within each of the five classes.

c. Primary Uses of Data

i. Developing multiple spatial scale management objectives: Indicators and the reference were used to generate management objectives at the mid-scale SEORMP level, the mid-scale Geographic Management Area level, and the fine-scale pasture level.
ii. Ascertaining achievement or non-achievement of Oregon's habitat quality land-health standard: The geographic (spatial) extent of big sagebrush canopy cover classes at the pasture level formed the basis for ascertaining achievement or non-achievement of Oregon's habitat quality land-health standard, when combined with understory herbaceous species composition data.

4. How Data are Aggregated or Reported

Spatial extent in percent of land area for big sagebrush canopy cover classes 3, 4, and 5 is aggregated by pasture, combined with extent of each pasture in mid-seral, late seral, or potential natural community seral stages for understory herbaceous composition. These data are used to report achievement or non-achievement for each pasture for the habitat quality land-health standard for Oregon (Oregon's Standard 5). The pasture achievement or non-achievement results are then aggregated to the allotment level, for reporting of allotment achievement or non-achievement that ends up being a part of BLM Oregon's land-health standard achievements. Oregon's land-health standard achievements are reported annually in the "Rangeland Inventory, Monitoring, and Evaluation" (RIME) report, http://www.blm.gov/nstc/rangeland/rangelandindex.html.

The pasture-level spatial extent of big sagebrush canopy cover classes 3, 4, and 5 is aggregated across pastures within a GMA to report on achievement or non-achievement of the GMA objective. Sequential assessment of all eight GMAs within the Jordan Resource Area will aggregate big sagebrush canopy cover class spatial extent data to report on achievement or non-achievement of the Jordan Resource Area portion of the SEORMP objective (see section 1 above for the SEORMP objective).

5. Advantages and Limitations

Advantages

a. Uses assessment information in a multi-spatial scale framework. Big sagebrush habitat objectives are generated from assessment information applicable at a broader scale, so that the broader scale provides context for setting of finer scale objectives. Conversely, finer scale big sagebrush habitat objectives are designed so that, if achieved, they contribute to achievement of big sagebrush habitat objectives at the next higher (broader) spatial scale.
b. Attempts to link the big sagebrush habitat objectives to big sagebrush habitat conditions that can be produced on an ecological site scale. Therefore the big sagebrush habitat objectives are grounded in reality.
c. Uses more of a coarse-filter approach to managing big sagebrush habitat because the assessment approach is designed to set big sagebrush habitat objectives that will benefit sagebrush-obligate wildlife species in general, rather than just a single sagebrush-obligate species. A coarse-filter approach is believed by the Vale District to be more implementable in labor and time for managing habitat across the large acreages of BLM land than fine-filter approaches designed for individual wildlife species.

Limitations

a. Although the spatial scales are linked in regard to big sagebrush habitat objectives, the collection of assessment data at each spatial scale is not concurrent in time. Pasture level big sagebrush habitat data are collected within one GMA at a time. A single GMA is completed before the next is initiated. All eight GMAs need to be completed in the Jordan Resource Area before it can be ascertained if the Jordan Resource Area's portion of the SEORMP's big sagebrush habitat objective has been achieved. By the time the last GMA is completed the big sagebrush habitat conditions in the first GMAs will likely have changed, attributable to natural disturbances such as wildfire, and treatments implemented to achieve the pasture level and GMA level big sagebrush habitat objectives. Constraints in labor and funding are causal in this.
b. Although not yet supported with evidence, it is believed by some BLM biologists that a coarse-filter approach, like this big sagebrush habitat assessment technique, is not suitable for achieving habitat conditions needed by single species such as greater sage-grouse.

IV. Designing a Framework for Integrated Vegetation Assessment

Assessment approaches within BLM have been designed typically within the context of a single program, and therefore rarely meet the needs of other programs in identifying management opportunities and setting treatment priorities. BLM's land-health standards (LHS) and the land-health standards assessment process (see "BLM Rangeland Health Standards Handbook H-4180-1," Release 4-107, dated 2001), associated with "Rangeland Health Standards and Guidelines for Grazing Administration" (Title 43 Code of Federal Regulations 4180) provide a framework under which all disciplines can assess vegetation condition together. Although originally designed to apply only to rangelands, the land-health standards developed by BLM in coordination with Resource Advisory Councils in the late 1990s are applicable to all land types and management actions ("BLM Land Use Planning Handbook, H-1601-1," Release 1-1693, dated 2005). These standards are to be incorporated as ecological goals in all new land-use plans (see "BLM Land Use Planning Handbook") and have been characterized by BLM leadership as the process that would be used on all BLM lands and by all BLM programs. However, the LHS process has not yet completely fulfilled the vision of being a fully integrated assessment process. Continued integration effort is needed to make this vision a reality, such as the development of additional indicators that better address conditions related to fish and wildlife habitat and forested landscapes.

The need for integrating assessments across disciplines and spatial scales has been raised for many years. However, nearly two decades after adopting ecosystem management principles to guide the management of BLM-administered lands, a number of different approaches—many of which are not integrated with each other—continue to be used to assess and describe vegetation condition. While no "one-size-fits-all" assessment approach exists that meets the detailed needs of all the programs, or likely ever will, commonalities within assessment approaches can be identified that facilitate the integration of the needs of several programs.

The following components represent commonalities and can be the building blocks of a framework for integrated vegetation assessment within the BLM. Offices are encouraged to incorporate them where appropriate in designing assessments of vegetation condition.

A. Focusing the Assessment

Assessments are conducted for a variety of purposes including determining the status of a particular resource within an area. At times, assessment results are under-utilized because the data do not answer key questions that help managers understand where they should focus their work and funding to have the greatest impact upon achieving the desired future condition. Since vegetation management is one of the key activities that BLM implements through changes in land-use and direct treatments, assessment information on the condition of plant communities and individual plant species can provide the type of information managers are seeking to develop strategies and set priorities. By focusing the intent of the assessment on identifying risks and opportunities for treatments/actions that maintain or improve native plant community diversity, resilience, and productivity, the assessment information will have a greater relevance to multiple programs with interest in managing vegetation and will assist managers in locating and prioritizing treatments.

B. Developing Integrated Management Questions

As discussed above, the current assessment approaches typically used within the BLM were designed to achieve particular objectives, often within the context of only one program area. Each has advantages and limitations, depending upon the information needed to satisfy a particular objective. In other words, assessment approaches have varied depending upon the management questions being asked.

Perhaps the area that holds the greatest potential for optimizing the integration of vegetation condition assessments is in the development of activity plans for implementing land-use plan decisions. Conducting assessments on geographic landscape delineations (for example watersheds or allotments) to identify interdisciplinary opportunities for improving vegetation condition is greatly facilitated if the goals and objectives for the plant communities are described in an integrated manner in the land-use plan.

Desired native plant communities should be a focus for development of integrated vegetation management objectives at multiple spatial scales. How they are used in vegetation management objectives will vary by spatial scale. At landscape spatial scales (large geographic extents) such as regional planning areas or one or more contiguous BLM field offices, vegetation management objectives could be focused on the composition of desired plant communities denoted by proportions of the landscape planning area in each desired plant community. These objectives could then be correlated to each biophysical setting in the planning area. At a finer spatial scale than biophysical setting, the same could be done by stratifying to ecological sites in the planning area if and when ecological site descriptions contain information on proportion of the ecological site's area in various plant communities (both in reference and non-reference states in state-and-transition diagrams), as discussed in more detail in section C below.

Where program-specific descriptions of the desired plant community have been previously developed, it may be necessary to develop a cross-walk between the various descriptions of vegetation condition to facilitate working together. The following example of such a cross-walk is from the Pocatello Field Office RMP in southeastern Idaho:

During development of the Pocatello Field Office RMP common terminology was developed to describe the desired future ecological condition (land-health). The term "Land Health Condition" or (LHC) was defined as the presence or absence of ecological components necessary to sustain a healthy ecosystem. To ensure continuity between approaches used to assess ecological condition by the two largest vegetation management programs in their office, the Pocatello Field Office built a crosswalk between the LHC descriptions and Ecological Site Inventory (ESI) used primarily by range program specialists and Fire Regime Condition Class (FRCC) used by the fire and fuels program. Table 4-2 shows how the vegetation classifications were cross-walked:

Table 4-2. Example of Land Health Condition Classification Compared with ESI and FRCC Classes for the Pocatello RMP.

Land Health Condition Class (LHC)	Definition	Key Ecological Components	
		Land Health Indicators	Fire Regime Condition Class Descriptions
LHC-A	All key ecological components are present as identified in land-health standards and defined by FRCC 1	-Appropriate amount and distribution of ground cover, including litter. -Native Plant communities are maintained or improved to ensure proper functioning of ecological processes. -Diversity of native plant species. -Minimal erosion. -Proper functioning riparian areas. -Noxious weeds absent or not increasing.	FRCC 1 -Area is within the natural (historical) range of variability of vegetation characteristics, fuel composition, fire frequency, severity and pattern, as well as other disturbances. -Vegetation attributes (species composition, structure, and pattern) are intact and functioning within the natural range.

For each alternative, the Pocatello RMP displays the percentage of the land that will likely achieve each of the LHC classes for each vegetation type. This consistent terminology was also used in the description of vegetation management goals and objectives for each of the programs that manages vegetation.

For example, the goal for the shrub steppe vegetation type for one alternative might read as follows:

Maintain or increase LHC-A to >60% in the shrub steppe plant communities, with at least 15-25% of this area in sagebrush cover. Move toward >60% LHC-A in this community type so that wildland fire occurs less frequently and at a smaller scale (smaller burned patch size) on the landscape.

This concept is discussed further in Chapter 5.

C. Selecting an Assessment Area

Although the "Rangeland Health Standards Handbook" (H-4180-1) recommends using a watershed (5th unit of Hydrologic Unit Code) as the assessment unit for land-health standard assessments, many

offices have conducted land-health standard assessments using allotments or pastures as assessment units. Doing so has made it difficult to address issues that transcend allotment boundaries, such as water quality, wildlife habitat quality, or wildland fire risk. To improve the opportunity to integrate assessment approaches, the assessment area selection should be done using an interdisciplinary team and specifically to address interdisciplinary management questions. The use of watershed, eco-region or other units delineated ecologically, is recommended when conducting vegetation condition assessments.

Assessment Scale and Vegetation Assessment Units

While metrics for assessing vegetation condition at the stand or site scale, such as plant density, cover or age are plentiful and techniques for measuring them are readily available, landscape-scale metrics for assessing ecological processes and functions and techniques for measuring them are limited. However, landscape-scale metrics have proven to be more useful at assessing landscape-scale risks, such as the invasion of invasive species, or threats to habitat for wide-ranging species.

Some indicators associated with land-health standards are best assessed at the vegetation stand or site scale, such as the population level of a special status plant species. Other indicators, for example those focused on ascertaining wildlife habitat quality and wildfire risk, often require a more landscape or plant community assessment approach. Metrics such as the number and size of the vegetation patches, which are critical in understanding wildlife habitat fragmentation and hazardous fuel continuity, are being developed and prototyped under the BLM Assessment, Inventory and Monitoring Strategy, at the National Operations Center, and elsewhere.

Additional indicators applicable to other disciplines, including forestry, wildlife and fuels have also been developed that have the potential to be used with the land-health standards assessment, however their use has been limited and additional work is needed to improve their ability to be integrated with the techniques currently employed in land-health standards assessment.

Ecological sites are baseline inventory units that represent stratifications of the landscape into relatively homogeneous vegetation-soil and management units (Source: Handbook H-4410-1, National Range Handbook, Release 4-101, dated 1990; Technical Reference 1734-7, Ecological Site Inventory, dated 2001). Ecological sites should be used as the smallest geographic area assessment units for vegetation. Ecological sites (originally called range sites) have been and continue to be operationally used by BLM's rangeland management program. Additionally, BLM's wildlife management program has policy requiring ecological sites for development of habitat sites, the wildlife management program's baseline habitat inventory unit (Source: Manual 6602, Integrated Habitat Inventory and Classification System, Release 6-87, dated 1982). Therefore, ecological sites have some interdisciplinary history in BLM. Aggregations of ecological sites within a watershed or other assessment area have the potential to serve the interdisciplinary vegetation management needs, but need some improvements in order to fully realize their interdisciplinary potential and multiple spatial scale application. Some of these improvements are in process whereas others are yet to be developed.

Improvements in process are focused on plant cover, state-and-transition succession-disturbance diagrams, and standardization of naming of plant communities in ecological sites. The standard way of characterizing vegetation of a historic climax plant community or potential natural community in an ecological site description was plant species composition that was composed of individual plant species annual aboveground dry weight production by acre. An added improvement that will serve interdisciplinary use of ecological sites is that vegetation of the diagnostic plant community, as well as all other plant communities identified as being possible to exist on that ecological site either in the

reference state or outside the reference state, will be characterized by plant species by cover (basal, foliar, or canopy, depending on plant species life form) by vertical strata (Source: Unpublished technical document dated December 2006 that supports the Draft Interagency Ecological Site Manual). These data will characterize the vertical structure of plant communities so important to wildlife habitat condition assessments and fire/fuel assessments.

A state-and-transition diagram will be a necessary feature in ecological site descriptions. Example state-and-transition diagrams can be found in "BLM Technical References 1734-6 (page 16), 1734-7 (page 20)," and in ecological site descriptions, located at http://esis.sc.egov.usda.gov/ESIS/. A reference state, and one or more non-reference states, will be included. Plant communities and their relation to each other with succession, natural disturbances, and human-caused disturbances, will be integral to each state in the state-and-transition diagram. Vegetation data that were used to identify each plant community in the state-and-transition diagram must be useable (that is, able to be cross-walked) so that each plant community can be named as one or more of those included in the National Vegetation Classification (NVC), a part of the National Vegetation Classification Standard, (http://www.fgdc.gov/standards/projects/FGDC-standards-projects/vegetation/index_html; Federal Geographic Data Committee, Vegetation Subcommittee, National Vegetation Classification Standard, Version 2—Final Draft, dated October 30, 2007). In most instances the plant communities identified as part of the NVC will need to be at the association level, the lowest (most detailed) level of the NVC, because these are most suited to the site spatial scale of ecological sites. The NVC is a repository of classified existing (rather than potential) plant communities in the United States, currently hosted by NatureServe at http://www.natureserve.org/explorer/ (Source: Unpublished technical document dated December 2006 that supports the Draft Interagency Ecological Site Manual).

The reference state, with one or more plant communities comprising it, with plant communities able to be cross-walked to standardized plant communities in the NVC, will be quite similar in concept to the reference condition models for BpSs that serve as the basis for FRCC estimation. The differences are that the ecological site is usually a finer spatial scale (smaller geographic extent) landscape stratification unit compared with a BpS. Also, plant communities that can exist in the reference state for an ecological site are not yet estimated as to the proportion of the landscape of that ecological site they each are believed to have covered at historic, given historic range of variability. In BpS reference condition models, proportions of the landscape in a BpS are stated for each vegetation-fuel class so that the proportions for each vegetation-fuel class, when summed, total to 100% of the area of the BpS (Sources: Unpublished technical document dated 15 December 2006 that supports the Draft Interagency Ecological Site Manual; Interagency Fire Regime Condition Class Guidebook, Version 1.2, 2005, http://www.frcc.gov/docs/1.2.2.2/Complete_Guidebook_V1.2.pdf).

Improvements needing development are focused on making ecological sites useful at spatial scales broader than site. Descriptions of ecological sites should contain additional vegetation parameters that are applicable to geographic extents broader than soil map units—to permit multiple spatial scale usage. For example, for the geographic area of a Major Land Resource Area (MLRA), and a Land Resource Unit (LRU), which are levels in the Natural Resource Conservation Service (NRCS) Soil Geography Hierarchy roughly equal to a Section and a Subsection in the National Hierarchical Framework of Ecological Units used by the Forest Service, a needed vegetation parameter is the proportion of each ecological site's area predicted to be comprised by each plant community contained in the reference state. The MLRA or Section would be a geographic area large enough in most instances to cover one to many contiguous land-use planning areas and would serve a regional-type planning effort. The LRU or Subsection would be comparatively smaller in geographic extent and would cover one to a few contiguous land-use planning areas and would serve a regional-type planning effort or an individual Resource Management Plan effort.

These data would serve to set a baseline for vegetation plant community composition on a landscape (the planning area under consideration) and plant community pattern that can be gauged against with management alternatives in EISs or EAs. These data on plant community composition of ecological sites across large geographic extents are very similar to the BpS reference condition concept of FRCC and these data can be used to improve, but not replace, BpS reference condition models to improve integration. Management alternatives analyzed could be managing for some plant communities that will be in non-reference states. Land use plan and implementation plan objectives could be developed using this information and the objectives would be focused on the proportion of the landscape that is to be managed for in each of various desired plant communities (DPCs).

Biophysical settings as used in assessing FRCC, provide a description of reference conditions that include more than one plant community and the historic plant cover, as well as vertical and horizontal structure. BpSs also include estimations of the range of natural variability for coverage by each plant community. These plant community characteristics are important when assessing how well ecological processes are likely to function, such as how wildfire will affect the vegetation, and how well the mosaic of plant communities provide habitat for a variety of wildlife species.

Applying information from landscape scale assessments, particularly those that use maps produced by satellite images or other remotely sensed data, to design and monitor vegetation treatments has been difficult due to scale differences. Linking information across scales is even more difficult because vegetation attributes collected at the site-scale typically have not been designed to nest within attributes at the next scale up. One example of how vegetation management objectives were developed at multiple spatial scale planning is the Vale Field Office's assessment of big sagebrush condition.

This assessment incorporated information from the broad-scale (Interior Columbia Basin Ecosystem Management Project area, 145 million acres), the mid-scale (Southeast Oregon Resource Management Plan-Final Environmental Impact Statement area, 4.6 million acres; and Louse Canyon Geographic Management Area, 0.52 million acres), the fine-scale (pasture, ranging in size between less than 2,000 to 88,000 acres), and the site-scale (ecological sites, variable in size but typically smaller than pasture) levels. The Vale Field Office reported that the scales used were interrelated and played equally important roles in building management objectives.

Although this example does not focus on identification of the desired plant community using BpS reference condition models or ecological site description state-and-transition diagrams, the concepts used are similar. In particular, the desired plant communities are characterized at multiple spatial scales through use of desired big sagebrush canopy cover classes. The example shows how vegetation management objectives at various spatial scales are tiered to each other. An abridged explanation can be found in section III.F in Chapter 4.

The full assessment can be found in "BLM Technical Note 417, Assessing Big Sagebrush at Multiple Spatial Scales: An Example in Southeast Oregon," at http://www.blm.gov/nstc/library/pdf/SagebrushTN417.pdf.

Offices are encouraged to explore ways of linking site or stand-level assessment approaches with landscape or watershed-level assessment approaches so that on-the-ground treatments can more easily be stepped down from these assessments and so the benefits from stand level treatments on the larger landscape condition can be better understood.

D. How Does LANDFIRE Rapid Assessment Mapping of Fire Regime Condition Classes Correlate with Assessment and Mapping Using Ecological Sites and Fine-Scale Data?

A comparison of LANDFIRE rapid assessment mapping of FRCC, with mapping of achievement and non-achievement areas for an upland soils and an ecological processes land-health standard using vegetation and soil data on ecological sites and other fine-scale data, was done on three allotments in the BLM Burns District in spring of 2006. The purpose of the comparison was to improve understanding of the similarities and differences in the two assessment techniques when used on the same pieces of ground for the same objective. The hypothesis was that these two assessment techniques, which both compare current vegetation conditions to reference conditions, would produce similar mapping results in terms of areas that were highly departed from reference condition (that is, areas not achieving the upland soils land-health standard, areas not achieving the ecological processes land-health standard, and Condition Class 3 of FRCC). For more information on how this pilot was conducted, see Appendix 2.

A couple of limitations in the comparison analysis constrain the results. First, although the polygons of achievements and non-achievements for land-health standards on the three allotments were mapped on BLM-administered lands only, the mapping of FRCC was done on all lands. Second, the acres in each condition class were not tallied and compared with the tallied acres within the achievement polygons or to the tallied acres within the non-achievement polygons—the acres in each condition class were only summarized by the entire acreage of each of the three allotments.

Resorting to a visual appraisal method, visual appraisal of the maps produced from both assessment techniques showed that the non-achievement polygons for the upland soils land-health standard and the ecological processes land-health standard were classified into all three condition classes—pixels of Condition Class 1, 2, and 3 were all present within the non-achievement polygons. The hypothesis was that Condition Class 3 should have dominated these non-achievement polygons. Similarly, a visual appraisal of the achievement polygons for the upland soils land-health standard and the ecological processes land-health standard showed that pixels of all three condition classes were present. The hypothesis here was that Condition Class 1, and to a lesser extent, Condition Class 2, should have dominated the achievement polygons. Neither hypothesis was supported from this admittedly crude visual appraisal.

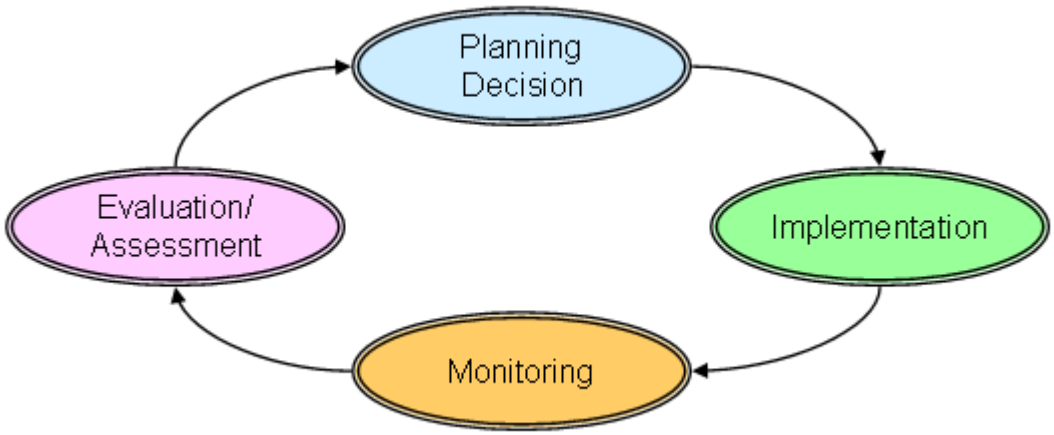
What are the postulated reasons for this apparent lack of correlation? First, the FRCC input data layers in this analysis—potential natural vegetation groups (PNVG) and successional class layers—were created from national-scale grids and were verified with only limited field observations/local expertise. Because of this, the FRCC outputs should only be summarized and interpreted at the national or regional scales. Second, the PNVG FRCC input data layer created through the rapid assessment methodology was apparently inaccurate particularly for ponderosa pine, mountain sagebrush, and western juniper BpSs. Field verification was not conducted. Because of this, current conditions were compared with inaccurate reference conditions which resulted in misclassification of condition classes. Third, mapping of polygons of non-achievement using vegetation and soil data on ecological sites is not a 30 meter pixel-by-pixel exercise. Often, soil map units correlated to ecological sites are the base unit used for mapping polygons of non-achievement, and although these soil map unit-ecological site correlated base units are relatively homogeneous in regard to vegetation types produced and response to management, they still contain a certain amount of variation in vegetation and soil condition, so in this regard, it should not be expected that every 30 meter pixel in a non-achievement polygon would be classified as a Condition Class 3.

Chapter 5 – Addressing Vegetation in Planning Documents, Plan Implementation, Monitoring and Adaptive Management

I. Introduction

Chapter 4 introduced the importance of inventory and assessment, at different scales, to management of vegetation. This chapter reviews the relationship between those processes and the planning process, and introduces the need to monitor condition and effectiveness over time. Ultimately, vegetation management, like other actions BLM may implement, should be organized around phases of inventory, assessment, planning, implementation, monitoring, evaluation and re-assessment (see Figure 5-1).

Figure 5-1. Four Step Implementation Process.



This chapter also describes the concept of adaptive management, whereby modifications to actions or management practices may occur without amendment or revision of the underlying planning documents, as long as assumptions and impacts disclosed in the analysis remain valid for the new actions or proposed practices. This chapter clarifies the purposes of these processes, with particular attention given to the importance of writing clear goals and objectives for diversity, resiliency and productivity of plants and plant communities. Goals and objectives should be written so that progress against them can be monitored and evaluated and that the need for change can be gauged.

II. Background

A. Land-use Planning

Land-use plans (LUPs) and planning decisions are the basis for every on-the-ground action BLM undertakes. LUPs include both resource management plans (RMPs) and management framework plans (MFPs). The decisions in LUPs include goals and objectives (desired outcomes), and uses or actions that are intended to achieve goals and objectives. LUP goals and objectives guide subsequently developed

implementation plans (watershed or activity plans) and actions (specific projects). No actions may be taken to manage vegetation unless they conform to the goals and objectives identified in the LUP.

B. Land Health Assessments

Land health assessments are used to determine the condition of the land using four broad land-health fundamentals: watershed function, ecological processes, water quality, and habitat quality for threatened and endangered and special status species. Once gathered, assessment information is used to evaluate whether standards for land-health are being achieved, and if not, to help identify the causal factors. Under "BLM's Land-use Planning Handbook" (H-1610-1), Land Health Standards must be expressed as goals in BLM's LUPs. Under "BLM Manual 4180," all 258 million acres of BLM-administered surface lands should be assessed for land-health using Land Health Standards.

C. The Need to Monitor Vegetation

The vegetation growing within the boundary of a planning area determines the area's uses, productivity, resistance to disturbance, and scenic quality. The vegetation protects the soil from erosion; provides habitat for wildlife; provides food, fuel and fiber for human use; shapes the visual character of the landscape setting; and, largely determines the area's capability to support various uses. Monitoring is needed to help BLM determine potential uses and limitations of the vegetative resource. Because the agency's activities can cause changes in plant communities, monitoring helps BLM evaluate how management affects vegetation, including its sustainability and future potential. Since changes in plant communities are often the first detectable changes in an area, they provide the earliest indication that management actions may be causing impacts that affect the area's long-term potential.

The Public Rangelands Improvement Act of 1978 requires BLM to report annually the condition of rangelands. The Federal Land Policy and Management Act of 1976 (FLPMA) also requires a periodic inventory of the public lands and their resources. Together, these statutes form the basis for gathering information about condition and trend at a national level.

BLM is developing a national strategy for assessment, inventory, and monitoring (AIM) that will respond to requests from the administration and Congress for better information about the condition of the public lands. This AIM strategy is being designed to meet requirements for information at several scales (local, regional and national), and to improve the efficiency and effectiveness of BLM's AIM processes throughout the organization. Understanding and managing vegetation and ecological processes are fundamental to developing and implementing AIM standards. A critical component of the AIM strategy will be the integration of AIM information gathered for various program and resource needs.

III. Identifying Vegetation Goals and Objectives

The identification of goals and objectives is a cornerstone of BLM management. Goals and objectives reflect the desired outcomes or conditions that we are striving to achieve. Goals and objectives that are developed in LUPs and other planning documents tier to broader-scale goals and objectives reflected in BLM's Operating Plan and the Department's Strategic Plan. Goals and objectives provide the basis for management actions that will be implemented to achieve them. The process for identifying and implementing these actions is discussed in Section D of this chapter. Because vegetation goals and objectives affect numerous programs (rangeland management, wildlife, watershed, wildland fire, visual resources, etc.), it is critical that they are developed in an interdisciplinary setting to ensure that goals or objectives for one program do not conflict with the goals and

objectives of another program. Goals and objectives may be identified at all planning levels: the LUP level; implementation (activity) plan level; and at the individual project or treatment level.

A. Identifying Goals and Objectives in Planning Documents

LUP decisions are made according to the procedures in BLM's planning regulations at 43 CFR 1600 and the implementing regulations for NEPA at 40 CFR 1500-1508. BLM actions and LUP decisions are guided by FLPMA. Section 202(c) of FLPMA (43 U.S.C. 1712) requires that in developing LUPs, BLM use a systematic interdisciplinary approach to integrate physical, biological, economic, and other sciences. FLPMA also requires that BLM relies, to the extent available, on an inventory of public lands, their resources, and other values. These requirements make it critical that BLM work among programs, on an interdisciplinary basis, to assess the condition of BLM lands and develop integrated goals and objectives for its use.

Goals and objectives for vegetation must address the needs of the various programs and resources BLM manages.

LUP goals and objectives must be developed in the context of larger-scale goals and strategies, such as eco-regional or sub-regional scales. For example, regional assessments of sage-grouse habitat may have led to identification of regional goals or management strategies for habitat improvement that should be reflected in LUPs. Wisdom et al. (2005) provides a detailed discussion about integrating regional assessment information with the management process, including the direct use of regional assessments in local LUPs. Included in this discussion is the concept of using simultaneous top-down (regional assessments guiding local management actions) and bottom-up (local planning affecting regional management strategies) processes.

An example cited by Wisdom, et al. (2005) is the need to consider species whose habitats can be included in a regional assessment, versus those species' habitats that can be assessed only within local areas. Many species of concern are local endemics, requiring local assessment with the use of fine-scale spatial data or field surveys. Overlaying the results of these local assessments with the results for regional assessments is an important part of integrating the needs of local endemics versus species whose needs are assessed over larger areas. Typically, consideration of results from local assessments will allow managers to establish management strategies for small areas, or for specific conditions related to the needs of local endemics. Simultaneously, managers can consider the broad conditions and risks depicted by regional assessments as a complement to local assessments.

Goals are broad statements of desired outcomes that are usually not quantifiable (e.g., maintain ecosystem health and productivity, promote community stability, ensure sustainable development). The identification of land-health standards should be reflected as goals in LUPs, though not exclusively of other goals. Following is an example of a LUP goal that was derived from a land-health standard:

> *Watersheds are in, or are making significant progress toward, properly functioning physical condition, including their upland, riparian-wetland, and aquatic components; soil and plant conditions support infiltration, soil moisture storage, and the release of water that are in balance with climate and land form and maintain or improve water quality, water quantity, and timing and duration of flow.*

For certain unique vegetative resources, it may be important to spell out goals at a broad scale in the LUP. For example, the "Healthy Forests Restoration Act" (HFRA) requires identification of old-growth

forest stands — or a process for identifying them — in the LUP based on the structure and composition characteristic of the forest type. Under HFRA, BLM is expected to provide management direction to maintain, or contribute toward the restoration of, the structure and composition of old-growth forest stands. Similarly, protection of species listed under the Endangered Species Act requires allocations of habitat that may be so significant that they deserve mention in the LUP's goals.

Objectives identify specific desired outcomes for resources. They should be quantifiable and measurable and may have established timeframes for achievement, as appropriate. The indicators associated with land-health standards provide a starting point for the development of quantifiable objectives. LUP objectives should specify within the planning area the desired mix of vegetative types, structural stages, and landscape and riparian functions; and provide for native plant, fish, and wildlife habitats, livestock forage, fire conditions, and forest uses. Following is an example of a LUP objective:

> *Manage vegetative communities on the upland portion of the Clear Creek Watershed to achieve, by 2020, an average 15 to 25 percent canopy cover of sagebrush to sustain sagebrush-obligate species, improve water quality and restore natural fire regimes.*

Current and potential vegetative conditions are addressed during the "analysis of the management situation" phase of the LUP process. The Analysis of the Management Situation is a report that documents available inventory data and other information to characterize the resource area profile, portray the existing management situation, and identify management opportunities to respond to identified issues. The analysis should describe briefly and concisely the current conditions and trends of the vegetative resources.

Wherever possible, the desired future condition of the vegetation should be spelled out in terms of its diversity (both species and structural diversity), resiliency and productivity. Where possible, one desired future condition of the vegetation should be a shared objective for all programs and should be compatible with, and a reasonable expected outcome of, the uses allocated and management actions proposed within the plan. Describing the desired plant community by plant cover types, such as those described by the Society of Range Management or the Society of American Foresters, or plant association type are often used at the LUP level. The BLM is currently using the National Vegetation Classification System to describe vegetation types and those types should also be considered when describing desired future conditions for vegetation.

B. Using Assessments to Identify Goals and Objectives

Information from assessments is commonly used as the basis for goals and objectives in LUPs, activity-level plans and project-level plans. Following is an example of how an assessment was used to support identification of goals and objectives:

Land-use Plan Goal for the Gallagher Creek Watershed:

> Manage public lands within the watershed to improve the health and resiliency of the forested lands to wildfire and insects and diseases, while at the same time providing forest products to local communities and spring and summer forage habitat and fall security habitat for elk and deer.

Assessment situational analysis and recommendations:

> *Situation:* The current understory vegetation provides ladder fuels that could move ground fires, which were common in this Habitat Type Group, into the usually fire-resistant overstory canopy.

The watershed currently provides spring and summer forage habitat and fall security habitat for elk and deer.
Objective: In Habitat Type Group 2 (Dry Douglas-fir Habitat Type), manage forest stands with the objective of developing large and very large size trees by reducing the present understory of conifers, primarily Douglas-fir.
Management Recommendations: Commercial and pre-commercial thinning should be used in these mixed-conifer communities to reduce tree densities and retain ponderosa pine which is the most fire-resistant conifer in the Habitat Type Group. Prescribed fire should also be used to reduce the live fuels in the forest understory but prescriptions should be written which will result in little or no mortality in the overstory.

Measurable objectives for the project plan:

- Maintain wildlife habitat and mimic natural disturbance patterns by reducing the average conifer canopy coverage by 50-75% in patches. Create a mosaic of roughly 50% treated forest communities with a relatively open canopy and 50% untreated communities, both dominated by Douglas-fir.
- Retain 50 to 75% of larger size class (>18”diameter) Douglas-fir trees and retain 90 to 100% of the larger size class ponderosa pine.

Project plan decision (from the NEPA document proposed action or preferred alternative):

Treat approximately 400 acres of Douglas-fir forests in the Gallagher Creek watershed in the next decade using commercial timber harvest followed by low severity prescribed fire to reduce stand density and ladder and ground fuels to reduce the risk of unwanted tree mortality from bark beetles and wildfire.

Effectiveness monitoring:

Monitoring studies would be established to determine the effectiveness of the action implemented in meeting land-use plan goals and project objectives. Studies would address whether the silviculture practice was effective in:

- Achieving an average conifer canopy coverage of patches between 50 – 75%
- Achieving a mosaic of 50% treated and 50% non-treated
- Retaining 50 – 75% of large Douglas-fir trees (requires pre-treatment studies)
- Retaining 90 – 100% of large ponderosa pine trees (requires pre-treatment studies)
- Providing spring and summer forage habitat and fall security habitat for elk and deer
- Improving forest health and resiliency from wildfire, insects and disease

C. Stepping Down Goals and Objectives:

BLM should only take actions on vegetation in furtherance of goals and objectives spelled out in some guiding document – the LUP, an activity plan, or a watershed plan. Typically, goals and objectives developed at broader scales (for example, LUPs) are more general than objectives developed in finer-scale plans such as activity plans. Similarly, activity plan objectives are often broader than project-specific objectives. Objectives in documents below the LUP should tier to the LUP and actions should aggregate up to result in achievement of LUP goals and objectives.

A LUP might identify a general goal such as “maintain or manage for native plant communities that are appropriate for the site.” An activity plan for a smaller geographic management area within the LUP area

might in turn require that “75 % or more of the big sagebrush communities” be at a specific canopy cover class with shrubs in a predominantly mid-to-late seral stage. A project plan may identify an objective of “increasing the percent cover of Wyoming big sagebrush from 10% to 14% over the next 10 years” at a specific key area. A trend study that measures plant cover and was used to establish the current level of 10% could then be read periodically to determine whether or not the prescribed management is resulting in the expected increases in cover for the species identified.

In authorizing project implementation, it is not always necessary to develop intermediate-level activity plans tiered to LUPs if management objectives specified in the LUPs are sufficiently detailed to support subsequent implementation decisions. In such circumstances, the assessment information supporting development of the LUP objectives is presumed to also be sufficient for authorizing the implementation actions.

When developing site-specific vegetation objectives, an interdisciplinary team should be used to integrate multiple resources such as forest management practices, grazing, wildlife habitat, threatened and endangered species, wild horse and burros, vegetation treatments, noxious and invasive weed control, visual resource management, or manipulation methods (including fuels treatments) to achieve desired plant communities, as well as integrated vegetation management techniques for rehabilitation.

IV. Identifying and Implementing Actions to Achieve Goals and Objectives

Allowable uses and management actions to achieve vegetative goals and objectives must be identified through the planning process. They may be identified at any of the planning levels: LUP, activity plan or project plan.

At the LUP level, allocations identified to meet the vegetation goals and objectives should show where uses are allowed, including any restrictions or constraints that may be needed. This could include identification of areas where commercial timber harvest is allowed, areas where livestock grazing is allowed, or areas where wild horses and burros will be managed. In conjunction with these spatial allocations, criteria or guidelines for establishing levels of use are normally established. Management actions, such as implementation of vegetation treatments, are also identified. For example, the location and magnitude of mechanical, biological, chemical, and prescribed fire treatments may be identified. The land-use plan should also identify any standards or thresholds needed to guide vegetation management. For example, acceptable levels of invasive non-native species in vegetation treatments or communities.

At the activity plan or project level, actions taken to achieve land-use plan goals and objectives or to implement land-use plan decisions need to be well coordinated between programs. Projects or actions that modify vegetation should be considered in an interdisciplinary setting during on-site project planning meetings and during the NEPA analysis process. Vegetation changes may affect various resources or programs, including ecological processes, watershed function, water quality, wildlife habitat, wilderness characteristics or scenic values. The visual resource contrast rating system outlined in BLM Handbook H-8431-1 provides a means to analyze and minimize potential visual impacts of proposed projects and activities (DOI BLM, 1986). Other programs may also have analysis processes that should be followed when analyzing vegetation treatment projects.

Following are examples of LUP allocations and management actions:

- Allocation: Designate the Clear Creek allotment as being available for livestock grazing, and provide up to 2,000 AUMs of livestock use, consistent with goals and objectives for the area.

- Allocation: Manage the Big Creek watershed area with an emphasis on commercial timber harvest.
- Management Action: Treat approximately 50,000 acres in the Benson Creek watershed to move from fire regime condition class 3 to condition class 2.
- Management Action: Conduct stand conversions treatments to return specific areas to historic species composition on approximately 7,000 acres.

Table 5-1 summarizes guidance in H-1601-1 regarding LUP decisions and shows the relationship among goals, objectives, allowable uses and management actions.

Land-use PLANNING HANDBOOK GUIDANCE (H-1601-1)

Table 5-1 — LAND-USE PLAN DECISIONS			
Land-use PLAN DECISIONS FOR PUBLIC LANDS FALL INTO TWO CATEGORIES: DESIRED OUTCOMES (GOALS AND OBJECTIVES) AND ALLOWABLE USES (INCLUDING RESTRICTED OR PROHIBITED) AND ACTIONS ANTICIPATED TO ACHIEVE DESIRED OUTCOMES.			
DESIRED OUTCOMES		ANTICIPATED USES AND ACTIONS	
Land-use plans identify desired outcomes expressed in terms of goals and objectives. Desired outcomes should be identified for and pertain to resources (such as natural, biological, and cultural), resource uses (such as energy and livestock grazing), and other factors (such as social and economic conditions).		Land-use plans identify allowable uses (land-use allocations) and management actions (e.g., implementation of vegetation treatments) to achieve the goals and objectives.	
GOALS	OBJECTIVES	ALLOWABLE USES	MANAGEMENT ACTIONS
GOALS are broad statements of desired outcomes (e.g., maintain ecosystem health and productivity) that usually are not quantifiable. Land Health Standards must be expressed as goals in the land-use plan. A sample goal derived from a Land Health Standard is: "Maintain healthy, productive plant and animal communities of native and other desirable species at viable population levels commensurate with the species and habitat's potential."	OBJECTIVES identify specific desired outcomes for resources. Objectives are usually quantifiable and measurable and may have established timeframes for achievement (as appropriate). A sample objective is: "Manage vegetative communities on the upland portion of the Clear Creek Watershed to achieve, by 2020, an average 15 to 25 percent canopy cover of sagebrush to sustain sagebrush-obligate species and improve water quality."	ALLOWABLE USES. Land-use plans must identify uses, or allocations, that are allowable, restricted, or prohibited. The land-use plan must set the stage for identifying site-specific resource use levels. Site-specific use levels (e.g., livestock use levels) are normally identified during subsequent implementation planning or the permit authorization process.	MANAGEMENT ACTIONS. Land-use plans identify actions needed to achieve desired outcomes, including actions to maintain, restore, or improve land-health. These actions often include proactive measures that will be taken to enhance watershed function and condition. For example, where exotic invasive species are extensive, active restoration may be necessary to allow native plants to reestablish and prosper. In these cases, identifying restoration opportunities and setting restoration priorities are critical parts of the land-use planning process.

Certain situations may exist that do not require additional or in-depth assessment information before authorizing implementation actions, and BLM may use a single land-use planning/National Environmental Policy Act (NEPA) process to make both land-use plan and project- level implementation decisions. In this situation, both levels of decisions must have an appropriate level of NEPA analysis (refer to LUP Handbook, Making Land-use Plan and Implementation Decisions in the Same Planning Effort, page 30**)**. Following is an example where such an approach may be appropriate:

An RMP or plan amendment covers a relatively small geographic areas or where there are a number of activity-level vegetation treatment projects being addressed simultaneously with a land-use planning effort. These vegetative treatments could be designed to address:

- conifer encroachment into aspen stands or sagebrush habitats
- herbaceous invasive species displacement of native habitats
- abnormally high fuel loads in forested areas when compared to HRV volumes

A. NEPA Tools Available for Plan Development and Implementation:

NEPA established a national environmental policy that, among other things, encourages environmental protection and informed decision-making. It requires the use of an interdisciplinary process to analyze environmental effects of proposed actions and alternatives, and to use that information as an integral part of the decision-making process. BLM land-use plans are developed and revised through the environmental impact statement (EIS) process while subsequent activity plans and implementation actions are normally developed through the environmental assessment (EA) process.

Several tools have been developed to assist in meeting NEPA responsibilities. One of these tools, categorical exclusions, has proven to be very effective in terms of reducing the amount of time it takes to satisfy NEPA requirements. Categorical exclusions (CXs) are categories of actions that federal agencies have determined do not have a significant effect on the quality of the human environment (individually or cumulatively) and for which, therefore, neither an EA nor an EIS is required (40 CFR 1508.4). Departmental policy and CEQ regulations require that CX actions be subjected to sufficient environmental review to determine whether any of the extraordinary circumstances outlined in 516 DM 2, Appendix 2 apply. If any of the extraordinary circumstances apply, then either an EA or an EIS must be prepared.

When using a CX, other procedural requirements may apply, for example, tribal consultation and consultation under the National Historic Preservation Act and the Endangered Species Act. An EA may be prepared for proposed actions otherwise excluded when the manager feels that an EA would be helpful in planning or decision- making (40 CFR 1501.3 and 516 DM 3.2 B).

The procedures on how to identify potential CXs, how to determine if an extraordinary circumstance precludes the use of a CX, and how to document use of a CX is included in BLM NEPA Handbook (USDI, BLM, 2008), which is available at: http://www.blm.gov/style/medialib/blm/wo/Information_Resources_Management/policy/blm_handbook.Par.47884.File.dat/h1790-1.pdf. Categorical exclusions that are available for BLM use are listed in the BLM NEPA Handbook. The BLM CXs that are most applicable to vegetation management are listed under the following sub-headings: Forestry, Rangeland Management, and Emergency Stabilization. The DOI Manual (516 DM 2) also identifies two Department-wide CXs for hazardous fuels management and post-fire rehabilitation activities. They are also listed in the BLM NEPA Handbook.

The Healthy Forests Initiative, established in 2002, directs the Departments of Agriculture and the Interior, and the Council on Environmental Quality, to improve regulatory processes to ensure more timely decisions, greater efficiency, and better results in reducing the risk of catastrophic wildland fires. In support of this initiative, the Departments have developed tools to facilitate the decision-making process. These tools include the following:

- NEPA categorical exclusions
- Guidance for environmental assessments for forest health projects
- Full force and effect regulations (43 CFR 5003)
- New endangered species act procedures
- Stewardship contracting

These tools are described in more detail in "The Healthy Forests Initiative and Healthy Forests Restoration Act – Interim Field Guide" (USDA, Forest Service, and USDI, BLM, 2004). The field guide is available on-line at http://www.blm.gov/nhp/news/releases/pages/2004/pr040303_forests/FullFieldGuide.pdf. The "Healthy Forests Restoration Act of 2003" (P.L. 108-148) **(**HFRA**)** contains a variety of provisions to speed up hazardous-fuel reduction and forest-restoration projects on specific types of federal land that are at risk of wildland fire and/or of insect and disease epidemics. HFRA helps states, tribes, rural communities and landowners restore healthy forest and rangeland conditions. Additional information on HFRA can also be found in "The Helathy Forests Initiative and Healthy Forests Restoration Act — Interim Field Guide" (USDA, 2004).

V. Monitoring and Evaluation

A. Types of Monitoring

Monitoring is the repeated measurement of activities and conditions over time. BLM planning regulations (43 CFR Part 1610.4-9) call for monitoring resource management plans on a continual basis and establishing intervals and standards based on the sensitivity of the resource to the decisions involved. CEQ regulations implementing NEPA state that agencies may provide for monitoring to assure that their decisions are carried out and should do so in important cases (40 CFR Part 1505.2(c)).

Monitoring is conducted to determine whether the agency's planned actions were implemented as planned (implementation monitoring), whether the agency's actions were effective in reaching desired goals and objectives (effectiveness monitoring), and whether the predicted cause-and-effect relationship of management activities is valid (validation monitoring).

The three types of monitoring are further described below:

Implementation Monitoring: Implementation monitoring is the most basic type of monitoring and simply determines whether planned activities have been implemented in the manner prescribed by the plan. Specific thresholds or indicators have not been established for implementation monitoring.

Effectiveness Monitoring: Effectiveness monitoring determines if the implementation of activities has achieved the desired goals and objectives. Effectiveness monitoring answers the question: Were the specified activities successful in achieving the objective? This requires knowledge of the objectives established in the planning document as well as indicators that can be measured. Indicators are established by technical specialists in order to address specific questions, and thus avoid collection of unnecessary data. Success is measured against the benchmark of achieving the objectives (desired future conditions) established by the plan.

Validation Monitoring: Validation monitoring determines whether predicted cause-and-effect relationships are valid. It confirms whether the predicted results occurred and if assumptions and models used to develop the plan are correct. This type of monitoring is often done by contract with another agency, academic institution, or other entity, and is usually expensive and time consuming since results often are not known for many years.

These three types of monitoring are applicable at all levels of the planning and implementation process: for LUPs, for implementation (activity) plans, and for project-level plans and actions. Additional information for treatment-level monitoring is provided in Chapter 6. Regardless of the planning/ implementation level that monitoring is occurring, it is important to integrate monitoring activities between programs to eliminate duplication of efforts and ensure that appropriate vegetation attributes are addressed.

Integrated vegetation management and monitoring for vegetation change should include monitoring effects of:
- treatments
- land-uses
- natural disturbance

In the land-health standards assessment process, the effectiveness of all three is done in relation to vegetation for some land-health standards (i.e., those land-health standards that relate to vegetation). Since land-health standards are incorporated into the LUP as goals, land-health standard assessments can be used to monitor LUP effectiveness. Land health standards assessments can serve as an integrated monitoring platform because typically, an interdisciplinary team goes out to the same piece of ground and assesses one or more standards.

LUP monitoring is the process of: (1) tracking the implementation of land-use planning decisions; and (2) collecting and assessing data/information necessary to evaluate the effectiveness of LUP decisions. Consequently, monitoring related to RMPs consists of implementation and effectiveness monitoring.

BLM must monitor LUPs to determine whether the goals and objectives set forth in the plan are being met and if applying the land-use plan direction is effective. Monitoring for each program area is outlined in the "Management Decision" section of the Approved Plan. If monitoring shows land-use plan actions or best management practices are not effective, these actions and practices may need to be adjusted. In some situations, changes to the plan may be made without amending or revising the plan as long as the assumptions and impact analysis remain valid for the proposed changes (see adaptive management discussion below).

B. Evaluations

1. Evaluating Land-use Plans

LUP evaluation is a process in which the plan and monitoring data are reviewed to determine if:
- management goals and objectives are being met
- management direction is sound

- decisions are being implemented as planned
- mitigation measures are satisfactory
- there are significant changes in the related plans of other entities
- there is new data of significance to the plan
- decisions should be changed through amendment or revision

Effectiveness monitoring data gathered over time is examined and used to draw conclusions on whether management actions are meeting objectives, and if not, why. Conclusions are then used to make recommendations on whether to continue current management or to identify what changes need to be made in management practices to meet objectives.

BLM will use LUP evaluations to determine if the decisions in the plan, supported by the accompanying NEPA analysis, are still valid in light of new information and monitoring data. LUP evaluations will generally be conducted every five years, unless unexpected actions, new information, or significant changes in other plans, legislation, or litigation triggers an evaluation. Evaluations will follow the protocols established by BLM Land-use Planning Handbook (H-1601-1).

2. Evaluating Land Health Standards

The data from effectiveness monitoring may be used in the assessment and evaluation process for land-health standards. These processes are described in detail in the Rangeland Health Standards Handbook (H-4180-1). Following is an example that incorporates an assessment, a decision, monitoring, and evaluation(s).

Example to Clarify Terms:
Rangeland Management in the Leaky Watershed

Assessment: An interdisciplinary team used the Interpreting Indicators of Rangeland Health protocol to assess the soil/site stability and watershed function of the Leaky Watershed as part of the Standards for Rangeland Health process. The assessment covered the entire watershed in 2001 and the watershed was subsequently mapped into areas where accelerated erosion was or was not occurring. The assessment showed 60% of the watershed (12,000 acres) had accelerated erosion, but the cause was not established using the qualitative protocol.

Evaluation 1: This assessment information along with existing monitoring studies (trend, utilization, actual use, and climate), a "Soils, Vegetation, Inventory, and Monitoring (SVIM)" inventory and the knowledge and experience of the inter-disciplinary (ID) team was combined in an evaluation of the watershed. The authorized officer, in reviewing the evaluation, found that the Standard for Rangeland Health for Watershed Integrity was not being met (documented in the Determination) and that livestock and recreation impacts were responsible.

Decision/Objectives: One objective established in the decision was, within 5 years, to increase vegetative cover and reduce accelerated erosion by 25% on 12,000 acres identified in the assessment as having accelerated erosion. A decision was issued changing livestock management in the affected parts of the watershed. In addition, recreation use was modified by adding patrols and increasing public education.

Monitoring: Cover studies were established using the line intercept technique on 20 permanent study sites (reportable as 20 units of accomplishment) in the Leaky Watershed. This watershed has 20,000 acres (reportable as 20,000 acres monitored) that are represented by these 20 study sites. The majority of the studies were placed in those parts of the watershed where management changes were made to reduce accelerated erosion. The assessment provided information to select appropriate monitoring study sites. Cover studies were read again five years later using the same protocol.

Evaluation 2: Based on the results of monitoring studies, the number of acres in the Leaky Watershed where accelerated erosion is occurring had decreased 15% over the past five years. The objective in the decision of reducing accelerated erosion by 25% by implementing grazing and recreation changes were not met. Consequently, further changes in management were warranted, based on quantitative monitoring of the vegetation.

Decision —> Monitoring —> Evaluation —> Modified Decision (Adaptive Management Loop)

C. Monitoring Techniques

BLM frequently documents the presence, absence, or use of plants and plant communities on public lands. Rangeland vegetation use is generally monitored by studies of the percent of plant material that was removed from an area, the volume of plant material removed, and the percent of plants used or removed. BLM also measures changes in plant communities over time. Examples of attributes commonly used to measure change over time include:

- Density (number of individuals or stems per unit)
- Cover (the amount of ground covered by the basal or aerial portion of a plant)
- Frequency (the percentage of sampling units occupied by the species)

Advances in remote sensing and GIS are making it possible to quickly and accurately monitor, portray and analyze plant community characteristics at broader scale scales, markedly improving cumulative effects considerations in space and time. New assessment and monitoring techniques, such as the sage-grouse habitat assessment framework (USDI, BLM, and Western Association of Fish and Wildlife Agencies, In Prep.) incorporate important attributes not previously addressed in BLM assessment and monitoring protocols, and will assume increasing importance in BLM management. These include multi-scale plant community structural characteristics, habitat interspersion and habitat patch size.

VI. Adaptive Management

Adaptive management is a system of management practices based on clearly identified outcomes, monitoring to determine if management actions are meeting outcomes, and, if not, facilitating management changes that will best ensure that outcomes are met or re-evaluated.

Management of natural resources involves making decisions in the face of uncertain outcomes. Adaptive management is a structured decision-making process that embraces uncertainty, promotes learning, engages stakeholders, and increases accountability and explicitness in resource management decisions. Learning plays an important role in adaptive management by contributing to good management through improved understanding. Several attributes of adaptive management make it appropriate for many (but not all) resource management decisions:

- Adaptive management involves stakeholders from the outset and incorporates alternative viewpoints in the form of hypotheses and testable models
- Adaptive management promotes iterative and flexible decision-making within an objective, science-based framework
- Adaptive management emphasizes monitoring and evaluation of the effects of management decisions
- Adaptive management recognizes the importance of natural variability in contributing to ecological resilience and productivity

Adaptive management holds great promise in reducing the uncertainties that limit effective resource management. However, adaptive management is not a cure-all and it is not necessarily quick or inexpensive. To maximize adaptive management's potential, resource managers must: (1) understand when it is appropriate to use adaptive management: and (2) make the necessary commitments.

When should adaptive management be implemented?

Adaptive management is appropriate when:

- Alternative management options exist
- Decisions can be revisited / modified over time
- Clear objectives exist
- Stakeholders can be engaged
- Uncertainty can be reduced over time
- Hypotheses can be expressed as testable models
- A monitoring program exists or can be established to inform decision-making

Adaptive management is not appropriate when:

- Management objectives and/or thresholds for triggering changes in management direction cannot be clearly identified
- The natural system does not have resilience to respond, or responses to actions are not measurable
- Little uncertainty exists regarding outcome of a proposed action
- Decisions are one-time events that cannot be revisited
- Biological processes are changing faster than ability to learn about them through experimentation

Adaptive management can be applied effectively to decisions made at the land-use plan level, at the activity plan level and for individual treatments. The key conditions described above may apply just as well to a localized management issue with few stakeholders as to complex regional issues.

Regulatory compliance, including NEPA, for adaptive management differs from other management approaches in that managers, scientists, and stakeholders consider up-front the range of anticipated future actions and their effects. As this implies more inclusive analysis, the initial workload for regulatory compliance may be larger than without adaptive management. However, the advantage of a broader first analysis is that re-initiation of regulatory compliance may be avoided when changes in management approach have been anticipated in the initial regulatory compliance process.

Field Offices should use adaptive management in those situations where managers determine it will enhance the decision-making process. More information on adaptive management may be found in the publication, “Adaptive Management: The U.S. Department of the Interior Technical Guide” (Williams et al., 2007).

Chapter 6 - Treatment Selection and Effectiveness Monitoring

I. Introduction

Where proactive manipulation of the vegetation is identified as an appropriate activity toward achieving the desired vegetative condition in a land use or activity plan, treatments should be selected that will best achieve this desired condition. An interdisciplinary (ID) team should be used to identify treatment options for achieving the objectives, and evaluate the strengths and weaknesses of potential methods within each option. The ID team members should be thoroughly familiar with treatment techniques commonly used to manipulate vegetation in the area(s) under consideration, or have ready access to experienced individuals or other resources where such information can be obtained.

Although vegetation management programs have been evolving since Plummer et al. (1968) first proposed ten principles to follow when planning and implementing vegetation management programs, the principles are still valid, and applicable to most sites in the western United States (Jordan, 1981; cited in Monsen et al., 2004). Most of the principles, which primarily address ecological considerations, have been incorporated in some fashion into existing BLM guidance elsewhere. However, no BLM reference presents all ten in a single source. Briefly, they are:

1. The proposed changes to the plant community must be necessary and ecologically sustainable.
2. The terrain and soil must support the desired changes.
3. Precipitation must be adequate to assure establishment and survival of indigenous planted species.
4. Competition must be controlled to ensure that planted species can establish and persist.
5. Plant and manage site-adapted species, subspecies, and varieties.
6. A multi-species seed mixture should be planted.
7. Sufficient seed of acceptable purity and viability should be planted.
8. Seed must be planted on a well-prepared seedbed and covered properly.
9. Plant during the season that provides the most favorable conditions for establishment.
10. Newly seeded areas must be managed properly.

In addition to ecological considerations, vegetation treatments and methods are also selected based on cost and implementation considerations. Cost considerations should address treatment type and relative effectiveness, the ability of treatments to achieve multi-program objectives, and site accessibility. Implementation considerations include equipment type and availability, staff availability, impacts to ongoing or other land uses and land users, impacts to other landowners in the vicinity, on-site and off-site impacts to flora and fauna, and post-treatment management capability and control. Evaluation of treatment options should address, but not necessarily be limited to, the following:

1. Site capability (soils, elevation, slope, aspect, precipitation): *Does the site have the capacity to produce the desired vegetation community?*
2. Site disturbance effects: *What soil disturbance will be created by a given treatment and what will the subsequent effects be?*
3. Seed availability: *Is a sufficient quantity of quality seed available to not only implement the treatment as planned, but, if necessary, to also meet re-treatment needs?*
4. Susceptibility to invasive species: *To what degree would a potential treatment method increase or reduce post-treatment susceptibility to invasive species?*
5. Project timing: *Can a potential treatment be implemented at a time that is ecologically optimal?*

6. Success of past treatments under similar conditions: *What types of treatments in the past have produced successful results? Was the success related to the type of treatments, or to other factors not related to the treatments?*
7. Treatment cost-effectiveness: *Given the probability of treatment-related success, what is the relative cost-effectiveness of potential treatment methods? Do some treatment methods present opportunities to prevent future undesirable situations more than other treatment methods?*
8. Land uses on or near the site(s) to be treated: *What would the effects be of potential treatment methods on land users or other landowners adjacent or proximate to treatment areas?*
9. Potential to impact humans, fish, wildlife or special status plants: *What would the effects be of potential treatment methods on fish, wildlife or special status plants either on-site or adjacent or proximate to treatment areas?*
10. Need for subsequent re-vegetation or re-treatment: *What is the relative probability of needing to re-treat, restore, or otherwise take unplanned post-treatment actions to ensure successful outcomes of treatments?*

II. Integrated Pest Management

Because of its legal and growing functional significance, the role of Integrated Pest Management (IPM) in achieving vegetation management objectives is an important early consideration in selecting treatments. The Department of Interior has adopted and endorses Integrated Pest Management as defined in the Food Quality Protection Act, 7USC§136r-1: "Integrated Pest Management is a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools in a way that minimizes economic, health, and environmental risks." (USDI, BLM, 2007).

IPM incorporates management goals, consensus building, pest biology, environmental factors, pest detection, monitoring, selection of the best available technology to prevent unacceptable levels of pest damage, and project evaluation. IPM opportunities and objectives are identified early in the planning process, and incorporated into integrated vegetation management objectives. Methods for pest management can include one or a combination of: no action, non-chemical, cultural, mechanical, physical, biological, and chemical management methods.

A. Sources of IPM Information

Although BLM has no specific IPM manuals or handbooks, the following Manual Sections and Handbook describe policy and guidance for programs or applications that are regularly employed in IPM:

Departmental Manual 517 DM 1 – Integrated Pest Management
Manual Section 9011 – Chemical Pest Control, Handbook H-9011 – Chemical Pest Control
Manual Section 9012 – Expenditure of Rangeland Insect Pest Control Funds
Manual Section 9014 – Use of Biological Control Agents of Pest Control on Public Land
Manual Section 9015 – Integrated Weed Management

Many sources of technical and other information outside of BLM for IPM exist at national, regional and state levels. Most are readily accessible through internet searches. Two examples are provided as a starting point from which to expand information searches.

The USDA National Site for USDA Regional IPM Centers Information System (http://www.ipmcenters.org) provides information about commodities, pests and pest management practices, people and issues in the U.S. It also provides links to sites for each of the four Regional IPM Centers (Western, Southern, Northeastern, North Central), which, in turn, also provide links to other important IPM resources, such as the Database of IPM Resources.

Integrated Pest Management: Guidance for Preparing and Implementing Integrated Pest Management Plans is a planning document produced by the U.S. Fish and Wildlife Service that has general applicability for IPM planning. It is posted on the internet (http://www.fws.gov/contaminants/Documents/GuidanceIPMPlan.pdf).

A. Pesticides in IPM

Pesticides, EPA labeled substances that control, destroy, repel, or attract pests, are often referred to according to the type of pest they control; insecticides, insect repellents, miticides, herbicides, fungicides, fumigants, nematicides, rodenticides, avicides, plant growth regulators, defoliants, desiccants, antimicrobials, and algicides. All pesticides must be used in accordance with the pesticide labeling, and at a rate shown in the EIS for the area of use, by personnel with appropriate training in pesticide application. The handling and use of all pesticides must be according to the pesticide label and by, or under the supervision of, a certified applicator (BLM Course 9000-1) [FIFRA Section II (e) (1)]. Additionally, it is BLM policy that all non-restricted pesticides shall be applied by a certified applicator.

B. Levels of Control

From a vegetation management perspective, IPM generally targets weeds or weedy/invasive species. Planning for IPM includes incorporating the degree of management desired for each pest species into overall objectives; prevention, containment, reduction, or eradication. Whatever strategy or combination of strategies is chosen, a monitoring program is needed.

Prevention is an option available for consideration in IVM. A discussion of Prevention of Weeds and Early Dection and Rapid Response is presented in the Final Vegetation Treatments EIS, (USDI, 2007b).

Containment, keeping an established population in check so that the size of the infested area does not increase, can be employed against newly invading weeds or well-established species. It is especially useful when time and money are in short supply and the when an infestation is very large.

Reduction is the reducing of either the spatial area covered by a weed, or reducing its dominance. Although reduction can be used for either small or large established weed infestations, it requires more resources and more time than containment.

Eradication is completely eliminating the target species from a management area and usually consumes the greatest amount of time and resources. Eradication is applicable mainly to newly invading weeds that are confined to a limited number of small areas.

C. Insect and Disease Management

Controlling insects and diseases that may alter vegetation diversity, resiliency and productivity must be an integral component of vegetation management activities on Public Lands. In addition, vegetation management activities that potentially injure trees and plants must include steps to limit insect outbreaks and the spread of disease.

Through an interagency MOU, the USDI, Forest Service provides technical advice and insect and disease identification mapping on BLM-administered lands. During planning, field offices should coordinate needs and activities with their local Forest Service Forest Health Protection office. Funding is also available through the Forest Service to suppress outbreaks and prevent future epidemics (see Funding Sources for Vegetation Management in Chapter 9). The BLM is also engaged in cooperative efforts with

the USDI, Animal and Plant Health Inspection Service Plant Protection and Quarantine for grasshopper and Mormon cricket control.

Guidelines for reducing the impact of bark beetles and other forest insects and diseases were issued by the Department of the Interior in 2003 (see Appendix 3). These guidelines should be followed to prevent unanticipated impacts from vegetation treatments in forests and woodlands.

D. IPM for Vegetation

No individual treatment method will control vegetation such as noxious weeds in a single treatment. Diligence and persistence are required over a number of years to manage such infestations. The success of different treatment methods depends on the type of weed and age of infestation to be controlled. It is important to think of treatment methods as they relate to specific vegetation, such as weed characteristics.

Chemical Controls: In IPM programs, herbicides are considered transition tools used in the process of replacing undesirable plants with desirable vegetation that is competitive with the undesirable plants. BLM Manual 9011 recommends selecting the least toxic, low-residual herbicide that is effective against the target vegetation and applied in a judicious manner.

Specific information on the chemical and physical properties of active ingredients in pesticides as well as recommendations and precautions for use, is available from the National Pesticide Information Center (NPIC) (http://npic.orst.edu). Pesticide Emergency Resources are:

911 for pesticide emergencies or the appropriate contacts below.
Human Poison Control Centers in the U.S.: 1-800-222-1222
Recognition and Management of Pesticide Poisonings, 5th ed.
ASPCA Animal Poison Control Center 1-888-426-4435 (credit card fee charged)
Small Pesticide Spills - Call the manufacturer or call NPIC at 1-800-858-7378
Large Pesticide Spills - Call Chemtrec as follows:
In the U.S.: 1-800-424-9300
Outside the U.S.: (703) 527-3887 **AND** call the National Response Center at 1-800-424-8802

III. Treatment Methods

The treatments used by BLM for manipulating or restoring vegetation include fire, mechanical, manual, biological, and chemical. In-depth discussion of the various methods and techniques within these categories, including advantages, limitations, effectiveness, and relative costs, is described in the Vegetation Treatments on BLM Lands EIS/PER (USDI, BLM, 2007b) and Monsen et al. (2004). These or other sources of such information relevant to treatment methods and techniques should be consulted during the treatment selection process.

For most vegetation treatment projects, pre-treatment surveys are conducted before selecting one or more treatment methods. These surveys involve consideration of all feasible treatments, including their potential effectiveness based on previous experience, local monitoring results and best available science, potential environmental impacts, and costs. Before vegetation treatment or ground disturbance would occur, BLM should consult specialists or databases for sensitive areas within the project area. Sites may require survey for listed or proposed federal threatened or endangered species, BLM sensitive species, and for evidence of cultural or historic sites. In some cases, areas may receive one or more treatments in combination, such as prescribed burning followed by an herbicide application. Some areas may be treated using one or more treatment methods

over several years. The following general characteristics of each treatment category are summarized from the Vegetation Treatments on BLM Lands EIS/PER (USDI, 2007).

A. Fire

Fire applications can include using prescribed fire, wildland fire use, or other pyrrhic methods to achieve resource benefits. Prescribed fire is the intentional application of fire to wildland fuels under specified conditions of fuels, weather, and other variables. In areas where there is no threat to human life or property, wildland fires are used for resource benefit to maintain ecosystems that are functioning within their normal fire regime. These fires must meet specific environmental prescriptions and they are utilized only in pre-planned areas and when there are adequate fire management personnel and equipment available to achieve defined resource objectives.

The Fire Management Plan (FMP) serves as the program strategy document for fuels treatments and prescribed fire activities. It identifies how fuels treatments, fire use, and other fire management strategies will be used to meet the overall land management goals identified in land-use plans. The FMP also identifies areas where the use of wildland fire for resource benefits is acceptable.

The Prescribed Fire Plan is a stand-alone, legal document that provides the prescribed fire burn boss all the information needed to implement the project. Prescribed fire projects must be implemented in compliance with the written plan.

A Wildland Fire Implementation Plan (WFIP) is prepared for all wildland fires that are managed for resource benefit. The WFIP is an operational plan for assessing, analyzing, and selecting strategies for wildland fire use. It is progressively developed, and documents appropriate management responses for any wildland fire managed for resource benefits.

Factors considered when designing a burn plan and implementing a prescribed burn include weather conditions, vegetation types and density, slope, fuel moisture content, time of year, risks to dwellings and property, alternative treatment methods, and potential impacts on air quality, land use, cultural resources, and threatened and endangered species.

Hand-held tools, such as drip torches, propane torches, diesel flame-throwers, and flares, may be used to start a prescribed fire. Mass ignition techniques include terra-torches and heli-torches, which release an ignited gelled fuel mixture onto the area to be treated. Helicopters may also be used to drop hollow polystyrene spheres containing potassium permanganate that are injected with ethylene glycol immediately before ignition. The sphere ignition method is best used for spot-firing programs.

Prescribed fire can be used in some situations where some other treatment methods are not feasible due to soil rockiness, slope steepness, or terrain irregularity, although prescribed fire is limited to situations where adequate fuel is available to carry the fire. It is also relatively inexpensive to treat vegetation using fire, ranging from $20 to $500 per acre, with higher costs associated with treating forest lands in California and Oregon.

The use of prescribed fire comes with a risk of the fire getting out of control and damaging property and endangering human life. Thus, chemical, biological, mechanical and manual methods, instead of fire, are often used to control vegetation near communities. In some situations, prescribed fire can encourage the germination and establishment of weeds if a treatment site is not treated with herbicides or re-vegetated after fire use.

B. Mechanical

Mechanical treatment involves the use of vehicles such as wheeled tractors, crawler-type tractors, or specially designed vehicles with attached implements designed to cut, uproot, or chop existing vegetation. The selection of a particular mechanical method is based upon characteristics of the vegetation, seedbed preparation and re-vegetation needs, topography and terrain, soil characteristics, climatic conditions, and an analysis of the improvement cost compared to the expected productivity (USDI, BLM, 1991a). Mechanical methods that may be used by BLM include chaining, root plowing, tilling and drill seeding, mowing, roller chopping and cutting, blading, grubbing, and feller-bunching. As new technologies or techniques are developed, they could be used if their impacts are similar or less than existing methods.

Chaining consists of pulling heavy chains (40 to 90 pounds per link) in a “U” or “J” shaped pattern behind two crawler-type tractors. A chain is usually 250 to 300 feet long, and may weigh as much as 32,000 pounds. The width of each swath varies from 75 feet to 120 feet. Chain link size, modifications to links, and operation of the crawler tractors determine the number and size of trees and shrubs that are removed and the effects on understory species. Chaining can be conducted during the appropriate season to benefit soil stability and plant seeding, and reduce the invasion of weeds (Monsen et al., 2004).

Chaining works best for crushing brittle brush and uprooting woody plants. Chaining can be done on irregular, moderately rocky terrain, with slopes of up to 20%. Chaining may cause soil disturbance, but the plant debris can be left in place to minimize runoff and erosion, shade the soil surface, and maintain soil moisture and nutrient recycling. Alternatively, the debris can be burned to facilitate seeding, improve scenic values, and eliminate potential rodent habitat. Chaining is a cost-effective means of incorporating seed into soil, especially in burned areas. Chaining provides a variety of seeding depths and microsites, as well as improves ground cover and forage production. Recent studies showed improved seedling establishment on chained sites resulted in less downy brome establishment three years after fire in sagebrush and pinyon-juniper habitats (Ott et al., 2003).

Tilling involves the use of angled disks (disk tilling) or pointed metal-toothed implements (chisel plowing) to uproot, chop, and mulch vegetation. This technique is best used in situations where thinning or complete removal of vegetation is desired, and in conjunction with seeding operations. Tilling leaves mulched vegetation near the soil surface, which encourages the growth of newly planted seeds. Tilling is usually done with a brushland plow, a single axle with an arrangement of angle disks that covers about 10-foot swaths. An offset disk plow, consisting of multiple rows of disks set at different angles to each other, is pulled by a crawler-type tractor or a large rubber tire tractor. This method is often used for removal of sagebrush and similar shrubs. It works best on areas with smooth terrain, and deep, rock-free soils. Chisel plowing can be used to break up soils such as hardpan.

Often, drill seeding is conducted along with tilling. Seed drills, which consist of a series of furrow openers, seed metering devices, seed hoppers, and seed covering devices, are either towed by or mounted on tractors. A seed drill opens a furrow in the seedbed, deposits a measured amount of seed into the furrow, and closes the furrow to cover the seed.

Mowing tools, such as rotary mowers or straight-edged cutter bar mowers, can be used to cut herbaceous and woody vegetation above the ground surface. Mowing is often done along highway rights-of-way (ROW) to reduce fire hazards, improve visibility, prevent snow buildup, or improve the appearance of the area. Mowing in sagebrush habitats can create mosaics of uneven-aged stands and enhance wildlife habitat. Mowing is most effective on annual and biennial plants (Rees et al. 1996). Weeds are rarely killed by mowing, and an area may have to be mowed repeatedly for the treatment to be effective. However,

the use of a "wet blade," in which an herbicide flows along the mower blade and is applied directly to the cut surface of clipped plants, has greatly improved the control of some species. In addition, chipping equipment can be used to cut and chip vegetation in one pass.

Roller-chopping tools are heavy-bladed drums that, through a rolling action, cut and crush vegetation up to five inches in diameter. The drums are pulled by crawler-type tractors, farm tractors, or a special type of self-propelled vehicle designed for forested areas or range improvement projects.

Blading entails using a crawler-type tractor blade to shear small brush at ground level. Topsoil could be scraped with the brush and piled into windrows during this operation. Blading use is limited to areas where degradation to the soil is acceptable, such as along ROW or in roadside ditches (USDI BLM 1991a).

Grubbing is done with a crawler-type tractor and a brush or root rake attachment. The rake attachment consists of a standard dozer blade adapted with a row of curved teeth projecting forward at the blade base. Brush is uprooted and roots are combed from the soil by placing the base of the blade below the soil surface. Grubbing greatly disturbs perennial grasses, so grubbed areas are usually reseeded to prevent extensive runoff and erosion (USDI BLM 1991a).

Feller-bunchers are machines that grab trees, cut them at the base, pick them up, and move them into a pile or onto the bed of a truck (BPA, 2000). Feller-bunchers are used in forest and woodland thinning to remove potential hazardous fuels. Large chippers, or "tub-grinders," are often used to chip the limbs, bark, and wood of trees to generate mulch or biomass, which can be used in power generation facilities.

Mechanical methods are effective for removing thick stands of vegetation. Some mechanical equipment can also mulch or lop and scatter vegetation debris, so debris disposal is taken care of while the vegetation is removed. Mechanical methods are appropriate where a high level of control over vegetation removal is needed, such as in sensitive wildlife habitats or near homesites, and are often used instead of prescribed fire or herbicide treatments for vegetation control in the WUI.

Unless used with follow-up herbicide treatments, mechanical treatments have limited use for noxious weed control, because the machinery tends to spread seeds and not kill roots. Mechanical vegetation control costs from $100 to $600 per acre for equipment and labor (BPA, 2000). Additionally, repeated mechanical treatments are often necessary due to residual weed seed in the seed bank.

C. Manual

Manual treatment involves the use of hand tools and hand-operated power tools to cut, clear, or prune herbaceous and woody species. Treatments include cutting undesired plants above the ground level; pulling, grubbing, or digging out root systems of undesired plants to prevent sprouting and regrowth; cutting at the ground level or removing competing plants around desired species; or placing mulch around desired vegetation to limit competitive growth (USDI, BLM, 1991a).

Hand tools used include the handsaw, axe, shovel, rake, machete, grubbing hoe, mattock (combination of cutting edge and grubbing hoe), pulaski (combination of axe and grubbing hoe), brush hook, and hand clippers. Power tools such as chain saws and power brush saws are also used, particularly for thick-stemmed plants.

Manual treatments, such as hand-pulling and hoeing, are most effective where weed infestation is limited and soil types allow for complete removal of the plant material (Rees et al., 1996). Additionally, pulling

works well for annual and biennial plants, shallow-rooted plant species that do not re-sprout from residual roots, and plants growing in sandy or gravelly soils. Repeated treatments are often necessary due to soil disturbance and residual weed seeds in the seed bank.

Manual techniques can be used in many areas and usually with minimal environmental impacts. Although they have limited value for weed control over a large area, manual techniques can be highly selective. Manual treatment can be used in sensitive habitats such as riparian areas, areas where burning or herbicide application would not be appropriate, and areas that are inaccessible to ground vehicles (USDI, BLM, 1991a).

Manual treatments are expensive and labor intensive, compared to other vegetation management methods such as prescribed burning and herbicide application. Typical manual vegetation control costs range from $70 to $700 per acre. Manual methods may also be more dangerous for the workers involved in implementation because of the use of sharp tools and the difficulties associated with working conditions, such as steep terrain with slippery ground cover. Also, some plants may contain potentially toxic or hazardous compounds. While manual techniques may not be highly efficient or cost effective over large acreages, they may be very useful, and necessary, for specific invasive species problems, and for educating public land users.

D. Biological Control

Biological control involves the intentional use of domestic animals, insects, nematodes, mites, or pathogens (agents such as bacteria or fungus that can cause diseases in plants) that weaken or destroy vegetation (USDI, BLM, 1991a, BPA, 2000). Biological control is used to reduce targeted weed populations to acceptable levels by stressing target plants and reducing competition with desired plant species.

Domestic animals, such as cattle, sheep, or goats, control the top-growth of certain invasive and noxious weeds, which can help to weaken the plants and reduce the reproduction potential. Using the weeds as a food source, some animal species can consume 50% or more of their daily diet as target weeds after a brief adjustment period (Tu et al., 2001). They can also reduce the amount of flammable vegetation or alter the vertical and horizontal of the vegetation to alter wildfire behavior and effects.

Cattle primarily eat grass, but also some shrubs and forbs. Sheep consume many forbs, as well as grasses and shrubs, but tend not to graze an area uniformly. Goats typically eat large quantities of woody vegetation as well as forbs, and tend to eat a greater variety of plants than sheep (USDI BLM 1991a; Tu et al. 2001). Goats and sheep are effective control agents for leafy spurge, Russian knapweed, toadflax, other weed species, and some types of shrubs.

A successful treatment program can enhance habitat for wildlife. For example, cattle and sheep feeding in the spring and early summer can thin understory forbs and grasses, reducing competition for light, nutrients, and water for desirable shrub species. The shrub species will increase their vegetative output for winter browsing by deer and other wildlife (USDI, BLM, 1991a).

In order for this treatment to be effective, the right combination of animals, stocking rates, timing, and rest must be used. Grazing by domestic animals should occur when the target species is palatable and when feeding on the plants can damage them or reduce viable seeds. Additionally, grazing should be restricted during critical growth stages of desirable competing species. When desirable species are present, there must be adequate rest following the treatment to allow desirable species to recover.

Whenever the use of livestock to control vegetation is being considered, the needs of the domestic animals as well as the other multiple-use objectives for the area must be considered. A herder, fencing, or mineral block may be required to keep livestock within the desired area. Many weed species are less palatable than desired vegetation, so livestock may overgraze desired vegetation rather than the target weeds. Additionally, some weeds may be toxic to certain livestock and not to others, which will influence the management option selected (Tu et al., 2001). Proper management of domestic animals is extremely important if this method of treatment is to be successful (Olson, 1999).

Caution should be used whenever grazing or any other vegetation control is prescribed near riparian areas, in steep topography, or in areas with highly erodible soils. Weed seeds may still be viable after passing through the digestive tract of animals, so the animals should not be moved to weed-free areas until ample time has passed for all seeds to pass through their systems. Seeds can also travel on the animals' fur (Tu et al., 2001). Plant-eating insects, nematodes, mites, or pathogens affect plants directly, by destroying vital plant tissues and functions, and indirectly, by increasing stress on plants, which may reduce their ability to compete with other plants (BPA, 2000). Several biological control agents can be used together to reduce undesired vegetation density to an acceptable level. Biological control agents currently used by BLM have been tested by the USDA Agricultural Research Service to ensure that they are host-specific and will feed only on the target plant and not on crops, native flora, or endangered or threatened plant species.

Once biological control agents become established, they can reproduce and increase in numbers and continue to affect target organisms. However, it may take as many as 15 to 20 years for agents to establish themselves and bring about the desired level of control. Biological control agents are most suitable for treating large sites where target plants are well established and very competitive with native species. Agents are also often fairly mobile and can seek out new host plants (Rees et al., 1996). It is unlikely that biological control agents will eradicate a pest plant, because as populations of the host plant decrease, populations of the agent will also decline.

Treatment of noxious weeds using domestic animals is relatively inexpensive, costing about $12 to $15 per acre. Biological control costs using insects, nematodes, mites, or other pathogens range from $80 to $150 per release for ground applications and $150 to $300 for aerial releases (BPA, 2000). The cost reflects the limited availability of appropriate control agents and expertise required in dealing with the agents and treating areas. Biological treatments are most effective when followed with other treatments.

E. Herbicides

Herbicides are chemicals that kill or injure plants, and all herbicides interfere with plant metabolism in a variety of ways (Bussan and Dyer, 1999). They can be categorized as selective or non-selective. Selective herbicides kill only a specific type of plant, such as broad-leaved plants. Some herbicides used for noxious weed control are selective for broad-leaved plants, so that they can be used to control weeds while maintaining grass species. Non-selective herbicides must be used carefully around desirable and non-target plants (Rees et al., 1996).

Only those herbicides approved for BLM use can be used (See the Final Vegetation Treatments EIS (USDI, BLM, 2007b) for additional information the approval process. Some new chemicals may be used for experimental trials on three plots of no more than five acres each.

Herbicide treatments must comply with USEPA label directions and follow BLM procedures outlined in BLM Handbook H-9011-1 (Chemical Pest Control), and manuals 1112 (Safety), 9011 (Chemical Pest Control), and 9015 (Integrated Weed Management), and meet or exceed states' label standards

(USDI, BLM, 1991a). Application methods depend upon treatment objective(s) (removal or reduction); the accessibility, topography, and size of the treatment area; characteristics of the target species and the desired vegetation; location of sensitive areas and potential environmental impacts in the immediate vicinity; anticipated costs and equipment limitations; and meteorological and vegetative conditions of treatment areas at the time of treatment.

A project file with NEPA documentaion and a ROD is developed for each herbicide project. A pesticide use proposal (PUP) is then completed by a person whose certification by BLM course 9000-1 is current and sent to the State weed coordinator for signatures. The NEPA documentation includes information on project specifications, key personnel responsibilities, communication procedures, safety, spill response, and emergency procedures. The plan should also specify wind speeds and temperature ranges, minimum buffer widths between treatment areas and water bodies for non-aquatic use herbicides that comply with BLM policy and label restrictions (BLM Handbook H-9011-1).

Herbicide application schedules are designed to maximize impacts to target species and minimize potential impacts to non-target plants and animals, while remaining consistent with the objective of the vegetation treatment program. Application rates depend upon the target species, the presence and condition of non-target vegetation, weather and site conditions, soil type, depth to the water table, presence of other water sources, the label requirements, approved BLM rates, and sensitivity of non-target species. A pesticide application report (PAR) must be filled out within 24 hours of application.

Herbicides are applied aerially with helicopters or fixed-wing aircraft, and on the ground with vehicles or manual application devices. Although using helicopters is more expensive than fixed-wing aircraft, helicopters are more maneuverable and more effective in areas with irregular terrain. Helicopters also are more effective for treating target vegetation in areas with multiple vegetation types.

Manual applications of herbicides are used only in small areas, in areas inaccessible by vehicle, and/or to minimize potential impacts to non-target plants. Herbicides may be applied to green leaves with a backpack applicator or spray bottle, wick (wiped on), or wand (sprayed on). Herbicides can be applied to trees around the circumference of the trunk on the intact bark (basal bark), to cuts in the trunk or stem (frill, or “hack and squirt”), to cut stems and stumps (cut stump), or injected into the inner bark (Tu et al., 2001).

Herbicides can be used selectively to control specific types of vegetation, or nonselectively to clear all vegetation on a particular area. Herbicides can be applied over large areas and in remote locations using aircraft, or applied using spot applications in environmentally sensitive areas. The cost of herbicide application generally ranges from $20 to $250 per acre (BPA, 2000).

There are drawbacks and limitations to herbicide use. Herbicides can damage or kill non-target plants. Weeds may develop resistance to a particular herbicide over time.All herbicides must be applied by someone with the appropriate certification identified in state laws and BLM.

The Forest Service has prepared interactive spreadsheets for some herbicides that allow the determination of exposure concentrations for plants and animals under different application rates and exposure scenarios for these herbicides. The Ecological Rise Assessments (ERAs) are available at the Forest Service Pesticide Management and Coordination website http://www.fs.fed.us/foresthealth/pesticide/index.shtml.

Information contained in the ERAs was used by the BLM to characterize risks to non-target species from the specific chemicals and is incorporated by reference into the Vegetation Treatments PEIS. The BLM

has completed risk assessments for all approved chemicals and will not approve any new ones until a risk assessment for their use is completed. The relationship between risk assessments prepared by the Forest Service and those prepared and updated by BLM is discussed in the Vegetation Treatment EIS, Volume 1, Chapter 2 (USDI, BLM, 2007).

IV. Treatment Effectiveness Monitoring

Chapter 3 of this handbook defines monitoring as the regular collection of data over time to evaluate progress toward meeting a management objective or the effectiveness of our management actions. Monitoring is a key part of what has been termed "adaptive management," in which monitoring measures progress toward or success in achieving an objective and provides the evidence for management change or continuation (Holling, 1978; Ringold et.al.,1996 and Elzinga et.al., 1998).

Inherent in defining monitoring as part of the adaptive management cycle is the concept that monitoring is *driven by objectives*. What is measured, how well it is measured, and how often it is measured are design features that are defined by how an objective is articulated. In a land-use plan or activity plan the objective describes the desired condition. Management is designed to meet the objective and is implemented through a variety of activities and uses. Monitoring is designed to determine if the objective is met. When we implement a vegetative treatment, we monitor the post-treatment conditions to determine if our treatment has been effective at moving the vegetation closer to the overall desired condition. In many cases, multiple treatments and longer time periods may be necessary to actually achieve the desired condition described in a land-use plan. The effectiveness of an individual or a series of treatments is most often monitored within a shorter timeframe, such as one to five years after treatment, so that the cause and effect relationships are more clearly evident. Still, clear and measurable treatment objectives form the foundation of a treatment effectiveness monitoring effort (Elzinga et al.,1998).

The following guidance on planning and implementing treatment effectiveness monitoring has been summarized from numerous publications that go into much more depth than can be included in this handbook. Readers are encouraged to review the references provided in this section for more information on treatment effectiveness monitoring.

A. Monitoring Overview

BLM treatment effectiveness monitoring activities range from site evaluations to the BLM Legacy Program, which is an outgrowth of the need to provide current BLM field managers and specialists with an opportunity to learn about past management practices and land treatments, and to evaluate the results of those practices 25 or more years later.

To make monitoring data useful in building on successes and learning from past mistakes, monitoring must be designed to determine if the treatment was effective, and to ensure that treatment did not have unintended adverse impacts on other resources. Collaborative, multi-party monitoring is encouraged and in the case of treatments carried out under the authority of the Healthy Forests Restoration Act of 2003, is required. Multi-party monitoring can be an effective means of building trust and collaboration with local communities and diverse stakeholders, including interested citizens and tribes.

This handbook is not intended to provide a comprehensive listing of treatment effectiveness monitoring techniques. Other documents exist that provide the comprehensive information needed by field managers and staffs to develop effective treatment monitoring plans, including Measuring and Monitoring Plant Populations (Elzinga et.al., 1998) and Sampling Vegetation Attributes (Coulloudon et.al., 1996).

Rather, this section provides information on the importance of monitoring treatment effectiveness and adapting treatment design to better measure whether the desired outcomes are achieved. It also strongly encourages a multi-program approach toward monitoring to achieve multi-program objectives developed through the planning process, as well as interdisciplinary treatment design. By learning together about what works and what doesn't work, the vegetation management programs within the BLM will be better prepared to implement the integrated vegetation management approach outlined in this handbook.

B. The Benefits of Integrated Monitoring

Traditionally each resource program has conducted its own monitoring. Range specialists have collected vegetation data to estimate the forage resource for grazing. Wildlife biologists have visited the same ground to collect vegetation data that describes components of wildlife habitat. Fuels specialists have visited the same ground to estimate the volume of fuel the same vegetation provides. Foresters have visited the same piece of ground to measure the forest or woodland resource.

Today, BLM is faced with constrained budgets, limited personnel and increased work load. BLM must become more efficient in conducting business. Integrated monitoring across disciplines could increase efficiency particularly for the four programs that are engaged in monitoring the effectiveness of landscape treatments: range, wildlife, forestry, and fire/fuels.

Numerous benefits can be achieved from integrated monitoring in the realm of cost savings, connectivity to land-use plans, integration of resource management objectives across disciplines, and incorporation of stakeholder input.

1. Cost Savings

As mentioned before, sending one team of specialists to the same piece of ground to conduct vegetation studies for four programs at one time is more cost effective than sending four teams to the same piece of ground four different times. This approach would also foster better understanding among resource specialists of the management objectives from the various programs of range, wildlife, forestry and fire.

2. Better Connectivity to Planning Documents

Overarching management objectives for the field office and local management units are stated in various planning documents such as the field office or district office Resource Management Plan (RMP) and in various National Environmental Policy Act (NEPA) related documents, such as environmental assessments, environmental impact statements, and biological opinions. Integrated monitoring can develop one monitoring protocol to understand the effectiveness of treatments designed across the programs instead of addressing each program separately.

3. Landscape-Level Approach Facilitates Efficiency

Integrated monitoring is best applied at the landscape level such as a watershed scale. This approach allows for maintenance of connectivity among resources that cover large or linear geographic units such as:

- Wildlife corridors
- Riparian corridors

- Fire management units
- Areas of interest for t&e species recovery plans
- Habitat management units
- Timber sales
- Wildlife habitat
- Ecological site descriptions

A landscape-level approach also facilitates synthesis of integrated management objectives. There are more opportunities to identify "added value" between/among program areas. One multi-disciplinary team can serve multiple programs with "one-stop shopping" or "one-stop monitoring." For example, one interdisciplinary team for range evaluations can also collect data to serve wildlife needs and at the same time assist in development of prescribed burn plans for a unit or watershed.

Focusing personnel on one planning unit will provide efficiency in coordinating calendar schedules, reduced access time to the field, reduced cost by reducing vehicle use and employee time.

4. Improved Stakeholder Involvement

When BLM personnel, issues and management objectives are focused within a planning unit, the stakeholders are apt to be more focused and involved. For example, working within a watershed unit allows the permittees to focus on management of the whole complex of allotments within the watershed. This reduces the number of agency personnel the permittee needs to communicate with and the number of issues the permittee needs to understand. It should enhance the permittees understanding of the overall management objectives and the relationship among the resource programs. It should facilitate opportunities for the permittee to contribute to the management objectives.

5. Focused Adaptive Management

Integrated monitoring across disciplines within a planning unit should reduce the potential for conflict among disciplines. Managers can look at the impact or affect a decision will have on the various resources within the whole planning unit, and select adjustments to management that will be constructive for all resources.

C. Mechanisms for Integrating Monitoring

BLM has much to gain from integrated monitoring. Interdisciplinary teams that examine resource values within a single program are already functioning well. However, providing integrated monitoring to serve multiple programs at the same time is a new concept. Implementing this program may require some adjustment, particularly at the field office and district levels (locally) and to some extent for broad planning units (regionally) such as at the sage grouse habitat region.

1. Organize Treatments and Programs by Watershed or Landscape Unit

By aggregating vegetation treatments in a watershed or other geographic unit, treatments can more effectively alter large vegetation communities, thus having a greater impact on how that vegetation functions as wildlife habitat and how ecological processes, such as watershed and fire, work. It can also have the effect of focusing monitoring on plant community condition rather than site-level effects.

In many field offices the vegetation monitoring program is driven by one program more than others. For example, the expiration dates of grazing permits may dictate which allotments are monitored and when. To facilitate integration of program treatment objectives and effectiveness monitoring, permit expiration dates should be adjusted so that grazing allotments within one watershed are monitored during the same time period.

Monitoring associated with T&E species should be streamlined to facilitate cooperation with US Fish and Wildlife Service. Vegetation treatments such as weed control, prescribed burns and timber harvest are also facilitated by management within a planning unit.

2. Consider Identifying a Visible Platform for Monitoring

BLM offices should consider consolidating monitoring activities in one central person or group within a field office. A monitoring group or person may provide the service of vegetation monitoring to range, wildlife, forestry and fire. In this way, duplication of monitoring activities could be reduced. Duties would include those of science advisor for sample design and monitoring implementation, as well as quality checking of data, data base management, analyses, interpretation, report writing and recommendations to adjust management. The monitoring specialist should have close coordination with the GIS specialist for the construction of maps and geo-referenced data.

The monitoring specialist or group should be positioned with the office to allow for close coordination with the various program specialists and Bureau needs.

C. Writing Measurable Treatment Objectives

Management objectives typically increase in specificity as they progress from national policies to land-management plan objectives to project objectives, to individual treatment objectives. For example, objectives to improve the overall condition or health of the vegetation, as prescribed in national policies, typically begin with broad statements concerning the diversity or productivity, such as those contained in the Fundamentals for Rangeland Health (USDI, BLM, 2001a) or the 10-Year Comprehensive Strategy Implementation Plan (USDI and USDA, FS, 2006).

As these broad objectives are refined in land-use plans and activity plans, additional specificity is added, including a description of the desired future conditions for particular plant communities, the attributes of a vegetation community that are desirable and the priority and timing for applying treatments to improve condition.

In the design of treatments, these objectives must be further refined, particularly to ascertain if the treatment was applied properly and was effective at accomplishing the objective and to adapt future treatments to better achieve the desired outcome. In particular, treatment objectives should be measurable, either quantitatively or qualitatively. And, because some vegetation attributes are difficult to measure directly, surrogates or indicators should be used as a proxy for the actual attribute of concern. For example, where the objective is to increase community resiliency to wildfire, the objective should be described such that one or more of the community attributes is modified to improve community resiliency. The following is an example of such an objective:

Mimic natural disturbance patterns in Douglas-fir habitat type group 1 by reducing the average conifer canopy coverage by 50-75% in patches, while retaining 80% of the existing Douglas-fir trees over 24 inches in diameter on 400 acres in west Gallagher Creek.

In this example, stand resiliency to disturbance by wildfire is represented by reducing canopy cover and retaining large diameter Douglas-fir trees.

Another example of an objective which uses vegetation attributes to measure a characteristic that is difficult to measure directly is:

> Improve big game winter foraging habitat by reducing the density of pinyon pine and juniper trees on 1,200 acres in lower Basin Creek and thereby increasing the vigor and/or productivity of cool season perennial grasses.

The most common vegetation attributes used to describe vegetation communities within BLM are (Sampling Vegetation Attribute. 1999. BLM Technical Reference 1734-4):

- Frequency
- Cover
- Density
- Production
- Structure
- Species Composition

Other desirable characteristics of treatment objectives that will facilitate treatment effectiveness monitoring are (Elzinga et.al., 1998):

- Contain the specific geographic location where the treatment is expected to have an effect.
- Use an action verb, e.g., increase, decrease or maintain.
- Quantify a measurable state or degree of change for the attribute.
- Identify the time frame when the action effects are anticipated to be discernable.

Examples of treatment objectives that can more easily be monitored for effectiveness include:

- Decrease the frequency of *Bromus tectorum* by 30% at the Iron Creek population of *Penstemon lemhiensis* between 1997 and 2005.
- Increase the frequency of occurrence of key perennial native grass species to a density of three per square meter in the Five Creeks watershed by the end of 2004.
- Improve the overall Fire Regime Condition Class rating, as determined by the FRCC Interagency Guide protocols, in the ponderosa pine habitat types in the East Fork Elk Creek drainage by decreasing the amount of mid-seral/closed stand structures by 20 percent over the next five years.

Of particular concern in the arid west, is the control of invasive grass and noxious weed species following restoration treatments and other ground-disturbing activities and events. It is BLM policy to prevent, control and contain the spread of noxious and invasive weeds on BLM land. In situations where invasive grasses or noxious weeds are likely to persist or expand into treated areas, treatment objectives should identify threshold values for these species for specified time periods following treatment. For example, if an invasive grass such as Lehman's lovegrass were to become 15% or more species composition two years following a vegetation treatment, the decision record could include management action to further control invasive species at that time. Threshold values are defined by the local vegetation experts with guidance from state and county agencies.

Chapter 7 - Best Management Practices

I. Introduction

Best Management Practices (BMPs) are defined by BLM Handbook H-1601-1 as a suite of techniques that guide or may be applied to management actions for achieving desired outcomes. The BMPs in this handbook are measures considered highly applicable to management actions related to integrated vegetation management that can be applied on a site-specific basis to reduce or avoid adverse environmental or social impacts. They should also be given consideration during the development of land use and activity plans.

The following list of programmatic BMPs is not intended to be all inclusive, and other sources of BMPs, such as Manual Section 6840 (Special Status Species), H-4120-1 (Grazing Management), and H-8550-1 (Management of Wilderness Study Areas) should also be consulted when designing vegetation treatments.

Many of the BMPs listed below are identified as Standard Operating Procedures (SOPs), Prevention Measures, or Mitigation Measures in the BLM Vegetation Treatments Using Herbicides Environmental Impact Statement Record of Decision (ROD) (USDI, BLM, 2007a) or as SOPs in the BLM Vegetation Treatments Programmatic Environmental Report (PER) (USDI, BLM, 2007b). These documents contain a much more extensive list relative to weed prevention and herbicide use. Those SOPs required by the ROD and included as BMPs in this section are identified with an asterisk. The ROD should be consulted for all required SOPs, Prevention Measures and Mitigation Measures when designing vegetation treatments. The associated Biological Assessment and Biological Opinion should also be consulted when designing vegetation treatments that use herbicides near federally listed species.

The BMPs listed in this handbook should not be considered as a “one-size-fits-all” approach and don’t encompass all the effective BMPs currently required. They should be considered and applied where applicable to promote healthy, functioning native plant communities or to meet regulatory requirements. The appropriate BMPs for a particular site may vary to accommodate unique, site-specific conditions and local resource concerns. Specific BMPs should be evaluated by an interdisciplinary team to ensure they are not in conflict with resource goals and objectives. Regardless of the chosen practices, the final strategy used should ensure that the overarching goal of a healthy and functioning native plant community can be achieved by BLM vegetation management projects.

II. Best Management Practices

A. Invasive and Non-Native Species

The following BMPs focus on the prevention of further spread and/or establishment of invasive and non-native species:

- * Before ground-disturbing activities begin, inventory weed infestation and prioritize areas for treatment in project operating areas and along access routes.
- * Minimize soil disturbance to the extent practical, consistent with project objectives.
- * Locate and use weed-free project staging areas. Avoid or minimize all types of travel through weed-infested areas or restrict travel to periods when the spread of seed or propagules is least likely.
- * Pre-treat high risk sites for weed establishment and spread before implementing projects.
- Design vegetation treatments to retain native vegetation in and around project activity areas.
- Begin project operations in areas without non-native or noxious weed species.
- Clean vehicles and equipment (remove soil and plant parts) before entering public land.
- * Clean all equipment before leaving the project site if operating in areas infested with weeds. Utilize standard contract provisions to ensure that contractors adhere to this guideline.

- Locate and manage vehicle and equipment wash stations to limit weed and invasive species spread into native plant communities.
- * Inspect and treat weeds that become established at equipment cleaning sites.
- Inspect sand, gravel and fill materials on site, and ensure that they are weed-free before use and transport. Treat weed-infested sources to eradicate weed seed and plant parts, and strip and stockpile contaminated material before using pit material offsite.
- * Survey the area where material from treated weed-infested sources is used for at least three years after project completion to ensure that any weeds transported to the site are promptly detected and controlled.
- Use caution when transporting vegetative materials and wood products from project sites to minimize the spread of invasive and non-native pests.
- *Locate project staging areas for refueling, maintenance equipment, materials and operating supplies in weed-free areas.
- Dispose of noxious weed and non-native vegetation properly to prevent unwanted spread.
- * Use certified weed-free and/or weed-seed-free hay or straw where certified materials are required and/or are reasonably available.
- * Use weed-free feed for horses and pack animals.
- Schedule management activities (e.g. livestock grazing) when they may be most detrimental to populations of noxious weeds and non-native species without harming preferred species.
- Utilize domestic animals to contain the target species in the treatment areas prior to weed seed set. If seed set has occurred, do not move the domestic animals to uninfested areas for seven days.
- Use sterile or non-persistent exotic plants at low planting densities as nurse crops for local natives to preclude the migration of noxious weeds into adjacent natural areas.
- Schedule and coordinate roadside maintenance activities in consultation with weed specialists.
- * Inspect and document all limited term ground-disturbing operations in noxious weed infested areas for at least three growing seasons following completion of the project.

B. Soil Resource

The following BMPs relate to the protection of soil structure and integrity as well as prevent erosion and compaction:

- Identify soil or site conditions that may dictate specific timing, treatment methods, or equipment, or that may lead to weather-related or seasonal closure of the operation.
- Minimize rutting on primary trails, roads, staging areas, and landings and avoid rutting in the general project area.
- Inspect soil-stabilization practices throughout all stages of operations to ensure they are successful and remain functional.
- Use heavy equipment on dry and/or frozen ground to minimize soil compaction and rutting.
- Minimize damage and/or impacts to biological soil crusts by limiting the use of heavy machinery or excessive traffic in sensitive areas.
- * Minimize use of domestic animals if removal of vegetation may cause significant soil erosion or impact biological soil crusts.
- Minimize site-disturbance on slopes with high erosion potential. Implement erosion control measures where necessary.
- Minimize soil disturbance by limiting the piling and burning of treated fuels.
- Minimize the amount of time between soil disturbance and remediation.
- Conduct mechanical treatments along topographic contours to minimize runoff and erosion.
- Minimize use of heavy equipment on slopes greater than 20%.

C. Native Plant Conservation and Revegetation

The following BMPs apply to the conservation of native plant species and communities. They also relate to the re-vegetation/reestablishment of native plants on disturbed and/or treated sites:

- Reestablish native vegetation on sites if natural regeneration is unlikely. Use native vegetation that is genetically appropriate (e.g. from the same seed zone and of similar elevation) to the area treated when conducting revegetation activities.
- Manage for a mosaic of native plant communities and successional stages across the landscape.
- *When available, use native seed of known origin, as labeled by state seed certification programs that is free of noxious and invasive weeds, as determined and documented by a seed inspection test by a certified seed laboratory.
- Mitigate and limit impacts to habitats with existing and healthy native plant populations. Consider site characteristics, environmental conditions, and application equipment in order to retain native vegetation in and around project areas to the maximum extent possible consistent with project objectives.
- Conduct pre-treatment surveys for special-status plants within or adjacent to proposed treatment areas
- Consider seasonal impacts of management actions (e.g. growing vs. dormant season disturbance effects) when developing objectives and strategies.
- Maintain proper stocking rates and livestock distribution to protect native plant communities. Manage the intensity and duration of containment by domestic animals to minimize over utilization of desirable plant species.
- Where possible, provide interim revegetation in areas being actively disturbed.
- *Limit fertilizer applications that favor annual grass growth over forb growth in newly seeded areas where invasive annuals are becoming established.
- *Use native or sterile species for rehabilitation and stabilization projects to compete with invasive species until desired vegetation establishes.
- Exclude livestock from revegetated areas for a minimum of two growing seasons or until vegetation has become established. Additional time may be required for the arid regions. Consult local policies and decisions to determine the appropriate amount of time.
- Avoid attracting bark beetles to forest and woodland areas where vegetation is being manipulated by removing the treatment residue or by burning or chipping it on site and by minimizing bark damage to residual trees. Chipping should be conducted in the fall to allow the chips to dry over the winter and before the spring bark beetle flight.
- *To support local pollinators use native seed mixes that maximize blooming times when pollinators are most active and include native nectar and pollen-producing plants.

D. Using Pesticides and Biological Controls

The following BMPs relate to the use of pesticides and/or biological controls for the purposes of integrated vegetation management (See SOPs, Prevention Measures or Mitigation Measures in the BLM Vegetation Treatments Using Herbicides Environmental Impact Statement Record of Decision (ROD) (USDI, BLM, 2007a) for complete list of required SOPs when implementing vegetation treatments using herbicides):

- Use only biological control agents on species that have been tested and have approval.
- *Select pesticides that are the least toxic, which will provide the most desired results.
- * Develop plans to thoroughly evaluate the need for chemical treatments and their potential for impact on the environment.
- * Use herbicides after considering the effectiveness of all potential methods or in combination with other methods or controls.

- * Select herbicide that is least damaging to the environment while providing the desired results.
- * Apply the least amount of herbicide needed to achieve the desired result.
- * Follow herbicide product label for use and storage.
- * Have licensed applicators apply herbicides.
- * To protect special status species, implement all conservation measures for plants, aquatic animals and terrestrial animals presented in the *Vegetation Treatments on Bureau of Land Management Lands in 17 Western States Programmatic Biological Assessment.*
- Evaluate soil characteristics prior to pesticide application to prevent unwanted transport or leaching.
- * Consider effects of wind, humidity, temperature inversions, and heavy rainfall on herbicide effectiveness and risks.
- * Use appropriate buffer zones based on label and risk assessment guidance.
- Minimize use of pesticides near wetlands and riparian areas.
- * Maintain buffers between treatment areas and water bodies. Buffer widths should be developed based on herbicide- and site-specific criteria to minimize impacts to water bodies.
- *Minimize impacts of pesticides on pollinators by utilizing typical application rates, maintaining chemical free buffers around important pollen/nector sources and nesting habitats.
- Minimize damage to non-target plants by using non-broadcast treatments (e.g. spot treatments) and considering seasonality (e.g. treating during dormant periods) when possible.
- *Use chemicals only when they are the minimum method necessary to control weeds that are spreading within the wilderness or threaten lands outside the wilderness.
- * Use the "minimum tool" to treat noxious and invasive vegetation in wilderness, relying primarily on the use of ground-based tools, including backpack sprayers, hand sprayers, and pumps mounted on pack and saddle stock.
- Avoid using pesticides in areas actively grazed by livestock and/or wild horses and burros.
- Avoid using pesticides in areas of special wildlife consideration (see wildlife habitat section below).
- * Notify potentially affected parties of treatment activities that occur on public lands.
- *Post signs noting exclusion areas and the duration of exclusion, if necessary.
- * To minimize fears based on lack of information, provide public educational information on the need for vegetation treatments and the use of herbicides in an integrated pest management program for projects proposing local use of herbicides.

E. Air Quality

The following BMPs deal with the protection and maintenance of air quality. However, these BMPs are not tied directly to any air quality standards and thus, as explained earlier, are only suggestions to be considered when planning integrated vegetation management projects:

- Minimize dust impacts along roads to the extent possible.
- Manage treatments to prevent air quality violations and minimize impacts to smoke-sensitive areas.
- Consider weather-related factors such as wind when developing a smoke management plan for prescribed fire.
- Minimize burning pesticide treated vegetation for at least six months after application.

F. Wildlife Habitat

The following BMPs relate to the protection and maintenance of wildlife habitat. It is important to note that these BMPs were selected not because they minimized impacts directly to wildlife (e.g. direct take of wildlife species) but because they focused more on the habitat (i.e. the vegetation component of habitat). Therefore, any project that may directly impact wildlife should review programmatic BMPs and policies directly related to the take of individual animals:

- Follow standard procedures for compliance with Section 7 of the Endangered Species Act.
- Survey for species of concern when a project may impact sensitive or protected species (e.g. federally and state listed species) and/or their habitat.
- Consider all aspects of wildlife habitat needs (e.g. feeding, shelter, etc.) when developing management strategies. Use site-specific conservation measures from approved biological evaluations for listed species/species of special concern.
- Limit the size and intensity of disturbances within critical habitats or areas where protected/sensitive species are present that could be affected by disturbance. Limit activities which may result in long-term and/or cumulative impacts to sensitive species habitats (e.g., creation of trails or roads in or adjacent to important wildlife habitat).
- Minimize direct impacts to species of concern through appropriate mitigation measures (e.g. season of activity, etc.). Avoid treatments during critical periods for wildlife (e.g. breeding, nesting, foaling, etc.).
- Consider habitat needs of bird populations (both migratory and non-migratory). Avoid activities that may disrupt nesting and breeding of sensitive bird species.
- Provide appropriate amounts of dead woody material following treatments for wildlife habitat (e.g. snags, downed logs, etc.). Take into consideration fuels management and insect pest species.
- When aircraft are used, plan flight paths and schedules to minimize impacts on wildlife.
- Minimize treatments on important forage areas necessary to sustain local livestock and wildlife populations unless they are required to stimulate growth. Use mosaic strategies to treat large areas grazed by animals.
- Design projects so that important food sources for pollinators are treated in patches and vegetation treatments are timed to occur before these sources bloom. Projects should also consider when pollinators are most actively foraging.

G. Cultural and Historical Resources

The following BMPs are related to protection and preservation of cultural and historical resources:

- *Follow standard procedures for compliance with Section 106 of the National Historic Preservation Act.
- Initiate necessary consultations with appropriate cultural resource staff, State Historic Preservation Offices, and Native American Tribes to locate any areas of significance (cultural or historical) that may be impacted.
- Conduct archeological surveys and soils tests in culturally sensitive areas where ground disturbance is possible.
- *Consider impacts to culturally significant plants and work with the appropriate federal, tribal, and state resources to plan mitigation.

H. Water Quality and Wetlands

The following BMPs deal with protection of water resources, maintenance and preservation of riparian areas, and protection of wetlands.

- Minimize crossing of streams (intermittent and perennial) and wetlands with vehicles and heavy machinery.
- Locate residue piles (sawdust, field chipping residue, etc.) away from drainages where runoff may wash residue into water bodies or wetlands.
- *Maintain appropriate vegetative/riparian buffers between treatment areas and water bodies to protect water quality.

- Manage riparian areas to provide adequate shade, sediment control, bank stability, and recruitment of wood into stream channels.
- Locate project staging areas for refueling, maintenance equipment, materials and operating supplies in areas not designated as riparian and/or streambank management zones.

I. Recreation, Visual, and Wilderness Resources

The following BMPs pertain to values and resources related to recreation, aesthetics, and wilderness values and integrity:

- Use the least-intrusive methods possible to achieve objectives in wilderness areas.
- * Use chemicals only when they are the minimum method necessary to control weeds that are spreading within the wilderness or threaten lands outside the wilderness.
- * Use the "minimum tool" to treat noxious and invasive vegetation, relying primarily on the use of ground-based tools, including backpack sprayers, hand sprayers, and pumps mounted on pack and saddle stock.
- Avoid staging areas and large clearings within the view of travel routes or recreation areas.
- Design activities that mimic the form, line, color, and texture of the natural landscape.
- Upon completion of a project remove all trash and human waste from project areas.
- Minimize visual and audible impacts in high use recreation areas.
- Design vegetation treatments to repeat natural openings and mosaic on the landscape.
- Avoid straight line edges by scalloping or feathering edges and creating irregular openings.
- Retain a mix of native plant species and sizes to create a more natural appearance.
- * Notify the public of treatment methods, hazards, time and nearby alternative recreation areas.

III. Summary

As stated previously, the BMPs listed in this handbook are not "one-size-fits-all" and do not encompass all the effective BMPs currently required and/or available. However, several common themes related to the mitigation of environmental impacts were expressed throughout the previous sections. They include:

- The need for proper planning related to timing, spatial extent, and duration are critical to minimize environmental impacts.
- The value of consulting with a cross-section of natural resource specialists (e.g., biologists, ecologists, botanists, range conservationists, foresters, fuels specialists, etc.) to inform the decision making processes.
- The importance of considering multiple factors such as wildlife or water quality when developing and implementing management activities.
- The necessity of contingency revegetation plans in cases where natural reestablishment of native vegetation may not be feasible due to lack of seed source or impacts from competing non-native/invasive vegetation.
- The need to give special emphasis to the protection of sensitive resources (e.g. listed species habitats, cultural resources, etc.).
- The importance of developing inventory and monitoring strategies.

Regardless of the project proposed or outcomes desired, managers involved in integrated vegetation management should consider these six thematic best management practices as well as the protection of human health and safety throughout all stages of planning and implementation.

Chapter 8 - Using Native Plant Materials

I. Introduction

This chapter provides guidance on the use of native plants and seed in restoration and other revegetation projects and provides a brief overview of BLM's Native Plant Materials Development Program. As stated in Chapter 2 of this handbook; it is the policy of the Bureau of Land Management to manage for biologically diverse, resilient and productive native plant communities to sustain the health and productivity of the public lands. This policy recognizes that, for a variety of reasons, not every acre of public land will contain native plants and that, in certain circumstances to prevent further site degradation and improve functionality, non-native plants may be used as part of post fire stabilization and rehabilitation activities as well as in restoration to achieve short-term site stabilization objectives. However, where practical, uses and activities will be conducted to favor the health and persistence of native plant communities where they currently exist and rehabilitation or restoration actions will be undertaken to improve their diversity, resiliency and productivity. The policy in BLM Manual Supplement 1745 requires that native species shall be used except under limited circumstances. This handbook updates the 1745 policy and the procedures used in complying with it.

Healthy native plant communities are typically self-sustaining and rarely require management intervention to recover from natural disturbance. Natural recovery by native plant species is preferable to planting or seeding. However, the introduction of many non-native invasive plants into the United States, combined with disturbances that are often outside the range of natural variability, require BLM to analyze the potential for native plant community recovery and determine which types of treatment are warranted to assist in restoring their health. In some instances, it may be necessary to either reintroduce native species or augment native plant communities to aid in ensuring that more BLM-administered lands achieve Land Health Standards, particularly those focused on the Fundamentals of Land Health of: (1) upland and riparian watershed function; (2) ecological processes such as the nutrient cycle, energy flow, and the hydrologic cycle; (3) water quality; and (4) habitat quality for Threatened & Endangered and special status species.

Native plants are used in a wide range of programs within BLM including, burned area emergency stabilization and rehabilitation, hazardous fuels reduction, forest and rangeland health restoration, wildlife habitat improvement, threatened and endangered species recovery, noxious weed control, and others. It is essential that these programs work together in developing vegetation objectives and determining whether plant community and land health goals will require reintroduction or augmentation with native plants.

II. Establishing Priorities for Using Native Plants

Because native plant materials are in short supply, and many new native plant species are needed in the plant material toolbox for restoration and rehabilitation, combined with the length of time it takes to get new plant materials developed and released for use, the planning phase may be the most important part of any project.

Determining native plant materials needs should be part of the land-use planning process. While developing a LUP, field offices should determine priority areas for restoration and rehabilitation, the native plant species needed to restore those areas and the desired densities, frequencies or composition of those plants in the desired plant community or the potential natural community. Field offices should evaluate the suitability of the native plant material that is available for the sites, and begin collecting from local populations of those species that are not currently available using the protocol developed for the *"*Seeds of Success*"* project (see Appendix 4). Seed collected in this manner should be contributed to the native plant germplasm collections curated by the Agricultural Research Service (in Pullman, Washington and Fort Collins, Colorado facilities) for future plant

material development. It could also be taken to local growers for immediate seed increase or it could be used in a project requiring a small amount of seed.

When collecting seed for a project, generally use several (~ 50 or more) unrelated (spaced at least one-quarter mile apart for self pollinated species and within one-quarter mile for some cross-pollinated species) source plants within the collection area to maximize genetic diversity, would be collected in areas that match the ecological characteristics of the project area. Only use healthy source plants. It is best to collect seed when it is mature and still on the plant (if possible). For plants that disperse their seed quickly at maturity, spreading sheets beneath the parent plant is advised. Try to collect an equal number of seeds/cuttings from each source plant. These steps are outlined with more detail in Appendix 4.

Document the location of all source populations and as much as possible, track the plant materials taken from each population until they reach the field, and monitor the performance of each collection over time.

III. Treatment Design Considerations

The following criteria should be considered when designing treatments that reintroduce native plant species or augment existing native plant communities:

A. Seed collection from the site to be disturbed prior to disturbance actually taking place is an ideal means for acquiring locally adapted seed. Stockpiling should begin as early as possible. If nursery-grown seedlings are required, allow plenty of time for growing out. Early consideration should also be given to soil stockpiling, erosion control methods, and on-site planting and maintenance activities.

B. In the case of stabilizing and rehabilitating sites following wildfire, or other unplanned disturbance event, the use of a Programmatic Emergency Fire Stabilization and Rehabilitation Plan prepared in advance can help identify native plant material needs. Determining what native seed will be needed for stabilization and rehabilitation purposes in the event of an unplanned disturbance is recommended for areas prone to disturbance events.

C. Careful consideration must be given to selecting native plant species to be reintroduced or used in augmenting existing plant communities. A variety of sources are available for information on plant species native to a particular site. References including local floras and herbarium collections should be consulted as well as the sources mentioned in Chapter 4 to determine what species should be in the mix to increase the likelihood of success. Climatic information should be reviewed for information on timing of growing season, precipitation and annual precipitation patterns. The following are important sources of information for evaluating and planning vegetation treatments:

    1. The Ecological Site Descriptions for your local area can be obtained either from the NRCS state rangeland management specialist or on the web at: http://www.nrcs.usda.gov/technical/efotg/.
    2. The Fire Effects Information System (FEIS) at http://www.fs.fed.us/database/feis/ is one source of information on fire effects and recovery potential for many plants.
    3. The NRCS “VegSpec” website (http://www.plants.usda.gov and click on “VegSpec” icon) is an expert system that aids technical specialists or managers in making decisions on what to plant on specific sites. VegSpec integrates the Natural Resources Conservation Service (NRCS) soils, plants, and climate databases to select adapted plants including those native to the United States to seed in rehabilitation or restoration projects.

4. "Guidebook to the Seeds of Native and Non-Native Grasses, Forbs and Shrubs of the Great Basin," Scott Lambert 2005. Bureau of Land Management, Idaho Technical Bulletin No. 2005-04.
5. The Plant Conservation Alliance (http://nps.gov/plants) website has many useful links and sources of information for determining species that may be appropriate to use in restoration work.

F. Determine if appropriate commercially available native plant material exists, thereby decreasing costs considerably over locally collected and grown out native seed. If the plant material is not commercially available, determine the collection method (seeds or cuttings), the amount needed, and the planting method (seeding or transplanting), potential revegetation success, and costs in choosing what to collect or what to plant on the site. If nursery or seed collection and grow-out services are required, keep in mind that some nurseries and collectors require a year or more advance notification.

G. Determine techniques applicable to the life form you are collecting material from, transplanting, and/or seeding through literature review and personal contacts. Use the best method of seeding or planting as developed by knowledgeable plant researchers, such as the BLM Seed Warehouse, U.S. Forest Service Shrub Lab, National Resource Conservation Service Plant Materials Centers, and the U.S. Forest Service research stations.

H. When special-status plants are known or suspected in an area to be treated, avoid the use of any plant material that can interbreed with or out-compete the special-status species. Some taxa interbreed more easily than others. When choosing species for restoration and rehabilitation efforts where special status plants are present, consider the risk of genetic contamination to the genus level for special status plants and other declining plant species. For example, where listed or sensitive Penstemon species occur, choose only common Penstemon species that are native to the project site in a rehabilitation or restoration mix. Avoid the use of plant material releases that were developed to aggressively establish and out-compete other plant species in special status plant habitats. The use of locally rare plant species in vegetation treatments should be avoided except when special status plant species reintroduction/augmentation plans are written and approved. Federally listed or proposed species shall not be used for native plant reintroduction or augmentation efforts unless authorized in an approved recovery plan. Following the best management practices outlined in the previous chapter for native plant protection and revegetation will benefit special-status plant populations.

I. Develop plans for long-term maintenance and monitoring of planted or seeded areas.

J. The management of seeded or planted areas must be designed to maintain or enhance the native plant species that have been reintroduced or augmented.

K. Develop a contingency plan in case the plant materials become unavailable or fail to survive in the field. Seed availability may be a limiting factor for some species, so several different native species should be considered.

L. If possible, maintain an ongoing stock of seed or vegetative materials from frequently used local species, to aid in maintaining species composition on site during restoration projects. This is especially useful for species currently not available in the seed industry such as native annual grasses and important forb species. Meticulous records must be kept on the source of all materials. Use of a central collection facility such as ARS seed storage or an NRCS Plant Material Center may be more advantageous than developing field office storage.

M. Some plant species, such as oaks, have seeds that will not survive in storage. If possible, designate and manage areas of those species to maintain seed sources in the field when they are determined to be priority species needed for restoration in the land use planning process.

IV. Plant Material Sources

A. Natural Regeneration

If there is an ample seed source and suitable conditions, natural regeneration is preferred. However, to rely on natural regeneration, one must be confident there is not significant weed seed existing in the soil or on an adjacent site. Topsoil should be salvaged and re-spread if possible, as native seeds and microbiota can often be preserved (if storage length is limited). Care should be taken during the time it is stored to keep it free from invasive plants and their seeds.

B. Plant Salvage

If a project will take place where native plants will be lost in a location that will not be managed to meet land health standards such as developing a new open pit mine, plants can be salvaged from the site and used in nearby restoration and rehabilitation projects. Replant salvaged material as soon as possible to avoid loss of plants. Replant salvaged material in sites that match the original one to the extent possible to ensure adaptability.

C. Wildland Seed Collection

To the extent possible, seeds and plants used in restoration, erosion control, burned area stabilization and rehabilitation, forage enhancement, and other projects should originate from local sources. Local sources often possess genotypes that are adapted to the local environment, leading to higher short-term and long-term establishment and survival rates. “Local” refers to sources within or as close as possible to the project area and within the same ecological region. Collections should also be made within the same vegetation series and general soil type. Follow the recommendations outlined in native plant seed transfer zones as they become available.

If a plant population occurs on an unusual soil (e.g., serpentine), is found in an extreme environment or has distinct morphological characteristics that may be genetically based, then take seeds/cuttings from these local variants for use in projects where these occur. For example, a restoration effort on serpentine soil would use only seeds/cuttings collected on serpentine soil from within the same ecological site and elevation band. Ideally, riparian species should be collected from riparian areas immediately upstream or downstream, or within sub-watersheds within the same ecological site and at similar elevations. These guidelines can and should be tailored to individual species, sites and conditions. The use of common garden studies, out-plantings, and genetic analysis can be helpful in determining the presence and distribution of ecotypes, and should be done by personnel experienced with the various techniques.

When contracting seed collection, make sure the collector is experienced in seed collection, knowledgeable of the area and species and reputable; with a history of satisfactorily completing contracts. Determine payment based on pure live seed delivered. If collected seeds are grown out in a nursery, make sure that the contract states that the seeds are government property, and cannot be used for commercial purposes. For additional information on wild seed collection see Appendix 4 – “Seeds of Success Protocol.”

D. Commercial Seed Sources

If local sources are unavailable, commercial sources of native plants and seeds may be used. There are two sources of commercially available native plant seed. Seed can come from germplasm releases made by USDA Plant Materials Centers that was grown out and multiplied by growers in the seed industry or it can be collected from wildland plants. Germplasm releases are often named cultivars. Wildland collected seed is typically from shrubs like sagebrush, or forb species that are requested by the seed industry, but to date have not been included in germplasm releases. Cultivars can be manipulated or they can be natural, without genetic manipulation. Many of the cultivars available today are grass species. Information on the location of seed used to make a cultivar or release, the type of manipulation, if any, and the intended uses of a cultivar or release are available on line at http:/nativeseednetwork.org or from the USDA Plant Material Center responsible for release. This information can be helpful in determining if the use of released germplasm is appropriate in a restoration or rehabilitation project.

Plant materials should be bred and/or grown under environmental conditions that are similar to the project area. Ideally, plant sources should be within the same eco-region as the project area. It is best to use commercial sources where the genetic origin is verified by source identification through seed certification. When possible, purchase nursery-produced native seed grown under conditions that did not allow hybridization with other species or non-adapted collections of the same species.

The Association of Official Seed Certifying Agencies (AOSCA) has a process for certified production of native seed. During seed procurement, communicate with the state AOSCA certification agency to get independent verification of the identification as to the subspecies, seed type, and seed source location, including elevation. When buying native seed, the best choice is Pre-Varietal, Germplasm Category Source Identified (Yellow Tag). If native seed comes from a common garden selection it will be Pre-Varietal, Germplasm Category Selected Class (Green Tag). More information on AOSCA is available at http://www.aosca.org.

1. Consolidated Seed Buys

The national seed coordinator and the National Business Center contracting officer coordinate consolidated seed buys, which occur at least three times per year: spring (March-April), summer (July), and fall (October). The consolidated seed buys procure seed for Great Basin area BLM field offices and district offices, and for selected programs such as Burned Area Emergency Stabilization and Rehabilitation. The advantage of being part of the consolidated seed buy is that the seed coordinator and the contracting officer are familiar with the seed industry and knowledgeable about the current native seed market and help BLM offices get the best quality native seed for the best price.

2. Indefinite-Delivery, Indefinite-Quantity Contracts

Indefinite-Delivery, Indefinite-Quantity (IDIQ) contracts may be useful for seed procurement and for grow-out or increase of local, herbaceous, native plant materials. An IDIQ contract estimates the quantities and species to be ordered by BLM over the entire life of the contract. These contracts can be developed using an interagency approach so that contracting officers from BLM, Bureau of Indian Affairs, Fish and Wildlife Service, National Park Service, and U.S. Forest Service are authorized to place delivery orders against an IDIQ contract.

3. Non-native Plant Materials

Although native plants should always be given first consideration, there are certain situations where non-natives may be desired. For example, on highly disturbed sites that have had their physical characteristics altered so that native vegetation can not reestablish or survive, it may be necessary to use non-natives to help restore site stability. Other examples include noxious weed containment and emergency situations where there is a risk of soil loss or threats to life and property. In cases where the use of non-native vegetation is desired, a justification, including the identification of any desired native species that is not available, should be submitted for approval by the state director or other delegated authority. As outlined in BLM Manual 1745 - Introduction, Transplant, Augmentation, and Reestablishment of Fish, Wildlife, and Plants, the use of non-native seeds as part of a seeding mixture is appropriate only if:

a. Suitable native species are not available,
b. The natural biological diversity of the proposed management area will not be diminished,
c. Exotic and naturalized species can be confined within the proposed management area,
d. Analysis of ecological site inventory information indicates that a site will not support reestablishment of a species that historically was part of the natural environment and,
e. Resource management objectives cannot be met with native species.

When suitable natives are not available, identify the native species (including subspecies or variety when applicable) that is not available. Identify plant species native to the project area that may be available as a first substitute. If natives are only partially available, or not available, identify a non-native species of the same functional group to use on that site. If analysis of ecological site inventory information indicates that a site will not support reestablishment of a species that historically was part of the natural environment, look for suitable native species replacements before choosing non-native plants.

In considering the natural biological diversity of the area, it is best to consider the whole community, its processes and the dynamics between species rather than maintenance of vascular plant diversity. For example, there can be unintended consequences of the use of non-natives if or when soil microbial communities or pollinating animals including insects are displaced because non-native plants are chosen.

All non-native vegetation used should be non-invasive and ideally be short-lived, have low reproductive capabilities, or be self-pollinating to prevent gene flow into the native community. One good example is sterile oats, which provide erosion control and will fade out in one year without cultivation (although they do release seed if disturbed). Non-native vegetation should not compete with the naturally occurring or returning native plant community or exchange genetic material with common native plant species. Non-native material must not invade plant communities outside the targeted management area. Non-natives listed on state and federal noxious weed species lists or non-natives listed in state weed seed lists must not be considered for use.

As stated in Chapter 2, diverse, healthy, and resilient native plant communities provide the greatest opportunity to be successful in meeting multiple use objectives within BLM. Set resource management objectives that can be met using native species for most situations. However, as a last resort, it may be necessary to introduce non-native, non-invasive plant materials to break unnatural disturbance cycles or to prevent further site degradation by noxious or invasive plants.

V. Seed Quality

All seeds/plants used for BLM projects will be tested for weeds, pests and diseases, and shall be processed, stored, and conditioned properly. All field offices are required to use seed on public land that contain no noxious weed seed and meets certified seed quality. All seed to be applied on public land must have a valid seed test, within one year of the acceptance date, from a seed analysis lab by a registered seed analyst (Association of Official Seed Analysts). The seed lab results shall show no more than 0.5 percent by weight of other weed seeds; and the seed lot shall contain no noxious, prohibited, or restricted weed seeds according to state seed laws in the respective state(s). The seed procured for use on public land will meet the Federal Seed Act criteria. Seed may contain up to 2.0 percent of 'other crop seed' by weight, which includes the seed of other agronomic crops and native plants; however, a lower percent of other crop seed is recommended. Purchase seed with less than 12% moisture content to avoid mold or rot of seed.

Copies of the seed lab test results, including purity and germination (viability) rate, must be forwarded to the appropriate BLM office prior to seed application. If the seed does not meet the BLM and state/federal standard for noxious weed seed content or other crop seed allowances, it shall not be applied to public land. All seed test results must be retained in the seeding project file. The BLM state contracts for seed may be more restrictive with "other weed seeds" of concern as deemed necessary.

VI. Seed Storage

The native seed BLM buys or collects should be stored in the most optimal conditions to ensure the longest shelf life. Ensure that the seed going on the ground has not lost its viability during seed storage. For example, sagebrush seed not stored under optimal cold storage conditions (36-38 degrees Fahrenheit and average 25 percent relative humidity) may last only a few weeks in hot localities and a few months in cooler localities.

Seed storage requirements are highly variable for each species. Generally, each 1% reduction in seed moisture and each 10 degree Fahrenheit reduction in seed temperature doubles the life of the seed. Dry the seeds to between 5-8% moisture content before tightly sealing in durable containers to store seeds for three to five years at ambient temperatures. For longer storage, dry to 2.5-5% moisture. As a minimum, properly label each container with information on species, location of source plant, environmental information, date of collection, and the collector. A central collection facility such as an ARS seed storage facility or an NRCS plant material center may be more advantageous than developing field office storage.

The BLM National Seed Warehouse in Boise, Idaho, provides most seed needed in the Great Basin states (ID, OR, NV, and UT) under a Memorandum of Understanding between the state directors and the seed warehouse. However, all other states can receive seed and/or assistance in procurement of seed. Because of space limitations, the National Seed Warehouse stores only the seed procured through consolidated seed buys and only until the seed can be delivered to the office requesting it.

BLM participates in the native seed collection that is stored and curated at the ARS seed storage facility in Pullman, Washington. Seed that has been collected from public land and is cleaned and ready for storage can be sent to this collection with the proper documentation.

VII. Seeding Rates

Determining and applying suitable seed rates is an essential aspect of developing successful, cost-effective plans and treatments. Consult the BLM national seed coordinator and other local plant material specialists or appropriate literature when developing seeding treatments to determine the most appropriate seeding rate.

The USDA recommendation for drilled seeding rate for large seeded species is 20 pure live seeds (PLS) per square foot. The recommended drill seeding rate for small seeded species (most BLM seed mixes) is 30 to 40 seeds per square foot.

Broadcast or aerial seedings are recommended at the rate of 60 to 80 seeds per square foot (about double the drilled rate).

Aerial or broadcast seeding rates should not be higher than has proven to be successful and cost effective. As an example, 0.2 lbs PLS of Wyoming big sagebrush seed (approx. 1.25 lbs bulk) per acre equals 11.5 sagebrush seeds per sq. ft. should not be exceeded, even in an aerial seeding.

If multiple seed applications are planned, the rate per treatment should be lowered so that the total seed rate, combining all application methods, does not exceed 80 seeds per square foot.

Because of limited knowledge of the techniques necessary to plant and establish many new native plant species, monitor and document the success of the application of native plant materials using quantitative, measurable methods.

VIII. Native Plant Materials Development Program Overview

The BLM Native Plant Materials Program began in 2001 with direction from Congress to develop a long-term program to manage and supply native plant materials for use in federal land management rehabilitation and restoration efforts. The native plant materials program recognizes that public lands are the primary source of new plant materials needed for restoration and rehabilitation work.

Congress specifically directed “the Secretaries of Interior and Agriculture to report jointly to Congress with specific plans and recommendations to supply native plant materials for emergency stabilization and longer-term rehabilitation and restoration efforts.” The “Report to Congress” (Appendix 5) outlined the following five action items for the federal land managing agencies:

A. Undertake a comprehensive assessment of the short-term and long-term need for native plant materials including estimate of the amount of native plant materials needed and whether an adequate supply of these plant materials exists. Agencies also need the ability to identify and track this information.

B. Make a long-term commitment to native plant materials production, research and development, education and outreach, and technology transfer. On-going financial and organizational support will be required to increase the variety and quantity of native plant materials. The average time it takes to develop a typical native plant cultivar is between ten and twenty years.

C. Expand efforts to increase availability of numerous species of native plant materials. Both increases in commercial field production and wildland seed collection are needed to meet public land needs. Annual seed purchases by federal agencies, or as a result of federal programs, vary greatly creating an unpredictable market. Multi-year contracting and increased storage capacity could enhance market stability. Agencies can also facilitate a secondary, non-federal market.

D. Invest in partnerships with state and local agencies and the private sector. Identify restoration and rehabilitation efforts to conduct in partnership with other land managers and interested parties. Close cooperation and coordination with the private seed industry will ensure their interests and concerns are addressed.

E. Ensure that adequate science-based protocols for monitoring of restoration and rehabilitation efforts are established. To promote efficiency and economy, monitoring programs with consistent protocols for measuring success must be developed and implemented.

Chapter 9 - Funding, Budget Development and Accomplishment Reporting

I. Introduction:

This chapter provides information to assist program leaders and managers in developing an integrated program of work for vegetation management. A program of work includes the planned activities, treatments, staffing, funding and accomplishments for a set period of time, typically for a period of three to five-years into the future. For example, a program of work might include all the costs and staffing necessary to assess vegetation conditions, plan vegetation management projects, prepare NEPA documents, conduct clearances, develop and issue contracts, implement treatments, monitor treatment compliance and effectiveness, and report project accomplishments over the next five fiscal years (see Table 9-1). A portion of the costs associated with this five-year program of work could come from base budgets for various programs, from operational funding from various programs, or a combination of the two funding sources, depending upon the particular project.

The concept of an out-year program of work is not new to BLM. Several programs have required a program of work in the past, such as the three-year fuels program of work, the five-year Timber Sale Plan, the five-year Construction Plan, and the five-year Deferred Maintenance and Capital Improvement Plan. These plans may have contained different funding sources and involved staffing from other program areas, however, many times they were program specific. An integrated program of work for vegetation management is designed to leverage the expertise and resources of each of the vegetation management programs toward meeting common objectives and outcomes.

To be successful in achieving the degree of leveraging envisioned, use of an interdisciplinary team and management oversight during program of work formulation and approval is essential. This approach must be employed at all levels of the organization to ensure that all aspects of the program of work are adequately considered and program objectives are transparent. To be successful, the process must be inclusive with benefits accrued to all programs.

II. Developing Integrated Budget Requests

Identifying and securing funding is a critical part of the vegetation management process in meeting national, regional and local goals and objectives. Work focused on achieving goals and objectives at all of these organizational levels has the greatest chance of being funded. National goals, objectives and priorities are spelled out in various laws, policies, directives, initiatives and budget documents. They are often linked to the President's Management Agenda and the Department's Strategic Plan. Stating the goals, objectives and priorities for vegetation management in terms that are applicable to multiple programs will help facilitate integration at the regional and local levels. In other words, developing common goals, objectives and priorities at all levels of BLM organization is essential toward successful leveraging of expertise and resources to plan, implement and monitor vegetation projects at the field level.

Table 9-1. Example of an Integrated Five-Year Program of Work for Vegetation Management

Treatment/Activity	Subactivity	PE	Cost	Acres to be Treated By Year				
				1	2	3	4	5
NEPA Completion	1040, 1150, 2823	DD	$15k					
Cultural Resource Clearances	1050	BC	$25k	20k				
T & E Surveys	1150		$50k	20k				
Weed Inventory	1020	BS	$48k	20k				
Fuels Treatment (Mechanical)	2823	JQ	$1500k	1k		2k		
Fuels Treatment (Prescribed Fire)	2823	JM	$3000k	2.5k	3k			1.5k
Juniper Sale	1030	JE	$50k	100	100	100	100	100
Wildlife Habitat Improvement	1150	JA	$400	1k				
Temp. Fence Construction	8100	JB	$50k	5 (mi.)				
Purchase Seed	8100	JA	$10k					
	1020	JA	$10k					
	1150	JA	$10k					
	2823	JA	$10k					
Drill Seeding	8100	JA	$2300k	8k	5k		2k	
Weed Treatment	1020	JD	$300k		0.5k	0.5k		0.2k
Stream Bank Fencing	1040	JG	$30k	3 (mi.)				
Stream Bank Replanting	1040	JG	$10k		12 (mi.)			
Temp. Fence Removal	8100	JB	$10k					5 (mi.)
Monitoring	Multiple	MQ MT MKMO MX	$200k $200k $200k $200k $200k					

To facilitate the development of common vegetation management goals, objectives and priorities at the state and field office levels, the Washington Office will provide a set of integrated and prioritized criteria to be used in evaluating funding requests at the national level. Work plans that address these integrated goals, objectives and priorities have the greatest opportunity to receive funding from multiple program areas at the national level.

State directors may identify state-specific goals, objectives and priorities that tier to those developed at the national level. These may be identified in state director guidance for land use planning processes or in state-level directives related to budget development and staffing. Field office goals, objectives and priorities for vegetation management are identified in the associated land use plan, activity plans, and ultimately should be refined in the integrated program of work. They must take into account those developed at the national and state level and should involve local stakeholders and other partners in determining how best to achieve the goals and objectives of all levels of the organization.

Project proposals should include:

- An estimate of all funding required to cover direct project costs;
- An estimated timeline for completion of planning, clearances, implementation, and monitoring;
- An estimate of the reporting units of accomplishment as well as external partner contributions.

Project proposals within integrated funding sources should be submitted in the Budget Planning System (BPS) using the most appropriate budget theme category. Where themes are based upon subactivities, chose the subactivity theme corresponding to the main purpose of the project proposal. If the project proposal is submitted under multiple themes, care should be taken to avoid duplicate funding proposals and should state that other funding is required to complete the project if funded. As projects evolve and funding sources are positively identified, BPS entries should be updated to reflect actual funding allocations and workload targets.

Multiple data entries within several data bases are required if offices request funding from both fire (subactivities 2822, 2823, 2824, and 2881) and renewable resource program subactivities (e.g., subactivities 1020, 1030, 1110, 1770, 1776, 5900 and 9620) to conduct a single project. In these cases, offices have been directed (starting with the Fiscal Year 2009 BPS instruction memo) to include both fire and renewable resource program funding costs in their BPS project submissions. By including all requested funding sources in one database, field offices will ensure adequate consideration of project proposals at all levels of the organization, regardless of which programs are involved.

III. Funding Integrated Programs of Work

A. Funding Sources

Annually, BLM justifies a certain level of funding to accomplish specified types and quantities of work, categorized by subactivity and program element. Based upon these justifications and representations by BLM officials, Congress makes decisions on funding priorities, program emphases, workloads, and a resultant level of production from the various programs of BLM through the annual appropriations. BLM is obligated to carry out the intent of the policy decisions reflected in the Appropriations Act and not to substitute individual judgments for those specific policy decisions.

All states and offices are responsible for coding time and work accurately in accordance with BLM's budget structure and the benefiting subactivity concept. Under the benefiting subactivity concept, the subactivity driving or causing the action or event pays for the associated work. It is not appropriate under this concept to charge work and time to subactivities that do not benefit from the work. For example, where timber value needs to be determined as part of a land exchange which is designed to acquire lands to be used primarily for recreational purposes, it would be inappropriate to charge the time of the forester doing the timber valuation to the forestry program. Instead, the forester should charge his/her time to the recreation program.

With that said, it is also important to understand that the benefiting subactivity concept does provide BLM with a reasonable amount of flexibility in how subactivity funding can be used. Many work efforts benefit multiple programs, particularly when it comes to managing vegetation to meet multiple program objectives as discussed in earlier chapters. It is crucial that the full suite of program objectives be identified during the project planning process to facilitate funding across a variety of subactivities.

In addition, many programs, particularly renewable resource programs, place a high priority on maintaining and restoring land health, including the diversity, resiliency and productivity of native

vegetation communities. If planned and implemented with this overarching objective in mind, many projects focused on this goal can be funded by a variety of subactivities within the renewable resource programs.

B. Program Priorities and Objectives

Program Elements (PEs) are categories of work that are designed to provide information on the amount and the cost of specific types of work. They have been stratified into groups of similar work process, such as inventory (B), project/ treatment implementation (J), and monitoring/evaluation (M).

Each program has identified PEs that are a priority for their program, as well as other PEs that represent other work processes that are often part of program implementation. One way of determining which programs have similar focus and, therefore objectives, is to compare their priority PEs. In the case of vegetation management, many programs share common PEs in the "project/treatment implementation" group (J).

Table 9-2 includes a matrix that identifies priority program objectives or emphasis areas, which can be useful in identifying which subactivities might be combined to improve the effectiveness and efficiency of treatments to maintain or restore vegetative communities. These programs can be expected to work together to plan, implement and monitor vegetation management activities. It is not a complete listing and could change over time. Care should be taken in how objectives are described in planning documents and monitoring results to ensure that the benefiting subactivity concept, described under Funding Sources (Section III A) is followed.

Table 9-2. Priority program objectives identifying which subactivities might be combined to improve the effectiveness and efficiency of treatments.

Objective	Subactivity									
	1010	1020	1030	1040	1110	1120	1150	2823	2824	5900
Fish & wildlife habitat enhancement	X	X	X	X	X	X	X	X		X
Improve shrub and grassland health	X	X			X		X	X		
Improve forest health	X		X		X		X	X		X
Improve riparian health	X	X		X	X	X	X			
Utilize biomass		X	X					X	X	X
Protect WUI communities		X	X						X	
Reduce wildfire risk to the environment	X	X	X		X		X	X	X	X

Another way to determine work priorities within the different programs is by reviewing the annual Budget Justifications, Preliminary Target Allocation directives and the Annual Work Plan directives. As vegetation management and land health restoration directives become more and more integrated in these documents, it should become easier to identify common priorities and objectives across the programs that manage vegetation, therefore making it easier to fund vegetation projects and treatments using multiple program funding sources.

IV. Reporting Requirements

States must take care in reporting accomplishments for the various programs involved in a multi-program project, similar to the discussion earlier in this chapter on coding expenditures under the benefiting subactivity concept. All programs are evaluated for the accomplishments produced and the cost associated with those accomplishments. Costs incurred with no reportable accomplishment are discouraged by the programs, therefore program staffs are often reluctant to lend a hand in designing and analyzing projects that will have no reportable accomplishments in the program elements their program considers to be priority.

To overcome this problem where projects are being designed and implemented to meet multiple program objectives, accomplishments should be distributed across the programs proportionate to the level of involvement and expenditure by the program subactivity. For instance, if the wildlife program and the fuels program are working together to design and analyze a single treatment that will both reduce the risk of catastrophic fire and improve wildlife habitat, both program areas should report a share of the total acres treated under their priority program elements (For example, 100 acres reported under 1110 JA and 100 acres reported under 2823 JM). Care must be taken to avoid double counting treatment acres in cases where multiple subactivities are used to plan, analyze, implement and monitor treatments.

A. Budget Planning and Accomplishment Reporting

The BLM has numerous computer systems that have been developed over the years to meet specific objectives, including budget development, budget tracking and accomplishment reporting. The fact that these systems often do not communicate with each other creates a situation where multiple data entries are required for a single project or activity by the field to populate these databases. In the future, BLM will be attempting to either link these systems to reduce redundancy and multiple entries of the same information, or moving to a single project data warehouse that will then feed other systems. Until this is accomplished, multiple entries may be required to tell the complete story concerning the objectives accomplished by BLM.

Budget Planning and Development

The Budget Planning System (BPS) is designed to provide a mechanism for field offices to display and prioritize proposed out-year base program and project costs and workload. BPS data is used by the national office program leads in recommending program funding allocations and workload targets for the states. It is also used to portray the type of work that will be accomplished in out-years in the Budget Justifications.

Project proposals within integrated funding sources should be submitted in BPS using the most appropriate budget theme category. Where themes are based upon subactivities, chose the subactivity theme of the predominant funding source in the proposal. If the project proposal is submitted under multiple themes, care should be taken to avoid duplicate funding proposals and should state that other funding is required to complete the project if funded. As projects evolve and funding sources are positively identified, BPS entries should be updated to reflect actual funding allocations and workload targets.

BPS is used by all BLM programs except Fire Management, which uses the National Fire Operations and Reporting System NFPORS (see below). However, as mentioned above, multiple data entries

are required if offices request funding from both fire (subactivities 2822, 2823, 2824, and 2881) and renewable resource program subactivities (e.g., subactivities 1020, 1030, 1110, 1770, 1776, 5900 and 9620) to conduct a single project. In these cases, offices have been directed (starting with the 2009 BPS Instruction memo) to include both fire and renewable resource program funding needs in their BPS project submissions. By including all requested funding sources in one database, field offices will ensure adequate consideration of project proposals at all levels of the organization, regardless of which programs are involved.

Budget Tracking

Where projects are planned using funding from fire management and non-fire funding sources, information must be entered into both BPS and NFPORS during the budgeting process due to a lack of connectivity between the two systems. Non-fire funded projects that also achieve National Fire Plan (NFP) objectives must be entered into both BPS and the NFPORS Non-NFP module.

The MIS is BLM's national system used by all programs and all offices to track expenditures and performance at the subactivity and project level and at all levels of the organization. As such, it is an "implementation" tracking system, rather than a budget development system. Information from MIS is used in a variety of applications within BLM. Most pertinent to this chapter is the use of MIS information by the programs that manage vegetation. Both financial and performance data are used by the National Office program leads to monitor program implementation at Mid-Year, Third Quarter and End of Year. At Mid-Year and Third Quarter, state-level expenditures and accomplishments are reviewed to understand implementation progress and issues that may lead to over- or under-expenditure of funds or over- or under-achievement of accomplishment targets. MIS data is also used to understand annual performance and establish target allocations for the upcoming year, as well as reporting bureau-wide accomplishments in various documents, including the out-year Budget Justifications and Public Land Statistics.

NFPORS was developed to track activities related to implementation of the National Fire Plan. It is used in the development of out-year budgets and in making annual funding allocations for some of the fire funding accounts, including the Hazard Fuel Reduction (subactivity 2823) and Wildland Urban Interface Fuels (2824) programs. It serves as both an out-year budget development tool, similar to how BPS is used by many other BLM programs, and a performance tracking and reporting system, similar to how MIS is used by all BLM programs.

In addition to tracking performance of some fire management programs, NFPORS is also used to track non-fire funded activities that also achieve National Fire Plan objectives. Since 2003, field offices have been directed to enter cost and performance data into the NFPORS Non-NFP module relative to activities funded by programs other than fire management that achieve NFP objectives, including forestry, range, wildlife, and weeds. Beginning in 2007, field offices were directed to also enter data into the NFPORS Non-NFP module pertaining to planned costs and workload accomplishments for projects funded by Public Domain forestry related subactivities (subactivities 1030, 5900 and 9620). Data from the NFPORS Non-NFP module is used in combination with NFPORS data pertaining to fire program-funded activities to report on the overall costs and accomplishments of BLM toward meeting NFP objectives annually. NFPORS is used by all the fire management agencies within the Department of the Interior and the Forest Service. As such, information from NFPORS (all modules) is used report government-wide

accomplishments toward meeting NFP objectives annually.

Accomplishment Reporting

Reporting of project accomplishments will continue in MIS, NFPORS, and other tracking systems currently in use by BLM to report and track project and program accomplishments and expenditures. Some of these other accomplishment reporting systems include:

Range Improvement Projects System (RIPS) – The Rangeland Improvement Project System (RIPS) is a data base that stores local project data and provides standardized reports for BLM field offices to use in managing projects and responding to data calls and FOIA requests. Timely entry of improvements and costs into the system also provides data each year for development of BLM-wide reports such as "Public Land Statistics."

RIPS data bases reside at local BLM offices. Copies of these data bases are sent to other locations for backup and security purposes. The RIPS user representative is located in the National Applied Resources Science Center (RS-140) in Denver. He/she is provides assistance and training to users and facilitates changes to the system or data bases. Enhancements are planned that will provide reporting capabilities (standard reports and ad-hoc query) at the desired office tier level (field office, district, administrative state, national).

Timber Sale Information System (TSIS) – TSIS tracks information on the sale of timber and other forest products. Data is entered into TSIS when a contract is advertised (for all advertised sales) or when a contract is awarded (for all negotiated sales). When vegetation is sold related to a vegetation management project data regarding this sale must be entered into TSIS by the end of the current month. Information from TSIS is used to report the volume of timber and other forest products offered, sold and harvested from BLM lands annually, as well as to track timber volume offered by state for the purpose of meeting annual volume performance measure targets.

Stewardship Contracting Information Database (SCID) - SCID tracks information concerning stewardship contracting projects where forest products are traded for service work for all projects using the Stewardship Contracting authority provided in the Interior and Related Agencies Appropriation Act of 2003. This stewardship contracting information is not capture in TSIS. It is used in combination with TSIS to track and report the volume offered by state for the purpose of meeting annual volume performance measure targets.

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Appendix 1

LANDFIRE Biophysical Setting Model Example

Biophysical Setting: 1711260 Inter-Mountain Basins Montane Sagebrush Steppe

☐ *This BPS is lumped with:*
☐ *This BPS is split into multiple models:*

General Information

Contributors (also see the Comments field) **Date** 3/16/2005

Modeler 1 Gary Medlyn	gary_medlyn@nv.blm.gov	**Reviewer**
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Modeler 3		**Reviewer**

Vegetation Type

Upland Savanna and Shrub-Steppe

Map Zone

17

Model Zone

☐ Alaska ☐ N-Cent.Rockies
☐ California ☐ Pacific Northwest
☑ Great Basin ☐ South Central
☐ Great Lakes ☐ Southeast
☐ Northeast ☐ S. Appalachians
☐ Northern Plains ☐ Southwest

Dominant Species*

ARTRV
PUTR2
SYOR2

General Model Sources

☑ Literature
☐ Local Data
☑ Expert Estimate

Geographic Range

Montane and subalpine elevations across the western US from 1000m in eastern OR and WA to over 3000m in the Southern Rockies, and within the mountains of NV, western UT, southeast WY and southern ID.

Biophysical Site Description

This ecological system occurs in many of the western states, usually at middle elevations (1000-2500m). Within the Great Basin mapping zone, elevation ranges from 1370m in ID to 3200m in the White Mountains of CA (Winward and Tisdale 1977, Blaisdell et al. 1982, Cronquist et al. 1994, Miller and Eddleman 2000). However, elevations are predominantly between 1525 and 2750m in the mountains of NV and western UT. The climate regime is cool, semi-arid to subhumid, with yearly precipitation ranging from 25-90cm/year (Mueggler and Stewart 1980, Tart 1996). Much of this precipitation falls as snow. Temperatures are continental with large annual and diurnal variation. In general this system shows an affinity for mild topography, fine soils and some source of subsurface moisture. Soils generally are moderately deep to deep, well-drained and of loam, sandy loam, clay loam or gravelly loam textural classes; soils often have a substantial volume of coarse fragments and are derived from a variety of parent materials. This system primarily occurs on deep-soiled to stony flats, ridges, nearly flat ridgetops and mountain slopes. Soils are typically deep and have well developed dark organic surface horizons (Hironaka et al. 1983, Tart 1996). However, at the high ends of its precipitation and elevation ranges mountain big sagebrush occurs on shallow and/or rocky soils. All aspects are represented, but the higher elevation occurrences may be restricted to south or west-facing slopes.

At lower elevations, mountain big sagebrush occurs on upper fan piedmonts, where it typically intermixes

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

with Wyoming big sagebrush on north facing slopes. On mountain sideslopes at this elevation, it occurs on north-facing slopes. Where pinyon and juniper are present, it is usually on south-facing slopes with pinyon and juniper generally increasing on north-facing slopes within the sagebrush community. At mid-level elevations, mountain sagebrush begins to move into more southerly slopes intermingling with black sagebrush and low sagebrush and with mountain mahogany occurring on north-facing slopes. With continued elevation gain, curlleaf mountain mahogany generally crowds it out. Mountain big sagebrush then occupies drier sites at higher elevations.

Vegetation Description

Vegetation types within this ecological system are usually <1.5m tall and dominated by Artemisia tridentata ssp. vaseyana, Artemisia cana ssp. viscidula or Artemisia tridentata ssp. spiciformis. A variety of other shrubs can be found in some occurrences, but these are seldom dominant. They include Artemisia rigida, Artemisia arbuscula, Ericameria nauseosa, Chrysothamnus viscidiflorus, Ephedra viscidiflorus, Symphoricarpos oreophilus, Purshia tridentata, Peraphyllum ramosissimum, Ribes cereum and Amelanchier alnifolia. The canopy cover is usually between 20-80%. The herbaceous layer is usually well represented, but bare ground may be common in particularly arid or disturbed occurrences. Graminoids that can be abundant include Festuca idahoensis, Festuca thurberi, Festuca ovina, Elymus elymoides, Deschampsia caespitosa, Danthonia intermedia, Danthonia parryi, Stipa spp, Pascopyrum smithii, Bromus carinatus, Elymus trachycaulus, Koeleria macrantha, Pseudoroegneria spicata, Bromus anomalus, Achnatherum therburianum, Poa fendleriana or Poa secunda. Forbs are often numerous and an important indicator of health. Forb species may include Castilleja, Potentilla, Erigeron, Phlox, Astragalus, Geum, Lupinus, Eriogonum, Balsamorhiza sagittata, Achillea millefolium, Antennaria rosea, Eriogonum umbellatum, Fragaria virginiana, Artemisia ludoviciana, Hymenoxys hoopesii (=Helenium hoopesii), etc. Mueggler and Stewart (1980), Hironaka et al. (1983) and Tart (1996) described several of these types. This ecological system is critical summer habitat for greater sage grouse. Moreover, resprouting bitterbrush in mountain big sagebrush types is potentially important to wildlife in early stand development.

Disturbance Description

Mean fire return intervals in and recovery times of mountain big sagebrush are subjects of lively debate in recent years (Welch and Criddle 2003). Mountain big sagebrush communities were historically subject to stand replacing fires with a mean return interval ranging from 40yrs+ at the Wyoming big sagebrush ecotone, and up to 80yrs in areas with a higher proportion of low sagebrush in the landscape (Crawford et al. 2004, Johnson 2000, Miller et al. 1994, Burkhardt and Tisdale 1969 and 1976, Houston 1973, Miller and Rose 1995, Miller et al. 2000). Under pre-settlement conditions mosaic burns generally exceeded 75% topkill due to the relatively continuous herbaceous layer. Therefore, replacement fire with a mean FRI of 40-80yrs was adopted here. Brown (1982) reported that fire ignition and spread in big sagebrush is largely (90%) a function of herbaceous cover. These communities were also subject to periodic mortality due to insects, disease, rodent outbreaks, drought and winterkill (Anderson and Inouye 2001, Winward 2004). Periodic mortality events may result in either stand-replacement or patchy die-off depending on the spatial extent and distribution of these generally rare (50-100yrs) events.

Recovery rates for shrub canopy cover vary widely in this type, depending post fire weather conditions, sagebrush seed-bank survival, abundance of resprouting shrubs (eg, snowberry, bitterbrush) and size and severity of the burn. Mountain big sagebrush typically reaches 5% canopy cover in 8-14yrs. This may take as little as four years under favorable conditions and longer than 25yrs in unfavorable situations (Pedersen et al. 2003, Miller unpublished data). Mountain big sagebrush typically reaches 25% canopy cover in about 25yrs, but this may take as few as nine years or longer than 40yrs (Winward 1991, Pedersen et al. 2003, Miller unpublished data). Mountain snowberry and resprouting forms of bitterbrush may return to pre-burn cover values in a few years. Bitterbrush plants less than fifty years old are more likely to resprout than older plants (Simon 1990).

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

Adjacency or Identification Concerns

In MZ16, BpS 1126 was separated into two very distinct montane sagebrush steppe not distinguished by NatureServe: Inter-Mountain Basins Montane Sagebrush Steppe dominated by mountain big sagebrush (1126big) and Inter-Mountain Basins Montane Sagebrush Steppe dominated by low sagebrush (1226low). Both systems cover large high-elevation areas in the Intermountain West. Mountain big sagebrush is a tall shrubs with a mean FRI from 10-70yrs, whereas high-elevation low sagebrush is a dwarf shrub with a mean FRI of 200yrs+. For MZs 12 and 17, mountain big sagebrush communities fall into this model (BpS 1126), while mountain low sagebrush communtities fall into BpS 1124.

The NatureServe description does not distinguish between mountain big sagebrush that can be invaded by conifers at mid to high elevations (ie, within the tolerance of pinyon and juniper) and mountain sagebrush steppe that is too high elevation for pinyon to encroach. The ability for pinyon to invade has a large effect on predicted HRV and management.

This type may be adjacent to forests dominated by aspen, Douglas-fir, limber pine and bristlecone pine. It also occurs adjacent to pinyon-juniper woodlands. The ecological system, where adjacent to conifers, is readily invaded by conifers (Douglas-fir, sub-alpine fir, whitebark pine, limber pine, pinyon-pine and juniper spp) in the absence of historic fire regimes (Miller and Rose 1999). This type probably served as an ignition source for adjacent aspen stands. Mountain big sagebrush is commonly found adjacent to or intermingled with low sagebrush and mountain shrublands.

Uncharacteristic conditions in this type include herbaceous canopy cover <40% and dominance of the herbaceous layer by mulesears (Wyethia amplexcaulis) on clayey soils.

At lower elevational limits on southern exposures there is a high potential for cheatgrass invasion/occupancy where the native herbaceous layer is depleted. This post-settlement, uncharacteristic condition is not considered here.

Native Uncharacteristic Conditions

Scale Description

This type occupies areas ranging in size from 10s-10000s of acres. Disturbance patch size can also range from from 10s-1000s of acres. The distribution of past burns was assumed to consist of many small patches in the landscape.

Issues/Problems

This was initially 1126_a (Mountain Big Sagebrush) model from MZ16, which was itself based on Rapid Assessment models R2SBMT and R2SBMTwc where the reviewers and modelers had very differents opinions on the range of mean FRIs and mountain big sagebrush recovery times (see Welch and Criddle 2003). It is increasingly agreed upon that a MFI of 20yrs, which used to be the accepted norm, is simply too frequent to sustain populations of greater sage grouse and mountain big sagebrush ecosystems whose recovery time varies from 10-70yrs. Reviewers consistently suggested longer FRIs and recovery times. The revised model is a compromise with longer recovery times and FRIs. Modeler and reviewers also disagreed on the choice of FRG: II (modeler) vs. IV (reviewers). For MZs 12 and 17, modelers place this system in Fire Regime Group IV.

If conifers are not adjacent to this system, such as in the Tuscarora range, Santa Rose range and similar regions, use a three-box model with the following percentages per box: 20% A, 45% B, 35% C.

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

Comments

BpS 1126 for MZs 12 and 17 was based on BpS 1126_a (Mountain Big Sagebrush) from LF MZ16. BpS 1126_a is essentially PNVG R2SBMTwc (mountain big sagebrush with potential for conifer invasion) developed by Don Major (dmajor@tnc.org), Alan R. Sands (asands@tnc.org), David Tart (dtart@fs.fed.us) and Steven Bunting (sbunting@uidaho.edu). R2SBMTwc was itself based on R2SBMT developed by David Tart. R2SBMtwc was revised by Louis Provencher (lprovencher@tnc.org) following critical reviews by Stanley Kitchen (skitchen@fs.fed.us), Michele Slaton (mslaton@fs.fed.us), Peter Weisberg (pweisberg@cabnr.unr.edu), Mike Zielinski (mike_zielinski@nv.blm.gov) and Gary Back (gback@srk.com).

The first three development classes chosen for this PNVG correspond to the early, mid- and late seral stages familiar to range ecologists. The two classes with conifer invasion (classes D and E) approximately correspond to Miller and Tausch's (2001) phases 2 and 3 of pinyon and juniper invasion into shrublands.

Vegetation Classes

Class A 20 %

Early Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☑ Shrub
- ☐ Tree

Fuel Model 1

Description

Indicator Species* and Canopy Position

PSSP6	Upper
FEID	Upper
SYOR2	Lower
ARTRV	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	5 %
Height	Shrub 0m	Shrub 0.5m
Tree Size Class	None	

☑ Upper layer lifeform differs from dominant lifeform.

Dominant vegetation is herbaceous with scattered shrubs. Herbaceous cover is 0-80%.

Herbaceous vegetation is the dominant lifeform. Herbaceous cover is variable but typically >50% (50-80%). Shrub cover is 0-5%. Replacement fire (mean FRI of 80yrs) setbacks succession by 12yrs. Succession to class B after 12yrs.

Class B 50 %

Mid Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☑ Shrub
- ☐ Tree

Fuel Model 1

Description

Indicator Species* and Canopy Position

ARTRV	Upper
PUTR2	Upper
CONIFE	Lower
SYMPH	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	6 %	25 %
Height	Shrub 0m	Shrub >3.1m
Tree Size Class	Seedling <4.5ft	

☑ Upper layer lifeform differs from dominant lifeform.

Herbaceous cover is the dominant lifeform with canopy >50%. Shrub cover is 6-25% and the upper lifeform.

Shrub cover 6-25%. Mountain big sagebrush cover up to 20%. Herbaceous cover is typically >50%. Initiation of conifer seedling establishment. Replacemenfire mean FRI is 40yrs. Succession to class C after 38yrs.

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Class C **15%**

Late Development 1 Closed

Upper Layer Lifeform

☐ Herbaceous
☑ Shrub
☐ Tree

Fuel Model 2

Indicator Species* and Canopy Position

ARTRV	Upper
PUTR2	Upper
SYMPH	Low-Mid
CONIFE	Mid-Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	26%	45%
Height	Shrub 0m	Shrub >3.1m
Tree Size Class	None	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Shrubs are the dominant lifeform with canopy cover of 26-45%+. Herbaceous cover is typically <50%. Conifer (juniper, pinyon-juniper, ponderosa pine or white fir) cover <10%. Insects and disease every 75yrs on average will thin the stand and cause a transition to class B. Replacement fire occurs every 50yrs on average. In the absence of fire for 80yrs, vegetation will transition to class D. Otherwise, succession keeps vegetation in class C.

Class D **10%**

Late Development 1 Open

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☑ Tree

Fuel Model 2

Indicator Species* and Canopy Position

CONIFE	Upper
ARTRV	Mid-Upper
PUTR2	Mid-Upper
SYMPH	Low-Mid

Structure Data (for upper layer lifeform)

	Min	Max
Cover	10%	25%
Height	Tree 0m	Tree 10m
Tree Size Class	Sapling >4.5ft; <5"DBH	

☑ Upper layer lifeform differs from dominant lifeform.

Shrub cover generally decreasing but remains between 26-40% Conifers cover 10-25%.

Description

Conifers are the upper lifeform (juniper, pinyon-juniper, ponderosa pine, limber pine or white fir). Conifer cover is 11- 25%. Shrub cover generally less than mid-development classes, but remains between 26-40%. Herbaceous cover <30%. The mean FRI of replacement fire is 50yrs. Insects/diseases thin the sagebrush, but not the conifers, every 75yrs on average, without causing a transition to other classes. Succession is from C to D after 50yrs.

Class E **5%**

Late Development 2 Closed

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☑ Tree

Fuel Model 6

Indicator Species* and Canopy Position

CONIFE	Upper
ARTRV	Mid-Upper
PUTR2	Mid-Upper
SYMPH	Mid-Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	26%	80%
Height	Tree 0m	Tree 10m
Tree Size Class	Pole 5-9" DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Conifers are the dominant lifeform (juniper, pinyon-juniper, ponderosa pine, limber pine or white fir). Conifer cover ranges from 26-80% (pinyon-juniper 36-80% (Miller and Tausch 2000), juniper 26-40% (Miller and Rose 1999), white fir 26-80%). Shrub cover 0-20%. Herbaceous cover <20%. The mean FRI for replacement fire is longer than in previous states (75 yrs). Conifers are susceptible to insects/diseases that cause diebacks (transition to class D) every 75yrs on average.

Disturbances

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

Fire Regime Group:** IV

Historical Fire Size (acres)

Avg 100
Min 10
Max 10000

Sources of Fire Regime Data

- [x] Literature
- [ ] Local Data
- [x] Expert Estimate

Fire Intervals	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	49	15	100	0.02041	100
Mixed					
Surface					
All Fires	49			0.02043	

Fire Intervals (FI):

Fire interval is expressed in years for each fire severity class and for all types of fire combined (All Fires). Average FI is central tendency modeled. Minimum and maximum show the relative range of fire intervals, if known. Probability is the inverse of fire interval in years and is used in reference condition modeling. Percent of all fires is the percent of all fires in that severity class.

Additional Disturbances Modeled

- [x] Insects/Disease
- [ ] Wind/Weather/Stress
- [ ] Native Grazing
- [ ] Competition
- [ ] Other (optional 1)
- [ ] Other (optional 2)

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**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

Appendix 2

Assessing and Mapping Achievement Areas and Non-Achievement Areas for Land Health Standards on Allotments in the Burns BLM District: How Does Mapping of Fire Regime Condition Classes Correlate with Mapping Using Ecological Sites and Fine-Scale Data?

Introduction

Several methods for evaluating vegetation condition are currently employed by the BLM. The methods typically describe attributes related to the species composition, structure, abundance, and habitat quality of vegetation. Several methods are currently employed because there are management objectives that are somewhat unique to each of the several renewable resource and fire-fuel programs in BLM. Two of these methods are ecological sites and fire regime condition class (FRCC).

One focus of this handbook is to compare the use of ecological sites and FRCC, on the same pieces of ground, for the same objective. The objective is to map achievement areas and non-achievement areas for the Upland Soils Land Health Standard and the Ecological Processes Land Health Standard in Oregon. The same pieces of ground are the Skull Creek, Pine Creek, and Mountain allotments on the Burns BLM District in Oregon. The outcome sought is to interpret the degree of similarity—dissimilarity in the two methods for improved understanding of each method by the Renewable Resources and Fire-Fuel programs in BLM.

The interest in this comparison of ecological sites and FRCC began with a previously conducted (in FY 2005) pilot-test of improved reporting and mapping of Land Health Standard achievements/non-achievements in the Burns BLM District, funded out of the BLM Monitoring Strategy. The reporting and mapping results were presented to the Integrated Vegetation Management Handbook team members in early 2006. At that meeting, it was disclosed that ecological sites and ecological site inventory data were the primary methods by which Land Health Standard achievements and non-achievements were mapped in Burns for the upland soils and ecological processes Land Health Standards. Interest was expressed for the possibility of re-running the pilot-test, with the objective being to compare how the allotments would have been mapped if FRCC was used. This section of Chapter IV will explain the steps taken and the results of this example comparison.

FRCC Background

FRCC serves as a broad measure of ecological departure. FRCC is commonly applied to describe fire regime and vegetation conditions in the BLM's fire, fuels, and forestry programs. FRCC serves as an interagency performance measure for the fire and fuels program. Furthermore, it is a required element of Fire Management Plans, Resource Management Plans, and for projects under the authority of the Healthy Forests Restoration Act of 2003. More specifically, FRCC is a measure used to describe ecological departure through the variables of vegetation conditions and fire regime departure. In addition to variables such as urban locations, fire hazard, and fuel conditions, FRCC is another consideration used in fuels project development.

FRCC was conceptualized in the late 1990's to help describe underlying conditions leading to increasingly severe fire seasons. FRCC gained momentum in policy and from agency leadership, and in 2003 the first national map of FRCC was completed (Schmidt et al, 2002). With increasing interest in FRCC, an interagency working group was formed to assist field units in describing/calculating FRCC at a variety of scales. Tools currently available to FRCC users include a Version 1.2--May 2005 user's guide (Hann et al. 2005), software, GIS mapping tool, webpage, and helpdesk. Visit the FRCC webpage to print the user's guide, download software, or for further information (www.frcc.gov).

To improve upon the initial national FRCC mapping, the Rapid Assessment phase of LANDFIRE recently completed an updated national FRCC map. The intent for the application of this map is for state, regional, and national comparisons, not for any local or unit-level assessment. This GIS layer and the associated data are available at the LANDFIRE website at www.landfire.gov.

The concept of "reference conditions" is central to FRCC evaluation. Reference conditions represent the ecological processes and vegetation conditions for vegetation communities during a specific historic time period. By defining reference conditions, specialists can contrast current conditions against reference conditions to calculate ecological departure. For the purposes of FRCC evaluation, this reference period is prior to EuroAmerican settlement, and includes anthropogenic disturbances. FRCC reference conditions are comprised of the following:

(1) the proportion of seral stages, as characterized by dominate tree species, size and stand structural class, found on the landscape during the reference period;
(2) the historic fire frequency (years), describing the mean interval between fire events for a given vegetation type
(3) the historic fire severity (percent), which is the degree of replacement of the overstory canopy for a given vegetation type

Although these FRCC reference conditions may not match desired conditions, they are believed to adequately represent the landscape structures and disturbance processes of functioning, sustainable ecosystems. FRCC consists of 3 condition classes. Condition Class 1 vegetation communities have limited departure from reference conditions, and are with the natural range of variability. Condition Class 2 and 3 vegetation communities are defined as moderately and highly departed from reference conditions, respectively, and

are outside of the natural range of variability. FRCC can be applied at multiple scales, including landscapes, projects, and sites, provided that a landscape scale assessment has identified over- and under-represented seral stages for the landscape.

The steps involved in calculating FRCC are*:

(1) Define a large spatial scale analysis area. This is usually a watershed, such as a 5th code Hydrologic Unit, a large allotment, or other broad landscape stratification which defines an area of interest.
(2) Stratify the analysis area into Biophysical Settings (BpS). BpS's are units of vegetation comprised of aggregated, contiguous vegetation types that were believed to have existed historically, rather than existing vegetation types.
(3) Complete FRCC calculations to arrive at a condition class for each stratum, or subdivision of the landscape based upon BpS, found within the analysis area.
(4) Calculate site-level FRCC based upon the abundance or scarcity of seral stages, relative to reference conditions.

(* = more detailed instructions for FRCC analysis can be found in the FRCC user's guide)

In order to map FRCC across large spatial scale areas, a geospatial mapping tool has been developed. This mapping tool was used to analyze FRCC for the allotments in a geospatial environment. Reference conditions for the vegetation types found in the allotments were developed through Vegetation Dynamics Development Tool (VDDT) modeling. Generated reference values describe the historic seral stage proportions, fire frequency, and fire severity for each BpS. Historic seral stage proportions add up to 100% of the BpS area.

The following table illustrates reference values for a common BpS on BLM lands (the Wyoming Big Sagebrush BpS):

Wyoming Big Sagebrush BpS Reference Values			
Seral Stage	Percentage of Seral Stage in reference setting	Historic Fire Frequency	Historic Fire Severity
A: early seral, herbaceous dominated	20%	45 years	85%
B: shrub dominated, closed canopy	35%		
C: shrub dominated, open canopy	45%		

Land Health Standards Mapping Background

The BLM has Secretary of the Interior-signed Land Health Standards for nearly all of its BLM-administered lands—only the California Desert District in southern California

lacks Land Health Standards. BLM State Directors are responsible for developing state or regional Land Health Standards in consultation with affected Resource Advisory Councils. State Directors submit completed Land Health Standards to the Secretary of the Interior for Secretary approval. At the present time there are 77 Land Health Standards operative in the BLM, ranging from a minimum of 3 for the states of Arizona and New Mexico, to a maximum of 8 for the state of Idaho. Some states have more than one set of Land Health Standards if the state has more than one Resource Advisory Council area. In these cases, the approved Standards apply to the affected Resource Advisory Council area.

Land Health Standards are ecologically-based goal statements that conform with the Fundamentals of Rangeland Health found in 43 Code of Federal Regulations Subpart 4180, dated February 22, 1995. The Fundamentals of Rangeland Health are watershed function, ecological processes (for example nutrient cycling and energy flow), water quality, and habitat quality for special status species and native plant and animal populations and communities.

Land Health Standards were originally called Rangeland Health Standards but now apply not only to rangelands but all land types managed by BLM (BLM 1601 Handbook). Land Health Standards are to be incorporated in land use plans as goals, and indicators associated with each standard are recommended for use in developing measurable objectives (BLM 1601 Handbook).

BLM has been reporting annually on achievements and non-achievements in Land Health Standards since Fiscal Year 1998. Annual and cumulative data are hosted on the BLM National Science and Technology Center's website, http://www.blm.gov/nstc/rangeland/rangelandindex.html. In addition, some of the data are reported annually in BLM's Annual Report.

To date, acres achieving or non-achieving have been reported on an allotment basis, meaning that the entire allotment acreage has been reported as either achieving or non-achieving. If an allotment's acreage is reported as non-achieving, the allotment's acreage is also reported as to causal factor. The causal factors have been reported as either livestock grazing or other than livestock grazing. In many instances, portions of an allotment are achieving, whereas other portions are non-achieving, yet professional judgment is used to make the decision as to the entire allotment's acreage being reported as either achieving or non-achieving. This has created a situation of inadequate reporting of achievements and non-achievements, and for non-achievements, inadequate reporting of acres associated with causal factor. The inadequate data are used as a portion of two of AD-200's performance measures: 1) Upland Areas—Percent of acres achieving desired conditions where specified in management plans and condition is known, consistent with applicable substantive and procedural requirements of State and Federal water law; and 2) Percent of permitted acres maintained at appropriate land conditions and water and air standards.

Although reporting has been annual since Fiscal Year 1998, there is as yet no reporting format for Land Health Standards within BLM's Rangeland Health Standards Handbook

H-4180-1. The Handbook only contains a “reserved” section—a placeholder—for a future reporting format.

These problems were highlighted at a BLM Range Program State Lead—Inventory and Monitoring State Lead meeting held in January 2004 at the Utah State Office in Salt Lake City. Representatives from WO 220 (Rangeland, Soil, Water & Air Group) were in attendance also. Attendees agreed that a more accurate reporting of achievements and non-achievements in Land Health Standards was worth pursuing.

From 2004 to current, a set of reporting categories have been developed for Land Health Standard achievements and non-achievements, and for non-achievements the causal factor(s). Recommendations have also been developed for mapping polygons at a sub-allotment level for achievements and non-achievements that match the reporting categories. The reporting and mapping of Land Health Standards was pilot-tested in Oregon (Burns District), Colorado (Kremmling Field Office), and Utah (Grand Staircase-Escalante National Monument) in Fiscal Year 2005. In Fiscal Year 2006, pilot-tests are being conducted in Wyoming (Cody Field Office) and Arizona (Arizona Strip Field Office, Safford Field Office, and Sonoran Desert Monument).

Example: FRCC Assessment and Mapping and Land Health Standards Assessment and Mapping of 3 Burns BLM District Allotments

The Pine Creek, Mountain, and Skull Creek allotments were analyzed using the FRCC GIS mapping tool. Detailed guidance on the use of this tool is described in Chapter 4 of the FRCC user’s guide.

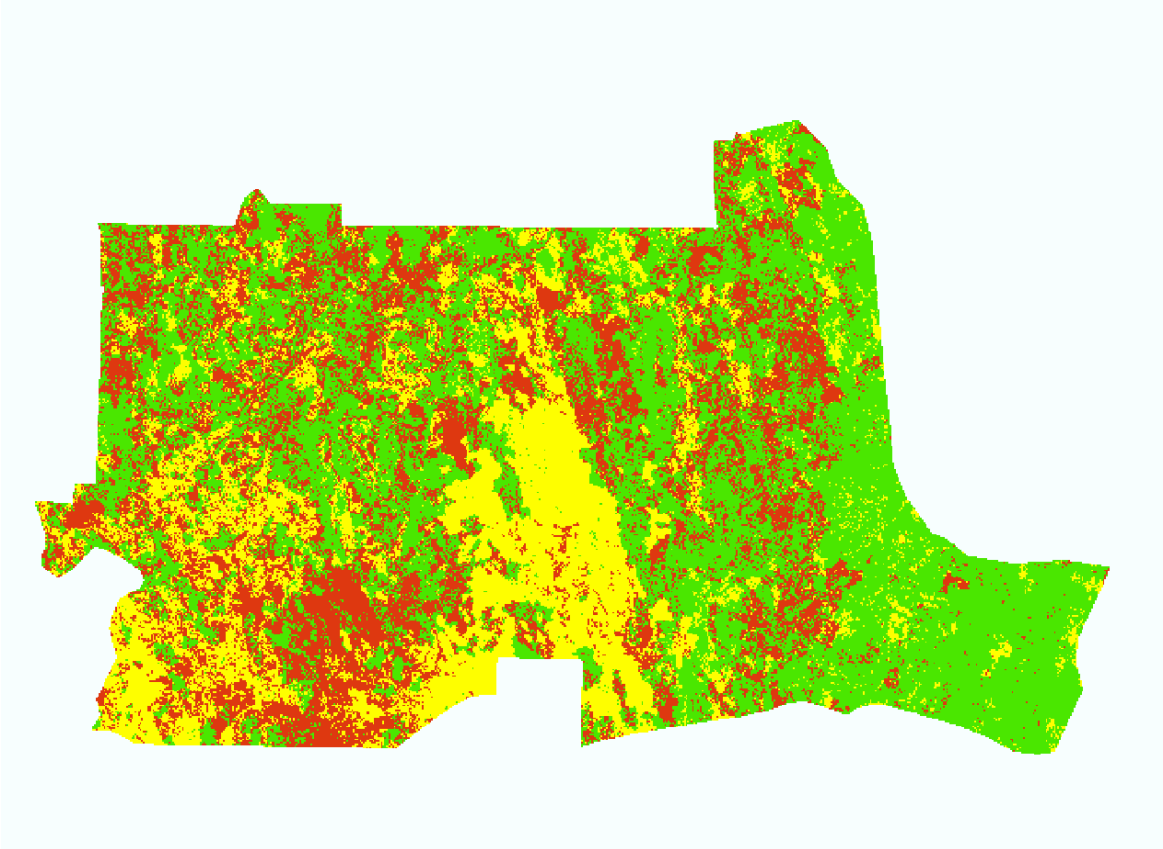
Two data layers are required as inputs for geospatial mapping of FRCC:

(1) An ARCgrid displaying historic vegetation, referred to as potential natural vegetation groups or BpS’s, and
(2) An ARCgrid displaying the current seral stage distribution, commonly called an S Class layer

These data are somewhat specialized, and are not commonly part of unit-level GIS libraries. These layers are currently available from the LANDFIRE Rapid Assessment, and will be available from the LANDFIRE National products in late 2006. For this analysis, the Rapid Assessment data layers were downloaded and clipped to the allotment boundaries. The three allotments were then analyzed in ARC GIS using the FRCC mapping tool.

Results of FRCC Assessment and Mapping

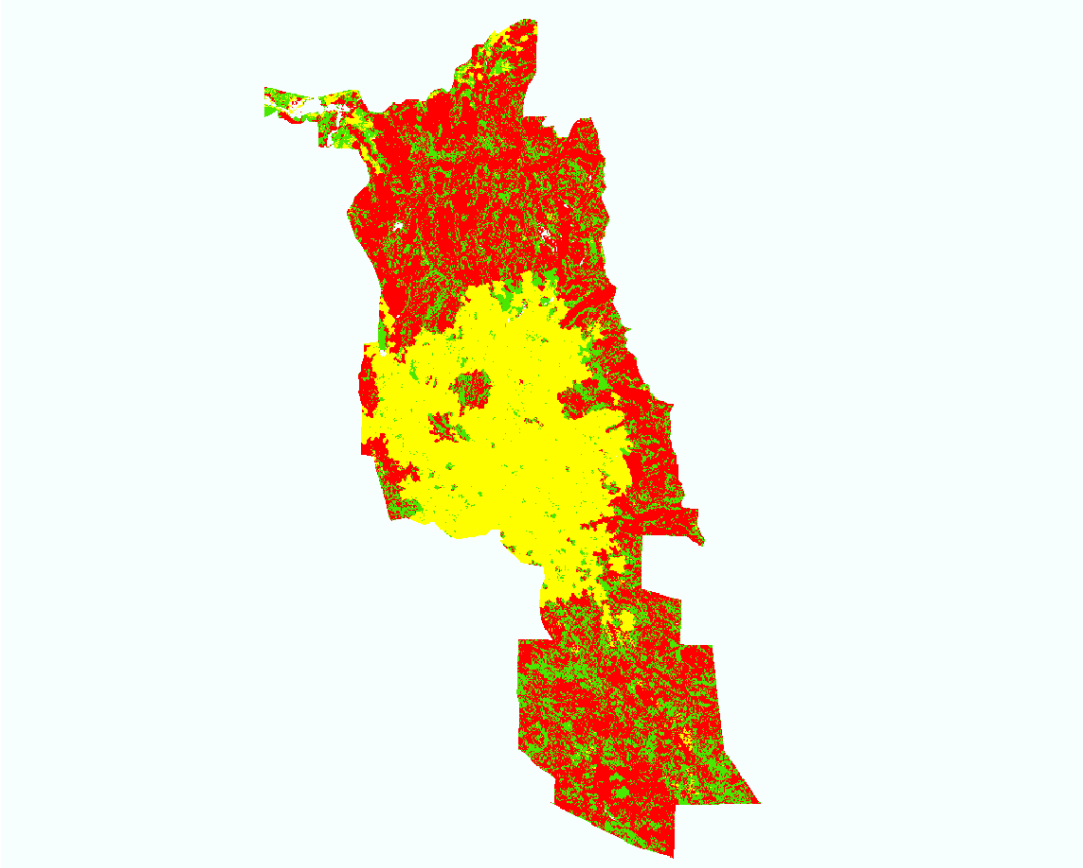
The findings from FRCC mapping can be interpreted at several scales. Condition Class can be described for entire landscapes, for the vegetation types making up landscapes, or for seral stages within vegetation types. In this analysis, condition class is presented two ways: (1) by vegetation type, called "strata"; and (2) at the local, seral stage scale, called "stand condition class". The following figures are GIS maps which display the stand condition class for the three allotments, and tables summarizing both stand and strata condition class.



Insert legend
Green = CC1
Yellow = CC2
Red = CC3

Figure 1. Stand-level FRCC for the Mountain Allotment

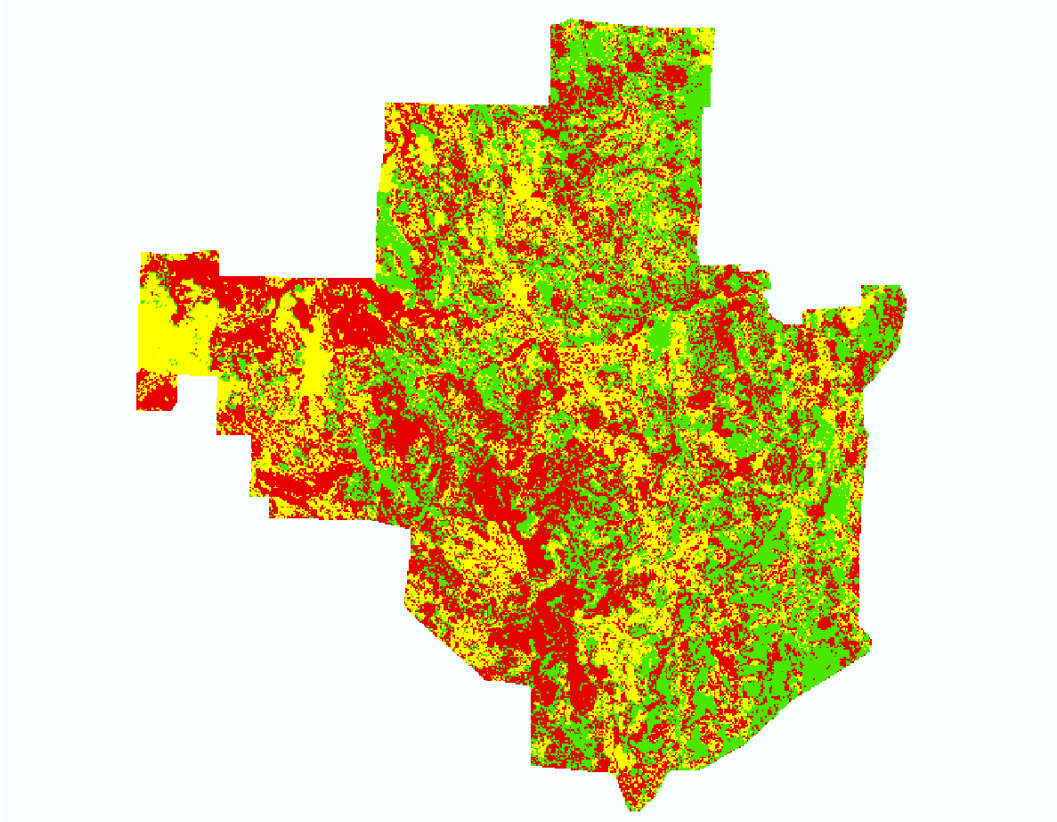
Mountain Allotment	
Strata Condition Class (acres)	Stand Condition Class (acres)
CC1 = 31,473	CC1 = 17,852 (48%)
CC2 = 6,023	CC2 = 8,856 (24%)
CC3 = 10	CC3 = 10,788 (28%)
	Sum = 37,496



Insert legend
Green = CC1
Yellow = CC2
Green = CC3

Figure 2. Stand-level FRCC for the Skull Creek Allotment

Skull Creek Allotment	
Strata Condition Class (acres)	Stand Condition Class (acres)
CC1 = 551	CC1 = 8,658 (23%)
CC2 = 20,308	CC2 = 11,549 (30%)
CC3 = 17,038	CC3 = 17,690 (47%)
	Sum = 37,897



Insert legend
Green = CC1
Yellow = CC2
Red = CC3

Figure 3. Stand-level FRCC for the Pine Creek Allotment

Pine Creek Allotment	
Strata Condition Class (acres)	Stand Condition Class (acres)
CC1 = 32,086	CC1 = 10,006 (31%)
CC2 = 52	CC2 = 8,970 (28%)
CC3 = 126	CC3 = 12,835 (41%)
	Sum = 31,811

The results of this example are influenced by several factors related to the spatial scale and resolution (grain) of the input data. The input data layers are from national-scale grids, and were not corrected by Burns BLM District staff with knowledge of site conditions. For example, areas within the allotments which have localized effects due to grazing or exotic species would not be detected using the national data due to the resolution of the data (pixel size). These conditions would more likely be detected using ecological sites, ecological site inventory data, qualitative data from the Interpreting

Indicators of Rangeland Health assessment, and other site-specific inventory and monitoring data, associated with a Land Health Standard assessment.

An additional problem with the input data was mis-mapped biophysical settings. For example, a ponderosa pine biophysical setting was assigned to portions of the allotments which resource specialists felt should be classified as mountain sagebrush or western juniper. Because of this, the current conditions were compared to the inaccurate reference conditions, which would skew the results.

Results of Land Health Standards Assessment and Mapping

Mapped polygons of achievements and non-achievements for the upland soils and ecological processes Land Health Standards for the Skull Creek Allotment are shown in Figures 4 and 5.

Figure 4. Upland Soils Land Health Standard mapping for Skull Creek Allotment.

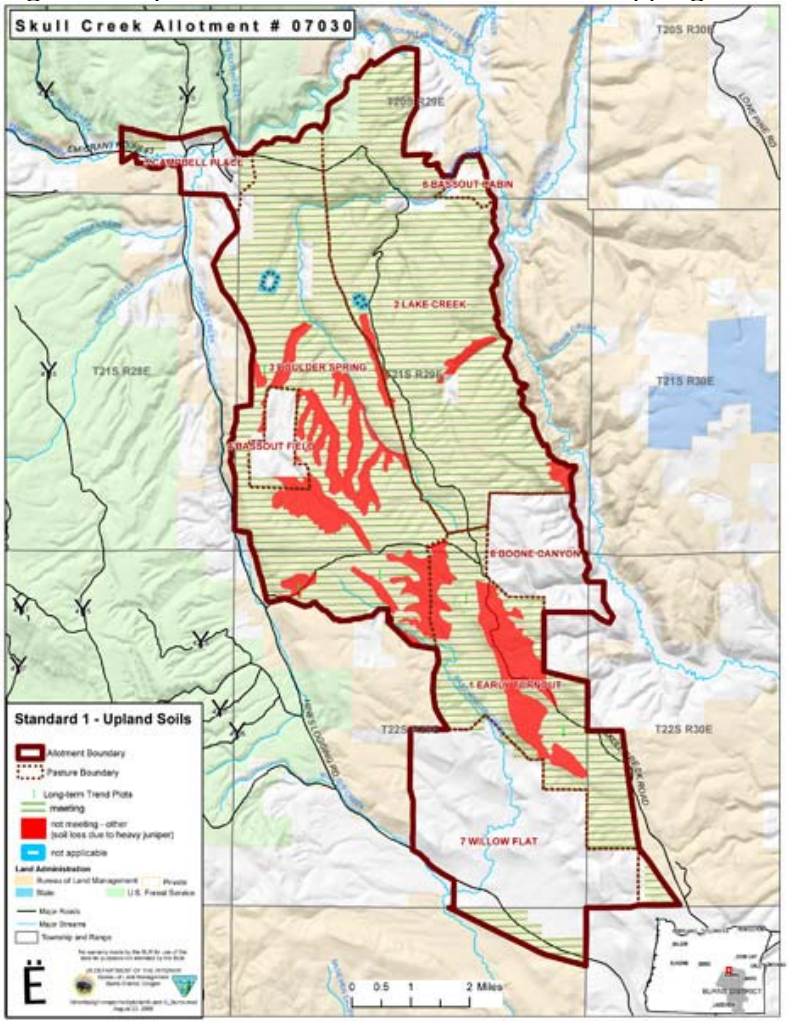


Figure 5. Ecological Processes Land Health Standard mapping for Skull Creek Allotment.

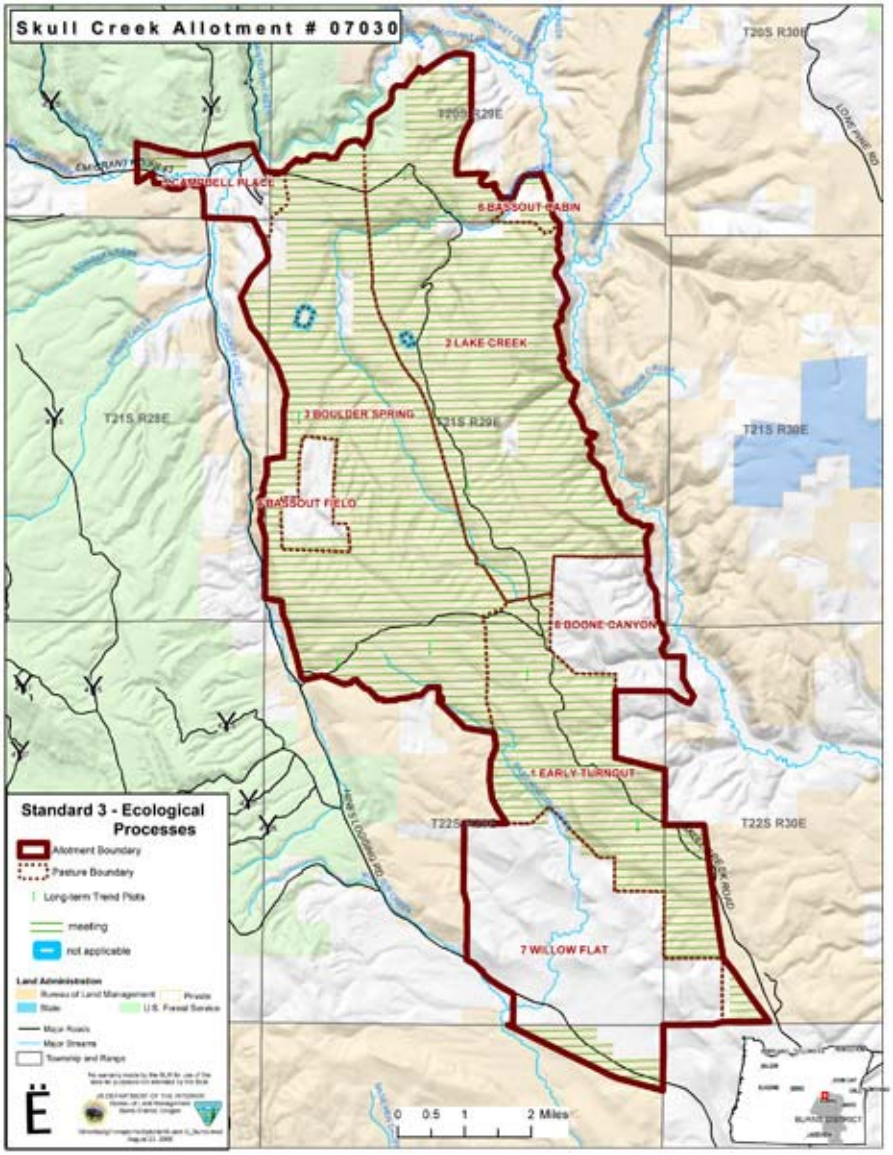


Table 1 shows the acreage associated with the mapped polygons of Skull Creek Allotment in Figures 4 and 5.

	Upland Soils Standard	Ecological Processes Standard
Achieving	23,412	27,524
Non-Achieving	4,112	0
Standard Does Not Apply	51	51
Total BLM-administered acreage	27,575	27,575

The 4,112 acres of non-achieving for the upland soils Standard was attributable to western juniper (see red-colored polygons in Figure 4). Where western juniper exceeded 10% foliar cover, soil movement was detected. Ecological site descriptions for the allotment area contained foliar cover data.

No polygons were mapped for non-achievement for the ecological processes Standard. If the livestock grazing system was a rest-rotation system, and trend plots showed an upward or static trend, then areas were considered to be achieving.

Mapped polygons of achievements and non-achievements for the upland soils and ecological processes Land Health Standards for the Pine Creek Allotment are shown in Figures 6 and 7.

Figure 6. Upland Soils Land Health Standard mapping for Pine Creek Allotment.

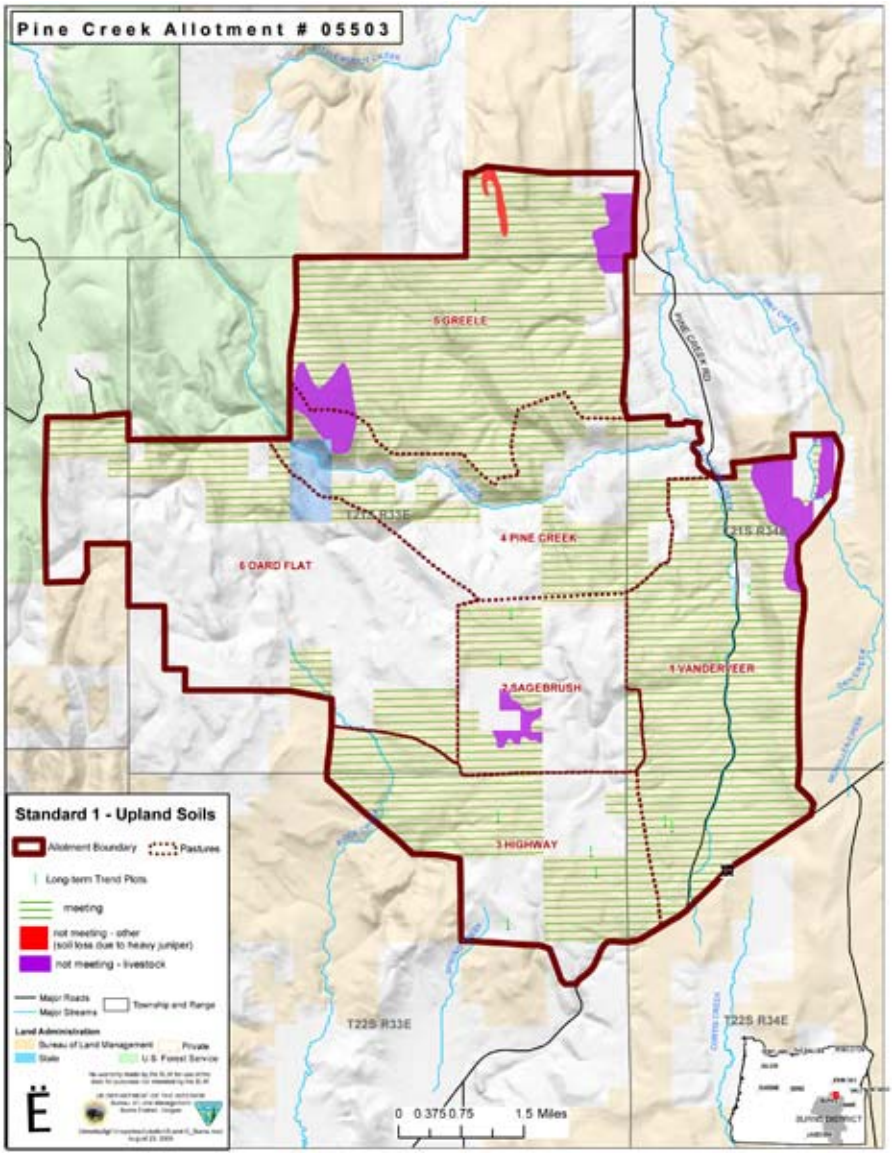


Figure 7. Ecological Processes Land Health Standard mapping for Pine Creek Allotment.

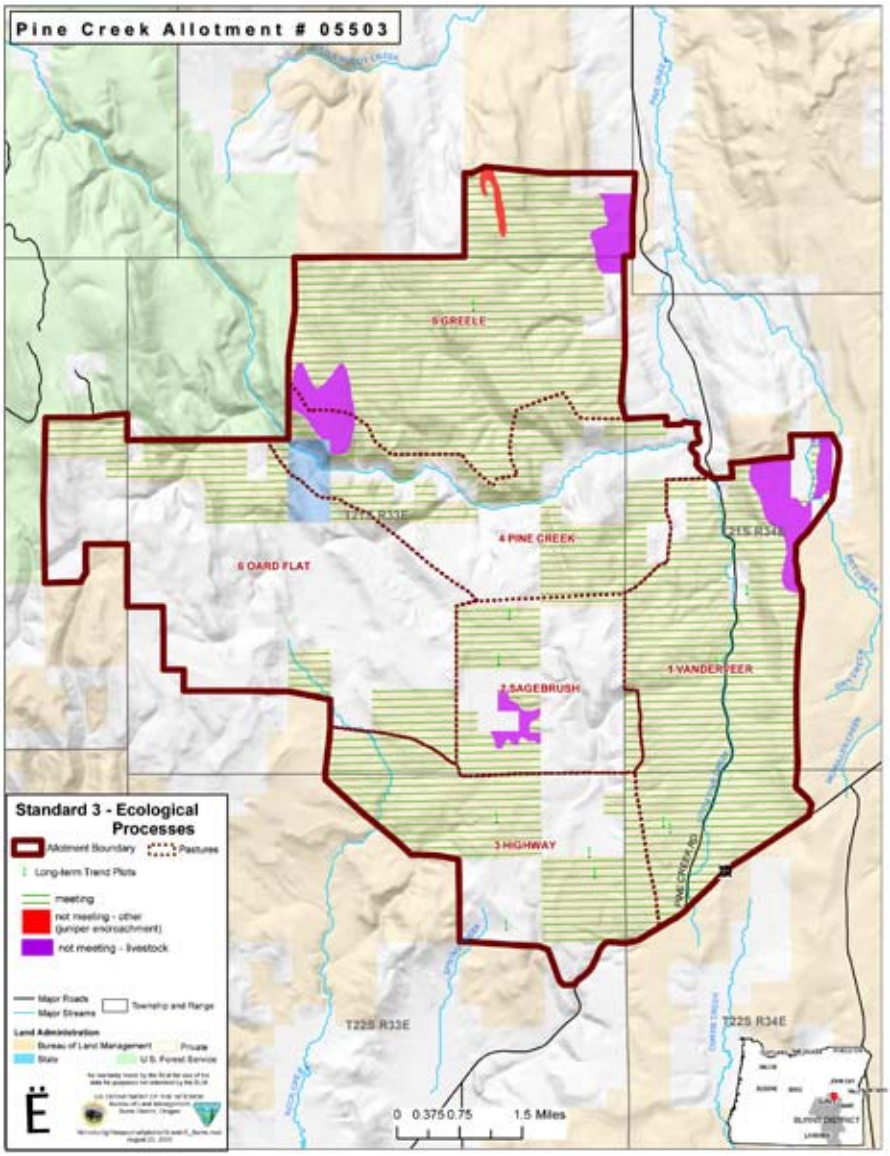


Table 2 shows the acreage associated with the mapped polygons of Pine Creek Allotment in Figures 6 and 7.

	Upland Soils Standard	Ecological Processes Standard
Achieving	19,045	19,045
Non-Achieving	1,147	1,147
Standard Does Not Apply	0	0
Total BLM-administered acreage	20,192	20,192

The 1,147 acres of non-achieving for the upland soils Standard was attributable to either western juniper or livestock grazing. Of the 1,147 acres, 53 acres (see red-colored polygon in Figure 6) was attributable to western juniper foliar cover exceeding 10% and contributing to soil movement. The remaining non-achieving acres (see purple-colored polygons in Figure 6) were attributable to bare ground increase exceeding 30% of the soil surface, caused by excessive livestock grazing pressure.

The same 1,147 acres were found to be non-achieving for the ecological processes Standard. Mapped polygons of non-achievement (see red and purple-colored polygons in Figure 7) were exactly the same as for the upland soils Standard and were ascribed to the same causes as for the upland soils Standard.

Mapped polygons of achievements and non-achievements for the upland soils and ecological processes Land Health Standards for the Mountain Allotment are shown in Figures 8 and 9.

Figure 8. Upland Soils Land Health Standard mapping for Mountain Allotment.

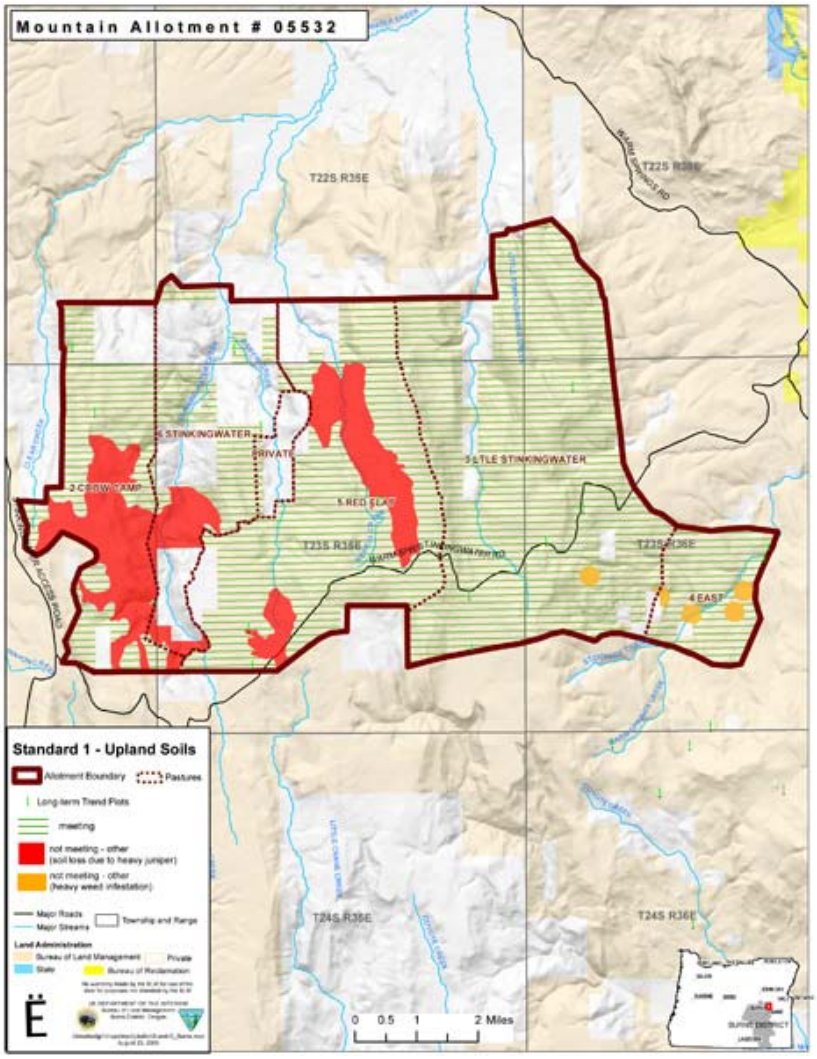


Figure 9. Ecological Processes Land Health Standard mapping for Mountain Allotment.

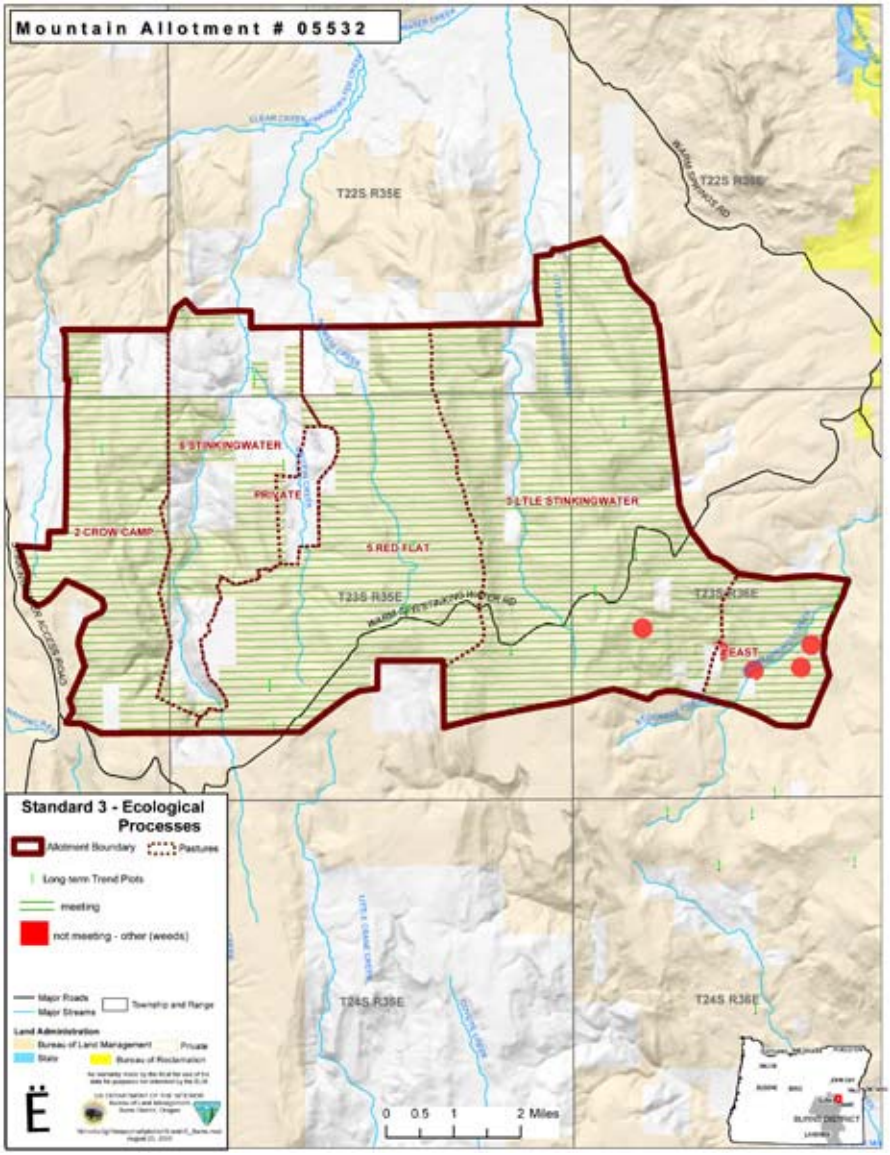


Table 3 shows the acreage associated with the mapped polygons of Mountain Allotment in Figures 8 and 9.

	Upland Soils Standard	Ecological Processes Standard
Achieving	26,242	30,750
Non-Achieving	4,688	180
Standard Does Not Apply	0	0
Total BLM-administered acreage	30,930	30,930

The 4,688 acres of non-achievement for the upland soils Standard were attributable to western juniper and medusahead (see red and orange-colored polygons in Figure 8). About 4,500 acres of the 4,688 acres were non-achieving because of western juniper. The remaining non-achieving acres were attributable to medusahead. Western juniper foliar cover exceeding 10% was contributing to soil movement. Medusahead mono-specific stands were contributing to excessive litter build-up of litter that does not decay as rapidly as litter from native species. Declines in soil quality were believed to be occurring because of the excessive litter and the lack of soil profile occupancy by roots of various native species.

The 180 acres of non-achievement for the ecological processes Standard were attributable to medusahead (see red-colored circle polygons in Figure 9). Medusahead mono-specific stands of large spatial extent were mapped as non-achieving because very few other plant species native to the ecological sites were present and the ecological processes of energy flow and nutrient cycling were degraded.

References

Hann, Wendel J., et al. 2005. Interagency Fire Regime Condition Class Guidebook, version 1.2. 76 p.

Schmidt, Kirsten M.; Menakis, James P.; Hardy, Colin C.; Hann, Wendell J.; Bunnell, David L. 2002. Development of coarse-scale data for wildland fire and fuel management. Gen Tech. Rep. RMRS-GTR-87. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 41 p.

United States Department of the Interior

OFFICE OF THE ASSISTANT SECRETARY
POLICY, MANAGEMENT AND BUDGET
Washington, D.C. 20240

APR - 2 2003

Memorandum

To: Bureau Directors

From: Assistant Secretary – Policy, Management and Budget

Subject: Forest Health Guidance – Reducing the Risks of Insects and Disease Mortality

Continued drought in the Interior West, coupled with high hazardous fuel loads and insect and disease outbreaks, have created forest and woodland health problems requiring prompt actions. The President's Healthy Forests Initiative and recent Congressional Hearings have drawn national attention to this forest and woodland health issue. Follow-up questions to the March 13th Senate Energy and Natural Resources National Fire Plan hearings prompted a data call on insect and disease outbreaks over 300 acres on Department of the Interior managed lands. The list was extensive and broad in scope, indicating forest and woodland health is in decline and the risk of increased severe fire activity is increasing.

Timely, active management is needed to remove diseased and infested trees. Bureau Directors should consider preventative measures to reduce the risk of creating or exacerbating insect or disease outbreaks. Several data sources are available to provide technical knowledge about pathogen life cycles and opportunities to suppress or prevent further problems. The attached ***Guidelines for Reducing the Impacts of Bark Beetles and Other Forest Insects and Diseases***, prepared by the Bureau of Land Management's Forest and Woodland Management Group, lists a number of these sources of information. The ***Guidelines*** also provide sound advice on actions which field managers can take for prevention, suppression or restoration of insect and disease epidemics.

Insect and disease surveys and biological assessments can be conducted by the Forest Service at the request of Federal and state agencies, local governments, and Tribes. Funding is also available for treatment through the Forest Pest Management program in coordination with the Forest Service. For further information on this program, please contact Rick Tholen, DOI Forest Pest Management Committee leader, at (208) 373-4049, or for information on biomass utilization or forest health contact John Stewart, Office of Wildland Fire Coordination, at (202) 606-0504.

Attachment
Guidelines for Reducing the Impacts of Bark Beetles and Other Forest Insects and Diseases

Attachment 1

Department of the Interior
Guidelines for Reducing the Impacts of
Bark Beetles and Other Forest Insects and Diseases
March 31, 2003

The following general principles and practices should be incorporated into all forest and woodland management activities, including hazardous fuels reduction, to ensure that appropriate steps are taken to reduce the impacts of bark beetles, and other forest insects and diseases. Most of these guidelines are referenced from the USDA Forest service Forest health protections web site, http://www.fs.fed.us/foresthealth/ . It is also suggested that managers consult with local insect and disease experts and universities when planning vegetative treatments.

1) Limit attracting bark beetles to areas where forest and woodland vegetation is being manipulated.

- Minimal damage to residual trees is necessary to prevent bark beetles from being attracted to pheromones produced by trees when they are injured or damaged. During management activities, plan activities to prevent damage or injury to trees that will remain after the treatment is completed. If possible, remove damaged trees before they attract bark beetles, particularly around high resource value areas such as campgrounds, structures and critical habitats.
- Some types of bark beetles infest green slash in the spring. Avoid creating treatment residue during the late winter and early spring months (January through June) where possible. Consult your local entomologist if unsure of the bark beetle's life cycle.
- Treat residue materials left following vegetation manipulation, either by removing it from the forest, burning on site or in offsite piles, or chipping on site. Piles may also be covered with black plastic where sunlight causes temperatures to exceed 180 degrees Fahrenheit, which kills bark beetle larvae. Residue treatment should occur prior to the next beetle flight (see specific bark beetle life histories at www.na.fs.fed.us/spfo/pubs/fth_pub_pages/fidl.htm).
- Wind-thrown, snow or wind damage trees should be inventoried and treated before the next spring beetle flight to avoid the spread of insects into adjacent areas.

2) Create stand conditions that improve tree vigor so they have a better opportunity to repel bark beetles when they do attack.

- Thin stands to a density or basal area that provides an optimal amount of moisture, sunlight, and nutrients to the trees, while still meeting other management objectives. Recommended stand densities for specific forest types (tree species, size class, habitat type) can be obtained from most foresters, forest entomologists, or in forest health publications (See literature at www.fs.fed.us/foresthealth/publications.html)

Prepared by Rick Tholen, BLM Forest Health Program Manager

Guidelines for Reducing the Impacts of Bark Beetles and Other Forest Insects and Diseases

- When thinning forest stands, remove trees that show signs of having been successfully attacked by bark beetles (See literature to identify bark beetle attacks).
- When thinning stands, leave trees that appear to be healthy and vigorous by observing their crown, foliage, and bole characteristics.
- Birds and insects are natural predators to bark beetles. Leave an adequate number of large or medium sized standing dead trees (snags) and down logs that provide habitat to these predators. A limited number of large dead trees or down logs typically do not contribute greatly to the wildfire risk. Avoid compacting soils when treating forest stands. Compacted soils do not release moisture and nutrients as readily as non-compacted soils; compaction negatively affects tree vigor and makes trees more prone to successful bark beetle attack.
- Avoid compacting soils when treating forest stands. Compacted soils do not release moisture and nutrients as readily as non-compacted soils; compaction negatively affects tree vigor and makes trees more prone to successful bark beetle attack.
- In some tree species, such as lodgepole pine, bark beetles are attracted to trees of a certain diameter (cambium thickness), and are an inevitable part of the renewal cycle for these forests. Management strategies should focus on creating a mosaic of age classes that will reduce the extent of damage by any particular bark beetle attack and also reduce the potential for large catastrophic fires, rather than strictly reducing tree spacing.

3) Be aware of forest diseases and parasites in your area and leave trees that reduce the likelihood of disease or parasite spread. As with forest insects, forest diseases and parasites require strategic long-term management prescriptions to successfully manage and treat problem areas.

- Mistletoe infested forest stands have been shown to provide a much greater risk of crown fire than those that are mistletoe free. It also alters tree growth and vigor and in some markets may affect the value. When thinning, select against trees exhibiting mistletoe infections.
- Blister rust is an exotic disease that infects most 5-needle pines, such as western white pine, whitebark pine and limber pine. As with mistletoe, select against trees exhibiting blister rust cankers during thinning.
- Annosus root disease affects most western conifer species, and predisposes them to bark beetle attack, or can kill the tree outright. It is spread through spores that typically enter a stand by landing on tree stumps and moving through interconnected root systems. When thinning trees in areas where annosus root rot is present, it is very important that freshly cut stumps 8 inches in diameter and larger are treated with a borate solution to prevent infection. (Refer to www.fs.fed.us/r6/nr/fid/fidls/annosus.pdf for additional information)

4) Monitor bark beetle and other forest insects and disease activities to determine where risks are greatest and tree mortality will likely jeopardize land management objectives.

The Department of the Interior (DOI) has a Pest Control Agreement with the Department of Agriculture to provide funding and services to manage forest pests.

Prepared by Rick Tholen, BLM Forest Health Program Manager

Under this Agreement the Forest Service is responsible, among other things, for:

- Providing and financing overall leadership and coordination for insect and disease control on all forest lands when the activities are financed with Federal funds;
- Providing and financing technical assistance for control projects on DOI managed lands;
- Performing and financing detection surveys and entomological or pathological evaluations of insect and disease outbreaks on DOI managed lands;
- Cooperating with DOI agencies in suppressing insect and disease outbreaks on DOI managed lands, and;
- Training key DOI employees in techniques for prevention, detection, and suppression of destructive forest insects and diseases.

DOI bureaus are responsible, among other things, for:

- Facilitating detection surveys and evaluations on DOI managed lands;
- Deciding for or against control action on DOI managed lands;
- Performing and financing supplemental field surveillance;
- Conducting and financing suppression projects on DOI managed lands, and;
- Cooperating with other agencies in insect and disease control programs and projects on other ownerships that involve DOI managed lands.

Mr. Rick Tholen coordinates BLM's Forest Health Program and chairs the DOI committee responsible for coordinating activities under the DOI and Department of Agriculture pest control agreement. Questions or concerns relative to forest insect or disease outbreaks, including bark beetles, and the interdepartmental agreement should be addressed to Mr. Tholen via email at rtholen@blm.gov or by telephone at (208) 373-4049.

BUREAU OF LAND MANAGEMENT
TECHNICAL PROTOCOL
FOR THE COLLECTION, STUDY, AND CONSERVATION OF SEEDS FROM NATIVE PLANT SPECIES

for

SEEDS OF SUCCESS

(Updated January 4, 2008)

Table of Contents

1. Introduction

This protocol outlines the procedures for making seed collections for *Seeds of Success*, part of the National Native Plant Materials Development and Conservation Program. The purpose of the *Seeds of Success* program in the United States is to establish a high quality, accurately identified and well documented native species seed collection at the population level. All seed collections made following this protocol can be used to support development of geographically appropriate native plant materials for restoration and emergency fire rehabilitation. Each seed collection should comprise of a significant representation of the genetic variation within the sampled population. The collections act as a basis for off site (*ex situ*) conservation and, where and when appropriate, can be used for study and multiplication in the native plant materials development program for restoration purposes.

The Bureau of Land Management and Royal Botanic Gardens, Kew's Millennium Seed Bank (http://www.rbgkew.org.uk/msbp/) are participating in the *Seeds of Success* (SOS) program under the terms of a cooperative agreement signed by both parties in May 2000 with renewed agreement signed in November 2005. Since the original signing of the Seeds of Success agreement between BLM and RBG, Kew in 2001, SOS has grown to include: Chicago Botanic Garden; Lady Bird Johnson Wildflower Center; New England Wild Flower Society and New York Department of Parks and Recreation, Greenbelt Native Plant Center; North Carolina Botanic Garden; and the Zoological Society of San Diego. This group is collectively referred to as the SOS Partners. SOS Partners have agreed to collect seeds for the program and grant access to the lands they manage for collection; grant prior informed consent to RBG, Kew for study and long term storage of seeds collected under the program; send the first collection of a species, vouchers and field data to RBG, Kew for processing; and send an itemized species list in the ***Notification of Transfer*** (***Appendix 3***) with seeds and herbarium voucher specimens. RBG, Kew agreed to clean, process, test, develop germination protocols, and store all seed sent by BLM and perform some or most of these duties for all the SOS Partners; send half of each collection to the US for long term storage; provide the results of all testing to the collecting partners and the SOS National Coordinating Office; fund a fixed term coordinator position in BLM-National Coordinating Office to develop the collection program; and provide training and advice during the program.

The goal of SOS is to provide wild collected seeds to researchers for common garden studies and other native plant materials development projects. Estimates have shown that between ten and twenty collections of a single species, across its range, are needed to develop genetically appropriate ecotypes. Because only one sample of each species, regardless of variety or subspecies, can be sent to RBG, Kew, additional processing and storage partnerships have been formed to achieve the program's goal of native plant materials development. Additional collections of species can be collected throughout their range by any collecting group and used as part of the National Native Plant Materials Development and Conservation Program. Since 2003, BLM has been cooperating with the US Forest Service Seed Extractory in Bend, Oregon for cleaning and storing restoration seed collected by BLM Field or State Offices that are also sending seed to Kew. Procedures for storing additional collections made by SOS Partners of species already stored at RBG, Kew are being developed, however all collection data for such species will be sent to the SOS National Coordinating Office regardless of storage facility.

2. Training, Resources, and Annual Reporting

2a. Training

The training course, "Seed Collection for Restoration and Conservation" is offered multiple times a year in various parts of the country. Before starting an SOS team, or making SOS collections, it is highly recommended that at least one lead botanist (all team members are welcome) participate in the training course. If you are founding a SOS team and need to train a collection team, contact the National Coordinating Office because additional courses can be added as needed to the schedule posted on the SOS website.

2b. Resources

On the first Tuesday of every month, collectors are invited to participate in the Collectors' Call, a conference call for all SOS collectors. This is a forum for discussion with other collectors and raising issues and questions for the National Coordinating Office who will relay specific questions to RBG, Kew and Bend Seed Extractory if necessary. The conference call number cannot be posted on the website, so contact the National Coordinating Office for details and to submit agenda items. Reminders, cancellations, and agendas will be posted to the SOS listserv.

Collectors' Call Time:
11 am – EST
10 am – CST
9 am – MST
8 am – PST
7 am – AKST

Additional resources can be found on the SOS website for packaging and shipping, listserv subscriptions, and promotional material.

2c. Annual Reporting

Each collecting team should complete the annual report template circulated at the end of the collecting season (late December). The team's annual report should summarizing the collecting season, collections, difficulties and highlights, as well as improvements to be made for the upcoming year and submitted to the SOS National Coordinating Office.

3. Target Species

The focus of *Seeds of Success* is on collecting species needed for emergency fire rehabilitation and restoration. In the U.S., the Center for Plant Conservation collects and stores the seeds of rare, threatened and endangered plant species; and the National Center for Genetic Resources Preservation in Fort Collins, Colorado stores many accessions of crop relatives. Both of these organizations are cooperating with the *Seeds of Success* program.

Seeds of Success manages target species information on a website hosted by the *Plant Conservation Alliance* (PCA) at http://www.nps.gov/plants/sos. As ecoregional lists of species are obtained, they are made accessible on the web to assist collectors in choosing target species. Information on target species assigned to collecting groups is also available on the web. These targeting lists track which SOS collecting group is assigned the one collection sent to RBG, Kew Millennium Seed Bank.

4. Storage and Distribution

Species can only be collected once for the Millennium Seed Bank. Collections sent to RBG, Kew's Millennium Seed Bank, are cleaned, tested for germination and divided in half. Half of each collection stays in long term conservation storage at the Millennium Seed Bank and half is returned to the U.S. For BLM collections, long-term and working collection needs are being met by the U.S. Department of Agriculture, Agricultural Research Service. The National Center for Genetic Resources Preservation in Fort Collins, Colorado is managing long-term collections, and the USDA-ARS National Plant Germplasm System is maintaining working collections for distribution to researchers for native plant materials development. Species currently available can be found at http://www.ars-grin.gov. An accepted formal collections management strategy, which will include all SOS Partner collections, will be written and added to the protocol in early 2008.

5. Identifying Priority Species to Collect

The collecting focus of this program is on species needed for emergency fire rehabilitation and restoration. Initial target species lists were determined at the ecoregion level by BLM, PCA and RBG, Kew after consultation with field office staff; the Society for Ecological Restoration International; State Heritage Program botanists; non-profit organizations including The Nature Conservancy and state native plant societies; university botanists and ecologists; and researchers from botanic gardens that are members of the Center for Plant Conservation network. See ***Section 7. Requesting Species for Collection*** for information on how to make additions or changes to the lists.

The SOS priorities have expanded to include species need in a variety of restoration and rehabilitation projects. Collecting teams are encouraged to work with local federal land managers to develop and execute priority lists. Projects may include emergency fire

rehabilitation and restoration, water way stabilization, landfill and corporate land recovery, wildlife habitat, threatened and endangered species habitat, and roadside revegetation.

Seeds of Success currently uses the ecoregions outlined by The Nature Conservancy. In early 2008, the program will begin using the Omernick Level III Ecoregions.

6. Species Excluded from this Program

The collecting focus of the SOS program is on species needed for emergency fire rehabilitation and restoration of federal lands and for native plant materials development in United States, and conservation of widespread native species. The species that will be excluded from *Seeds of Success* include:

- Any native plant species listed as Threatened or Endangered, under the Endangered Species Act
- Any Candidate, or any species Proposed for listing, under the *Endangered Species Act*
- Any species listed as G1 or G2 by a State Heritage Program
- Any species listed as S1 or S2 by a State Heritage Program will not be collected in the state listing it as S1 or S2.
- Any species designated as a BLM State Director Sensitive Species that have been ranked G3 or S3 by a State Heritage Program and is included in the CPC network collection. (See ***Appendix 1***) BLM Field Office Botanists should carefully coordinate with the CPC Garden that collects in their region to make sure that G3 and S3 species are not overlooked in the collection by both groups, or are not inadvertently collected by both groups
- Any species included in Appendix I of the *Convention in the Trade of Endangered Species* (CITES)
- Any non native invasive weed species
- Any agricultural or food crop species that may be growing on BLM lands
- All species in the genus *Quercus*
- All species in the genus *Vitis*
- All known recalcitrant seeds

7. Requesting Species for Collection

Seeds of Success is a large national program with partners from many different groups including the BLM with twenty or more collecting teams, Lady Bird Johnson Wildflower Center, Chicago Botanic Garden, New York Department of Parks and Recreation's Greenbelt Native Plant Center, New England Wild Flower Society, North Carolina Botanical Garden, and the Zoological Society of San Diego. In the first year of the program there were 23 different teams in the United States collecting species for *Seeds of Success*. Because RBG, Kew would like to minimize costs from duplication of species sent to the Millennium Seed Bank, **all collectors,** including BLM and SOS Partners, should coordinate with the SOS National Collections Data Manager for tracking species' assignments. This is best done via e-mail to mary_byrne@blm.gov.

Single species collections sent to the Millennium Seed Bank (MSB) at Royal Botanic Gardens, Kew are the first of 20 collections needed for researchers to develop seed transfer zones for restoration species. Each team should be working from a regional restoration target list. Regional restoration target lists should be compiled with federal land managers, native plant materials development and conservation researchers, and any other native plant stakeholders.

The *Seeds of Success* website has a searchable database of the species in need of collecting and accessions recorded (current inventory) available on the website (http://www.nps.gov/plants/sos). Use the website before requesting species to make sure the species is not already assigned or collected. Contact Mary to request a subset of data, which can aid in compiling a unique target list and building on existing collections. Teams may make multiple collections of species on their restoration target list, but not specifically assigned to them for shipment to MSB, so long as they are capturing unique populations in each collection (accession). Species should not be collected if listed as G1, G2, or S1, S2 in the state in which they are being targeted.

Requests to collect species should be sent in the form of an Excel spreadsheet. Column **A** is used by the national coordinator to identify the collecting group assigned. Columns **B**, **C**, **D**, and **E** represent the taxonomic family, genus, specific epithet (species), and subspecies or variety respectively. Column **F** is the NRCS PLANTS database symbol and column **G** is a common name for the plant.

Each species may be marked in as many ecoregions as it has been identified in and this information will be included in the data accessible on the *Seeds of Success* website (http://www.nps.gov/plants/sos/species).

**Collectors are assigned all occurrences of the requested species in the database, regardless of variety or subspecies.

Species requests are assigned to collecting teams in the order in which the requests are received. If a collecting team does not collect all of the species assigned to them by the end of the collecting year, the species will remain on the collector's list until it is collected or traded to another collector. Collectors interested in collecting a species on another collector's list should initiate the swap by contacting the assigned collector and when the exchange is finalized, forward Mary the other team's confirmation e-mail.

8. Permission to Collect

Collecting seeds on public land managed by the Bureau of Land Management is categorically excluded in NEPA. Department of the Interior (DOI) 516 Manual is the official guidance for determining the level of NEPA required. BLM's CX list is incorporated into the DOI NEPA manual at 516 DM 6, Appendix 5, Section 5.4 (effective 5/19/92). In the Forestry program section of the BLM Categorical Exclusion list there are five categorical exclusions. The fifth one applies to seed collection as follows: *(5) Disposal of small amounts of miscellaneous vegetation*

*products outside established harvest areas, such as Christmas trees, wildings, floral products (ferns, boughs, etc.), cones, **seeds**, and personal use firewood.*

BLM may give permission to other volunteer groups to collect for the *Seeds of Success* program on BLM managed lands, however, when these volunteers collect for BLM, a BLM employee must sign the ***Notification of Transfer*** as part of the shipping documentation for all species collected under the cooperative agreement between BLM and Royal Botanic Gardens, Kew. To comply with DOI privacy standards, individuals acting in a personal capacity may not be listed as a collector on the data form. Team leads should be listed when no other collector names are available.

Notification of Transfer is not needed when shipping material domestically; non-BLM SOS teams working on BLM public land should still work with their local field or district office on targeting species and notify BLM that collections are taking place.

Collection may take place on private lands or lands managed by another federal agency (Fish and Wildlife Service, US Forest Service, and Department of Defense) or a state agency, with landowner permission. Document landowner permission on the field data form associated with the seed collection. Keep written documentation of permission to collect in your office's files when collections are made on lands other than those managed by BLM.

Collecting is NOT permitted on National Park Service land.

9. Targeting the Population(s) for Collection

It is essential that a knowledgeable botanist familiar with the target species leads the collection and is involved in identifying the most suitable population(s) for sampling. Choosing target populations will be up to the lead botanists and plant ecologists working at the field office level in BLM and at other collecting partner institutions. An "ideal" collection will be from a large number of individuals (between 100 and 500) and will contain more than 10,000 viable seeds. Collections larger than 20,000 viable seeds are preferred; collections this large maximize the flexibility of the collection and allow for a portion of the collection be held at a second seed bank. Maximizing the use of the collection means that:

- Sufficient seed is available for germination and viability testing
- Samples are available for distribution to users for restoration, education or scientific purposes
- A substantial amount of seed can be conserved as a long term safeguard against loss of the wild population

Where populations are suitable and the quality and quantity of seed is adequate, it may be possible to make collections of a number of different species from the same site. Preliminary site visits are often necessary to assess the populations, confirm the identification with the collection of herbarium voucher specimens (see ***Section 11***), and estimate the likely harvesting date and potential seed production.

The following points should be considered before harvesting takes place:

- Ensure that the population is of wild origin, not planted or cultivated. For example, do not collect seeds of native species that were included in a seed mix as part of post fire management in areas that were burned and seeded. Native species that were not seeded in those areas could be collected.
- Small populations (less than 50 individuals) or those that will yield less than 1,000 viable seeds in a collection following the sampling strategy above should not be collected. Seed development can vary within and between populations of the same species. Monitor seed maturation and to assess insect damage and empty seeds throughout the population before making the seed collection.
- Collections taken from the exact same population may be combined in to one accession (seed collection reference number) over the course of a season to maximize genetic diversity and collection material. Collectors must ensure that no more than 20% of the viable seeds are collected on any given day, and that all combined material is from the same population and uses the same seed collection reference number or accession number. Note on the SOS field data form the dates the material was collected.

10. Sampling Strategy

For many potential users and uses of the collection, it is important to maximize the number of alleles present within the sample by capturing the greatest proportion of those alleles represented in the field population. According to Brown and Marshall (1995), at least one copy of 95% of the alleles occurring in the population at frequencies of greater than 0.05 can be achieved by sampling from:

1. 30 randomly chosen individuals in a fully outbreeding sexual species, or
2. 59 randomly chosen individuals in a self fertilizing species.

The reproductive biology of most target species has not been studied, and the capture of rarer alleles would require a markedly increased sample size. Therefore, collectors are advised to sample from a single population with individuals of the target species in excess of 50 individuals, and to look for populations with larger numbers of plants. This analysis suggests that, with care, a single population seed sample collected in this way would possess the potential for re-establishment at that site.

As previously mentioned, between 10 and 20 collections across a species range are needed to establish seed zone guidelines and ecotype for a species. Each collection needs to be of a unique population and contain more than 20,000 seeds. The first collection of a species should be sent to MSB and subsequent collections should be sent to the Bend Seed Extractory or other domestic cleaning facility, detailed in ***Section 17***.

In addition, BLM is continually identifying species of priority restoration value needed for native plant materials development. Teams collecting for BLM should work with their BLM colleagues to ensure that collections are being made of these high priority species.

Other partners in the *Seeds of Success* program will need to work through the Plant Conservation Alliance to develop a similar agreement for the cleaning and storage of collections from multiple populations that are not going to Kew as part of the Millennium Seed Bank program.

11. Identification and Herbarium Specimens

It is critical to the value of the seed collections that the species is accurately identified. Voucher material is essential to enable the accurate identification of seed collections. Vegetative material and close-up photographs can occasionally be used, but the most useful voucher material for this program is a set of quality herbarium specimens (pressed, dried plant specimens) for each collection. Therefore, collectors are required to collect herbarium voucher specimens for all *Seeds of Success* seed collections and to enter comprehensive identification notes on the field data form including where each specimen was sent and any additional identification notes. Do not mount the voucher materials on a herbarium sheet or make a herbarium label for the collection.

Guidelines for Shipment

Collections Shipped to the Bend Seed Extractory Voucher Specimen Distribution	**Collections Shipped to the Millennium Seed Bank Voucher Specimen Distribution**
Voucher 1. U.S. National Herbarium 10th and Constitution Ave., NW MRC-166 Smithsonian Institution Washington, DC, 20560 Contact: Rusty Russell 202-633-0920 russellr@si.edu	Vouchers 1-3. Send to the Millennium Seed Bank, with instructions to distribute voucher specimens 2 and 3 to the following: 2. U.S. National Herbarium 3. Regional Herbarium
Voucher 2. Regional Herbarium (see ***Appendix 5***)	or send specimens separately, all with field data form
Voucher 3. Collecting Team's Herbarium	Voucher 4. Collecting Team's Herbarium

Send all voucher material marked with the seed collection number and a copy of the correlating field data forms.

For most collecting teams, the easiest approach to their MSB collections will be to send duplicate specimens to RBG, Kew (to the same address as for the seed collections) where updated herbarium labels will be printed and subsequent distributions to the National Herbarium at the Smithsonian Institution and regional herbaria can be organized. If it is convenient, please include these specimens with the next scheduled shipment to RBG, Kew; ideally, they will be sent in a separate cardboard package from seed collections.

For voucher specimens of collections sent to Bend, it is the collectors' responsibility to send out all vouchers with associated field collection data forms. Again, these should be unmounted without a label and should include the completed field collection data forms.

Herbarium specimens are valuable additional outputs from the collecting program in their own right, and collectors should take three to four representative herbarium specimens for each seed collection made. These specimens can be held at the most appropriate regional, national and international herbaria where they will be available for study or for classification by visiting taxonomists. Close-up photographs, especially of flowers or organs that may be damaged by pressing and drying, are welcome and should be sent to the herbarium coordinators with the collection number clearly written on the reverse or, in the event of digital files, cited in the file name.

Collectors wishing to learn the correct technique for herbarium specimen preparation should accompany an experienced botanist taking specimens in the field. SOS program collectors should attend a SOS training session (see ***Section 2***). Literature available to consult includes: Bridson and Forman (1992); Radford, Dickison, Massey and Bell (1974); and Ross (1994).

For those species that will not be in bloom during seed collecting time, it is suggested that a herbarium voucher specimen be taken during a preliminary trip to the population. Herbarium specimens must be taken from the exact population earlier in the season (e.g. for the purposes of identification and population monitoring). **The herbarium material must truly represent the individuals from which seed was collected**. If a preliminary trip is not made and material for a herbarium voucher specimen is inadequate at seed collection time, collectors should follow the instructions in the paragraph below.

Record a representative individual(s) of the population with GPS so that herbarium specimens can be taken from those individuals in the following season when vegetative and fertile material would be available. Identification should still be carried out in the field by an acknowledged expert familiar with the species (i.e. lead collecting botanist).

Verification of herbarium voucher specimens can be made by one of the options outlined below.

11a. Verification by a local taxonomist

If you have colleagues at local or regional herbaria that are willing to verify your specimens, please indicate on the field data form that you intend to pass a duplicate set of herbarium specimens to a local taxonomist (together with a copy of the field data form) for verification. Do not assume that all herbaria are willing to provide this service. However, if the specimens are of good quality, and it is explained that the transferred set of specimens can be incorporated into the herbarium, many taxonomists are willing to help by confirming or updating the collector's identification. If the taxonomist verifies the specimens, it is the collector's responsibility to share the verification results (collection number and complete scientific name together with the month verified and the name of the verifying taxonomist and herbarium) with the National Collections Data Manager for dissemination to all other parties holding that *Seeds of Success* collection.

11b. Verification by Kew Taxonomists for Shipments sent to the Millennium Seed Bank

If you do not have local or regional herbarium colleagues that can help with the verification of the herbarium specimens, please forward the complete set of duplicates to RBG, Kew (to the

same address as for the seed collections). Kew will prepare herbarium labels with the collector's field identification and pass the duplicates to the Kew herbarium for verification. The determinations will be attached to the specimens, which will then be separated for the Kew herbarium, Smithsonian Institution herbarium, and regional herbaria, as numbers of duplicates allow and according to recommendations by the collecting teams. See ***Appendix 5*** for the herbaria that have been identified for distribution in your state to make sure you collect the proper number of voucher specimens.

11c. Nomenclature

Nomenclature will follow Kartesz and Meacham (1999), *Synthesis of the North America Flora* (http://www.bonap.org/synth.html). This is the standard taxonomy used in the USDA PLANTS Database and other national databases. Partners collecting for *Seeds of Success* will be given a copy of a new BLM edition of the Synthesis of the North American Flora in FY2006 which is valid until July 2008. Only Kartesz scientific names will be used on the species tracking lists and only Kartesz scientific names should be used on the field data forms. **Where subspecies and/or varieties are listed in Kartesz and Meacham, identification should be made to the subspecies and/or variety level.** One goal of the program is to identify the varieties of widespread species that are found in each ecoregion.

12. Seed Collection Techniques

All seed collections should follow this protocol, including seeds that are used for restoration projects, sent to the US Forest Service Seed Extractory in Bend, OR, and all seeds that are collected for germination and other testing and long term conservation storage at the Royal Botanic Gardens, Kew's Millennium Seed Bank. Seed collection should follow the outline in the table below:

	Method	Rationale
1.	Assess the target population and confirm that a sufficient number of individual plants (> 50) have seeds at natural dispersal stage.	To ensure that adequate genetic diversity can be sampled from the population, and that the seeds are likely to be at maximum possible viability and longevity.
2.	Carefully examine a small, representative sample of seeds using a cut test and for smaller seeds a hand lens.	Estimate the frequency of empty or damaged seeds and confirm that the majority of seeds are mature and fully formed.
3.	Collect mature, dry seeds into either cloth or brown paper bags. Large collections can be made using plastic buckets and then transferred into bags.	Ensure the highest possible viability at collection and maximize the potential storage life.
4.	In general, cleaning should be left to the processing staff at the MSB and Bend Seed Extractory.	Maximize the use of available field time and clean and prepare seeds in controlled laboratory conditions.

	Method	Rationale
5.	Fleshy fruits should be collected directly into plastic bags. Specific advice on ripening and cleaning fleshy fruits is in ***Section 15***, or contact RBG, Kew or Bend Staff if specific guidance is needed.	Fleshy fruits decompose rapidly and poor storage can lead to mold infested seed collections.
6.	Sample equally and randomly across the extent of the population, maintaining a record of the number of individuals sampled.	Capture the widest possible genetic diversity from the plant population sampled. Where the population exhibits a pattern of local variation, use a stratified random sampling method to ensure sampling from each microsite.
7.	Collect no more than 20% of the viable seed available on the day of collection.	Ensure that the sampled population is not over collected and is maintainable.
8.	Collect seeds from a population throughout its dispersal season, seeds from a population collected in the same year can be combined as one collection, using the same seed collection reference number. Note the multiple dates of collections on the SOS field data form.	Maximize genetic diversity in the collection, capturing early, mid, and late bloomers.
9.	Collect 10,000 to 20,000 viable seeds.	Enable maximum use and study of the collection.
10.	Collections of all sizes are welcome, at both MSB and Bend. However, the smaller the collection, the less use will be made of it.	Less use will be made of these collections.
11.	**Collections > 20,000 are most desirable.** Collections sent to the MSB are halved upon return to the U.S., and as quantities allow, will be made available for distribution.	This ensures long-term storage at 2 facilities, and a working collection that can be made available for researchers. Halved MSB collections will be stored for long-term conservation, but will probably not be available for distribution.
12.	Collections sent to Bend can be cleaned and sent back to collectors if they are needed for native plant materials development research or a re-seeding project. The first 10,000 seeds of each collection sent to Bend becomes part of the SOS National Collection. See ***Section 17*** for details on requesting material from Bend.	Seeds 1-2,500: Long-term Storage at NCGRP, Ft. Collins, CO Seeds 2,501-5,000 – Long-term Storage at Western Regional Plant Introduction Station, Pullman, WA Seeds 5,001 to 10,000 – Working Collection, available for distribution through the Germplasm Resource Information Network

	Method	Rationale
13.	Collections between 1,000 and 5,000 viable seeds are welcome, but distribution opportunities are limited.	Less use will be made of these collections.
14.	Collections of less than 1,000 seeds are welcome at RBG, Kew only when more productive populations are not available for sampling.	These samples will not receive any testing at RBG, Kew and if sent to Bend will not be available for distribution.
15.	For each collection, estimate the viable seed production per fruit, per individual and per population, and note these on the field data form.	Document species seed biology, better assess the influence of collecting on the population, and gather information to better document if we are meeting *Standards for Rangeland Health* for native plant communities.
16.	Clearly label all bags (inside and out) with the appropriate collection number. No other data needs to be included on the label. Do **not** write on the cotton seed bags with permanent marker because it hinders their re-use in the seed collection program.	To ensure that this unique identifier is attached to each sample of a collection. All other data will be recorded on the field data form.

Some additional information can be found in ***Frequently Asked Questions*** (***Appendix 7***).

13. Field Documentation & Photos

Use a copy of the ***Field Data Form*** (***Appendix 2***) for each seed collection made and fill out all the data fields. Please make sure you use the Seed Collection Reference Number as described in ***Section 14*** below.

Completed field data form and **send one copy to the data manager or email it to mary_byrne@blm.gov** as soon as possible to document collection of the species. Hold one copy in the office where the collection took place, and send the original with the seeds to the appropriate seed cleaning facility, RBG, Kew or the Bend Seed Extractory.

Digital photos of the species being collected should also be made while in the field. At least three photos should be taken for each collection:

1. Landscape Level/Population
2. Individual Plant
3. Material Collected (seed)

Instructions on how to properly name the files are included in ***Section 14*** below.

14. Seed Collection Reference Number Format & Image Names

Seeds of Success collecting teams use the following format to identify their collections. The Seed Collection Reference Number will include two parts: the SOS team code (office mail stop or organization acronym) and collection number; for example, **OR020-26** for the Burns District Office's 26th collection and **CBG-25** for the Chicago Botanic Garden's 25th collection. Seed collection reference numbers should be unique and sequential from year to year, and should never be repeated. If the last collection of the previous year was 34, the next year's collection numbering should start with 35. See ***Section 18*** for collector codes and ***Appendix 6*** for a list of all BLM Field Offices and mail stop codes.

Digital images of the collections should be taken as described in ***Section 13***. The following naming convention should be used: PLANTS Code_Collection Number_Picture Number. For example Chicago Botanic Garden's collection of *Symphyotrichum lanceolatum* would have photos named **SYLA6_CBG-419_A.jpg**, **SYLA6_CBG-419_B.jpg**, etc. Send images to the SOS Data Manager on CD or DVD via FedEx (see ***Section 18*** for the FedEx address).

15. Care of Seed Collections after Harvest

In general, **keep the seed collections in a cool, dry place** prior to sending to the seed bank, but do not freeze them. Do not allow collections to overheat, and do not leave them in a vehicle in full sun. Exposure to such sustained high temperatures can badly damage the seed collections. Maintain ventilation around the collections at all times and try to park the collecting vehicle in the shade, or at the very least, try to shade the windshield. Damp collections should be spread out on newspaper to dry naturally, either outside in the shade or in a well-ventilated room, as soon as possible, before shipping the material.

All teams have specific cleaning and processing arrangements; follow your institution's cleaning agreements and take advantage of the cleaning facilities' expertise and knowledge in cleaning seeds.

Fleshy fruits may require careful handling and partial cleaning. Notify cleaning staff that fleshy material is coming, ship immediately and never on a Friday.

Fleshy fruit shipping options:

a. Pack the whole fruits in strong plastic bags with as much air as possible. The bags should then be packed in some kind of rigid plastic container. Shipping cold and wet ensures the fruits are not squashed and also do not get too hot and ferment too much during their journey. This method is preferred.

b. Remove as much flesh from the fruits as possible before transit. This can be done under cool running water using a sieve. The seeds should then be left to air dry *for a little while* before shipping. Dry carefully on material that will not stick to the seeds (do not use newspaper). They should then be packed as dry seeds, i.e. in cloth bags.

If you have any specific questions such as, what "*a little while"* means for the species that you have collected, and to notify seed bank staff that fleshy fruits are in transit, please contact seed bank and cleaning staff as follows:

Curation Section, RBG Kew
Email**:** sos@kew.org
Tel: 011+44 1444-894128
Fax: 011+44 1444-894110

Nita Rauch, Bend Seed Extractory
Email: nrauch@fs.fed.us
Tel: 541-383-5646
Fax: 541-383-5498

16. Shipping Collections to Kew

16a. Packaging

In general, **it is critical to the successful conservation of the seed that it is sent to the seed bank within a few days of collection**, together with the completed field data forms, using one of the air freight companies listed below. Voucher photos and herbarium specimens may be sent for verification at a later date, and any other additional information may be sent to the program coordinators quoting the unique collection number given to the seed collection.

As often as possible, place your entire seed collection in one bag. Keep a variety of sizes of bags on hand. Make sure that the seed bags are clearly labeled with the unique collection number. The preferred labels are those that can be neatly tied to the neck of the bag with string. This should allow for the bag to be opened and checked while in transit to the seed bank. As an additional precaution, place a second label on top of the seeds inside the bag. RBG, Kew prefers that we do **not** write on the cotton seed bags with permanent marker because it hinders their re-use in the seed collection program.

The labeled bags should be securely packaged for shipping to RBG, Kew. The following packaging is recommended, either:

- Sturdy cardboard box (secured with string to permit customs inspection and resealing) into which cotton seed bags have been placed
- A canvas or thick cotton sealable sack
- Woven PVC or nylon air freight sack

Do not use the following for shipping seeds to the RBG, Kew:

- Any non-breathable bags or containers
- Any bags made from plastic or from PVC backed fabric (although you may be instructed to ship fleshy fruits in PVC bags as part of a shipment, see ***Section 15***).

16b. Species Restricted for Shipment to the United Kingdom

Plant Health restricted species listed below cannot be shipped to Kew, UK without a letter of authority to UK customs or a phytosanitary certificate issued by the USDA Animal and Plant Health Inspection Service (APHIS). A letter of authority to UK customs can be obtained by contacting Janet Terry at Kew (seedbank@kew.org) with details of the collections, ideally pre-collection so that there is ample time to send the paperwork to you.

We recommend that you get a plant health letter from RBG, Kew for this program rather than an APHIS phytosanitary certificate. There is no cost for a letter from Kew, but there is a $25.00 fee for a phytosanitary certificate and inspection is not routinely available in most towns where BLM offices are located. Remember, these are only required for shipments of seeds and fruits listed below. They are not required for any other species.

16c. Plant Health

You will need a ***Letter of Authority*** issued by Janet Terry at RBG Kew (seedbank@kew.org) to send SEED from the following plants from the USA to RBG Kew: *Allium ascalonicum*; *Allium cepa*; *Allium porrum*; *Allium schoenoprasum*; *Beta vulgaris*; *Capsicum*; *Helianthus annuus*; *Lycopersicon lycopersicum*; *Medicago sativa*; *Oryza*; *Phaseolus*; *Prunus*; *Rubus*; *Secale*; *Triticum*; *Zea mays*.

You will need a ***Letter of Authority*** issued by Janet Terry at RBG Kew (seedbank@kew.org) to send FRUITS from the following plants from the USA to RBG Kew: *Annona*; *Cydonia*; *Citrus*; *Diospyros*; *Fortunella*; *Malus*; *Mangifera*; *Passiflora*; *Poncirus*; *Prunus*; *Psidium*; *Pyrus*; *Ribes*; *Syzygium*; *Vaccinum*.

As more becomes known about the potential hosts of *Phytophthera ramorum* (sudden oak death), the APHIS-listed species in ***Section 16d*** of the protocol are now to be treated as quarantine species for entry to UK and will need a ***Letter of Authority*** issued by Janet Terry at RBG Kew (seedbank@kew.org).

Potato relatives (any member of the Solanaceae family) have also acquired quarantine status for import into the UK and will need a ***Letter of Authority*** issued by Janet Terry at RBG Kew (seedbank@kew.org).

Please note: Vitis species (and also true seed of potato and other tuber-forming or stoloniferous Solanceae) are totally prohibited for import into the European Union, so on no account ship Vitis collections to the UK under this program.

16d. U.S. Phytosanitary Certificates

U.S. phytosanitary certificates are not requited for shipment of seeds to RBG, Kew when the species listed above have a letter of authority from RBG, Kew. If your collection has been positively identified and is not within the above listed genera, UK authorities will not require any additional paperwork. If your shipping company asks for a phytosanitary certificate, contact the program coordinator to try to resolve the problem.

Hosts of *Phytophthora ramorum*, known as sudden oak death may require a phytosanitary certificate **for re-entry of seeds into the U.S**. The known host plants of sudden oak death listed by APHIS (http://www.aphis.usda.gov/) where phytosanitary certificates may be required are:

Arrowwood (*Viburnum* x *odnantense*)
big leaf maple (*Acer macrophyllum*)
black oak (*Quercus kelloggii*)
California bay laurel (*Umbellularia californica*)
California buckeye (*Aesculus californica*)
California coffeeberry (*Rhamnus californica*)
California honeysuckle (*Lonicera hispidula*)
canyon live oak (*Quercus chrysolepsis*)
coast live oak (*Quercus agrifolia*)
huckleberry (*Vaccinium ovatum*)
madrone (*Arbutus menziesii*)
manzanita (*Arctostaphylos spp*.)
Rhododendron (*Rhododendron spp*., including azalea)
shreve's oak (*Quercus parvula* var. *shrevei*)
tanoak (*Lithocarpus densiflorus*)
toyon (*Heteromeles arbutifolia*)
douglas-fir (*Pseudotsuga menziesii*)
California redwood (*Sequoia sempervirens*)
cascara (*Rhamnus purshiana*)
salmon berry (*Rubus spectabilis*)
western poison oak (*Rhus diversiloba*)
western star flower (*Trientalis latifolia*)
victorian box (*Pittosporum undulatum*)

Contact seedbank@kew.org for more instructions before sending any of these species to RBG, Kew.

16e. CITES Species

Over 600 species of US plants are controlled by the Convention on International Trade in Endangered Species (CITES). International transfer of specimens of these species may require export and import licenses depending on the species and the part of the plant involved. For *Seeds of Success*, the only CITES material that will be shipped internationally to RBG, Kew, is **clean** seed of either Appendix II or Appendix III species. Herbarium vouchers of these collections should only be sent to the U.S. National Herbarium and local herbaria, thus there is no need to contact the U.S. Fish and Wildlife Service for permits, since herbarium material and live plants will not be sent to RBG, Kew. Follow the shipping process detailed below. CITES listed species shipped domestically do not need further documentation and seeds do not need to be cleaned before domestic shipment.

Shipping Procedures for Appendix II and Appendix III Species Cacti, Orchids, and Sarracenia Species

Destination	Material
DHL/FedEX Courier	Letter to Courier Check appropriate boxes Fill in the name(s) of the **clean** seed being sent to Kew
Kew	**Clean** Seed Data Sheets Images

Destination	Material
U.S. National Herbarium **10th and Constitution Ave., NW** **MRC-166** **Smithsonian Institution** **P.O. Box 37012** **Washington, DC , 20560** **Contact: Rusty Russell** **202-633-0920** **russellr@si.edu**	Unmounted Vouchers Data Sheets Package the same way vouchers are sent to Kew
Seeds of Success, Washington Office	Data Sheets Images

16f. Arranging Shipment via Air Freight

RBG, Kew has accounts with DHL and FedEx for the sole purpose of express shipping seed collections and appropriate field data to Kew for processing. Please always send the data forms along with the seed collections as this helps to accession the collections correctly. Herbarium specimens may be sent either by express freight or by standard airmail.

DHL is the program's preferred freight agent, and full DHL shipping instructions follow below. If DHL will come to your office location and pick up, then you are required to use DHL. If DHL will not pick up shipments from your location, please contact the National Coordinator to get help with resolving the problem.

16g. Shipment with DHL to RBG, Kew

To arrange a pick-up, to get information about the nearest DHL office or to track a shipment already made, call 1800-CALL DHL or (480) 303 5797 or visit http://www.dhl-usa.com/. You are required to include the following documents with the shipment:

Document	Number required	Notes
DHL Shipment Airwaybill	One original – one copy in box	See below
Notification of Transfer and Shipping Invoice	Five signed originals – one copy in box	See below and use form in ***Appendix 3***
Letter of Authority (if plant listed in ***Section 16c***)	One original – one copy in box	Obtained from RBG Kew
CITES import/export permits if CITES material is to be shipped (see ***Section 16e***)	One original – one copy in box	Contact national coordinator before sending herbarium voucher material
Note to inform seed bank staff of any irritant, toxic or hazardous material	One original in box	

**To avoid loss and confusion, include a copy of all documents inside the box as well as the external shipping envelope.

Completing a DHL Shipment Airway Bill
Pre-addressed DHL airwaybills are available from the program coordinators. DHL will supply blank airwaybills for completion by hand if necessary, the following details should be entered.

1. From (Sender)
   Account Number (**call the SOS National Office for the number: 202-452-7767**)
   Sender Name (**enter your name**)
   Company Name and Address (**enter your organization name and address**)

2. To (Receiver)
   Company Name (**Millennium Seed Bank**)
   Delivery Address (**Royal Botanic Gardens, Kew; Wakehurst Place: Ardingly Near Haywards Heath: West Sussex; Postcode RH17 6TN, United Kingdom**)
   Contact Person (**Keith Manger**)
   Contact Phone Number (**01444-894-151**)

3. Shipment Details
   Worldwide Parcel Express; Transport Collect, NO Shipment Insurance;
   Description of Contents (**non commercial wild plant seeds and herbarium specimens collected from the USA for scientific purposes, plus associated documents**)
   Declared Value for Customs (**$1** per collection or other reasonable figure, as entered on the invoice)
   Permanent Export: Receiver pays all duties/taxes

*Due to abuse of the account number, the new account number is not being made public.

Completing a Shipment Invoice and Notification of Transfer
Please use the form prepared for the program in ***Appendix 3***, noting the following points:

- Invoices must be originals
- Invoices must be completed on the letterhead of your organization, if available
- Invoices should be typewritten, if possible
- Invoices must not have any handwritten or obvious typewritten corrections
- Details on the invoice must match those given on the airway bill
- Five original signed invoices are required

16h. Shipment with FedEx to RBG, Kew
Use of the Royal Botanic Gardens, Kew account for shipping with FedEx is limited for use by only those offices where DHL will not make a pick up. If you cannot ship with DHL, please contact the National Coordinator to attempt to resolve the problem and get shipments set up. The Coordinator will need the name of the city where DHL is located that would need to come to your office, and the name of the person in DHL who you talked to when trying to set up a pickup at your office. If the National Coordinator cannot reach agreement with DHL for timely pickup, then permission will be given to use the RBG, Kew shipping account with FedEx.

Be careful not to use the regular BLM FedEx account number on any FedEx airway bills or the combined FedEx Invoice and Notification of Transfer document when sending collections to RBG, Kew. BLM Field Offices do not typically budget money for international courier service, and someone will notice if the cost of using FedEx skyrockets in your office. The sub activities you work in could be taxed to pay the substantial shipping charges. Since RBG, Kew is willing to pay for courier service for all shipments of seed and plant material to the Millennium Seed Bank, please make sure that the account number you use is the correct one. Also, shipping costs are a part of the in-kind match that Kew gives to BLM for any challenge cost share type of program involving the *Seeds of Success* program.

The following documents are required for shipment with FedEx:

Document	Number required	Notes
FedEx Shipment Airwaybill	One original, one copy in box	
Notification of Transfer and Shipping Invoice	Five signed originals, one copy in box	See above and use form in ***Appendix 3***
Letter to Courier Service	One signed original, one copy in box	See ***Appendix 4***
Letter of Authority (if plant listed in ***Section 16c***)	One original, one copy in box	Obtained from RBG Kew
CITES import/export permits if CITES material is to be shipped (see ***Section 16e***)	One original, one copy n box	Contact RBG Kew
Note to inform seed bank staff of any irritant, toxic or hazardous material	One original, one copy in box	

**To avoid loss and confusion, include a copy of all documents inside the box as well as the external shipping envelope.

Completing a FedEx Shipment Airway Bill
FedEx will supply blank airwaybills for completion by hand if necessary, the following details should be entered.

1. From (Sender)
   Account Number (**call the SOS National Office for the number: 202-452-7767)**
   Sender Name (**enter your name**)
   Company Name and Address (**enter your organization name and address**)

2. To (Receiver)
   Company Name (**Millennium Seed Bank**)
   Delivery Address (**Royal Botanic Gardens, Kew; Wakehurst Place: Ardingly Near Haywards Heath: West Sussex; Postcode RH17 6TN, United Kingdom**)
   Contact Person (**Keith Manger**)
   Contact Phone Number (**01444-894-151**)

3. Shipment Details

   Worldwide Parcel Express; Transport Collect, NO Shipment Insurance;
   Description of Contents (**non commercial wild plant seeds and herbarium specimens collected from the USA for scientific purposes, plus associated documents**)
   Declared Value for Customs (**$1** per collection or other reasonable figure, as entered on the invoice)
   Permanent Export: Receiver pays all duties/taxes

Completing a Shipment Invoice and Notification of Transfer
Please use the form prepared for the program in ***Appendix 3***, noting the following points:

- Invoices must be originals
- Invoices must be completed on the letterhead of your organization, if available
- Invoices should be typewritten, if possible
- Invoices must not have any handwritten or obvious typewritten corrections
- Details on the invoice must match those given on the airway bill
- Five original signed invoices are required

17. Shipping Seeds to the USDA Forest Service Bend Seed Extractory in Bend, Oregon

Multiple collections of a single species for restoration projects or native plant materials development by BLM employees or contractors and partners can be sent to the following address:

USDA USFS - Bend Seed Extractory
63095 Deschutes Market Road
Bend, OR 97701
(541) 383-5646
(541) 383-5498 Fax

Notify the Bend Seed Extractory that seeds will be shipped and **always send the seeds overnight mail or with FedEx**. Include a copy of **the completed field data forms** documenting the collection with all shipments of seed to the Bend Seed Extractory; material will not be cleaned without this documentation. Pack the seed in the same manner outlined in previous sections. Senders are responsible for all shipping costs related to seed sent to the Bend Seed Extractory.

Field data forms and return request letters (see below) need to be sent to the SOS National Collections Data Manager, via fax or e-mail. A herbarium voucher should be sent to the U.S. National Herbarium at the Smithsonian, along with a copy of the field data sheet (see ***Appendix 5*** for the contact information).

The first 10,000 seeds are taken off the top from each collection sent to Bend for incorporation into the *Seeds of Success* National Collections. BLM collectors can request that seeds in excess of the initial 10,000 be returned to their offices. The following information should be included in the return request when the material and data is originally sent to the Bend Seed Extractory and the SOS National Coordinating Office:

1. Seeds Collection Reference Number of Material Requested for Return
2. Purpose of return (i.e. direct re-seeding, bulking up, common garden study, etc.)
3. Ideal date material will be returned

Annually, an inventory of collections at Bend larger than 10,000 seeds and not requested for return by the collector will be circulated in June to all National Native Plant Materials Development and Conservation Program partners. Again, collectors have the right of first refusal. This annual distribution will be managed by the National Coordinating Office for *Seeds of Success*. In order for distribution requests to be filled, an explanation of material usage needs to accompany every collection requested.

The Bend Seed Extractory is developing cleaning protocol for native seeds which will be put on the web.

Ideally, all SOS Partners would send their multiple collections of a single species to the Bend Seed Extractory. However, this type of agreement has not yet been finalized with the Bend Seed Extractory. BLM's Washington Office is in discussions with Bend in regards to allowing SOS programwide shipments.

18. Program Contacts

18a. Main Contacts

Below are program contacts in the Washington office and in the UK at the Millennium Seed Bank. Not all BLM offices have the capacity for international phone calls or faxing. Collectors are welcome to call or e-mail Mary with any questions for Kew, and she will relay the correspondence.

SOS National Coordinator
Peggy Olwell
(For US Postal Service mail)
Bureau of Land Management
Division of Fish, Wildlife and Plant Conservation
1849 C Street NW (LSB-204)
Washington, DC 20240
Tel: 202-452-7764
Fax: 202-452-7702
Email: peggy_olwell@blm.gov

(For FedEx or UPS or DHL)
Bureau of Land Management
Division of Fish, Wildlife and Plant Conservation
1620 L Street NW Room 204
Washington, DC 20036

SOS Webmaster
Olivia Kwong
Plant Conservation Alliance/Center for Plant Conservation
(use the same addresses as listed above for Peggy)
Tel: 202-452-0392
Fax: 202-452-7702
Email: plant@plantconservation.org or olivia_kwong@blm.gov

National Collections Data Manager
Mary Byrne
Bureau of Land Management
(use the same addresses as listed above for Peggy)
Tel: 202-452-7767
Fax: 202-452-7702
Email: mary_byrne@blm.gov

Coordinator for the Americas at RBG, Kew
Michael Way, BSc. MIEEM
Seed Conservation Department
Royal Botanic Gardens, Kew
Wakehurst Place, Ardingly, Haywards Heath
West Sussex, RH17 6TN, UK
Tel: 011+44 1444-894106
Fax: 011+44 1444-894110
Email: m.way@rbgkew.org.uk
http://www.rbgkew.org.uk/seedbank/msb.html

Processing team leader (USA)
Nicola Mills
Seed Conservation Department
Royal Botanic Gardens, Kew
Wakehurst Place, Ardingly, Haywards Heath
West Sussex, RH17 6TN, UK
Tel: 011+44 1444-894128
Fax: 011+44 1444-894110
Email: n.mills@rbgkew.org.uk
http://www.rbgkew.org.uk/seedbank/msb.html

Questions or information about individual collections of seed, herbarium material, data, taxonomy, training, shipping and packaging, and general enquires:
mary_byrne@blm.gov, or SOS listserv below

Questions about specific species pre-cleaning and packaging:
seedbank@kew.org, nrauch@fs.fed.us, or SOS listserv below

Questions about new team set-up:
peggy_olwell@blm.gov

Requests for plant health letter of authority for United Kingdom customs:
j.terry@rbgkew.org.uk

Species requests:
mary_byrne@blm.gov

***Seeds of Success* USA e-mail discussion list:**
http://www.nps.gov/plants/sos/maillist.htm

18b. Seeds of Success Collectors Contacts

Coll. Code	Team Contact	Email	Phone
AK930	Jeanne Standley	jeanne_standley@blm.gov	907-271-3082
AZ930	John Anderson Kathy Rice (Desert Bot. Garden) Jennifer Johnson (DBG)	john_anderson@blm.gov krice@dbg.org jjohnson@dbg.org	623-580-5520 480-481-8137 480-481-8187
AZ932	Sheila Murray (The Arb. at Flagstaff)	sheila.murray@nau.edu	928-774-1442 ext 112
CA320	Michael Dolan	michael_dolan@ca.blm.gov	530-233-7903
CA170	Anne Halford	anne_halford@ca.blm.gov	760-872-5022
CA190	Julie Anne Delgado	julie_delgado@ca.blm.gov	831-630-5028
CA330	Jennifer Wheeler	jennifer_wheeler@ca.blm.gov	707-825-2316
CA610	Ron Gartland	ronald_gartland@ca.blm.gov	951-697-5387
CA930	John Willoughby	john_willoughby@ca.blm.gov	916-978-4638
CO932	Carol Dawson	carol_dawson@co.blm.gov	303-239-3725
ES030 ES933	June Wendlandt	June_Wendlandt@blm.gov	414-297-4416
ID930	Roger Rosentreter Susan Filkins	roger_rosentreter@blm.gov susan_filkins@blm.gov	208-373-3824 208-373-3815
MT050	Brian Hockett	brian_hockett@blm.gov	406-683-8010
MT060	Vinita Shea	vinita_shea@blm.gov	406-538-1919
MT923	Nora Taylor	nora_taylor@blm.gov	406-896-5032
NM930	Mike Howard	mike_howard@nm.blm.gov	505-525-4348
NV030	Dean Tonenna	dean_tonenna@nv.blm.gov	775-885-6189
NV052	Gayle Marrs-Smith Christina Lund	gayle_marrs-smith@nv.blm.gov christina_lund@nv.blm.gov	702-647-5156 702-515-5198
NV930	Ted Angle	ted_angle@nv.blm.gov	775-861-6401
OR030	Roger Ferriel	roger_ferriel@blm.gov	541-523-1424
OR050	Ron Halvorson	ron_halvorson@or.blm.gov	541-416-6736
OR090	Nancy Sawtelle	nancy_sawtelle@blm.gov	541-683-6111
OR110	Doug Kendig	douglas_kendig@or.blm.gov	541-773-6087
OR120	Jennie Sperling	jennie_sperling@or.blm.gov	541-756-0100
OR130	Pam Camp	pamela_camp@or.blm.gov	509-665-2100
OR930	Ellen Kuhlmann (Rare Care) Joan Seevers	ekuhlman@u.washington.edu joan_seevers@or.blm.gov	206-616-0780 503-808-6048
OR931	Christa von Behren (Berry Bot. Garden)	christa.vonbehren@gmail.com	503-481-7905
UT030	Holly Beck	holly_beck@blm.gov	435-644-4300
UT933	Maria Ulloa	maria_ulloa@blm.gov	435-896-1518
UT931	Greg Maurer (Red Butte Garden)	gregmaurer@gmail.com	801-716-0293
WY930	Tyler Abbott	tyler_abbott@blm.gov	307-775-6227
WY030	Frank Blomquist	frank_blomquist@blm.gov	307-328-4207
WY040	Jim Glennon	jim_glennon@blm.gov	307-352-0336
CBG	Emily Yates (Chicago Botanic Garden)	eyates@chicagobotanic.org	847-835-6861
LBJWC	Michael Eason (Lady Bird Johnson Wildflower Center)	michael.eason@wildflower.org	512-292-4200
MABG	Michael Eason (Mercer Arb. & Botanic Gardens)	michael.eason@wildflower.org	512-292-4200
NCBG	Andy Walker (North Carolina Botanical Garden)	aswalker@email.unc.edu	919-962-0522

Coll. Code	Team Contact	Email	Phone
NEWFS	Tristram Seidler (New England Wild Flower Society)	tseidler@newfs.org	508-877-7630
NYCDPR-BBG	Camille Joseph (NYC Dept. of Parks & Rec. w/ Brooklyn Botanic Garden)	camille.joseph@parks.nyc.gov	718-370-9044
UCBG	Barbara Keller (University of California Botanical Garden)	bkeller@berkeley.edu	510-643-8040
VNPS	Nicky Staunton (Virginia Native Plant Society)	nstaunton@earthlink.net	---
ZSSD	Bryan Endress (Zoological Society of San Diego)	bendress@sandiegozoo.org	760-291-5486
	Center for Plant Conservation		314-577-9450

18c. Bend Seed Extractory Contacts

Organization	Contact Name	E-mail	Phone
USDA FS Bend Seed Extractory	Jim Barner Nita Rauch	 nrauch@fs.fed.us	541-383-5481 541-383-5646

Appendix 1. CPC National Collection of Endangered Plants

Seeds of Success does not collect seeds from threatened or endangered species. The SOS Technical Protocol is designed for the sustainable collection of common 'work-horse' species that can be used in restoration projects.

The Center for Plant Conservation's National Collection of Endangered Plants contains plant material for more than 600 of the country's most imperiled native plants. An important conservation resource, the National Collection is a back up in case a species becomes extinct or no longer reproduces in the wild.

Seeds, cuttings and other plant material are collected and carefully maintained by botanical institutions that participate in the Center for Plant Conservation. Researchers and botanists at each participating institution collect plant material and seeds from the most imperiled plants in their regions. The institutions study and hold this material in protective custody. An important conservation resource, the Collection is a back up in case a species becomes extinct or no longer reproduces in the wild. The Collection is also an important resource for the scientific study of plant rarity, rare plant life cycles and rare plant storage and germination requirements.

After studying and growing the plants, institutions provide plant material to federal and state agencies and private land managing organizations to assist their efforts to recover imperiled plants in the wild. CPC participating institutions are involved in restoring more than 60 of America's rarest plants in their natural habitat.

Current information on the National Collection of Endangered Plants is available online at http://www.centerforplantconservation.org/NC_Choice.html

For more information contact: Center for Plant Conservation 314-577-9450.

Appendix 2. BLM *Seeds of Success* Field Data Form

Please use BLOCK CAPITALS
Please complete all the priority fields labeled in **bold**.
Please circle relevant descriptions shown in *italics*.

MSB Serial Number:
NRCS PLANTS Code:

Date Collected (DD/MM/YY): | **Seed Collection Reference Number:**

Collector(s):

Country: USA | **Ecoregion:** | **State:** | County:

Location Details:

Lat. (dg/min/sec) **(ex: 40˚ 34' 19.5" N):** N | GPS Used?: *Yes No* | If no, please see other side.

Long. (dg/min/sec) **(ex: 107˚ 36' 51.54" W):** W | GPS Datum: *NAD83 NAD27 WGS84 Other:*

Elevation (feet): | Landowner Details (Permission?):

HABITAT DATA

Habitat & Associated Species:

Modifying Factors: *Mowed Burned Grazed Flooded Seeded Trampled Other:*

Land Form: | Slope°:

Land Use: | Aspect: *N NE E SE S SW W NW*

Geology:

Soil Texture: *Clay Silt Sand Other:* | Soil Color:

COLLECTION DATA - If plant has been identified by a specialist, please see other side.

Family: | **No. of Plants Sampled** **(min. 50):**

Genus: | **No. of Plants Found (approx.):**

Species: | **Area Sampled (acres):**

Subspecies/Variety:

Seeds Collected From: *Plants Ground Both*

Plant Habit: *Tree Shrub Forb Succulent Grass/Grasslike* | Plant Height (feet):

Does the pressed specimen have the same reference as the seed collection?: *Yes No*

If not, enter details of collector, reference, where lodged, and date collected:

Notes to assist identification of pressed specimen (e.g. flower color, odor, presence of closely related species):

Common Name(s) of Plants:

Photograph Taken: *Digital 35mm* | Reference (PLANTS Code_Coll. Number_Pic. No.): | Where Image will be Filed:

PRE-COLLECTION CHECKLIST

*(Check box to right if condition indicated by **boldface** is met or is the most frequently occurring condition.)*

Assess Population & Seed Dispersal Stage	
Approximate area of population: x (feet, yards, miles……)	
Approximate total number of individual plants present and accessible: *0-50* *50-500* *500-5000* *> 5000*	
Evidence of disturbance or damage: *Resown* *Burnt* *Sprayed* ***No damage***	
Readiness of population for collecting: give percentages or circle the most frequently occurring: *Vegetative* *In flower* *Immature seeds* ***Around natural dispersal*** *Post dispersal*	
Estimate the number of individual plants at natural dispersal stage: *<50* ***≥50***	
Is the population: ***A single population*** *A population with distinct sub-populations* (Can you sample separately or from the most suitable?)	

Assess Seed Quality & Availability	
On a typical individual, where on the plant/branch/fruit is the seed at natural dispersal stage: **Recognized**	
Using a cut test on the seeds at this stage, give percentages or circle the most frequently occurring: ***Healthy*** *Insect-damaged* *Empty* *Moldy* *Malformed/other damage*	
Estimate the number of healthy seeds per fruit:	
Estimate the number of fruits per individual plant:	

Should Seed Be Collected On This Trip?	
Using the above information, if you only collect 20% of the healthy seeds available today, will this result in a collection of **≥10,000** healthy seeds?	

OTHER DATA

If GPS was not used, please state method of obtaining lat. and long.: *Altimeter* *Map*

Map Publisher: _____

Series: _____ Scale: _____

Map Coordinates: _____ Map Date (DD/MM/YY): _____

Herbarium voucher specimens:

Number of Pressed Specimens: *2* *3* *4* *or more*

Circle one:

a. *All Herbarium duplicates will be sent to Kew to arrange labeling, verification and distribution (default)*

b. *One duplicate will be sent to _____ herbarium for verification, other duplicates will be sent by the collector to Kew to arrange labeling and distribution.*

c. *All Herbarium duplicates will be sent to _____ herbarium that has agreed to arrange labeling, verification and distribution.*

By default, besides any herbaria mentioned above, one specimen will be sent to Kew and one to the Smithsonian. If you would like to request that additional specimens be sent to regional and/or local herbaria, please fill in the following information:

Regional Herbarium: _____

Local Herbarium: _____

If collection has been identified by a specialist, please complete sections below:

Material Identified: *In Field* *From Pressed Specimen on Day of Collection* *From Pressed Specimen on Another Date* *From Photograph*

Date identified (DD/MM/YY): _____

Identified by: _____ Organization: _____

Appendix 3. Notification of Transfer and Shipping Invoice

THE FOLLOWING ITEMIZED LIST OF MATERIAL IS TRANSFERRED BETWEEN BLM AND RBG, KEW IN ACCORDANCE WITH TERMS AND CONDITIONS OF THE ACCESS AND BENEFIT SHARING AGREEMENT DATED MAY 9TH 2000.

SIGNED BY: **DATE:**

Title: **Name:**

For and on behalf of the United States Department of the Interior Bureau of Land Management

Date of invoice:			Airwaybill number:	
Invoice Number:			Carrier:	DHL Express
Number of pieces:			Total weight:	
Dimensions:	x x cm		Account number:	

Sender:	**Receiver:**
Name:	Name: Millennium Seed Bank
Address:	Address: Royal Botanic Gardens, Kew Wakehurst Place, Ardingly, West Sussex
Zip Code:	Postcode: RH17 6TN
Country: USA	Country: United Kingdom
Contact name	Contact name Keith Manger
Tel: Fax:	Tel 01444-894151 Fax 01444-894110

Customs Code number	**Reason for export**: scientific study, processing and conservation at Royal Botanic Gardens, Kew	**Terms of delivery** WPX United Kingdom	**Full description of Goods** Non-commercial wild plant seeds collected from USA for scientific purposes; dried pressed plant specimens; associated documents and data forms	**Type of export**: Permanent and temporary (Half of the processed seeds will be returned to US by agreement)	Collected on land managed by Bureau of Land Management? Indicate Yes or No
Date Collected	**Seed Collection Reference Number**	**Plant Family**	**Name of Plant Species**	**Number of herbarium Duplicates**	

DECLARATION: I declare that the above information is true and correct to the best of my knowledge, and that the goods are of USA origin. **Total value for Customs $USD** 10

SIGNED BY: NAME:

Job title Date:

Organization:

SIGNED ON RECEIPT BY: NAME:
Title: DATE:
For and on behalf of the Board of Trustees of the Royal Botanic Gardens, Kew, United Kingdom

Appendix 4. Letter to Courier Service

Date

Bureau of Land Management
Office address

Dear Courier:

Please be advised that this shipment complies with all Plant Health and Convention in the Trade of Endangered Species (CITES) regulations. One of the two following statements regarding plant health regulations is checked and applies to this shipment:

- ❑ This package does not need a phytosanitary certificate. It does not contain any material restricted for import into the European Union (EU) under plant health regulations.

- ❑ A *Letter of Authority* issued by the Plant Health Officer, Royal Botanic Gardens, Kew accompanies all *Seeds of Success* shipments that contain restricted plant material. The Letter of Authority allows import of such species into the licensed quarantine facilities on their premises at Wakehurst Place, Sussex, United Kingdom (UK), and replaces the phytosanitary certificate issued by the Animal and Plant Health Inspection Service (APHIS). This shipment contains _____ which require(s) *a Letter of Authority* for import into the UK.

The Bureau of Land Management does not include any listed (under provisions of the Endangered Species Act) threatened or endangered plant species or plants on Appendix I of CITES in the *Seeds of Success* Program. Appendix I species are not included in this shipment. One or more of the following checked statements covers the status of CITES permits or licenses.

- ❑ This shipment does not contain any species listed on CITES Appendix II or III. This shipment contains seeds and/or dried plant specimens that are not controlled by CITES. No permits or licenses are required.

- ❑ This shipment contains **seeds** of _____, which is/are included on Appendix II or III of CITES. Seeds of plants from the United States listed as Appendix II or III species are exempt from CITES regulations and do not require import licenses or export permits.

- ❑ This shipment contains **seeds** of _____, which is/are included on Appendix II or III of CITES. An export permit issued by the *US Fish and Wildlife Service*, the US CITES authority and an import license issued by UK authorities are included.

Please be advised that, as the shippers of plant material from public lands in the US, there is close co-ordination between the botany program personnel of the Bureau of Land Management, and the Royal Botanical Gardens, Kew. This close coordination ensures that all shipments are in accordance with all Plant Health and CITES regulations.

Sincerely,

NAME

POSITION

Appendix 5. Offices and Herbaria Selected to Receive Herbarium Duplicates from SOS

Office/ Team Code	Statewide or Regional Herbaria	Index Herb Code	Contact Info	Local Herbaria chosen	Contact Info
IF >1 Dup.	Royal Botanic Gardens Kew Herbarium	K	Stuart Cable s.cable @kew.org		
IF >2 Dups.	US National Herbarium, Botany Section MRC-166 Smithsonian Inst. P.O. Box 37012 Washington, DC 20013-7012	US	Rusty Russell Coll. Manager 202-357-2534 202-786-2563 f russell.rusty@nmnh.si.edu		
AK930	Univ. of AK Anchorage Herbarium 3311 Providence Dr. Anchorage, AK 99508	UAAH	Marilyn Barker 907-786-1324	BLM, ASO 930, Lands and Renewable Resources Anchorage, AK 99513	John Payne 907-271-3431
AK040	University of Alaska Museum Herbarium PO Box 756960 907 Yukon Dr. Fairbanks, AK 99775-6960	ALA	Carolyn Parker 907-474-7109	BLM, Anchorage FO 6881 Abbott Loop Rd. Anchorage, AK 99507	Randy Meyers 907-442-3430
AK025	University of Alaska Museum Herbarium PO Box 756960 907 Yukon Dr. Fairbanks, AK 99775-6960	ALA	Carolyn Parker 907-474-7109	BLM, NFO Kotzebue Field Station Kotzebue, AK	Randy Meyers 907-442-3430
AZ930	Arizona State Univ. Herbarium Dept. of Plant Biology PO Box 87101 Tempe, AZ 85287-1601	ASU	Dr. Les Landrum	Phoenix Field Office 21605 N. Seventh Ave. Phoenix, AZ 85027	John L. Anderson 623-580-5520
All AZ Field Offices	Arizona State Univ. Herbarium Dept. of Plant Biology PO Box 87101 Tempe, AZ 85287-1601	ASU	Dr. Les Landrum	Desert Botanical Garden 1201 N.Galvin parkway Phoenix AZ 85008	Kathy Rice 602-941-1225
AZ010				Arizona Strip FO 345 E. Riverside Dr. St. George, UT 84790-9000	Lee Hughes 435-688-3229
AZ100				Arizona Strip FO 345 E. Riverside Dr. St. George, UT 84790-9000	Kari Yanskey 435-688-3379
CA160 (also first BMP)	UC Jepson Jepson Herbarium University of California 1001 Valley Life Sciences Bldg. #2465 Berkeley, CA 94720-2465	JEPS	Bruce Baldwin 510-643-7008	Bakersfield FO	FO Botanist(Vacant) 661-391-6000

Office/ Team Code	Statewide or Regional Herbaria	Index Herb Code	Contact Info	Local Herbaria chosen	Contact Info
CA169	UC Jepson	JEPS	Bruce Baldwin 510-643-7008	Goodwin Education Center	Kathy Sharum 661-391-6033
CA170 (also second BMP)	Herbarium Rancho Santa Ana Botanic Garden 1500 N. College Ave. Claremont, CA 91711-3101	RSA	Steve Boyd 909-625-8767	BLM Bishop Field Office 785 N. Main, Suite E Bishop, CA 93514 (also third BMP duplicate to be sent here)	Anne Halford 760-872-5022
CA180	UC/Jepson Herbarium	JEPS	Bruce Baldwin 510-643-7008	University of California Davis	Ellen Dean 530-752-1091
CA190	UC/Jepson Herbarium	JEPS	Bruce Baldwin 510-643-7008		
CA320	UC/Jepson Herbarium	JEPS	Bruce Baldwin 510-643-7008		
CA330	Herbarium, Biological Sciences Department Humboldt State Univ. Arcata, CA 95521-8299	HSC	Robin Bency 707-826-4801	Arcata Field Office Herbarium	Jennifer Wheeler 707-825-2316
CA340	UC/Jepson Herbarium	JEPS	Bruce Baldwin 510-643-7008	University of California Davis	Ellen Dean 530-752-1091
CA350	UC/Jepson Herbarium	JEPS	Bruce Baldwin 510-643-7008	Eagle Lake FO Herbarium 2950 Riverside Dr. Susanville, CA 96130	Beth Corbin 530-252-5305
CA360	Herbarium, Biological Sciences Department California State Univ. Chico, CA 95929-0515	CHSC	Lawrence Janeway 530-898-5381	Redding FO Herbarium 355 Hemsted Dr. Redding, CA 96002	Joe Molter 530-224-2130
CA370	UC/Jepson Herbarium	JEPS	Bruce Baldwin 510-643-7008		
CA650	Rancho Santa Ana Botanic Garden	RSA	Steve Boyd 909-625-8767		
CA690	*No reply*. Use UC/Jepson Herbarium	JEPS	Bruce Baldwin 510-643-7008		
CA930	*No reply*. Use UC/Jepson Herbarium	JEPS	Bruce Baldwin 510-643-7008		
CBG	Nancy Poole Rich Herbarium, Research Department Chicago Botanic Garden 1000 Lake Cook Rd. Glencoe, IL 60022	CHIC	Dr Kayri Havens 847-835-8378		
All CO offices **1ST**	Univ. of Colorado Museum Herbarium Clare Small Bldg. Campus Box 350 Boulder, CO 80309-0350	COLO	Tom Ranker 303-492-5074 ranker@stripe.colorado .edu		

Office/ Team Code	Statewide or Regional Herbaria	Index Herb Code	Contact Info	Local Herbaria chosen	Contact Info
All CO offices **2ND**	University of Wyoming Rocky Mt. Herbarium Dept. of Botany PO Box 3165 Laramie, WY 82071-3165	RM	Ron Hartman 307-766-2236	Colorado College 14 E. Cache la Poudre Colorado Springs, CO 80903 **4TH**	Dr. Tass Kelso 719-389-6405
All CO offices **3RD**	CSU Herbarium Dept. of Biology Colorado State Univ. Fort Collins, CO 80523-1878	CS	Dr. Mark Simmons 970-491-0496 psimmons@lamar.colostate.edu	Adams State College 208 Edgemont Blvd. Alamosa, CO 81102 **5TH**	Catherine Kleier 719-587-7767 cckleier@adams.edu
All CO offices				Univ. of CO - Denver Dept. of Biology Campus Box 171 PO Box 173364 Denver, CO 80217-3364 **6TH**	Leo Bruederle 303-556-3419
ES	No response to memo. North Carolina Botanic Garden will be recommended				
ID070 and other Idaho without info.	Museum of Nat. History Ray D. Davis Herbarium Idaho State University Campus Box 8096 Pocatello, ID 83209	IDS	Karl Holte 208-282-3530		
ID080	Dept. of Biological Sciences Stillinger Herbarium Univ. of Idaho Moscow, ID 83844	ID	Pam Brunsfield 208-885-4623		
ID090	Boise State University Herbarium Dept. of Biology 1910 University Dr. Boise, ID 83725	SRP	Dr. Jim Smith 208-426-3551	Lower Snake River District.Herbarium 3948 Development Dr. Boise, ID 83705	Ann DeBolt 208-384-3465
LBJWC	Herbarium, Plant Resources Center Univ. of Texas at Austin 1 University Sta. F0404 Austin, TX 78712-0471	TEX	Dr Tom Wendt 512-471-5904 512232-3402 f		
MT030	North Dakota State Univ.. Herbarium Hastings Hall Fargo, ND 58105	NDA	Dr. Lee Manske 701-483-2076	Dickinson Research Ext. Center 1089 State Ave. Dickinson, ND 58601	Dr. William Barker 701-231-7222
MT923	408 Lewis Hall Dept. of Plant Sciences Montana State Univ. Bozeman, MT 59717	MONT	Curator Matt Lavin 406-994-2032 w 406-994-1848 f mlavin@ montana.edu,		

Office/ Team Code	Statewide or Regional Herbaria	Index Herb Code	Contact Info	Local Herbaria chosen	Contact Info
MT923	Herbarium Univ. of Montana Missoula, MT 59812-1002	MONTU	Curator David Dyer 406-243-4743		
MT923	Charles A. Taylor Herbarium Agricultural Hall 320 Dept. of Biology & Microbiology SD State Univ.	SDC	Gary E. Larson, Curator 605-688-4552 605-688-6677 f		
NV052	Nevada State Museum 600 N. Carson St. Carson City, NV 89701	NSMC	George Baumgardner 775-687-4810	Herbarium Dept. of Bio. Sci. Univ. of NV - Las Vegas 4505 Maryland Pkwy Box 454004 Las Vegas, NV 89154-4004	Dr. Wes Niles 702-895-3098
NV052				BLM Las Vegas FO 4701 N. Torrey Pines Dr. Las Vegas, NV 89130	Gayle Marrs-Smith 702-515-5156
NV030	Herbarium, Environmental and Resource Sci. Dept. Univ. of Nevada 920 Valley Road Reno, NV 89512-0013	RENO	Christy Malone 775-784-1105		
NM	No response to memo				
OR010 OR014 OR020 OR030 OR050 OR080 OR090 OR100 OR110 OR120 OR134	OSU Herbarium Dept. of Botany and Plant Pathology 2082 Cordley Hall Corvallis, OR 97331-2902 Also OR015 to be sent here, but unconfirmed.	OSC	Aaron Liston-Director Richard Halse-Curator 541-737-4106		
OR030				Albertson Coll. of Idaho 2112 Cleveland Blvd. Caldwell, ID 83605	Dr. Don Mansfield 208-459-5287
OR020				BLM Burns District Herbarium 28910 Hwy 20 West Hines, OR 97738	Douglas Lin 541-573-4465
OR110				Medford BLM Herbaria, 3040 Biddle Rd, Medford, OR 97504	Mabel Jones 541-618-2269
OR130	Herbarium Botany Dept. Univ. of Washington Box 355325 Seattle, WA 98195-5325	WTU	Dick Olmstead 206-543-1682 206-685-1728 f	Spokane District Herbarium Wenatchee, WA	Pamela Camp 509-665-2100

Office/ Team Code	Statewide or Regional Herbaria	Index Herb Code	Contact Info	Local Herbaria chosen	Contact Info
UT930 (formerly known as RBG)	Stanley L Welsh Herbarium Brigham Young Univ. 378-MLBM Provo, UT 84602	BRY	Duane Atwood 801-378-4955	BLM Utah State Office P.O. Box 45155 Salt Lake City, UT 84145-0155	Ronald Bolander 801-539-4065
UT030				Grand Staircase-Escalante NM 190 E. Center St. Kanab, UT 84741	Walter Fertig 435-644-4363
UT050	Stanley L. Welsh Herbarium Brigham Young Univ. 378 MLBM, BYU Provo, UT 84602	BRY	Duane Atwood 801-378-4955	Utah Valley State College - Herbarium Dept. of Biology Life Sciences 800 W. 1200 S. Orem, UT 84058-5999	Renee VanBuren 801-222-8479 801-222-8695
UT080	Intermountain Herbarium Utah State University 5305 Old Main Hill Logan, UT 84322	UTC	Dr. Mary Barkworth 435-797-1584	Uinta Basin Herbarium BLM 170 S. 500 East Vernal, UT 84078	Robert Specht 435-781-4436
UT080	Rocky Mt. Herbarium University of Wyoming 3165 University Sta. Laramie, WY 82071	RM	Dr. Ron Hartman 307-766-2236		
VA (vnps)	Massey Herbarium, Biology Dept. VA Polytechnic Inst. and State Univ. Blacksburg, VA 24061-0406	VPI	Thomas F. Wieboldt 540-231-5746 540-231-9307 f wieboldt@vt.edu	URV Herbarium, Biology Department University of Richmond Richmond, VA 23173	W. John Hayden 804-289-8232 804-289-8233 f jhayden@richmond.edu
VA (vnps)	North Carolina Botanical Garden Univ. of North Carolina CB 3280, Coker Hall Chapel Hill, NC 27599-3280	NCU	Carol Ann McCormick 919- 962-6931 919-962-6930 f herbarium@bio.unc.edu	WILLI Dept. of Biology The College of William and Mary P.O. Box 8795 Williamsburg, VA 23185-8795	Holly J. Grubbs 757-221-2213 757-221-6483 f willi@wm.edu
WY930	Western Wyoming College				
WY930	Rocky Mt. Herbarium University of Wyoming	RM			

Appendix 6. BLM Offices and Mail Stop/Collector Codes

AK020 - Northern Field Office
AK025 - Central Yukon Field Office, Fairbanks District Office
AK040 - Anchorage Field Office
AK050 - Glenallen District Office
AK930 - Alaska State Office
AZ030 - Kingman Field Office
AZ010 - Arizona Strip Field Office
AZ020 - Phoenix Field Office
AZ040 - Safford Field Office
AZ050 - Yuma Field Office
AZ060 - Tucson Field Office
AZ061 - San Pedro Project Office
AZ070 - Lake Havasu Field Office
AZ930 - Arizona State Office
CA067 - El Centro Field Office
CA068 - Barstow Field Office
CA160 - Bakersfield Field Office
CA170 - Bishop Field Office
CA180 - Folsom Field Office
CA190 - Hollister Field Office
CA320 - Alturas Field Office
CA330 - Arcata Field Office
CA340 - Ukiah Field Office
CA350 - Eagle Lake Field Office
CA360 - Redding Field Office
CA370 - Surprise Field Office
CA610 - California Desert District
CA650 - Ridgecrest Field Office
CA660 - Palm Springs-South Coast Field Office
CA690 - Needles Field Office
CA930 - California State Office
CO100 - Little Snake Field Office
CO110 - White River Field Office
CO120 - Kremmling Field Office
CO130 - Grand Junction Field Office
CO140 - Glenwood Springs Field Office
CO150 - Uncompahgre Field Office
CO160 - Gunnison Field Office
CO172 - San Juan Field Office
CO200 - Royal Gorge Field Office
CO210 - La Jara Field Office
CO220 - Saguache Field Office
CO932 - Colorado State Office
ES930 - Eastern States Office
ID100 - Boise District Office
ID120 - Bruneau Field Office
ID110 - Four Rivers Field Office (was ID095)
ID130 - Owyhee Field Office (was ID096)
ID200 - Twin Falls District Office
ID210 - Jarbidge Field Office (was ID097)
ID220 - Burley Field Office (was ID078)
ID230 - Shoshone Field Office (was ID076)
ID300 - Idaho Falls District Office
ID310 - Upper Snake Field Office
ID320 - Pocatello Field Office (was ID075)
ID330 - Challis Field Office (was ID084)
ID340 - Salmon Field Office (was ID085)
ID400 - Coeur d'Alene District Office
ID410 - Coeur d'Alene Field Office (was ID086)
ID420 - Cottonwood Field Office (was ID087)
ID930 - Idaho State Office
MT010 - Billings Field Office
MT020 - Miles City Field Office
MT030 - North Dakota Field Office
MT040 - South Dakota Field Office
MT050 - Dillon Field Office
MT06? - Havre Field Office
MT060 - Lewistown Field Office
MT070 - Butte Field Office
MT090 - Malta Field Office
MT092 - Glasgow Field Station
MT100 - Missoula Field Office
MT923 - Montana/Dakotas State Office
NM??? - Amarillo Field Office
NM010 - Albuquerque Field Office
NM011 - Cuba Field Office
NM012 - Grants Field Station
NM018 - Taos Field Office
NM030 - Las Cruces District Office
NM040 - Tulsa Field Office
NM050 - Socorro Field Office
NM060 - Roswell Field Office
NM070 - Farmington District Office
NM080 - Carlsbad Field Office
NM930 - New Mexico State Office
NV010 - Elko Field Office
NV020 - Winnemucca Field Office
NV030 - Carson City Field Office
NV040 - Ely Field Office

NV050 - Las Vegas Field Office
NV060 - Battle Mountain Field Office
NV065 - Caliente Field Station
NV065 - Tonopah Field Station
NV930 - Nevada State Office
OR010 - Lakeview District Office
OR014 - Klamath Falls Resource Area
OR020 - Burns District Office
OR030 - Vale District Office
OR035 - Baker Resource Area
OR050 - Prineville District Office
OR054 - Central Oregon Resource Area
OR056 - Deschutes Resource Area
OR080 - Salem District Office
OR086 - Tillamook Resource Area
OR090 - Eugene District Office
OR091 - West Eugene Wetlands
OR100 - Roseburg District Office
OR110 - Medford District Office
OR115 - Butte Falls Resource Area
OR116 - Ashland Resource Area
OR117 - Grants Pass Resource Area
OR118 - Glendale Resource Area
OR120 - Coos Bay District Office
OR130 - Spokane District Office
OR134 - Wenatchee Resource Area
OR930 - Oregon State Office
OR931 - Berry Botanic Garden
TC200 - National Training Center
UT010 - Fillmore Field Office
UT020 - Salt Lake Field Office
UT030 - Escalante Interagency Resource Center
UT030 - Grand Starcase-Escalante National Monument
UT040 - Cedar City Field Office
UT052 - Richfield Field Office
UT055 - Henry Mountains Field Station
UT060 - Moab Field Office
UT070 - Price Field Office
UT080 - Vernal Field Office
UT090 - Monticello Field Office
UT100 - St. George Field Office
UT110 - Kanab Field Office
UT930/3 - Utah State Office
UT931 - Red Butte Botanical Garden
WO230 - Fish, Wildlife, and Plant Conservation Division
WY010 - Worland Field Office
WY020 - Cody Field Office
WY030 - Rawlins Field Office
WY040 - Rock Springs Field Office
WY050 - Lander Field Office
WY060 - Casper Field Office
WY070 - Buffalo Field Office
WY080 - Newcastle Field Office
WY090 - Kemmerer Field Office
WY100 - Pinedale Field Office
WY930 - Wyoming State Office

Appendix 7. Frequently Asked Questions

Questions about Species List Assignments

Q: What if I want to add a species to my list that is already assigned to another collector?
Collectors interested in collecting a species on another collector's list should contact that collector to get the switch approved and then notify Oliva Kwong & Mary Byrne of any changes via e-mail to speciesrequest@plantconservation.org.

Q: What if I don't collect everything on my list during the collecting year?
Unless your collecting group has been contracted for a certain quota, there is no penalty. If a collecting group does not collect all of the species assigned to them by the end of the collecting year, the species will remain on the collector's list until it is collected or traded to another collector.

Questions about Collecting

Q: How should I collect Orchid seeds?
A: Orchid seeds should be carefully collected as entire, ripe capsules just prior to dehiscence. Ensure that the capsules are completely dry, wrap gently in filter or other absorbant paper, then pack gently into a small rigid plastic box for shipping (tic-tac boxes have worked ok). Seeds that affix directly to the sides of a plastic container will be almost impossible to remove due to static that builds up, but seeds can be easily brushed from paper.

Q: Can I make repeated collections from the same population to get sufficient seed for a single collection?
A: Seed samples from a single population that are collected over a period of approximately one week are likely to share similar viability, germination and storage characteristics. We recommend that normally, samples from this length period can be combined to achieve a single, larger collection. If seed has to be collected in stages from across the entire season, the initial samples must be held at low relative humidity (e.g. over silica gel) or dispatched to the seed bank to prevent unnecessary ageing. The field data form should be used to record the dates and handling used for the parts of the collection, which should be given a suffix e.g. a, b, c, to allow any variation in the quality of the samples to be managed. We would not normally combine seed from collections over more than one month.

Q: Can I collect from several locations to get sufficient seed for a single collection?
A: The sampling strategy is intended to achieve a representative sample of the genetic diversity of a single population. Seed samples may only be combined into a single population sample if samples have been collected:

- from groups of apparently similar individual plants from nearby locations, and
- which appear capable of frequent interbreeding (consider the seed dispersal characteristics and the kind of pollination agent for the species - 'nearby' may mean 1 mile for an insect pollinated species, but as far as 10 miles for a wind-pollinated species) if the sampling approach has been consistent at each location, such that that combined sample is truly representative of the population. In this case, it is good practice to note the location of the centre of each sub-population on the field data form. If you have any doubt about combining such samples, it would be wise to select the most suitable sub-population for sampling.

Appendix 8. References

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Topic Index

U. S. Department of the Interior
U. S. Department of Agriculture

Report to the Congress **April 2002**

Interagency Program to Supply and Manage Native Plant Materials for Restoration and Rehabilitation on Federal Lands

Report to Congress

Interagency Native Plant Development Program

This report responds to the direction from Congress in the Fiscal Year 2002 Interior Appropriations House Report. Congress specifically directed *"the Secretaries of Interior and Agriculture to report jointly to the Congress by December 31, 2001, with specific plans and recommendations to supply native plant materials for emergency stabilization and longer-term rehabilitation and restoration efforts."*

Executive Summary

Wildland fires in 1999 and 2000 were the worst in 50 years and burned millions of acres of public lands. A shortage of native plant materials substantially increased the cost of rehabilitation and restoration efforts on the burned lands. Ecosystem restoration with native plants, in many cases, is the best option for restoring land health for multiple resource values and minimizing the establishment of invasive weeds.

An interagency team, representing the Departments of the Interior and Agriculture, was formed in December of 2001 to address the native plant development issue and assess needs. Land management agencies represented on the team include the Forest Service (FS), the Bureau of Land Management (BLM), the National Park Service (NPS), and the Fish and Wildlife Service (FWS). Other participants include the Natural Resources Conservation Service (NRCS), the Agricultural Research Service (ARS), the Geological Survey (USGS), and the Office of Surface Mining (OSM). The BLM and the FS directed $5 million and $10 million, respectively, in FY2001 to the development of a long-term program to supply and manage native plant species. These funds were expended in accordance with an interagency strategy that identifies three elements key to the success of a long-term program:

- Support for Federal, State and Tribal Production, Development, Storage, and Research Facilities
- Public-Private Partnerships
- Education and Outreach

In the 1920s, the Forest Service began efforts to establish and implement programs to produce specific plant materials, primarily conifer trees. Early efforts had high failure rates, but by the mid-1980s average survival rates of native trees was better than 70 percent, with some species exceeding 90 percent survival. As a result of the Dust Bowl Era of the 1930s, the Natural Resources Conservation Service instituted a nationwide system of centers whose mission was to develop plant materials for natural resource conservation. Although these centers traditionally focused on both introduced and native plants, within the past two decades research emphasis has shifted predominantly to native species. The Agricultural Research Service has also played an important role in research and development of native and introduced grasses and legumes.

These efforts have yielded a great deal of information about the genetics and propagation of some tree species, primarily conifers, but substantially less about native shrubs and grasses. Relatively little is known about the native forbs which often comprise the most diverse component, in terms of species, of native plant communities. For

public land management agencies to achieve the goals of maintaining and restoring healthy, diverse ecosystems, it is essential that adequate resources be devoted to similar basic research on native shrubs, grasses, forbs, and selected native trees that are in short supply.

Federal land management agencies have different missions and even within a single agency there are a variety of land management objectives. These differences must be considered in both short- and long-term strategies for native plant materials development. Despite these differences, there are many areas where interagency coordination and integration can increase efficiency, reduce costs, and increase the probability of success. A comprehensive assessment of long-term plant material needs can only be accomplished through a focused and ongoing effort to gather information from the inventories, large-scale assessments, and project-level planning efforts which are the catalyst for defining and quantifying these needs. To be successful, federal land managers and researchers must coordinate their efforts with tribes, state and local partners, and private industry.

To ensure a stable and economical supply of native plant materials for rehabilitation and restoration needs, agencies need to implement measures that facilitate the development of a long-term program to supply and manage native plant materials for use on public lands. It is important to recognize, however, that the use of most native plant materials in restoration and rehabilitation efforts on the vast expanses of public lands is in its infancy. For this reason, many of our current recommendations pertain to a short-term focus on increasing the availability of diverse native plant materials and the efficient management of that supply. Much work remains to be accomplished before federal agencies can truly define a comprehensive and integrated strategy for a long-term program that will meet our plant materials needs for restoring and maintaining the health of public lands. The actions that the federal land management agencies intend to take include:

- Undertake a comprehensive assessment of the short-term and long-term need for native plant materials including an estimate of the amount of native plant materials needed and whether an adequate supply of these plant materials exists. Agencies also need the ability to identify and track this information.
- Make a long-term commitment to native plant materials production, research and development, education and outreach, and technology transfer. On-going financial and organizational support will be required to increase the variety and quantity of native plant materials.
- Expand efforts to increase availability of numerous species of native plant materials. Both increases in commercial field production and wildland seed collection are needed to meet public land needs. Annual seed purchases by federal agencies, or as a result of federal programs, vary greatly creating an unpredictable market. Multi-year contracting and increased storage capacity, could enhance market stability. Agencies can also facilitate a secondary, non-federal, market.
- Invest in partnerships with state and local agencies and the private sector. Identify restoration and rehabilitation efforts to conduct in partnership with other land managers and interested parties. Close cooperation and coordination with the private seed growing industry will help ensure their interests and concerns are addressed.
- Ensure that adequate science-based protocols for monitoring of restoration and rehabilitation efforts are established. To promote efficiency and economy, monitoring programs with consistent protocols for measuring success must be developed and implemented.

Additional funding needed to successfully implement the above actions will be evaluated in the context of future budgets and, where appropriate, included in future budget requests.

Introduction

Native plant materials are an important genetic resource essential to ecosystem rehabilitation and restoration efforts. Native plants are needed for a wide range of projects including hazard fuels reduction, rehabilitation after fire and noxious weed control treatments, mined lands reclamation, strategic initiatives, and large-scale habitat restoration and conservation efforts such as the National Fire Plan, the Conservation Reserve Program, and the Great Basin Restoration Initiative.

In the past, the Department of Agriculture has led efforts to establish and successfully implement programs in support of specific plant materials. Breeding programs for forest trees were begun by the Forest Service as early as the 1920s and have evolved into a comprehensive research program on the genetics and conservation of the coniferous forest tree resources of temperate North America. As a result, practices for collecting, processing, testing, and use of conifer tree seeds, have developed over many years. The Forest Service has also identified collection zones to ensure locally-adapted conifer seeds are available and used appropriately for forest restocking.

The impetus for this initial focus in the early 20th century was to better assure reforestation success following large burns occurring on recently acquired public land. The history of these early efforts provides insight into the key areas that will require a sustained commitment in order to successfully expand these programs to provide for a broader mix of native grasses, forbs, shrubs, and tree species to optimize biodiversity. Early efforts to reestablish native tree species had very high failure rates. Survival rates of plantings in the first half of the 20th century seldom exceeding 50 percent even for the hardy, easy-to-grow native trees. Many areas had to be replanted, sometimes requiring 3 or 4 plantings before native trees were successfully reestablished.

As timber harvest levels increased on Federal lands after WWII, Federal agencies instituted programs to improve reforestation success. These programs involved investments in research, infrastructure, equipment and personnel. Since 1985, the Forest Service has consistently reported 3rd year survival of about 70 percent for all tree species; survival commonly exceeds 90 percent for hardy, easy-to-grow tree species.

Key to this improved success was a sustained commitment through research to better understand the:

- Ecological characteristics of species and site characteristics that support their successful establishment.
- Seed production characteristics of species and conditions for successful germination and establishment.
- Genetic characteristics of populations to better understand evolutionary adaptations.
- Life histories of species and insects, diseases, and other biotic and abiotic factors that influence survival.
- Operational factors and cultural techniques that allow for nursery production of desired species.

The Natural Resources Conservation Service instituted a nationwide system of centers whose mission was to develop plant materials for natural resource conservation in response to the Dust Bowl Era of the 1930s. Although these centers have traditionally focused on both introduced and native plant materials, research emphasis within the past two decades has shifted predominantly to native species. Agricultural Research Service research centers have played an important role in research and development of native and introduced grasses and legumes. The Forest Service's Reforestation, Nurseries, and Genetic Resources team has also made significant contributions to the development and use of native plant materials, including the publication of the Native Plant Journal in collaboration with the University of Idaho, and the establishment of the Native Plant Network, a website on which to share information about propagation techniques for native plants. Both the Fish and Wildlife Service and the National Park Service have led successful partnerships to collect, clean, and store plant materials for use in their restoration efforts on lands they manage. These efforts can provide valuable guidance to other Federal agencies in developing strategies to meet their native plant materials needs.

Although these efforts have increased our knowledge about the genetics and propagation of many native trees, especially conifer tress, much remains unknown about many native shrubs and grasses. Even less is known about the native forbs which often comprise the most diverse component, in terms of species, of native plant communities. For public land management agencies to achieve the goals of maintaining and restoring healthy, diverse ecosystems, similar basic research on native shrubs, grasses, forbs, and selected native trees that are in short supply is essential.

Again, early Federal agency efforts to reestablish native tree species provide a useful context for what needs to be done. Successful reestablishment of native tree species through reforestation programs has required the following elements:

- Ecoregional and local assessments to identify and quantify both critical and desirable plant material needs.
- Stable funding levels to build and maintain programs to establish desired native plant materials.
- A trained workforce that can integrate knowledge of local conditions, ecological characteristics, and cultural techniques to successfully grow native plant materials to achieve resource management objectives.
- Seed transfer guidelines and seed zones.
- Strict tracking of seed from local sources to project sites.
- An assured source of plant materials in needed quantities at economical prices.
- A system to facilitate information sharing among Federal and State agencies, and the private sector.
- Seeding equipment designed for use with a wide variety of native seed and often rough terrain.
- Adequate storage capacity for seed.

To ensure a stable and economical supply of native plant materials, agencies need to implement measures that facilitate the development of a long-term program to supply and manage native plant materials for restoration and rehabilitation efforts on public lands.

This report provides a specific interagency plan and recommendations to advance this program. It is important to recognize, however, that the use of most native plant materials in restoration and rehabilitation efforts on the vast expanses of public lands is in its infancy. For this reason, many of our current recommendations pertain to a short-term focus on increasing the amount and variety of native plant materials available and the efficient management of that supply. Much work remains to be done before federal agencies can truly offer a comprehensive and integrated strategy for a long-term program that will be successful in meeting future plant materials needs for restoring and maintaining the health of public lands.

Close coordination among researchers, land managers, and the private sector producers of native plant materials will be critical to the success of a long-term program. Researchers must understand the needs of land managers and the economic and technological constraints on plant production. Land managers must effectively communicate their plant materials needs to both researchers and native plant suppliers. Land managers must also appreciate the value that research on plant genetics and plant adaptation can add to the success of their restoration and rehabilitation efforts.

Purpose and Need

The use of native plants for rehabilitation and restoration efforts on public lands has received increasing emphasis throughout much of the past century. The importance of reestablishing native shrubs to improve wildlife habitat, recognized as early as the 1930s, was included in policies developed in the 1960s. Legislation passed in the 1960s and 1970s broadened public land management from a primary focus on consumptive uses to include more emphasis on wildlife habitat and recreational uses. Passage of the Surface Mining Control and Reclamation Act (SMCRA) of 1977 initiated a notable increase in demand for, and use of, native plants. The provisions of SMCRA required that a *"diverse, effective, and permanent vegetative cover of the same seasonal variety native to the area of land to be affected and capable of self-regeneration and plant succession"* be established.

Agencies in Departments of the Interior and Agriculture have policies on the use of native plants. Policies differ among agencies according to their missions, and within agencies depending on the management objectives for any given rehabilitation or restoration project. For example, principles for managing biological resources on National Park Service land include directives to preserve and restore *"the natural abundances, diversities, dynamics, distributions, habitats . . . of native plant populations and the communities and ecosystems in which they occur."* In contrast, the objectives of the BLM Emergency Stabilization and Rehabilitation program are to *"mitigate the adverse effects of fire on the soil-vegetation resource in a cost-effective and expeditious manner and to minimize the possibility of wildland fire recurrence or invasion of weeds. The purpose of rehabilitation is either to emulate historical or pre-fire ecosystem structure, function (including the reestablishment of the natural fire cycle) or if that is infeasible, then to restore or establish a healthy, stable ecosystem in which native species are well represented."* BLM policies do, however, require a site-specific evaluation of the use of non-native plants in all activity plans, including both normal and emergency fire rehabilitation projects. Both the BLM and Forest Service have a variety of policies related to various specific actions, but neither has a comprehensive policy on the use of native plants.

Federal land management agencies lack comprehensive data on their non-tree native plant needs, largely because most needs are identified and met at the field level and no system is in place to consolidate these data. The severe fire seasons that the nation experienced over the last few years, however, have highlighted the need for more comprehensive information about these needs.

Data from BLM consolidated buys are the best available information on the overall trends in seed purchase by federal agencies. These consolidated seed buys began in the mid-1990's due to the large quantities of seed needed for Great Basin emergency fire rehabilitation and a need to reduce competition for seed among field offices. In general, the proportion of native seed to non-native seed, both in terms of pounds of seed and dollars expended, increased over the six year period between 1996 and 2001 (Figures 1, 2). This trend was broken during 1999 when supplies of native grass seed, in particular, were inadequate to meet the demand created by widespread wildfires.

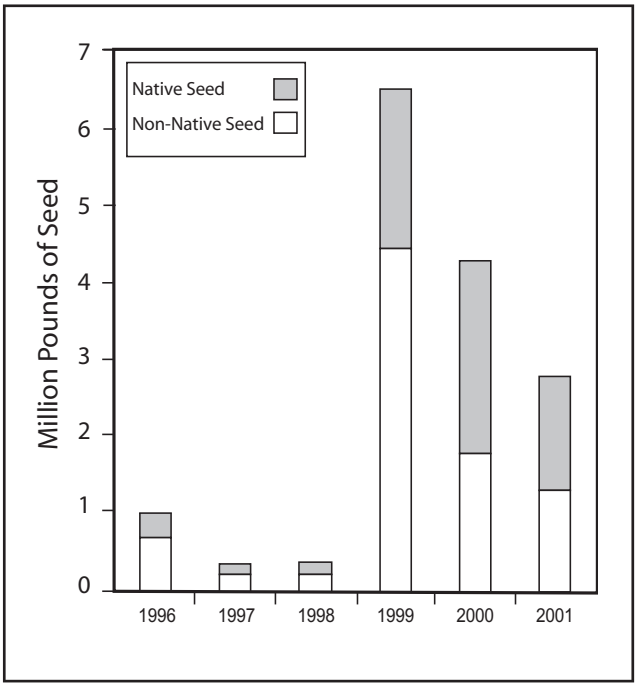

Figure 1. Quantities of seed purchased in BLM consolidated seed buys from 1996 to 2001.

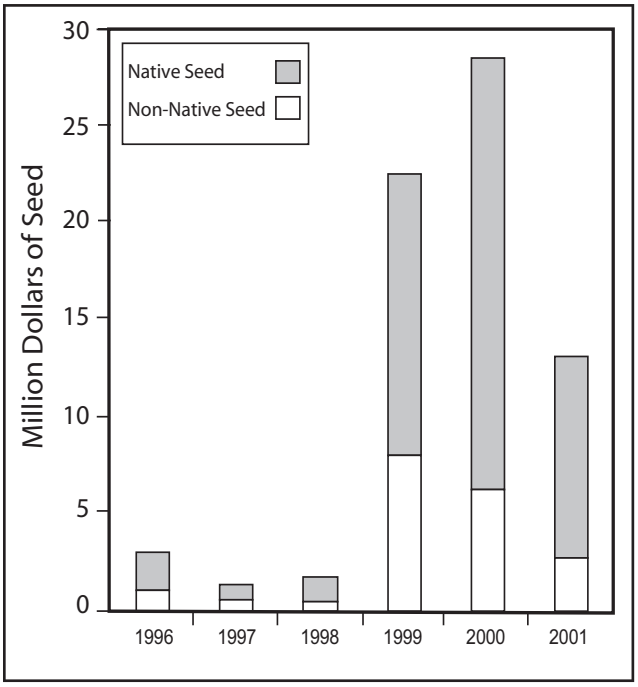

Figure 2. Dollar expenditures on seed purchased in BLM consolidated seed buys from 1996 to 2001.

Several other patterns can be seen in the BLM consolidated seed buys. During the three years prior to 1999, the total amount of seed purchased in these buys ranged between 500,000 and 1,000,000 pounds (Figure 1). The demand for seed for emergency fire rehabilitation in the Great Basin peaked in 1999 when over six million pounds of seed were purchased by the BLM. In subsequent years when wildfires were less severe, the demand for seed has decreased but still remains higher than pre-1999 because under DOI policy seed may be purchased for emergency rehabilitation for up to three years after an area has burned.

Overall expenditures for seed show a pattern similar to that shown by quantity. The peak in expenditures in 2000 is due to lingering high prices resulting from supply shortages that began the previous year (Figures 2, 3). A greater proportion of dollars was spent on native plant seed even during 1999 when native seed comprised only about one-third of the overall seed purchased. Field grown native grass seed remains more costly than non-native grass seed, although the disparity is becoming less as field production of native grass seed increases.

The inadequacy of native seed supply to meet the demand in bad fire seasons is reflected in the price trends for native grass seed paid during the BLM consolidated seed buys (Figure 3). The average price paid per pound for native grass seed nearly tripled in 2000 compared to 1996. This trend was also reflected in many individual grass species. In 2001 prices were lower, but remained at prices more than twice those paid in 1996. Native grass seed is field produced, so a major goal of the interagency strategy is to increase field production of species in short supply in order to bring prices into a range that is affordable yet provides a reasonable profit to growers. Lower prices for native seed grass will also encourage more use of native seed which remains higher priced than the traditional non-native grass cultivars. The use of native grasses allows land managers to address a broader range of resource values than the typical monoculture plantings of non-native cultivars.

Also reflected in the higher expenditure for native seed (Figure 2), is the high cost of wildland-collected seed. Most native shrub seed is manually harvested by field crews. In addition to the expense of manual seed

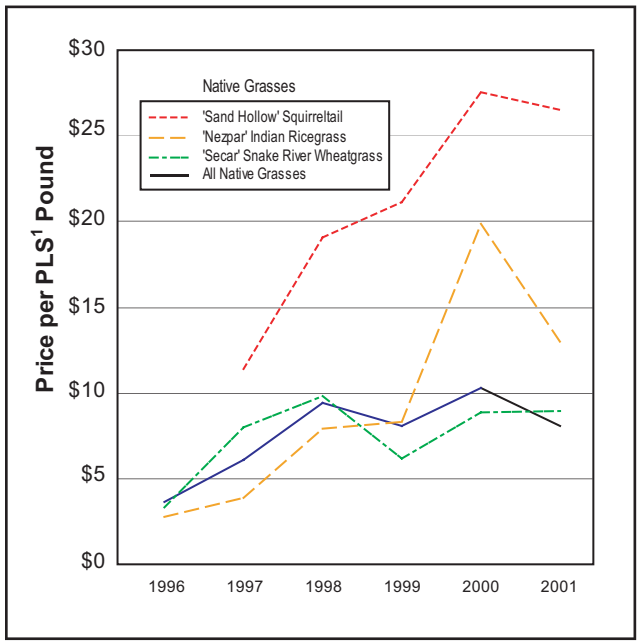

Figure 3. Price per PLS Pound of native grass seed purchased in BLM consolidated seed buys from 1996 to 2001.

[1]PLS = Pure Live Seed (Bulk weight minus non-viable seed and non-seed impurities).

collection, additional costs are incurred because of the long distances that must be traveled in search of seed collecting sites. Because environmental conditions vary regionally in any given year, potential collection sites must be identified on an annual basis. In addition, these sites must be revisited to monitor seed development so that seed can be collected when it reaches optimum ripeness in order to maximize germination success. Since agencies adjust the prices they pay for seed based on germination testing, under-ripe seed will lower profits. Further adding to the overall expense of wildland collected seed is the fact that different species may have divergent optimal harvest times, and thereby necessitate repeat collection trips.

While the cost of field grown seed can be lowered by increasing production, reducing the cost of wildland-collected seed poses a greater challenge. Although some increased production may be possible through special management of wildland collection areas, increased storage capacity will enable federal agencies to constrain costs for wildland-collected seed by allowing seed to be purchased in years when natural seed production levels are high and prices are lower. As with field seed production, it is important that a balance be struck between the necessity for land managers to be able to obtain seed at affordable prices and for the wildland seed collector to earn a reasonable profit if the native seed industry is to remain economically viable.

These data illustrate several aspects of native seed demand and expense, but it is important to understand that they reflect the short-term needs of a single federal agency primarily for fire rehabilitation in the Great Basin. A comprehensive assessment of long-term plant material needs can only be accomplished through a focused and ongoing effort on information gathering from the inventories, District and Forests assessments, and project-level planning efforts which are the catalyst for defining and quantifying these needs. Nevertheless, the BLM consolidated buy data are useful in conveying an appreciation of the size of the demand for native plant seed for landscape-scale needs related to fire rehabilitation.

Interagency Strategy

An interagency team, representing the Departments of the Interior and Agriculture, was assembled in December 2001 to address the native plant development issue and begin a preliminary needs assessment. Land management agencies represented on the team include the Forest Service (FS), the Bureau of Land Management (BLM), the National Park Service (NPS), and the Fish and Wildlife Service (FWS). Other participants include the Natural Resources Conservation Service (NRCS), the Agricultural Research Service (ARS), the Geological Survey (USGS) and the Office of Surface Mining (OSM). The BLM and the FS directed $5 million and $10 million, respectively, in FY2001 to initial development of a long-term program to supply and manage native plant materials. These funds were expended in accordance with an interagency strategy that identifies three elements key to the success of a long-term native plant materials development program:

Support for Federal, State and Tribal Production, Development, and Research Facilities

Federal and State governments have existing facilities and infrastructure critical to the testing, development, and production of native plant materials for use in restoration. For example, the NRCS Plant Materials Program, a network of 26 Plant Materials Centers (PMCs) nationwide, develops plants and plant science technologies to address natural resource conservation. The Forest Service also operates six nurseries, one of which has attained national recognition for its work on native plant species. Many States and some Tribes also have similar facilities, often associated with universities. Together the Federal, State, and Tribal facilities provide an infrastructure that can facilitate the development of a viable native plant materials industry. Adequate storage facilities for plant materials must be constructed or leased, and new equipment specifically designed to accommodate the wide variety of native plant materials must be acquired and maintained.

Public-Private Partnerships

While public agencies play a basic role in the development of materials and technologies, the private sector, including non-governmental organizations (NGO's), is essential to the long-term success of a native plant materials program. The private sector is particularly suited to the large-scale seed increases that are required to meet Federal demands for rehabilitation and restoration. The private sector can also provide a workforce with skills that are not available in some Federal land management agencies, conduct research to fill information voids, and organize partnerships to address resource issues that cross land management boundaries. Smaller private enterprises play a significant role in native plant material development by providing both local knowledge and local genetic stock for specific restoration project needs.

Education and Outreach

Education and outreach serve to inform the public on the purpose and needs for a native plant development program and to clarify for them its goals and objectives. Done effectively, education and outreach helps to leverage non-federal resources by building a constituency within the public for land management actions that enhance ecosystem health by conserving or restoring natural diversity, mitigating the effects of wildfires on the land, and reducing the threat that exotic weeds pose to our native ecosystems.

Project Scale and Time Considerations

Once quantitative needs for native plant materials have been identified, meeting these needs depends upon the scale of the specific rehabilitation or restoration project being addressed (Figure 4). For small projects, up to about 100 acres, it may be possible to let the area recolonize on its own, or collect seed locally and seed it directly into the project area. At the other extreme lie large-scale projects like the Great Basin Restoration Initiative (GBRI), where over 25 million acres have been invaded by cheatgrass. In between these extremes of scale lie rehabilitation and restoration projects to restore native plant communities and native ecosystems. Although the private sector can play a role in seed collection even for the smallest projects, their potential contribution increases rapidly as the scale of the project increases.

Time is also an important factor in meeting the demand for native plant materials and also relates to project scale (Figure 4). For small projects, wildland seed can be collected and used to restore native plant communities in a relatively short timeframe. Wildland-collected seed is also used for many shrubs, such as sagebrush. Ecosystem and landscape scale rehabilitation projects, however, usually require large amounts of field grown seed which may require several years to increase to adequate amounts if supplies are unavailable in storage.

Some cultivars of native grasses have been around for many years and are usually available at a reasonable cost. But many of these older varieties were developed from very narrow selections and may not perform well, or even survive, on a particular site. Common garden studies allow for rangewide comparisons to be made on variability in key characteristics such as germination rate, seedling establishment success, and ability to compete with invasive weeds. Modern genetic techniques allow for the rapid assessment of genetic diversity. In combination, common garden studies and genetic analysis allow for the development of seed transfer zones to provide guidance on the maintenance of diverse plant populations well-adapted for long-term success. Testing and development of new materials, however, is a multi-year process. Test fields must be maintained under strict rules to maintain genetic integrity and weed and pest control.

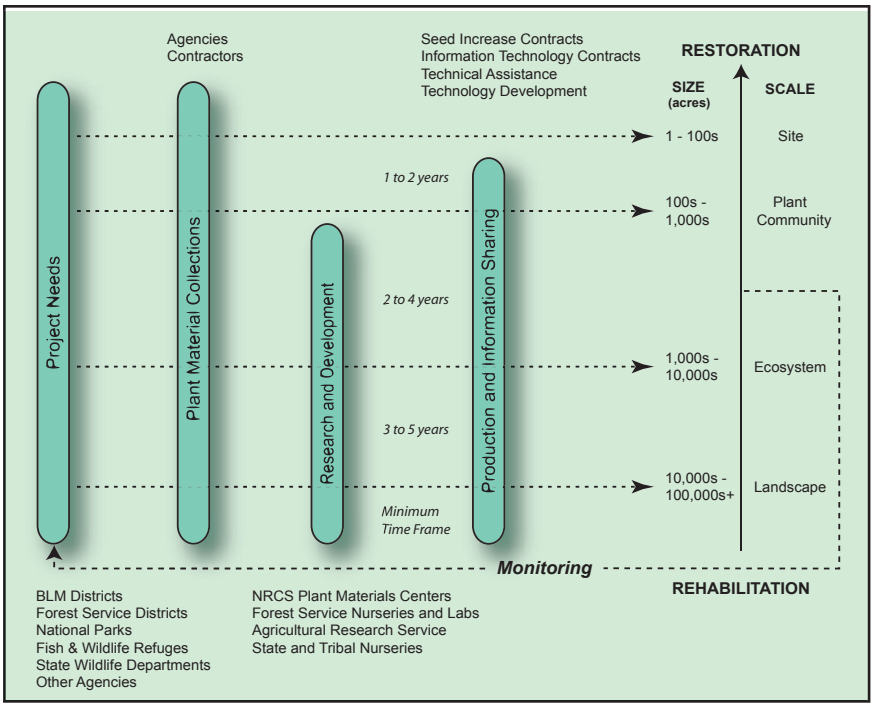

Figure 4. Conceptual diagram of the relationship between the Interagency Native Plant Materials Development Program Strategy, project scale, and time considerations.

Federal and State agencies play a critical role in the selection, testing, and development of new native plants for ecosystem rehabilitation and restoration. They can conduct field evaluations and genetic studies, and can provide guidance on seed transfer zones within which these plants can best be used to meet land management objectives and project needs. Public facilities can also guide the development of new technologies, including equipment, needed to produce native plants and cultural techniques for ecosystem restoration. Some Tribes also have extensive experience in the propagation of native plants. Finally, public agencies play a key role in developing and applying methods for monitoring the effectiveness of rehabilitation and restoration treatments in advancing conservation and resource management objectives.

Other public entities that play important supporting roles include universities, agricultural extension services, seed testing laboratories, and seed certification agencies. The Association of Official Seed Certifying Agencies has published "Pre-Variety Germplasm" and "Woody Plant and Forbs" Certification Requirements and Standards for the maintenance of genetic identity and purity of native plant materials as they are collected, developed, and produced. Seed testing laboratories evaluate seed germination and presence of contaminants such as inert matter, other species' seed, and weed seed. The genetic tracking and seed analysis provided by these agencies and laboratories are vital to native plant restoration efforts because using seed of known genetic origin, purity, and germination greatly reduces risks inherent in stand establishment and survival.

Public agencies can also work to facilitate the development of a viable native seed industry. Federal agencies, including programs such as the Conservation Reserve Program, are the primary market for native plant materials. Actions that may foster a predictable demand for native plant materials, such as the development of a secondary native seed market, increased storage capability, multi-year grower contracts, and better integration among fire rehabilitation and hazardous fuels reduction projects and other habitat restoration programs may help to ensure that plant materials are available when needed.

Specific Actions

Public land managers find themselves facing the cumulative threats of increasing wildfire frequencies, drought, and invasive plant species, potentially compounded by global climatic changes. To counter these threats, public agencies need to expand their efforts beyond emergency stabilization and rehabilitation of burned areas to the restoration of native plant communities. Doing so will help combat invasive species, decrease wildfire frequency, and also address broader goals of conservation of native biological diversity. The interagency team has identified five specific actions that land management agencies can take to develop a long-term program to supply and manage native plant materials:

ACTION ITEM 1: UNDERTAKE A COMPREHENSIVE ASSESSMENT OF THEIR NEEDS FOR NATIVE PLANT MATERIALS

As noted previously, Federal land management agencies lack comprehensive information on their native plant needs. A number of reasons for this can be identified. Among the most important are:

- Relatively recent recognition of the importance of native plants to ecosystem processes and functions including their ability to resist invasion by alien plant species.
- Increasing emphasis on the importance of going beyond rehabilitation focused on erosion control and forage production to native plant community restoration that addresses a broad range of ecosystem services.
- A trend toward larger and more frequent wildland fires resulting as a consequence of past fire suppression and invasion by alien plant species.

Federal land management agencies now recognize the need to undertake a comprehensive assessment of their ecoregional and local short-term and long-term needs for native plant materials. In order to do so, each agency will examine their past use of native plant materials as well as their anticipated future needs based on actions identified in their land use plans and other relevant decision documents. Specific areas to be addressed include an estimate of the amount of native plant materials needed and whether an adequate supply of these materials exists. In addition, agencies will develop the ability to identify and track this information.

ACTION ITEM 2: MAKE A LONG-TERM COMMITMENT TO NATIVE PLANT MATERIALS PRODUCTION, RESEARCH AND DEVELOPMENT, EDUCATION, AND TECHNOLOGY TRANSFER.

Biological and ecological characteristics of many native plant species are poorly known. This information gap includes data on genetic variability within individual plant species, transfer guidelines for native plant materials, information on cultural techniques and seeding/planting methods for successful germination and seedling establishment, and the effects of individual species and cultural techniques on ecological processes and species interactions. Each of these factors can significantly affect both short- and long-term success of restoration efforts as has been shown in the tree development programs. Sustained funding is needed to fill these information gaps and to facilitate sharing of data among agency land managers, researchers, and plant production specialists. In addition, substantial initial investment is needed to produce foundation seed for release to the private sector for the many species needed for rehabilitation and restoration. Funding provided by Congress for FY2001 and FY2002 allowed agencies to provide critical short-term support to ongoing programs in several ecoregions and initiate new plant development programs in fire-prone ecosystems where they were lacking. In FY2003, continued support of these proactive efforts to develop native plant materials will help ensure that agencies are better prepared to meet their future needs.

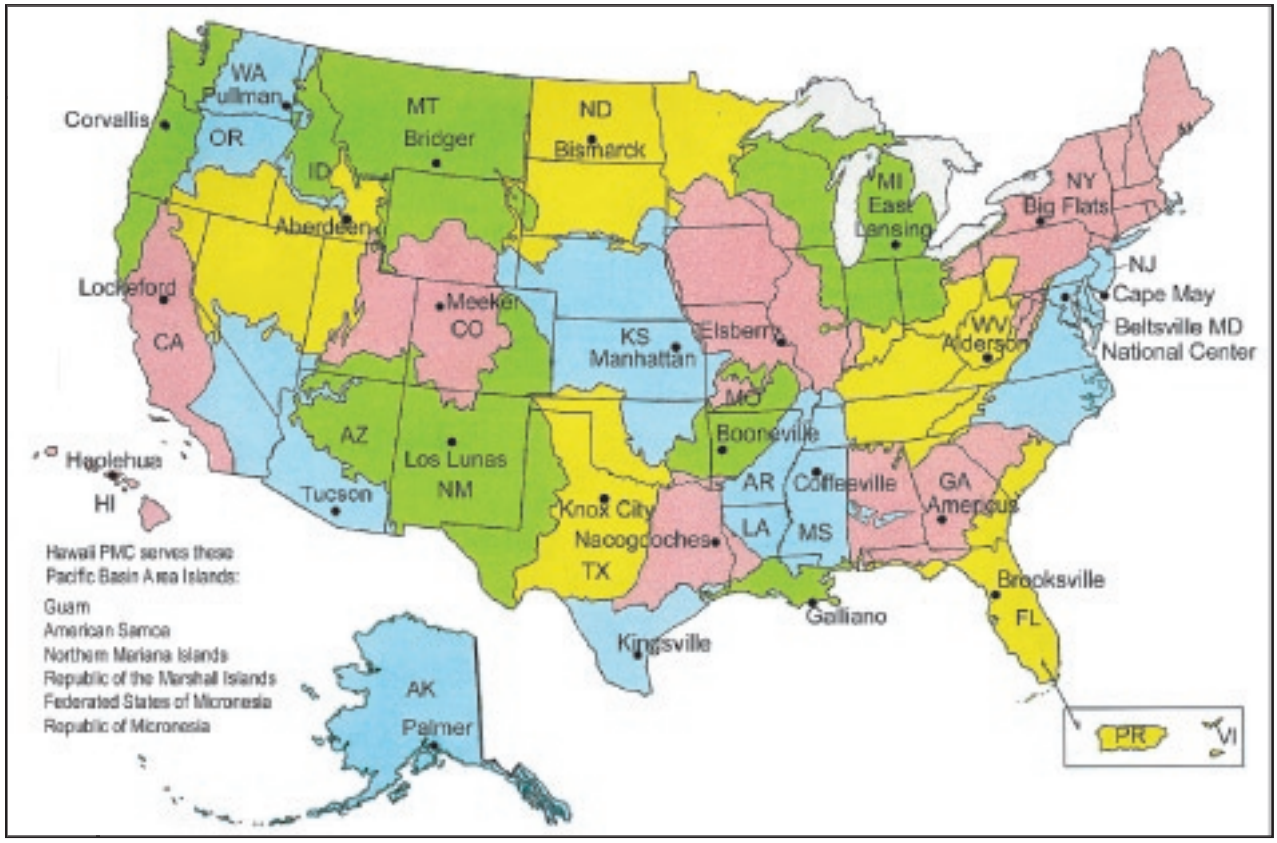

Figure 5. The 26 Plant Materials Centers and their geographic areas of responsibility

The Plant Materials Centers

Born of the Dust Bowl Era of the 1930s, the Plant Materials Centers (PMCs) were created to meet the conservation demands of the last century. The 26 PMCs have released over 500 plants, 350 of which are still in use today. Annually the PMCs produce 18,000 pounds of seed and 15,000 plants valued at $90 million. They have traditionally emphasized both native and introduced plants, but over the past five years all but 6 of 123 new releases have been native plants.

The Beltsville, Maryland PMC is the national center and a regional center for the central eastern states. In the late 1980s, the PMC was nearly closed. Subsequently, it developed a funding relationship with the National Park Service to produce native plants for restoration needs in the region and is now a thriving enterprise and a national leader in the development and production of native plants for ecosystem restoration.

The Beltsville, Maryland, Plant Materials Center.

Report to Congress Interagency Native Plant Materials Development Program

The current challenge to our Nation's wildlands is not unlike that posed to the agricultural lands of our Plains States during the Dust Bowl era of the 1930's. Like soil erosion and loss, the loss of wildland habitat and native ecosystems from wildfire and invasion by exotic species is an issue that crosses land management boundaries. To meet the Dust Bowl challenge, the Federal government responded by establishing a nationwide network of Plant Materials Centers (PMCs) to lead the development of plants for conservation uses. In meeting the challenges of soil erosion and loss over a half century ago, the PMCs, in cooperation with State and local partners, provide a successful model for addressing the issues of today. Success in meeting today's challenges, however, will require the PMCs to work closely with land managers and partners to ensure their needs for ecologically and genetically appropriate native plant materials are met.

The mission of the 26 PMCs (Figure 5) is to develop and transfer plant science technology to meet resource conservation needs. The PMCs are an established infrastructure that can and should play a critical role in restoration efforts. They have traditionally emphasized both introduced and native plant materials, but over the past five years all but 6 of 123 new plant releases have been native plants. A national Task Force was formed in August of 1999 to examine the current status of the Plant Materials Program and provide a business strategy on plant materials operations consistent with available resources. The Task Force prepared a report and briefed the NRCS Chief in April, 2000. Based on this briefing, an action plan was selected to expand the financial resources of the Plant Materials Program so that staffing, workload, and infrastructure needs can be met. Among the actions in the plan is a specific recommendation to integrate PMCs in the implementation of all plant-related initiatives, including those with a native species and invasive species focus.

Plant Materials Centers could contribute to the native plant materials development program in at least five ways:

- Collect, select, and evaluate native plant materials for new releases.
- Provide foundation seed to commercial growers for increase and distribution to end-users.
- Develop and transfer technology for establishment and management of native plant species.
- Provide key plant species information for use in land restoration.
- Help develop valuable biological information about plant species.
- Provide for improved technology transfer of successful propagation techniques to state and private growers.

The Forest Service produces over 150 species of native grass, forbs, and shrubs in addition to tree seedlings at six nurseries. It also operates seed extractories for the extraction and cleaning of seed, and acquires native plant materials from State nurseries and commercial growers. Reforestation programs have declined markedly on National Forests due to sharp reductions in the timber sale program, a decline projected to continue over the next 3-5 years. The Forest Service convened a core review team in July, 2000, to provide an estimate of traditional and non-traditional plant materials needs through 2005 and to provide management options and recommendations to support continued operation of the nurseries and facilitate the integration of Forest Service research with land management needs.

Based on their review, the Forest Service is now implementing an action plan that will:

- Develop infrastructure at FS nurseries and support Research Stations which focus on the development of native plant materials.
- Initiate internal reviews to assess the effectiveness of native plant materials programs.
- Expand the role of the National Forest Genetics Electrophoresis Lab to investigate the genetic characteristics of non-tree plant materials.
- Improve coordination of FS research on native plants with the needs of Federal land managers.

Forest Service nurseries were initially established to be a reliable source of seed and seedlings of native tree and range forage species on Federal lands. Explicit direction authorizing the use of these facilities to facilitate the development of other native plant materials for use on Federal lands, to ensure coordination with other agencies in establishing priorities to reach conservation and management goals, and to assist landowners and growers through the technical transfer of this information would be beneficial.

The Agricultural Research Service (ARS) is the research agency for the Department of Agriculture. Its programs in plant genetics, plant materials, plant germplasm, and pollination biology provide a scientific infrastructure for development of new knowledge about native plant materials. The ARS has major plant development programs in place for cool and warm-season grasses. The agency's National Plant Germplasm System (NPGS) curates and distributes seed sources (called accessions) via a network of 32 units throughout the nation. The NPGS preserves a wide range of plant material including many native plants. Seed is preserved and distributed through the system with security back-up of accessions provided by the National Center in Fort Collins, Colorado. The Germplasm Resources Information Network database documents accession availability, taxonomy, and other information about this collection. Many ARS locations have excellent facilities and motivated personnel that are positioned to pursue research-based solutions to problems associated with native plant material development.

J. Herbert Stone Nursery

Since its establishment in 1977, the Forest Service's J. Herbert Stone Nursery in Central Point, Oregon, has become a nationally recognized leader in the production of native plants for public lands. Their staff includes experts in seedling physiology, soils, and plant pathology. The 311-acre nursery serves the Forest Service, Bureau of Land Management, Tribes, and other Federal, State, and local agencies in the western United States. Although they do not grow native plant materials for sale to the public, they serve the public by providing a valuable source of knowledge and expertise.

The nursery has grown over a hundred species of evergreen and deciduous trees and shrubs for reforestation and watershed restoration. It began its native grass program in 1991 with 15 species on less than an acre of land and today produces over 12 tons of seed a year representing over 40 grass species and dozens of forbs native to the western United States. Grass and forb beds must be kept weed-free and separated from other collections of the same species to avoid cross-pollination. The nursery is also a leader in propagation of wetland plant species.

In March of 2001, the Bureau of Land Management recognized the contribution of the J. Herbert Stone Nursery to native plant materials development with an award presented at the 65th annual North American Wildlife and Natural Resources Conference.

Other specific ways in which ARS facilities can assist land management agencies in developing supplies of native plant materials include:

- Development of both broadly-adapted and local ecotypes of native grasses and forbs that readily establish, are adapted to stressful environments, and are amenable to seed production.
- Research on patterns of genetic variation in native plant species and the preservation of representative germplasm.
- Research on the physiology of seed preservation, maintenance of genetic integrity during seed collection and increase, and characterization of plant population diversity.
- Research on effective pollination and pollinator management practices for native forbs.

Action Item 3: Expand Efforts to Increase the Availability of Native Plant Materials.

Efforts to increase the availability of native plant materials needs to address two basic means of supply: wildland seed collection and field seed production. Most, although not all, shrub seed is collected from wildlands, much of it from public lands. Management activities related to wildland collection have largely focused on the permitting process. Equally important to the sustainability of wildland collection, however, is the identification and management of wildland seed sources; both are areas that have received less attention. To ensure adequate supplies of wildland seed, agencies will undertake the identification of critical source areas and implement management that furthers yields sufficient to meet the anticipated demand. Since many wildland sources representing local genotypes have already been lost or diminished by wildfire, efforts must be made to reestablish stands of native plants in high demand. Management of seed sources may require adjustments in season of use, fencing to reduce herbivory, and such cultural practices as pruning to increase yield. Opportunities may exist for contract management and seed harvest within specified areas. The highly variable nature of annual wildland seed production, however, will require development of seed storage facilities in anticipation of actual demand.

Field seed production, largely driven by market demand, is difficult to forecast because of the unpredictability of the number, size, intensity, and geographic location of wildfires, and enrollment in voluntary large-scale habitat conservation programs like the Conservation Reserve Program. Field seed production is also complicated by delay between the time the field is established and when it comes into full production, which may take several years. Nevertheless, a more stable and predictable market is in the best interests of the buyers, growers, and sellers of native plant materials. Multi-year or "forward" contracting for seed has proven successful in meeting small scale needs and is particularly useful where management objectives prescribe the use of local genotypes. Forward contracting has not been used to meet large-scale needs for broadly adapted plant materials, but there are no obvious reasons why it could not be successful. A more critical question is whether forward contracting would be a disincentive to growers without contracts and thereby have the unintended effect of lowering overall seed production. Agencies need to buy and store seed in advance of their anticipated need in order to avoid large seed purchases when supply is limited and prices are high. The longevity of seed of native species in storage is highly variable. Some species have seed with very short shelf-lives with viability beginning to decrease within weeks of harvest. Other species may produce seed that remains viable for decades or longer. In most cases, the period of seed viability can be extended by storage under cool, dry conditions. Much research remains to be done on this important aspect of native plant materials.

Federal land management agencies can help facilitate the development of a secondary market for native plant materials. The use of native plants is becoming increasingly common among state and local agencies, and in private habitat restoration efforts. Although these individual efforts may be relatively small, their cumulative effect could help ensure that growers remain economically viable in years when federal demand is low. In addition, the emerging market for native species for invasive species control is likely to continue to grow.

Finally, missions and needs differ among and within agencies. National Park Service needs are typically for small volumes of locally-adapted plant materials for small-scale restoration projects focused on preserving genetic diversity. Genetic diversity should be a concern of all land management agencies, but the volume of seed needed for large-scale restoration often precludes the use of local genotypes. Moreover, for some needs, such as that for native plants effective against invasive exotic weeds, highly-competitive and/or broadly-adapted plant selections may be better suited than local genotypes. For these reasons, multiple strategies and approaches are needed to address land management objectives and the practicalities imposed by project scale and time considerations.

ACTION ITEM 4: INVEST IN PARTNERSHIPS WITH STATE AND LOCAL AGENCIES AND THE PRIVATE SECTOR.

Many opportunities exist for Federal agencies to work collaboratively with state and local agencies and the private sector. Doing so not only builds production capacity and enhances skills and expertise necessary to the viability of a long-term native plant materials program, but also demonstrates the commitment of agencies to work with partners to address issues that cross land management boundaries.

State agencies that can make significant contributions include not only land management agencies, such as wildlife and natural resource departments, but agricultural agencies including extension services, seed testing laboratories, and seed certification agencies. State agricultural agencies play a particularly important role in the sharing of information and technology with the private sector and the development of a local seed industry.

State nurseries and universities will be integral partners in native plant materials research and development. There are about 75 state nurseries nationwide, many of which have been producing a wide variety of native plant materials for years and could contribute to restoration needs on public and private land. Many state nurseries already receive some federal funding. Increased coordination and integration between federal agencies and state nurseries provide significant benefits. Research cooperatives between federal agencies and state universities and nurseries will be established on a regional basis, possibly through the Cooperative Ecosystems Studies Units, of which many universities are already member institutions.

Other potential collaborators include partners in existing and new ecosystem restoration projects. Such projects provide land management agencies opportunities to team with groups with a broad array of interests to work together in furtherance of an agreed upon set of common goals. Because of the high incidence of wildfires and the threats posed by exotic weeds to the Great Basin, the BLM and Forest Service have initiated a multi-year project focused on developing a wider variety of native forbs for use in rehabilitation and restoration projects (see box below). This project exemplifies the coordinated and collaborative approach needed for success in native plant materials development.

The Great Basin Native Forb Selection and Increase Project

The Great Basin presents many challenges to Federal and State land management agencies and will be a major focal area for native plant material development in the Western United States for many years to come. The Great Basin Native Plant Selection and Increase Project is a collaborative approach to increase the variety and supply of native plants through an integrated approach to applied science.

Four components have been identified:

- √ *Increase native plant materials available for restoration.*
- √ *Manage or reestablish wildland seed sources.*
- √ *Technology development and transfer.*
- √ *Genetic research and garden trials.*

Cooperative studies with commercial growers are proposed to increase the availability of newly developed plant materials and to facilitate the transfer of production to the private sector.

Cooperators

Federal Agencies

BLM in Utah, Idaho, and Nevada
National Forest System
Forest Service Shrub Sciences Lab, Utah
National Forest Genetics Laboratory
Agricultural Research Service, Utah
Natural Resources Conservation Service, Idaho
Lucky Peak Forest Service Nursery, Idaho

State Agencies

Utah Division of Wildlife Resources
State Seed Certification Agencies
State Seed Testing Laboratories
Utah State University
Lone Peak Utah State Nursery

Others

Brigham Young University
Association of Official Seed Certification Agencies
Additional cooperators will be added as needed.

Action Item 5: Ensure Adequate Monitoring of Restoration and Rehabilitation Efforts.

Adaptive management requires detailed scientific data from carefully designed monitoring programs. About 10 percent of gross native plant development funding will be set aside for monitoring the ecological success and economic costs of seeding and restoration efforts. New monitoring methods and protocols need to be developed to supplement those already in existence. In particular, methods are needed that assess the maintenance of biological diversity, including genetic diversity. While expert opinion differs regarding the need for locally-adapted ecotypes versus plant materials selected for broad adaptability, very little data exists on which decisions can be based even for the most common native species. Failure to monitor the genetic and ecological effects that result from the initial selection, field production, and use of plant materials could affect the success of rehabilitation and restoration projects, or even lower the fitness of native populations into which restoration species are introduced. Such unintended consequences could affect the long-term success of restoration efforts.

Conclusion

To ensure a stable and economical supply of native plant materials, agencies will implement measures that facilitate the development of a long-term program to supply and manage native plant material for restoration and rehabilitation of public lands. This report provides an interagency plan that identifies specific actions to further this goal. It is important to recognize, however, that the use of most native plant materials in restoration and rehabilitation efforts on the vast expanses of public lands is in its infancy. For this reason, many of our current recommendations pertain to a short-term focus on increasing the amount and variety of native plant materials available and the efficient management of that supply. Much work remains to be done before federal agencies can truly offer a comprehensive and integrated strategy for a long-term program that will be successful in meeting future plant materials needs for restoring and maintaining the health of public lands. Close coordination among researchers, land managers, and the private sector producers of native plant materials will be critical to the success of a long-term program. It is imperative both for public land managers to be able to obtain adequate supplies of native plant materials at affordable prices and for seed growers and collectors to make a reasonable profit if the native plant materials market is to be economically viable over the long-term.

It must also be recognized that land management agencies have different missions and that even within a single agency there exists a variety of land management objectives. The specific needs of one agency, for example the need for the BLM to purchase seed in large consolidated seed buys or to have available large storage facilities, are not necessarily shared by other agencies. These differences must be taken into consideration in both short- and long-term strategies for native plant materials development. Despite these differences, however, there remain many areas where interagency coordination and integration will increase efficiency, reduce costs, and increase the probability of success.