# Forest Plan Appendices

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# Changes to the Forest Plan Appendices Since 2006

**Appendix F** – This appendix is new. It describes how the Forest Plan addresses climate change.

# Appendix A

# Vegetation Management Practices

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## INTRODUCTION

This appendix discusses various vegetation management practices focusing on silvicultural systems and treatments to be used on national forest lands that are suitable for timber production. The National Forest Management Act (NFMA) of 1976 and 36 CFR 219 (revised July 1, 1997) addresses the use of appropriate vegetation management practices to meet the goals, objectives, and requirements of the land and resource management plan.

The Monongahela National Forest (MNF) has 40 forest types. General information on these types is available in: *Silvicultural Systems for the Major Forest Types in the United States*, USDA Forest Service Agriculture Handbook 445 (1983); Silvics *of Forest Trees in the United States, Volume 1. Conifer and Volume 2. Hardwoods*, USDA Forest Service Agriculture Handbook 654 (1990); *The Scientific Basis for Silvicultural and Management Decisions in the National Forest System*, USDA Forest Service, General Technical Report WO-55 (1989); and *Forest Cover Types of the United States and Canada*, Society of American Foresters (1980). These publications describe geographical distribution of tree species and forest types, silvicultural characteristics, associated vegetation, and practices appropriate for various management objectives. They also have additional information on other resource considerations such as soils, water, recreation, wildlife, special uses, and insect and disease management.

Silviculture can be defined as the art and science of growing trees to meet management objectives. Although silviculture is usually thought of as growing trees for timber production, it is also used to manage vegetation for other resources of the forest including wildlife, water, recreation, and scenery. Growing pressures to provide a variety of resources and products, both commodity and non-commodity, to increasing populations presents challenging opportunities for multiple use management of national forest lands.

## SILVICULTURAL SYSTEMS

A silvicultural system defines the management needed to regenerate (or prepare for a regeneration cut) a forested stand of trees using a particular harvest method. Each system is formulated and designed for a specific set of circumstances, objectives, or environmental conditions, yet is dynamic to allow flexibility as situations or scientific knowledge changes. Basic considerations when choosing a silvicultural system include:

1) Characteristics of the tree species and forest types.
2) Environmental features of the site(s) where the trees are growing.
3) Protection or enhancement of other resources such as wildlife, water, soils, etc.
4) Goals and objectives for the area.

The characteristic of the tree species or forest type (such as tolerance to shade, susceptibility to windthrow, adaptability to soil and moisture conditions, and vulnerability to insects, disease, and fire) determines the range of alternative treatments that can be prescribed. Some examples include: 1) a forest type consisting mostly of tree species needing full sunlight will not regenerate and grow under the shade of a forest canopy that occurs when applying the single tree selection harvest method; or 2) a tree species with a shallow root system should not be regenerated with the seed tree, shelterwood, or two-aged harvest method because the residual trees might blow over before a new stand can become established; or 3) a tree species that requires substantial moisture to thrive should not be planted in an area where soil conditions are very dry.

Generally, there are two silvicultural systems that have been used to regenerate forests: even-aged and uneven-aged.

## Even-Aged Silvicultural System

This system is designed to create a forested stand where all the trees are about the same age or where the difference in age from the oldest tree to the youngest tree does not exceed 20% of the length of the rotation. The length of the rotation is the time when a stand of trees is mostly in the seedling stage (or immediately after a regeneration harvest) to the time when the stand is ready for a regeneration harvest. For example, in a recently regenerated stand with a 100-year rotation, most of the youngest trees would have an age between 0 and 1 while most of the oldest trees should be no older than 20. When most of these trees reach 100 years of age, the stand is again ready to be regenerated. This system is designed to create or maintain individual stands with trees that are similar in age. Collectively these stands should produce a diverse pattern of age classes across the landscape over time. The purpose of this system is to regenerate tree species generally intolerant or moderately tolerant of shade for a sustainable supply of forest products.

Harvest methods in the even-aged silvicultural system include:

1) Clearcutting with reserve trees,
2) Two-aged,
3) Shelterwood,
4) Seed tree, and
5) Thinning.

The even-aged system tends to mimic moderate to major disturbance events found in nature such as uncontrolled wild fires during periods of drought, hurricanes, tornadoes, ice storms, or insect/disease outbreaks, but in a more controlled manner. The intent is to open the forest floor to more sunlight so trees that need full or partial sunlight (shade intolerant) can grow. These methods require fewer harvest removal entries into a stand (at least 1 but usually no more than 4 within a 100 to 120 year rotation) to increase the growth or regenerate the desired species. The size of a single even-aged regeneration cutting unit has been limited to 25 acres in the existing Monongahela National Forest Land Management Plan, although the NFMA allows a 40-acre size limit for hardwood forest types. The 25-acre limit has been removed in the revised Plan. Exceptions to exceed the size limit need the approval of the Regional Forester.

The **clearcutting method** harvests most or all of the trees within a stand in one removal. Typically some reserve trees are left to meet wildlife habitat or other resource needs. This method requires fewer entries, is less costly to administer, and is considered to be the most economically efficient (over the long term) of all harvest methods. The **two-aged method** harvests most of the trees in the older age class to create a young age class. Harvest entries are usually scheduled 40 to 80 years apart to maintain two distinct age classes within the stand. The **shelterwood method** harvests the mature trees in two or more removal cuts within 3 to 20 years after the initial cut. Both the two-aged method and the shelterwood method are preferred where advanced regeneration is lacking or absent. The **seed tree method** is usually used in conifer stands, with the first cut removing all but 2 to 10 trees/acre of the best growing, seed-producing trees of the desired species to be regenerated. A second cut to remove the seed trees may be done once an adequate number of the desired seedlings have been established. The **thinning method** is an intermediate cut that prepares a stand for a regeneration harvest. This method removes high risk (trees that most likely will not survive until the regeneration harvest is initiated), low quality, diseased, and over mature trees to increase the health, development, and growth of the residual trees in a stand. One to several intermediate cuts may be applied in a stand prior to the regeneration harvest. Thinning is applicable to all of the forest types found on the Forest.

### Uneven-Aged Silvicultural System

This system is designed to maintain a high forest canopy cover of trees that have a range of diameter, size, and age classes while continuously regenerating desirable species. A stand is considered to be uneven-aged if three or more age classes are present. The purpose of this system is to regenerate desirable tree species that grow better under the shade of the forest canopy for a sustainable supply of forest products. It is often used to maintain or enhance the aesthetic values of a forested area.

Harvest methods in the uneven-aged silvicultural system include 1) single tree selection and 2) group selection. This system tends to mimic more of the minor disturbance events found in nature such as individual trees or small groups of trees dying from a weather, insect, disease, or age-related event. These events favor the regeneration of those trees that grow better underneath other trees (shade tolerant). Both harvest methods in this system require frequent entries into the stand (usually once every 10 to 20 years) to encourage continuous regeneration and growth of desired tree species. The **selection** or **single tree selection method** harvests individual trees, both large and small, favoring trees such as beech and sugar maple that are tolerant of the shade of the residual forest canopy. The **group selection method** removes all trees within a small area, generally at least ½ acre but typically no larger than 2 acres, within the larger forested stand. This method allows for the growth of some of the more shade intolerant trees species within the uneven-aged stand.

## BASIS FOR THE ALLOCATION OF SILVICULTURAL SYSTEMS

The NFMA and its Code of Federal Regulations require identifying forested lands suitable for producing sustainable yields of wood products. The selection of which silvicultural system and harvest method to use on these lands is based on the existing condition of the forested stand, other resource considerations such as wildlife habitat, riparian, visual concerns, proximity to public or private facilities, water quality, etc., and the desired future condition and objectives of the management prescription.

The existing condition of MNF land has been greatly influenced by intensive logging and subsistence agriculture that occurred during the period from mid to late 1800s through the early 1930s. In addition, native inhabitants and early settlers used fire as a tool to manage or clear forest vegetation. More recently the multiple use management activities of the MNF have continued to shape the structure of the forest vegetation on national forest land. The result of centuries of human manipulation and use of the vegetation is the mostly even-aged forest we have today. The large majority of stands on the MNF (84 percent) are over 60 years old. Less than 2 percent of MNF land is in young forested stands less than 15 years old. As the forest continues to age it will become more susceptible to insect and disease outbreaks and other age-related effects.

Table A-1 presents the forest cover types on the MNF, and shows how 40 distinct cover types have been combined into 7 general types that have similar species and responses to silvicultural systems and treatments.

Table A-2 shows the recommended harvest methods by silvicultural systems for the seven forest cover types.

**Table A-1. Forest Cover Types**

| Eastern Forest Cover Type | Forest Type (Combined Data System Code) |
|---|---|
| Eastern Spruce-Fir | Norway spruce (7)<br>spruce (10)<br>red spruce-balsam fir (13)<br>tamarack (15)<br>white spruce-balsam fir-Norway spruce (16) |
| Eastern White Pine Including Eastern Hemlock | red pine (02)<br>white pine (03)<br>white pine-hemlock (04)<br>hemlock (05) |
| Oak-Pine | Virginia pine (33)<br>pitch pine (38)<br>oak-white pine (41,43)<br>oak-yellow pine (45,49) |
| Oak-Hickory | chestnut oak (52)<br>black oak-scarlet oak-hickory (53)<br>white oak (54)<br>northern red oak (55)<br>scarlet oak (57)<br>mixed oak (59) |
| Bottomland Hardwoods | river birch-sycamore (72)<br>red maple, wet site (76) |
| Appalachian Mixed Hardwoods | yellow poplar-white oak-northern red oak (56)<br>white ash (74)<br>black walnut (78)<br>black cherry-white ash-yellow poplar (83)<br>black locust (88)<br>mixed hardwoods (89)<br>quaking aspen (91)<br>bigtooth aspen (93) |
| Northern Hardwoods | sugar maple-beech-yellow birch (81)<br>sugar maple-basswood (82)<br>red maple, dry site (84)<br>sugar maple (85)<br>beech (86)<br>sugar maple-beech-yellow birch-red spruce (87)<br>birch (96) |

**Table A-2. Recommended Harvest Methods By Silvicultural System**

| Eastern Forest Cover Type | Even-Aged System | | | | Uneven-Aged System | |
|---|---|---|---|---|---|---|
| | Clearcut | Two-Aged | Shelterwood | Seed Tree | Single Tree Selection | Group Selection |
| Eastern Spruce-Fir | P | NR | NR | NR | R | R |
| Eastern White Pine Including Eastern Hemlock | R | R | R | NR | NR | P |
| Oak-Pine | R | R | P | P | NR | P |
| Oak-Hickory | R | R | R | NR | NR | P |
| Bottomland Hardwoods | R | R | R | NR | P | R |
| Appalachian Mixed Hardwoods | R | R | R | NR | P | P |
| Northern Hardwoods | R | R | R | NR | R | R |

Codes used in Table A-2:
R = recommended. The harvest method has proven reliable in creating conditions favorable for the regeneration and growth of the desirable tree species in this forest cover type. Additional silvicultural treatments such as site preparation for natural regeneration, vine control, crop tree release, timber stand improvement activities, etc. may be needed to maintain or enhance the presence and growth of desired tree species.

P = possible. The harvest method may need multiple or intensive silvicultural treatments or mitigating measures based on site specific analysis to create conditions favorable for the regeneration and growth of the desirable tree species in this forest cover type. If silvicultural treatments and/or mitigating measures are not successful, there is substantial risk of conversion to another forest cover type. For example, concern for other resources such as riparian may determine the harvest method and result in conversion of the forest cover type.

NR = not recommended. The harvest method is not reliable in creating conditions favorable for the regeneration and growth of the desirable tree species, using standard or special treatments, in this forest cover type.

## MANAGEMENT PRESCRIPTIONS

There are seven different Management Prescriptions (MPs) in the 2006 Forest Plan. These prescriptions include different practices with different costs and benefits that result in different future Forest conditions. Timber harvest methods are specified in the Standards and Guidelines for each Management Prescription. This section summarizes the timber harvest methods to meet the objectives of each Management Prescription. Methods may also be designed for smaller areas such as campgrounds. For a full description of the Management Prescriptions and harvest methods, see Chapter III of the 2006 Plan.

**Management Prescription 3.0** emphasizes a variety of forest views, and large high quality hardwood trees for sawtimber and veneer, hard mast production, and scenic attributes. Forest areas are a mosaic of stands, predominantly hardwood, that vary in size, shape, and age depending on the silvicultural system applied. Even-aged management practices are used where intolerant species are desired, or where needed

for additional diversity. Uneven-aged management practices may be used where tolerant species are desired.

**Management Prescription 4.1** emphasizes the active and passive restoration of spruce and spruce-hardwood communities and the recovery of species of concern found in these communities, a mix of forest products, and management of hardwood communities where spruce is not present or represents only a negligible component of a stand, and research or administrative studies on spruce restoration. On lands determined to be suitable habitat for the West Virginia northern flying squirrel, vegetation management initially would be limited to research or administrative studies to determine effective habitat enhancement techniques for the squirrel. After such studies have demonstrated effective techniques, vegetation management to enhance habitat for the squirrel or other TEP species could occur on a larger scale (see FW standard TE61).

**Management Prescription 5.0** emphasizes management of congressionally designated wilderness. No timber management will be applied. Vegetation will follow natural succession.

**Management Prescription 5.1** is intended to maintain wilderness attributes until a congressional designation occurs or assigned to the 6.2 management prescription. No commercial timber management will be applied. Vegetation will follow natural succession.

**Management Prescription 6.1** emphasizes habitat for wildlife species intolerant of disturbance and a mix of forest timber products. In the revised Forest Plan active restoration of oak communities is also emphasized. Even-aged management practices of thinning and regeneration by the two-aged and clearcutting harvest methods best achieve the desired condition, and is normally used. Other practices may be used as specified in the Standards and Guidelines.

**Management Prescription 6.2** emphasis is on maintaining a semi-primitive non-motorized recreation environment. Salvage of dead or dying trees is allowed. The revised Plan allows for the restoration of ecological communities predominantly through natural processes, although some vegetation management may occur. This management might consist of thinning, individual tree selection, or prescribed fire to a level that would not alter the undeveloped character of the area. Additional Forest Service roads would not be constructed.

**Management Prescription 8.0** emphasizes the preservation of unique ecosystems for scientific or recreational purposes, areas to conduct research, and the protection of unique areas of national significance. Areas include the NRA (8.1), National Natural Landmarks (8.2), Scenic Areas (8.3), Ecological Areas (8.4), Research Areas (8.5), and Grouse Management Areas (8.6). Silvicultural systems may be either even-aged or uneven-aged, depending upon the management objectives and the silvics of the species involved. Relatively little mechanical vegetation management is expected in most areas. See Chapter III of the Plan for management variations within this prescription.

## HARVEST SYSTEMS FOR THE FOREST TIMBER TYPES

Due to the geographic location, elevation differences, and varying weather conditions on the MNF, the forest timber seldom fits the normal Society of American Foresters definitions for specific types. In this area, plant species common to northern climates intermingle with plant species common to southern climates. This results in stands with a great number of species mixes not found in the north or south. Over 30 commercial species occur on the Forest, and it is not uncommon to find 10 to 15 commercial species growing in a 10-acre stand. Under natural conditions, a single species seldom exceeds 70 percent

of the stocking except in very small areas. Generally, a single-species type name will indicate that one species represents 51 percent or more of the total stocking, whereas in a multiple-species type, a group of species will represent 51 percent or more of the total stocking.

Selection of a silvicultural system and related regeneration harvest method depends on many factors, including implementation costs. Uneven-aged management is generally considered to involve higher management and harvesting costs than even-aged systems. The size of openings can also affect the costs and in some cases the value of the future crop. Reducing the size of the area harvested in a single clearcut increases the management and harvesting costs. An additional disadvantage of small clearcuts in hardwood stands is the increased number of border trees that are degraded from epicormic branching. This is due to the greater length of border resulting from the increased number of small area cuttings needed to harvest a given acreage.

The major forest types are described in detail in the Vegetation section of Chapter 3 of the EIS. The descriptions below focus on the appropriate silvicultural systems that may be used in those types.

## Eastern Spruce-Fir Type

The eastern spruce-fir type represents about 4 percent of the forested area on the MNF and consists mostly of red spruce although there are some small scattered areas of balsam fir. Red spruce attains its maximum development in the Appalachians, and almost all the red spruce in the central Appalachians is in West Virginia. It has been estimated that red spruce originally occupied almost 470,000 acres in the mountains of northern and eastern West Virginia at elevations generally above 3,200 feet. The intense fires that followed the original c1earcutting around the turn of the 20th century drastically reduced the amount of red spruce. In the spruce areas, the climate is cool and humid with annual precipitation in the neighborhood of 60 inches.

Red spruce grows in association with hemlock, red and sugar maple, yellow birch, pin cherry, beech, and black cherry, but it may grow in almost pure stands. Part of the MNF formerly occupied by red spruce has been planted to Norway spruce due to the better post-planting survival rates and faster growth of this species.

Because the wildfires that reduced the acreage of spruce also reduced the depth of the largely organic soil in which most of the spruce formerly grew, site quality was also reduced. The relatively small acreage of spruce in pure or nearly pure stands generally occupies areas of shallow rocky soils where site quality is fair to poor. Most of the spruce found on better sites occurs as scattered groups or as individual trees in northern hardwood ecosystem. By definition, the eastern spruce-fir type includes stands composed 50 percent or more of spruce and/or fir, but because in most situations on the MNF this type includes stands composed of up to 50 percent hardwood stems, it is considered a spruce-hardwood complex.

Harvest Methods - Since red spruce is shade tolerant, the recommended regeneration harvest methods are in the uneven-aged silvicultural system. The two-aged, shelterwood, and seed-tree methods are not recommended because red spruce is so shallow-rooted that the residual trees tend to blow down before regeneration is established.

Where spruce is managed for improvement of deer and grouse habitat, even-aged management based on c1earcutting narrow patches of approximately 5 acres in size is recommended. Smaller and more numerous c1earcuts would be better for hares and the non-game species or the uneven-aged system may be used with the group selection harvest method. Both uneven-aged harvest methods may be used to secure regeneration, and they are particularly applicable where scenic

values, recreational use, and wildlife that are dependent on a healthy, continuous forest cover are of concern. However, care must be taken on exposed areas not to open up the stand heavily enough to risk wind throw.

## Eastern White Pine Type (Including Eastern Hemlock)

White pine is a moderately tolerant, long-lived species that occurs throughout the MNF in pure stands and as a dominant species in association with hardwoods, hemlock, and other pines. It grows under a wide variety of site conditions, with the best development in moist stream bottoms, lower slopes, and protected coves along with eastern hemlock. White pine is able to compete on upper slopes and ridge tops, and holds its own on a dry southerly exposure. Although classified as intermediate in tolerance, in the seedling stage it can survive and grow slowly with as little as 20 percent of full sunlight. However, in order to develop past the seedling-sapling stage, it must eventually be released from overtopping trees. Once it is established, it grows best in full sunlight.

White pine was a major component in the stands that were harvested around 1900, but presently comprises less than 1 percent of the Forest. Wildfires followed the logging and destroyed much of the white pine regeneration; thus most of the white pine stands were replaced by poor quality oak. An effective fire control program has promoted the establishment of natural white pine regeneration in those stands where a seed source exists.

Eastern hemlock is a shallow-rooted, very shade tolerant species. It can grow under dense shade for up to 200 years and still respond well to a release by partial removal of the overstory. Unfortunately, a non-native insect, the hemlock wooly adelgid, is having a devastating effect on hemlock trees throughout the East. Eastern hemlock trees are showing no resistance to this pest. Unless a solution can be found to control this pest, most of the hemlocks on the MNF will die within the next 20 years.

**Harvest Methods -** There is no known harvest method that will slow the decline of eastern hemlock from the wooly adelgid. Therefore, this discussion will focus on white pine. Growth characteristics of white pine indicate that it can be managed best under even-aged stand conditions, though considerable leeway is allowed in choosing regeneration methods. White pine can be naturally regenerated by clearcutting in blocks and strips, by two-aged, shelterwood, and group selection methods. Single tree selection cutting has not proven to be as successful and the seed-tree method has a higher potential risk of blowdown. Prescribed fire should not be used where there is advance regeneration of white pine if the silvicultural objective is to maintain a white pine component on site.

Clearcutting during, or just after, a heavy seed crop often results in well-stocked stands. Clearcutting in small patches or strips with seed dispersed from adjacent stands is also possible, but the constraints imposed by periodicity of seed crops must be considered. Clearcutting or two-aged harvest methods are recommended when there is advanced regeneration.

The shelterwood method is the most versatile for regenerating white pine. Control of overstory density through a series of shelterwood harvests, or leaving a higher residual density in a two-age harvest with an earlier re-entry harvest, can be used to improve seedbed conditions; to allow accumulation of seedlings over a period of years; to protect seedlings on hot, dry aspects; and to help suppress competition from herbaceous vegetation and hardwood sprouts. Three or more cuts spread over a number of years may be used, but a minimum two-stage shelterwood harvest has provided successful results.

The seed tree method is not recommended because good seed crops occur only every 3 to 10 years. The lower residual basal area of this method would encourage the growth of hardwood seedlings intolerant of shade. Without intensive herbicide treatments the hardwood seedlings would outgrow the white pine.

White pine has been successfully regenerated by the group selection method, however, other methods are more economical to implement.

## Oak-Pine Type

The oak-pine type is usually found on the eastern side of the MNF on dry ridges and generally on south- and west-facing slopes. Typically these are some of the least productive sites on the Forest due to lack of consistent moisture. The oak-pine type makes up about 5 percent of the vegetation types found on the MNF. This type is a transitional stage from a mostly pine type to the oak-hickory type. Without silvicultural treatments associated with timber harvests, such as planting with herbicide treatment or prescribed fire (if there are no pine seedlings in the understory), this type will continue to decrease.

**Harvest Methods** - All even-aged systems can be used to regenerate the oak-pine type. Clearcutting is the preferred harvest method to regenerate the pines since they are intolerant of shade. The two-aged or shelterwood method may be used when oaks are wanted in the next stand but advance regeneration is absent or too small. The first harvest cut will establish new oak seedlings and provide conditions that will allow them or existing small advance reproduction to develop into large sturdy stems. Care should be taken with the two-age harvest method not to leave too many residual trees. The growing crowns of too many residual trees would increase seedling mortality and prevent most seedlings from growing into the overstory. The seed tree method may be used if regenerating mostly pines is the main objective.

For the uneven-aged system, only group selection harvest is suitable for regenerating this forest type since the pines need open areas with substantial sunlight to regenerate and grow. Group selection harvests in the oak-pine type provides a more aesthetically pleasing view to most Forest visitors. Prescribed fire should not be used if there are substantial numbers of existing pine seedlings in the opening or surrounding forested area.

## Oak-Hickory Type

Although oak-hickory types occur over the entire Forest at elevations between 1200 and 3000 feet, the oak-dominated stands on good to excellent sites are classed with the Appalachian Mixed Hardwood type discussed elsewhere. This discussion will center on those stands of the oak-hickory complex with oak site indexes below 65.

The five widely distributed upland oaks in this type are white, northern red, black, scarlet, and chestnut. Although less abundant, the hickories are consistent stand components. This forest type comprises about 25 percent of the forested area on the MNF.

Most of the species found in this ecosystem are in the middle range in shade tolerance as exemplified by the oaks and hickories. However, considerable difference exists among species. For example, scarlet oak is relatively intolerant compared to white oak and red maple, while at the extremes, beech is very tolerant and black locust is very intolerant. Red oak is the most demanding oak in terms of site quality and is more abundant on the higher quality sites. Scarlet and chestnut oak are more commonly found at the lower end of the site range.

**Harvest Methods -** Any silvicultural system applied to the oak-hickory type will maintain a forest stand. However, species composition following cutting will differ by geographic location, site conditions, other species present, and the intensity of the cutting. The choice of silvicultural system and regeneration methods will depend greatly on the objectives of management and the requirements of the species desired. If the management objective is to perpetuate the oaks, even-aged systems will best satisfy the reproduction and growth requirements. Of the four even-aged reproduction methods, the seed-tree method is least useful for reproducing oaks and hickories. The heavy seed is poorly distributed and the slow growing seedlings are not able to compete with the other vegetation that will be present.

The decision whether to use clearcutting, two-aged, or the shelterwood method depends on the potential of existing advance reproduction and stump sprouting to replace the stand. Clearcutting will be successful if combinations of oak advance reproduction over 4.5 feet tall and potential stump sprouts are equivalent to 435 stems per acre well distributed over the area. When adequate advanced oak reproduction is present, the clearcutting method can reverse the naturally occurring conversion of the oak-hickory type to the more shade tolerant hardwood type.

The size of clearcuts is an important consideration but no size is optimum. The maximum size should be determined by stand and site uniformity, esthetic impacts, and wildlife needs. The minimum size is determined by silvicultural requirements, wildlife impacts, and logging economy. Although 0.5 acre openings will satisfy most silvical requirements, a large proportion of the opening will be affected by the surrounding stand. Openings must be at least 2 acres before a substantial area of the opening is not affected by the surrounding stand.

The two-aged or shelterwood method should be used when oaks and hickories are wanted in the next stand but advance regeneration is absent or too small. The first harvest cut will establish new oak seedlings and provide conditions that will allow them or existing small advance reproduction to develop into large sturdy stems.

Using the single tree selection method in the oak type will not perpetuate the quantity of oaks present now or other intolerant species. Harvesting single trees as they mature and cutting to maintain the specified size (age) class distribution results in an essentially complete crown cover at all times. Although oak seedlings will become established, they will be unable to survive in sufficient numbers and grow into the sapling and larger size classes. Furthermore, as the existing pole and small sawtimber-sized oaks pass through succeedingly larger size classes and are harvested, the sapling and small tree component will become dominated by whatever shade-tolerant species are present. Eventually the entire stand will be composed of these shade-tolerant species.

Group selection may be a successful regeneration method when certain conditions are met. Initial reproduction establishment and species composition will be the same as clearcutting in openings of 0.1 to 0.25 acres. Oaks will be present only to the extent they were present as large advance reproduction or as stump sprouts. However, reproduction growth will be retarded near the opening edges, with maximum growth occurring only in the central part of the opening not influenced by the surrounding stand. Although group selection is an effective method, controlling the amount of area regenerated and regulating the rate of cutting for sustained yield are difficult and expensive. The many small clumps of different age classes make cultural treatments and harvesting operations complicated and costly. The smaller openings allow heavier browsing by deer which may slow or prevent the oaks from growing into the overstory.

## Bottomland Hardwoods Type

The bottomland hardwood forest types of river birch-sycamore and red maple (wet site) comprise less than 1 percent of the forest vegetation types on the MNF. However, numerous forest types within the Appalachian mixed hardwood forest cover type make up the rest of the floodplain and riparian forest. Most of the desirable species that grow in this type are intolerant or moderately tolerant of shade, with the exception of beech, maple, and hemlock. A higher percentage of seeds germinate on these sites because soil moisture remains relatively high throughout the year. However, animals, birds, and insects use large amounts of seeds.

Most hardwood tree species that grow near streams can survive minor flooding during the growing season and longer durations of flooding during the dormant season. The majority of flooding along streams in the MNF is usually of short duration (less than 1 week) since most of the national forest land is at the head of the watersheds of several major river systems.

**Harvest Methods -** The even-aged silvicultural system is recommended in this type with the exception of the seed tree harvest method. The seed tree harvest method is not necessary since there is an abundance of seeds in the soil with good germination and survival potential (if heavy deer browsing is not a problem). Seeds can also be transported downslope by water during flooding events. Stump sprouting from cut hardwood trees will contribute to the regeneration of desirable species.

Either group selection or single tree selection may be acceptable harvest methods depending on the objective. Single tree selection would favor shade tolerant species such as beech and maple but these trees are not the well suited for large woody debris in streams since they decay fairly rapidly. Hemlock trees (also shade tolerant) are excellent for large woody debris. The wooly adelgid may prevent small hemlocks from growing large enough to provide this resource in most areas, although abundant debris may occur in the short term from adelgid-related mortality in larger trees. The group selection harvest method would favor some of the more intolerant and moderately tolerant tree species that would also provide more durable large woody debris (with the exception of species like buckeye, aspen, yellow poplar, and cucumber tree, which decay rapidly).

Concerns about stream sedimentation and the lack of large woody debris will limit the amount of harvesting near stream channels on MNF land. Many streams are still recovering from human disturbances such as agriculture (both pre- and post-settlement), grazing, and the railroad construction and subsequent logging that occurred around the turn of the 20$^{th}$ century.

## Appalachian Mixed Hardwoods Type

Appalachian mixed hardwoods, commonly called cove hardwoods, is a forest complex found in rich, moist locations and is characterized by great diversity in composition. This type represents about 40 percent of the Forest and is found in topographic coves, on lower slopes with a northern or eastern aspect, and on gentle terrain. Stands are characterized by a large number and variety of plant species. Overstory composition may range from nearly pure stands of northern red oak or yellow poplar to typical mixtures of 20 or more commercial species. Among the more important trees are: yellow-poplar, sugar maple, northern red oak, hickories, black cherry, white oak, basswood, aspen, cucumbertree, white ash, red maple, sweet birch, beech, elm, and black locust. The mixtures vary with site quality, past treatment, elevation, and latitude. Conifer species can include white pine, red spruce, and hemlock.

Sources of reproduction in these stands include buried seed, stump sprouts, root suckers, and advance regeneration. Seed of several species--such as yellow poplar, basswood, white ash, black locust, and

black cherry--remain viable in the forest floor for at least three winters. Acorns and seed from maples, birches, and beech commonly remain viable over one winter. Nearly all hardwood species sprout vigorously especially when young, but as stems mature, sprouting decreases. Advance regeneration of tolerant species such as maples and beech occurs under dense canopies. Advance oak regeneration composed of seedlings an inch or more in base diameter, with a well-developed root system, is generally necessary for satisfactory growth after release. Logging usually does not kill advance regeneration because the damaged stems sprout vigorously. During their early years, sprouts grow rapidly; often dominating other forms of reproduction, and can produce high-quality trees for a number of species. Prolific sprouters include oaks, yellow poplar, basswood, black cherry, red maple, black locust, and beech.

Reproduction of intermediate tolerant species usually follows a moderate opening of the canopy and can persist for several years. Seeds of white ash, yellow poplar, black cherry, and basswood germinate when favorable conditions of light, temperature, and moisture are created by canopy removal. Because of the abundance of different species in these stands, it is rare that seed crops do not occur for several of these species.

Among major Appalachian mixed hardwood species, shade tolerance ranges from very tolerant beech, hemlock, sugar maple, and basswood to the intermediately tolerant oaks, hickories, birches, and white ash to intolerant black cherry, black locust, and yellow-poplar. Most intolerants and some intermediates will not survive long under a dense canopy. Sugar maple, beech, and, to a lesser degree, oak saplings and pole-size trees can persist for a long time under a dense canopy and then respond to release. Many intermediate and intolerant species in these mixed hardwood stands developed in large openings due to windthrow, fire, snow, ice, logging, etc.

**Harvest Methods -** In Appalachian hardwood stands there are a number of species that reproduce successfully following any regeneration cutting, thus reproduction usually is not difficult. However, species differences in shade tolerance and other silvical characteristics, combined with site variation, lead to changes in species composition. Species composition is affected by the silviculture and harvest systems used.

Even-aged and uneven-aged silvicultural practices have been used to manage Appalachian hardwood stands. Even-aged practices such as clearcutting result in a greater variety of species and a higher ratio of intolerant to tolerant species than uneven-aged practices. The intolerant to intermediate species usually are fast-growing, high-value trees such as black cherry, red oak, white ash, yellow-poplar, and basswood. Clearcutting generally is recommended as the optimum method to regenerate these stands. Both intolerant and tolerant species are reproduced by this method, though the month in which a clearcut is applied can influence the amount of regeneration due to late seed germination. Planned clearcuts provide stands of differing ages in the forest, with each stand contributing wildlife food and habitat that allows a variety of wildlife to prosper.

Two-aged and shelterwood harvests include removing trees in the stand in two or more cuts, usually over a period of 3 to 20 years for shelterwood and 40 to 80 years for two-aged. The higher the residual basal area that is left after the first harvest removal, the sooner the next harvest should occur. For example, if the residual basal area is 50 square feet per acre after the first harvest, then the next harvest entry should be no more than 5 years later. The reason for this is with a high residual basal area the crowns of the trees will close faster and shade out the intolerant tree species that are the objective of using the shelterwood or two-age harvest method. These methods may be used for reproducing species of intermediate tolerance such as oaks and are often recommended where there is no desirable advance regeneration. The effect of these methods on the regeneration depends on the density and duration of the residual overstory. Loss of residual stem quality from epicormic branching may occur.

Regeneration by the seed-tree method is seldom used or needed in Appalachian mixed hardwood stands. Under most circumstances, regeneration comprising the new stand is already established or will become established the first growing season after cutting, regardless of the presence or absence of seed trees. Where seed trees are left in the stand, windthrow and loss of stem quality from epicormic branching are major concerns.

Where uneven-aged practices are used, the tolerant, slow growing, less valuable commercial species such as beech and maple, eventually dominate. Frequently, noncommercial and shade tolerant species such as dogwood or striped maple are found in the understory.

Single tree selection results in the least disturbance to the forest canopy and is used where a nearly continuous forest canopy is preferred, or when stand and site disturbance must be minimized. However, the single tree selection method should not be used if intolerant species are desired because this practice encourages shade tolerant trees and shrubs. Eventually, the mixed character of the Appalachian hardwood stand will be reduced by the single tree selection method to a few commercial and shade tolerant species, such as sugar maple, beech, and red maple.

Group selection provides a mixture of desirable tolerant and intolerant species in mixed hardwood stands, if the openings are at least 0.5 acre, but this system is difficult to apply at periodically short intervals. If the openings are small and well-scattered, aesthetic qualities remain high and excellent wildlife habitat, forage, browse, edge, and mast-producing trees are produced. However, epicormic branching may reduce the quality of the border trees. Epicormic branching may be reduced by leaving smaller trees around the perimeter of the opening to shade the boles of the larger trees. High deer populations may prohibit regeneration success due to heavy browsing pressure in these small openings.

## Northern Hardwoods Type

This type, comprising about 22 percent of forested area on the MNF, is normally found at higher elevations. At its highest limits, the type may merge with red spruce or may occupy areas where red spruce was formerly abundant but has been depleted by cutting and fire. When found at lower elevations on good and excellent sites, this type often merges with Appalachian mixed hardwoods and, depending on the cutting practices, may replace the Appalachian mixed hardwood type or be replaced by it. Repeated cuttings, wildfire, and past land use have created numerous combinations of stand conditions, age classes, and species.

Sugar maple and yellow birch are the most desirable hardwoods for timber production and also contribute to pleasing fall colors. Sugar maple, beech, and yellow birch are the major species and together comprise most of the stocking. Associated in varying mixtures are red maple, hemlock, black cherry, basswood, white ash, and red spruce. Noncommercial understory species include striped maple, hobblebush, eastern hophornbeam, witch hazel, pin cherry, viburnums and serviceberry.

All important, commercial species characteristically reproduce from seed, and some also reproduce by vegetative means. The yellow birch seeds prolifically, producing reasonably good crops every other fall. White ash, sugar maple, and beech produce good crops at intervals of as long as 5 to 8 years. Red maple produces abundant seed nearly every spring and sprouts prolifically from stumps of poletimber and small sawtimber size trees. Sugar maple, beech, and yellow birch sprout reasonably well from stumps of small trees. Beech sprouts on larger stumps generally are short lived but it root-suckers prolifically, especially following cutting. Striped maple also sprouts prolifically while brambles and pin cherry reproduce from seed buried in the upper soil horizon for as long as 100 years, though numbers decline sharply after 40 years.

Species in this type differ in shade tolerance, longevity, and growth rate. Yellow birch, white ash, and red maple are all intermediate in shade tolerance, but while the latter two have moderately fast growth rates, yellow birch has only a moderate growth rate. Sugar maple, beech, and red spruce are shade tolerant, long-lived species with moderately slow growth rates. Hemlock is also shade tolerant and long-lived and while it grows rapidly in diameter, it grows slowly in height. Tolerant small trees and shrubs such as striped maple, eastern hophornbeam, and hobblebush affect silvicultural procedures. Pin cherry, a very shade-intolerant small tree, can be a serious competitor in clearcuts.

The highly shade tolerant beech and sugar maple are the most common tree species in the understory of northern hardwood stands on well-drained sites. Red spruce and hemlock are more commonly found on wet or excessively well-drained sites. These species and the other long-lived tolerant species, when established, can respond to release after long periods of suppression. Yellow birch needs overhead light and a seedbed of moist humus or mineral soil for optimum early establishment and development. Yellow birch must become dominant early in life to survive to maturity. The capacity of birch and other less than tolerant species to respond to release after suppression is moderate to poor.

**Harvest Methods -** The choice of silvicultural systems and intensity of management in the northern hardwood type is influenced by species composition, habitat, site productivity, local markets, and objectives for the area. If the objective is to maintain or increase the stocking of intolerant and intermediate species, clearcutting is the optimum method to use because it allows these species to outgrow their competition.

In northern hardwoods, many seedlings and saplings grow under the shade of mature trees. They often include a variety of species and provide a primary source of regeneration for the new stand following clearcutting. Additional seedlings usually become established after clearcutting so that regeneration includes both trees that developed in advance of the cutting and ones from seeds that germinated later. This combination provides for a mix of species, including ones that will not survive under the shade of older trees. Yellow birch and red maple can develop quickly from seeds dispersed into newly created forest openings, especially if seeds fall onto mineral soil or decayed organic material. Clearcutting normally will increase the abundance of yellow birch, black cherry, white ash, and yellow-poplar. All of these need light and grow poorly under shaded conditions.

Stump sprouts grow rapidly in clearcuts and if the stumps are low, the sprouts develop into satisfactory trees. Because sprouting capacity decreases as trees age, sprouts seldom dominate regeneration following clearcutting of stands more than 75 years old.

The two-aged and shelterwood methods regenerate stands of trees all having about the same age. They establish a crop of new seedlings and allow them to get a good start before all the older trees are removed. These methods require at least two harvest removals on the same area in a rotation length. The initial harvest of some of the older trees allows sunlight to reach the ground. This added light stimulates growth of seedlings after germination, then a second cutting removes the remaining older trees. In the two-aged method the harvest re-entry is usually 40 to 80 years after the initial harvest. The residual basal area in a two-age harvest should be from 15-25 square feet of basal area per acre. The lower residual basal area is necessary due to the length of time to the next entry to allow the intolerant and moderately tolerant species to grow into the canopy before the residual crowns close and suppress the growth of the regeneration. The shelterwood method requires a re-entry harvest usually within 3 to 20 years after the first entry, allowing a higher residual basal area of 30 to 50 square feet per acre. The longer the time between the initial entry and the second entry, the lower the residual basal area should be.

The seed-tree method has no value in the northern hardwood type because the new stand generally originates from seedlings and saplings that were established prior to harvest. In addition, most species in this type produce abundant seed that will store in the leaf litter for 3 to 10 years, thus seed trees are unnecessary.

If the objective is to move the stand towards climax species, then the uneven-aged system will accomplish this in the northern hardwood type. Stands managed by the single tree selection method are harvested at regular intervals (usually every 10 to 15 years) to remove some of the trees. At each harvest, mature trees are removed to make space for new seedlings to develop and also, younger trees are thinned. These cuttings remove single trees from across the stand, leaving behind well-distributed immature ones. The combination of new, young, and older trees makes the stand uneven-aged.

Single tree selection works in the northern hardwood type because sugar maple, beech, hemlock, and red spruce can grow under partial shade and develop in the small openings created by harvesting of a single mature tree. Seedlings of black cherry, yellow poplar, white ash, yellow birch, basswood, and red oak will not normally survive in such shade. Their numbers will decrease with each subsequent harvest, unless the stands are cut heavily.

The group selection method will create larger openings in the forest canopy than the single tree selection method so more sunlight can reach the ground. Species that cannot survive and grow well under partial shading can develop in these openings, so the regeneration will often include more yellow birch, black cherry, white ash, and yellow-poplar seedlings than are found under single-tree selection. By combining group removals and thinning of immature trees, the cuttings maintain a proper mix of tree sizes and ages to provide for regular harvests.

## SILVICULTURAL TREATMENTS

Silvicultural treatments may include single or multiple actions of site preparation, reforestation, and timber stand improvement activities within a stand. Some of the more common silvicultural treatments on the MNF are described below.

### Prescribed Fire

Prescribed burning can be used to achieve one or more objectives including reducing the risk of hazardous wildfires, controlling understory vegetation, restoring fire dependent species or ecosystems, and improving forage for wildlife. An example would be to use prescribed fire to enhance or restore oak regeneration by killing tops of competing vegetation. Oak seedlings put most of their early growth as seedlings and saplings in their roots and are able to re-sprout after fires by out-competing other seedlings and saplings that put most of their early growth in their tops.

### Site Preparation with Hand Tools for Natural Regeneration

The objective of site preparation is to enhance germination, sprouting, and survival of natural regeneration. Site preparation includes cutting down residual trees between 1 and 5 inches in diameter during or immediately after a regeneration harvest. Normally red spruce, hemlock, white pine, dogwood, serviceberry, and shrub species that produce mast for wildlife are not cut. This treatment opens up the forest floor to increased sunlight to improve seed germination potential, promotes sprouting of cut trees, and reduces shading that could inhibit the growth of shade intolerant and moderately tolerant species.

### Herbicide

Similar to prescribed fire, herbicides can be used to control competing vegetation, allowing limited nutrients and moisture to be more readily available to improve growth of the remaining vegetation. Herbicides registered for forest use are usually applied to individual stems by cut stump treatments, stem injection, or basal spray. Foliar spraying or soil application methods may also be used. All treatments would follow label guidelines and would be supervised by a State-certified applicator. In some cases, especially where interfering understories of fern, grass, beech root sprouts, or striped maple have become established on gentle slopes, mechanized equipment or broadcast spraying may be used. Herbicides may also be used along roads and utility corridors.

### Planting

Although hardwood forests normally regenerate naturally after a timber harvest occurs, planting is sometimes used in stands to improve species diversity. Competition for sunlight, moisture, and soil nutrients is intense when a stand is regenerated. To improve the potential for planted seedlings to grow into and be retained as a viable component within a stand, protective tree shelters may be used to improve survival. A tree shelter acts like a mini greenhouse, providing increased temperatures over longer time periods than in open conditions, resulting in increased survival rates and overall growth of the planted seedlings. Tree shelters are also put in place to protect the seedlings from deer browsing.

### Vine Control

Vines interfere with the growth of trees, causing decreased growth, deformity, and broken tops. Broken tops allow entrance for insect and diseases, decreasing the vigor of a stand. Vines are severed with cutting tools near the ground and about 4 feet above the ground leaving a gap to deter any sprouting vines from utilizing the dead vine to grow again into the crowns of the surrounding trees.

## Crop Tree Release

This treatment may be used to achieve a variety of objectives including: to restore diversity of species within a stand; to develop mast producing trees for wildlife; increase commercial value; and/or to improve scenic quality. Criteria should be developed to meet specific objectives in selecting 30 to 50 trees per acre of good health and form to retain in the stand. These selected crop trees are released from competing vegetation by cutting or girdling nearby trees that touch the crowns of the selected trees. Cut or girdled trees that are of little commercial value or provide valuable wildlife habitat may be left on site.

### Precommercial Thinning

This treatment is similar to the thinning harvest method except the cut stems do not have enough value to support a commercial timber sale. Trees that are of low vigor, are poorly formed, or diseased, and species with little commercial value such as fire cherry and striped maple, are cut and left on site to reduce competition for sunlight, water, and nutrients for the residual trees.

# Appendix B

# Old Growth

## Table of Contents

## INTRODUCTION

This appendix describes the current conditions and potential for old growth on the Monongahela National Forest (MNF), and the approach the Forest is taking to manage old growth. A careful reader of the 2006 Forest Plan will notice that the term "old growth" rarely appears. There are various reasons for its absence. The principal reason is that old growth is not managed as a separate entity or distinct resource, but rather it is integrated into the larger spectrum of vegetation management. On the MNF it currently represents a minimal part, comprising less than one percent of the entire Forest. Where it does exist, old growth is limited to small, scattered patches within a larger matrix of primarily 70- to 90-year-old forests.

Forested vegetation can be classified by successional stage and further distinguished by age. The Forest Plan recognizes 3 successional stages (early, mature, and late); the last of which features old large trees and large standing dead and down trees. It is only during the late successional stage whereby old-growth conditions, as described in this appendix, can develop and be maintained. Viewed in this context, old growth represents the "oldest" subset of the late successional stage, which is one of many types of vegetation the Forest manages.

Over the past 20 years there has been a great deal of nation-wide interest and debate regarding the character and value of old-growth forests. Indeed, the term "old growth" has taken on a life of its own, with numerous definitions inspiring even more perceptions and opinions about its true nature. To many the term conjures up images of strolling through an open forest of towering trees filled with abundant wildlife. Some environmentalists and conservation biologists have touted these forests as the last bastions of biodiversity on the planet. Others consider old growth a waste of good timber and a breeding ground for insects and diseases.

As land managers, the Forest Service neither rhapsodizes nor condemns old growth, but rather evaluates what it means in terms of multiple-use management, including contributions towards biodiversity. Because forests grow older through natural succession, there is always the potential for stands to develop old-growth characteristics once they have reached the late successional stage. In order for forest stands to reach this stage, they must be able to grow older, typically well beyond 100 years of age, without large-scale natural or human-induced events that would remove the old/large tree component. From the land manager's perspective, the late successional stage has the greatest probability of occurrence in areas receiving relatively little or no vegetation management.

The Environmental Impact Statement that accompanies this Forest Plan states where these areas of little or no vegetation management are most likely to occur (i.e., areas providing the greatest potential for future old growth) and analyzes the effects that would occur on various resources. Generally speaking, these areas would have minimal effects on soil disturbance and erosion, water quality, and backcountry recreation opportunities. On the other hand, they would have fairly major effects on timber growth and yield, associated economic outputs, and opportunities for motorized recreation.

Old-growth forests can display a wide variety of vegetative conditions, depending on factors such as species composition, stand age, environmental conditions (climate, geology, topographic position), and soil productivity. The appearance and function of old growth differs dramatically depending on forest type (e.g., spruce-fir vs. oak-pine vs. mixed mesophytic). Some forest types do not support much plant or wildlife diversity no matter how old they grow. Others can be species rich at a fairly young age and continue to add diversity and complexity as they grow older. For virtually all forests, however, time is a critical factor in the attainment of old-growth characteristics. At the national and Forest levels, certain characteristics that are fairly common to old-growth forests have been identified. Characteristics for old growth on the Monongahela National Forest (MNF) are described below.

## OLD GROWTH DEFINITIONS AND CRITERIA

The 1986 MNF Forest Plan and supporting analysis included two definitions of old growth, one more conceptual in nature and one more operational.

In the 1986 Forest Plan (page 55), old growth is defined as: "Stands with large, mature or over-mature trees (both healthy and decadent) comprising a plurality of stocking, usually having a multi-layered canopy in trees of various age classes. Stands include dead trees and relatively large amounts of decaying material on the forest floor."

In the Glossary for the Final Environmental Impact Statement for the 1986 Forest Plan (page E-22), old growth is defined as: "A stand of trees older than normal rotation age for that timber type. Old growth provides important wildlife habitat conditions not normally found in younger stands."

Simply defining old growth as a stand of trees older than normal rotation age, while being technically accurate and easy to query in databases, does not adequately capture the complicated aspects of old-growth management. In determining where, when, and why to manage stands as future or potential old growth, the ecological, landscape, and social aspects of old-growth forests need to be considered.

In 1995 the Forest reviewed the 1986 Forest Plan intent for determining old-growth areas (DeMeo et al. 1995 internal report). This report provided a set of criteria to use in identifying areas as old growth, in accord with generic guidelines developed at the national scale. The criteria, described below, are: age, species composition, structural diversity, woody debris, gap formation, patch size, and adjacency.

**Age.** Age is an important component of an old-growth definition, as it helps explain forest stand origin and dynamics. While large, old trees epitomize an old-growth ecosystem and may be the ultimate goal of old-growth management for wildlife species or scenic values, a mix of young-, mid- and old-aged trees typically comprise old-growth stands. Old-growth conditions often develop through ongoing gap-phase dynamics as stands age and move toward uneven-aged or multi-aged structures.

**Species Composition.** Species present in old growth vary by forest type, dependent on a number of environmental (site) and disturbance factors. Most importantly, species composition greatly controls the structure and appearance of old growth. For example, in moist nutrient-rich coves sheltered from wind and fire, large, long-lived, moisture-loving trees (yellow poplar, white ash, and basswood) can develop. In contrast, dry, nutrient-poor ridge tops might only support smaller-sized, fire-adapted species (oaks and pines). In general, shade-intolerant, pioneer species such as black locust, aspen, or hawthorn are absent or a minor component in older forests on the MNF. Old-growth forests are described by the tree species that either currently exist or are expected to dominate the site over time.

**Structural Diversity.** Old-growth stands are normally characterized by multiple tree layers with diverse understories of forbs and shrubs. Tree diameter and height can range greatly according to component species and site conditions. For example, tree and canopy development will be slower on dry, nutrient-poor sites than on moist, nutrient-rich sites. The distribution of tree sizes in an old-growth forest is often skewed due to its complex history of stand dynamics. Knowledge of past disturbances and stand origin, coupled with age data, can help determine if size distribution represents true uneven-aged structural development.

**Woody Debris.** Old-growth forests are often characterized by large-diameter logs on the forest floor and standing dead trees called snags. These components are vital to old-growth function as they

provide habitat for flora, fauna, and fungi that perform much of the decomposition and nutrient turnover. Standing dead trees also provide habitat for larger fauna such as cavity-nesting birds and mammals. Woody debris may not be abundant in some cases; for instance in fire-adapted old-growth forests that continue to experience recurrent fire.

**Gap Formation.** Old-growth forests in pre-settlement West Virginia probably regenerated through combinations of frequent, small-scale wind events (Runkle 1982), low intensity surface fires, and insect or disease outbreaks. Large stand-replacing events, like blowdown from microbursts or hurricanes, occurred but were much less frequent. Small-scale disturbances resulted in canopy gaps that released growing space, which spurred tree regeneration and eventual gap closure. Over time, a shifting mosaic of multi-aged groups of trees developed across the landscape.

**Patch Size.** Considerable research has focused on the minimum area necessary to maintain viable old-growth structure and function (Ranney et al. 1981, Hansson 1992, Smith 1989). A small patch may contain the species composition, structural diversity, canopy layers, and other characteristics of old growth and yet lose viability over time because it is too small to maintain itself. For example, large windstorms can destroy the entire overstory.

Large patches (greater than 10,000 acres) should ensure the integrity of ecological functions and the distribution of old-growth conditions at the sub-regional scale. Medium-sized patches of old growth, ranging from 150 to 10,000 acres, can supplement the spatial distribution of large-scale patches across the landscape. Small patches typically protect existing old growth. They can also represent forest communities that are underrepresented or that normally occur in isolated fragments, or they can serve to connect or augment large or medium patches.

Large patch sizes have a higher proportion of interior conditions, and small patch sizes tend to have proportionately more edge, which is the boundary between two ecosystem states. Edge generates microclimatic and biological effects, such as increased sunlight, wind velocity, plant species invasion, and altered habitat for birds (Temple 1984) across an edge width. Edge width based on sunlight penetration in certain eastern forests is about 15 meters (Ranney et al. 1981), but about 100 meters based on bird habitat requirements (Temple 1984). Forest patch size minus the edge width gives interior area. Interior area is important in assessing old-growth viability, as areas with little or no interior can be substantially altered by relatively small disturbance events that result in loss in of patch integrity and function.

**Adjacency and Scale.** Vital to old-growth management is consideration of neighboring forest stands relative to the size of old-growth patches. In the eastern United States, old-growth patches are not widely distributed across the landscape. One objective for managing old growth is to identify and protect remnant patches so that over time they remain viable. A related objective is to promote future old growth by identifying older adjacent second-growth patches that can eventually develop into old growth and thereby expand the effective size and function of the remnant patches.

This list of seven criteria may be used as a conceptual definition for old growth on the MNF to determine if an existing area should be considered old growth, or the list may be used as guidelines for designating stands as future old growth. We do not expect to find large areas of true old growth on the Forest because of past land management. An arbitrary age, patch size, amount of woody debris, or other measure of the criteria listed above should not be used to define old growth. For example, a 100-year-old stand may not be identified and managed as future old growth if it is a small isolated patch surrounded by private land, but an 80-year-old stand adjacent to wilderness might be identified as future old growth because it has better potential for contributing to a large old-growth patch in the future. Definitions of old growth may

continue to be refined, even described for different forest types and disturbance regimes. These changes would be incorporated in the Forest's management of existing and potential future old growth areas.

The USDA Forest Service, Eastern Region has not developed operational definitions of old growth as has the Southern Region. Instead, the Eastern Region has compiled information on old-growth forests by forest type groups for reference (Tyrrell et al. 1998). The Southern Region operational definitions include minimum ages, minimum basal area per acre, and largest tree diameter at breast height by broad forest type groups (USDA Forest Service, Southern Region 1997). With these definitions, Southern Region Forests used database queries to identify stands or patches meeting the criteria. Not having operational definitions of old growth available, the MNF can continue to identify existing old-growth patches through project-level analyses, other analyses, searches initiated by the Forest Ecologist, or through public contacts. These candidate or possible old-growth areas would be compared to the data and descriptions of other known old-growth forests as described in Tyrrell et al. (1998) and applicable Southern Region definitions.

## EXISTING AND POTENTIAL OLD GROWTH ON THE MNF

In order to see how the MNF intends to provide for old growth, it is important to understand the two different types of old growth that are considered: 1) existing old growth, and 2) potential old growth. Existing and potential old growth are described in more detail below.

### Existing Old Growth

Existing old growth on the MNF is limited to small, scattered patches within a larger landscape of 70 to 90 year old forests. The value in protecting these patches is in the protection of the rareness of the older trees and associated communities, even though these patches may continue to be influenced by surrounding younger forests.

Few areas are considered true old growth on the MNF due to turn of the 20$^{th}$ century logging and associated burning. As noted above, time is a critical element in the development of old growth characteristics, and not enough time has elapsed on the MNF to allow for old growth characteristics to manifest themselves in most cases. The remaining known old-growth areas have been identified and protected by Botanical Area, National Natural Landmark, or Scenic Area designation, and are managed through specific Forest Plan direction. These areas total an estimated 318 acres and include the Gaudineer Scenic Area (140 acres), Shavers Mountain Spruce-Hemlock stand (68 acres), Virgin White Pine area (13 acres), North Fork Mountain Red Pine Botanical Area (10 acres), and the Fanny Bennett Hemlock Grove (70 acres). One other area has been documented on the Forest—the North Spruce Mountain old growth site of an estimated 17 acres. Other old-growth patches may exist in areas already protected from active management such as Cranberry Bogs and the Smoke Hole-North Fork Mountain area of the National Recreation Area. Undoubtedly there are small areas on the Forest like this where timber harvest did not take place due to poor access, terrain, or timber quality.

Gaudineer Scenic Area is also a National Natural Landmark. Direction for this area includes a goal to "maintain virgin forest characteristics" and standards that restrict timber products from being removed from the area and certain types of vegetation management. This area provides a fine example of what old growth looks like in a spruce-hardwood ecosystem. Large trees are present but not in great abundance, as many older trees have died and fallen to the ground, creating forest gaps and a profusion of logs, broken snags, and woody debris that make off-trail walking difficult.

The Shavers Mountain Spruce-Hemlock Stand is a National Natural Landmark. Management direction includes a goal to "maintain the old growth/mature forest ecosystem" and standards that prohibit timber harvest, road and facility construction, livestock grazing, and motorized use. Much of this area is also inside the Otter Creek Wilderness, which has similar prohibitions.

The Virgin White Pine Botanical Area has a goal to "emphasize the preservation of virgin forest" and standards that prohibit commercial timber harvest, road and facility construction, and firewood gathering.

The Fanny Bennett Hemlock Grove and North Fork Mountain Botanical Areas have similar goals to, "Emphasize the preservation of virgin forest", and standards that prohibit commercial timber harvest, road and facility construction, and motorized travel.

Virtually all of the existing old-growth patches on the MNF are small and adversely affected by surrounding second growth or open edge, which may beg the question why the Forest strives to protect them. The value in protecting these patches is in preserving the rareness of the stands of older trees and their associated communities, which adds to the overall diversity of the Forest. They may also contribute to larger patches of old growth as the forests around them age and develop old-growth characteristics.

## Potential Old Growth as a Result of Alternative 2 Modified

Potential old growth is defined as forest stands or patches that currently do not exhibit the suite of old-growth characteristics described above, but that have the potential to develop the characteristics in a reasonable length of time if left unmanaged. Some areas, such as fire-adapted oak forests, may benefit from management activities that emulate natural processes, such as prescribed fire and thinning, in order to achieve desired ecological conditions. All areas would likely continue to age and change through predominantly natural processes, thereby providing the potential for old-growth characteristics to develop in the future. The largely unmanaged states are identified in the 2006 Forest Plan through a combination of Management Prescription (MP) allocation and management direction.

**Management Prescriptions.** Management Prescriptions where active manipulation of vegetation is not allowed or is expected to be minimal include MP 5.0 (Designated Wilderness), MP 5.1 (Recommended Wilderness), MP 6.2 (Backcountry Recreation), and many MP 8.0 areas, including National Natural Landmarks, Scenic Areas, Ecological Areas, and Candidate Research Natural Areas. All of these MPs have management direction that prohibit or restrict timber harvest and new road construction. Estimated acres for these areas are displayed in Table B-1.

Patch sizes for MP 5.0, 5.1, and 6.2 units are generally over 5,000 acres each, with many exceeding 10,000 acres. The 10,000-acre and above areas correspond to, and can function as biological reserves, as described in the Ecological Diversity analysis in Chapter 3 of the Forest Plan Revision EIS. The numerous 8.0 areas are mostly small- to medium-sized patches (Table B-1), but several are adjacent to a 5.0, 5.1, or 6.2 MP units, which have the additive effect of expanding the old growth potential of each area. Also, there are two SPNM areas within the Spruce Knob-Seneca Creek NRA that are a combined 21,500 acres. These areas would also feature little or no vegetation management.

**Management Direction.** Within the MPs that promote commercial timber harvest and allow new road construction (MPs 3.0, 6.1, and portions of 4.1), there are many areas where these activities are prohibited or limited by Forest Plan standards and guidelines due to other resource concerns. These restricted areas include:

- Buffer areas around stream channels, lakes, and wetlands that extend anywhere from 25 to 100 feet around these features. See Forest-wide direction in the Soil and Water section.
- Corridors for eligible Wild and Scenic Rivers that have a Wild or Scenic classification.

- Suitable habitat for West Virginia northern flying squirrel, a federally listed species.
- Primary range, hibernacula and key areas for Indiana bat, a federally listed species.
- Corridors or buffer zones for areas with a Very High Scenic Integrity Objective.

Direction for these areas of restricted management can be found in a number of resource sections of the Forest-wide Management Direction section in Chapter II of the Forest Plan. Estimated acres for these restricted areas are listed in Table B-1, below.

In additions to the areas listed above, the MPs associated with suited timberlands also have Desired Conditions for late successional stages that would maintain lands for future old growth potential.

Patch sizes and shapes of the areas vary widely, from 25-foot linear buffers on either side of an ephemeral stream channel to very large blocks of WVNFS suitable habitat. Some of the larger blocks exceed 10,000 acres, and others exceed this threshold when combined with adjacent 5.0, 5.1 or 6.2 MP units.

**Table B-1. Potential Old Growth Acres* on the Monongahela National Forest**

| Potential Old Growth Areas | Estimated Acres |
|---|---|
| **Management Prescription Areas with Little or No Commercial Harvest Potential** | |
| MP 5.0 – Designated Wilderness | 78,700 |
| MP 5.1 – Recommended Wilderness | 27,700 |
| MP 6.2 – Backcountry Recreation (SPNM Emphasis) | 106,800 |
| MP 8.1 – NRA Semi-Primitive Non-Motorized Areas | 24,900 |
| MP 8.2 – National Natural Landmarks | 2,000 |
| MP 8.3 – Scenic Areas that are not also NNLs | 2,200 |
| MP 8.4 – Ecological Areas that are not also NNLs | 1,100 |
| MP 8.5 – Candidate Research Natural Areas | 2,200 |
| **Subtotal** | **245,600** |
| **Areas within Suitable Mgt. Prescriptions with Little or No Commercial Harvest Potential** | |
| Indiana Bat Primary Range, Hibernacula, and Key Areas | 146,100 |
| West Virginia Northern Flying Squirrel Habitat | 152,600 |
| Perennial and Intermittent Stream Channel Buffers | |
| "Wild"or "Scenic" Wild and Scenic River Corridors | |
| Very High and Distinct Scenic Integrity Areas | |
| Other Areas Tentatively Unsuited Areas (Non-forested, unstable soils, etc.) | |
| **Total Acres** | **544,300** |

*Acres are rounded to the nearest 100 and based on Alternative 2M for Forest Plan Revision

This acreage represents nearly 60 percent of the entire Forest. These numbers are believed to be conservative, based on the following factors:

- WVNFS suitable habitat and Indiana bat habitat areas may increase over time.
- There could be additional MP 8.0 designations in the future.
- Buffers for ephemeral stream channels and wetlands were not included in the estimates.
- Forests continue to age over time, which means that any area that the Forest Service does not actively manage for timber should continue to age as well, and the Forest Service rarely if ever manages every acre that is available to manage, even suitable timberland acres.

The Ecosystem Diversity (Coarse Filter) section of Chapter 3 of the EIS includes an extensive analysis of minimum dynamic area (MDA) reserves for all alternatives. The MDAs serve as potential old growth and are based on areas with MPs and other direction that will prohibit or greatly limit large-scale even-aged timber management. MDAs are defined for the Monongahela as at least 10,000 acres in size and total 390,000 for Alternative 2M, or over 40 percent of the Forest. The representation of ecological communities in these MDAs by alternative was used as an indicator of effects in the analysis.

## IDENTIFICATION AND DISTRIBUTION OF OLD GROWTH AREAS

"*Rather than transferring western ideas to the east, scaled down in some subjective fashion, eastern concepts of old growth should reflect the size and longevity of eastern species and the successional pathways, disturbance regimes, and perhaps even the extent of past human disturbance*" (Tyrell et al. 1998).

In response to external and internal interest regarding old growth, the Forest Plan has been revised to incorporate a new approach for the identification and management of old growth. This section describes the overall approach, which has two essential parts:

1) Identify and preserve existing patches of old growth forest.
2) Identify and maintain areas of potential old growth that can add to the size and efficacy of existing old growth over time.

The MNF did not adopt the strategy, as some other Forests have, of designating or allocating lands across the Forest to a specific management prescription of old growth areas or preserves. This approach can provide a sense of security for some—especially those that have a devotion to old growth and an inherent mistrust of the agency—that old growth will be protected in perpetuity. In reality, there are very few old growth stands on the Forest now, and the Forest cannot guarantee that old growth stand conditions will develop on any given area in the future. Even in the absence of management-related disturbance, natural disturbances may occur in unpredictable patterns. Therefore, the MNF has developed the following management strategies to address the old growth issue:

1) The Forest has identified and preserved existing small patches of old growth within National Natural Landmark (8.2), Scenic Area (8.3), and Ecological Area (8.4) Management Prescriptions.

2) The Forest should continue to look for and preserve existing old-growth stands, as stated in Forest-wide objective VE03. This objective also describes the need to identify potential old growth.

3) The Forest has allocated Management Prescriptions with little or no emphasis for vegetation management (5.0, 5.1, 6.2, portions of 8.0 and 4.1). These MPs should serve as potential areas for future old growth. These areas are referred to as minimum dynamic area (MDA) reserves in the EIS.

4) Within MPs that emphasize vegetation management (3.0, 6.1, and portions of 4.1), the Forest Plan has management direction for specific areas that restrict vegetation management. These areas include listed species habitat, stream channel and wetland buffers, eligible WSR corridors with a Wild classification, and very high Scenic Integrity Objective areas. They would provide additional areas where potential old-growth conditions could develop over time.

5) Within MPs that emphasize vegetation management (3.0, 6.1, and portions of 4.1), there are desired conditions for late successional forests. Where these desired conditions are fairly low, such as 5-10

percent, they can likely be met with the areas described under part 4), above. Where desired conditions for late successional forests are more extensive, additional areas can be selected during watershed and project assessments. These forests would provide additional areas where potential old growth conditions could develop over time.

The *Ecological Considerations when Identifying Future or Potential Old Growth* section, below, provides components to consider when determining if an area is a good candidate for designation of future or potential old growth and are not meant to determine if old growth conditions are present. However, there may be other considerations for where late successional forests are managed for on the landscape (recreation, visual, wildlife habitat, etc.).

This approach should provide abundant areas where old-growth conditions could develop over time. Because these areas are well distributed across the landscape, it is expected that potential old growth would be well represented in the major forest types and Ecological Subsections on the Forest.

## Ecological Considerations when Identifying Future or Potential Old Growth

The seven criteria listed under the Old Growth Definitions and Criteria section above can be used as a conceptual definition. When applying these criteria, site limitations should be kept in mind. For example, a dry site that is inherently infertile will not produce large trees at the same rate and dimensions as a moist, fertile site. The disturbance patterns and history of the site should also be considered. Because most of the lands that became the MNF were intensively logged at the turn of the 20$^{th}$ century and subsequently burned and grazed, the current forests date from this era and are mainly even-aged. The introduction of exotic pests and diseases has greatly impacted, and will continue to impact, forest composition. For example, American chestnut once dominated eastern West Virginia before the introduction of chestnut blight largely eliminated this species. More recently, hemlock wooly adelgid, beech bark disease, and gypsy moth are known to cause decline or mortality in the MNF and surrounding private forests.

The role of fire in oak-dominated forests should also be considered when maintaining old-growth patches. Oaks are fire adapted and in some areas are being replaced by more shade tolerant trees through fire suppression. However, their current dominance in some stands may reflect the altered disturbance regimes caused by the large-scale clearcuts, fires, grazing, and the elimination of American chestnut in the 1920s and 1930s.

At the project level, knowing the forest types and landtype associations (LTAs) of the project area can help determine the physical environment and disturbance regimes that helped create the current forest, as well as the forces likely to affect the forest in the future. Descriptions of the LTAs can be found in the *MNF Ecological Classification User's Guide* (USDA Forest Service 2002), including the distinguishing features, disturbance regimes, and management implications for each LTA on the MNF.

Historic disturbance regimes focus mainly on the occurrence of fire in an LTA. Other natural disturbances, such as wind, ice, or snow damage, drought, pests and pathogens, occur at various spatial scales. These disturbance agents have not yet been identified at the LTA scale. However, site factors such as climate, soil types, and elevation can give clues to the natural disturbance factors likely for the site or LTA. These disturbance factors and the likely scale they historically operated within should be considered when identifying existing or potential old growth.

The likely successional path of a current stand can also help in determining its suitability as potential old growth. Current vegetation may not represent the potential natural vegetation of the site. Care should be taken to ensure that conditions that historically drove old-growth dynamics are maintained at the proper

spatial scales (especially fire in fire-dependent communities), otherwise old-growth preservation may lead to degraded systems.

At the site level, potential natural vegetation predictions in the Forest's Terrestrial Ecological Units database can be used as an estimate of the future dominant tree species. The potential natural vegetation should be reviewed, on the ground if possible, and considered when determining the suitability of an area for meeting old-growth objectives.

Another tool is the MNF Fire Adapted Vegetation model and predicted fire regime condition class (FRCC) map. This model, based on potential natural vegetation and existing vegetation, summarizes at the landscape scale the fire adaptability of the forest communities across the Forest. This tool is useful in determining if areas with late successional forest are fire adapted or dependent, what fire regime and condition class they are in, and whether prescribed fire may be a tool to maintain or create the desired forest structure. One example of this would be in areas dominated by some oak species. Depending on the LTA, fire may be necessary to retain oak dominance and to avoid slow conversion to maple dominance.

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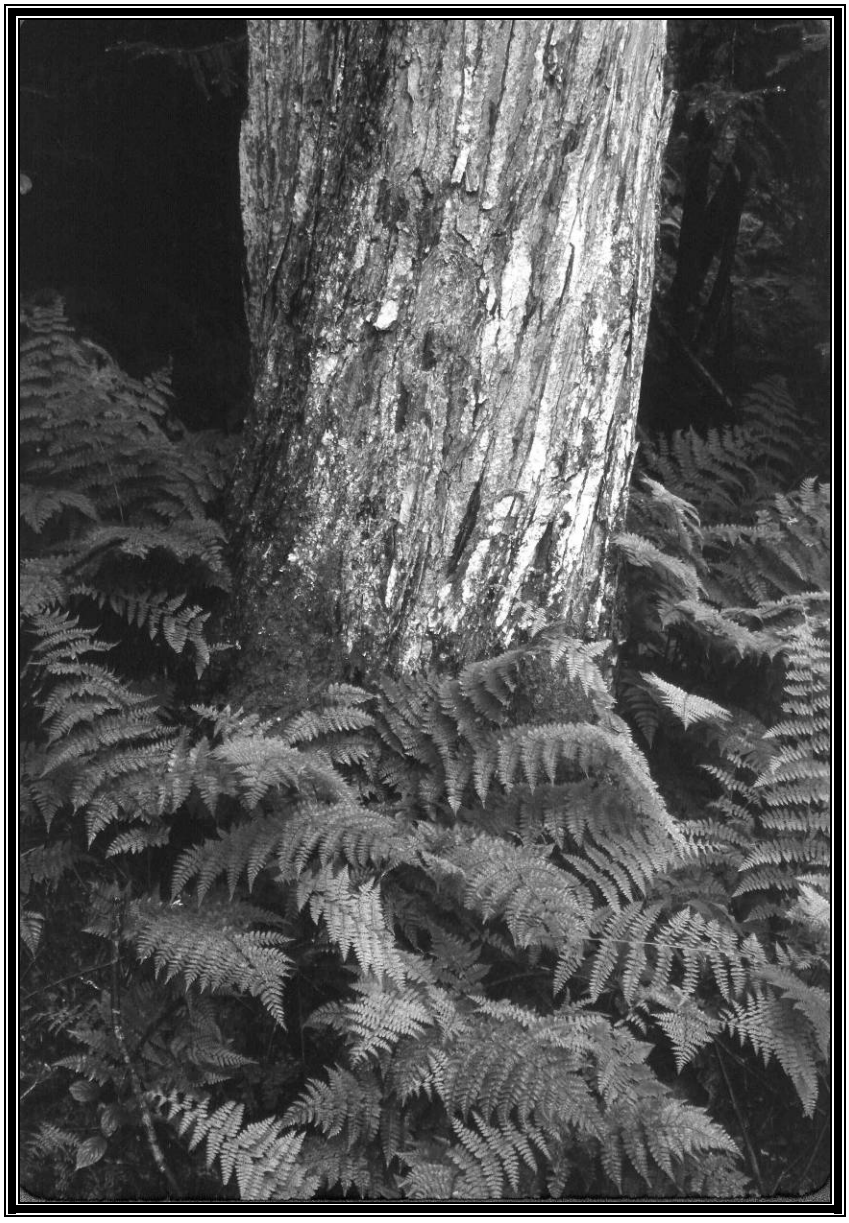


**Gaudineer Scenic Area**

# Appendix C

# Analysis Of The Management Situation

# Summary

## Table of Contents

## INTRODUCTION

The regulations to implement the National Forest Management Act (NFMA) require, as a part of the planning process, an analysis of the management situation (AMS). The primary purpose of the AMS is to identify any need for change from the direction in the original or 1986 Forest Plan. The AMS also determines the ability of the planning area to supply goods and services in the response to society's demands. Detailed AMS reports were prepared for the following topics:

- Recreation, Trails, Landscape Management and Wilderness Resources
- Heritage Resources
- Terrestrial Ecology and Special Forest Products
- Terrestrial Species Viability Evaluations
- Vegetation Management
- Timber Suitability Assessment
- Terrestrial Wildlife Species and Habitat
- Mineral Resources
- Soil, Water, and Air Resources
- Research Needs

The complete AMS is included in the official planning record. This appendix provides a summary that highlights the portions of the AMS that relate to the need for change. The need for change topics are:

- Backcountry recreation opportunities, including recommended wilderness
- Vegetation diversity and restoration opportunities
- Suitable timberlands and available timber supply
- Soil and water concerns.

This summary of the AMS highlights the following similar topics:

- Recreation and Wilderness
- Vegetation Diversity and Management
- Timber Management and Supply
- Soil, Water, and Air Resources

The intent of the summary is to give an overview of each resource summarized, anticipated demand for the resource, and a discussion of the change needed.

## RECREATION AND WILDERNESS

The West Virginia Department of Tourism Annual 2001 Report indicates that 22 million visitors traveled to the state and spent over $3.1 billion dollars, with a total economic impact of $4.86 billion. Included are 8.6 million visitors who stayed overnight with an average stay of 3.72 days/person. Leisure expenditures were $69.50/person/day. The 2001 Report indicates:

- The most popular outdoor recreation activities that visitors participated in include: Site-seeing (20%), Visiting Parks (17.8%), Hiking/Mountain Biking (15.5%), Visiting Historic Sites (10.1%), Hunting/Fishing (8.6%), and Camping (6.8%).

- Visitors to West Virginia are primarily from the following states: Ohio (16.4%), Virginia (9.3%), Pennsylvania (8.1%) Maryland (7.5%), Kentucky (5.4%), North Carolina (4.9%) and Florida (4.65).

The top five overnight metropolitan markets are: Washington D.C., Cleveland, Pittsburgh, Charlotte, and Columbus.

- The Monongahela National Forest is within a day's drive of 1/3 of the United States population.
- The 2001 visitor survey indicates that one of the primary attractions of West Virginia is Outdoor Recreation activities, while areas of concern identified by visitors are the quality of restaurants and accommodations.
- The Monongahela National Forest provides over 50% of the available public land available for outdoor recreation in the State of West Virginia.
- In 2001, over 1 million hunting and fishing licenses provided over $15.5 million in revenues to the State, including 71,201 conservation stamps to non-residents.
- There are 9 state forests and 41 state parks totaling over 200,000 acres in West Virginia. In general, state managed parks have significant development and provide more developed recreation and leisure activities than most Monongahela National Forest facilities.

The following recreation activity participation statistics are results of the National Visitor Use Monitoring Program. The numbers are averages based on surveys completed on the Monongahela National Forest (Forest). Only the top 10 activities have been listed.

**Table C-1. Visitor Use Monitoring Program Summary**

| Activity (participation on FS lands) | % Participation |
|---|---|
| 1. Viewing Natural Features (scenery, flowers, etc) | 59.42% |
| 2. Viewing Wildlife, Birds | 54.68% |
| 3. Hiking/ Walking | 46.64% |
| 4. General/Other (relaxing, hanging out, escaping noise and heat) | 45.79% |
| 5. Driving for Pleasure | 34.83% |
| 6. Fishing | 26.36% |
| 7. Nature Center Activities | 19.74% |
| 8. Camping, Developed Sites | 14.97% |
| 9. Picnicking | 14.95% |
| 10. Downhill Skiing | 11.18% |

Note: Bicycling (mountain biking) is 5.71% and horseback riding is 0.25%.

As the remainder of the country becomes increasingly populated, it is reasonable to assume that the relatively uncrowded State of West Virginia will become more attractive for both recreationists and others seeking areas to get away from the crowds.

In West Virginia, the Forest, and to a lesser extent the State lands, are almost the exclusive providers of public primitive or semi-primitive non-motorized recreation opportunities. The Forest contains five Wildernesses totaling over 78,000 acres, or about 9% of the Forest. There are also over 324,400 acres of the Forest in Management Prescription 6.1 and approximately 125,000 acres in Management Prescription 6.2. Both of these prescriptions emphasize semi-primitive non-motorized (SPNM) recreation opportunities and represent almost 50% of the Forest land base. The National Visitor Use Monitoring was completed on the Monongahela National Forest from October 1, 2002 to September 30, 2003. The

results indicate that there were an estimated 38,590 visits to the 5 wildernesses on the Forest, which is about 3% of the total recreation use.

### Need for Change

Revising the plan creates an opportunity to ensure our goals, objectives, standards, guidelines, and policies are appropriate to enhance our visitor's recreation opportunities and experiences. Opportunities exist to discuss, explore and define the role of the Monongahela National Forest as a recreation provider in terms of Forest settings. Using the Recreation Opportunity Spectrum (ROS) we have the opportunity to display a range of areas in a variety of existing and desired conditions across this spectrum. Because the Forest provides over 50% of the public lands outdoor recreation opportunities in the state of West Virginia, the amount of areas providing rural, roaded-natural, and semi-primitive non-motorized opportunities are extremely important to over 1 million visitors annually.

Revising the plan will also allow us to conduct a roadless area inventory and wilderness evaluation. This analysis will help identify what the appropriate amounts of semi-primitive non-motorized and wilderness study areas are for the Forest. The evaluation of wilderness potential and wilderness recommendation is one of the 6 planning decisions to be made in Forest Plan revision.

### Changes Under the Revised Forest Plan

Forest Plan direction was reviewed and updated. The desired conditions and goals for recreation management were greatly expanded, and standards and guidelines were revised to provide protection of recreation resources and settings, while allowing more flexibility for management at the site level.

The Forest conducted a roadless area inventory and wilderness evaluation. Four areas (27,700 acres) were recommended for wilderness study. Two of these areas would expand existing wilderness.

The overall backcountry recreation settings and opportunities offered by Management Prescriptions 5.0, 5.1, 6.2 and 8.1 SPNM (Semi-Primitive Non-Motorized areas in the Spruce Knob-Seneca Rocks NRA) show a substantial increase (34,900 acres) over those in the 1986 Plan.

The Spruce Knob-Seneca Rocks NRA was given its own Management Prescription, 8.1, to emphasize the importance of this national recreation attraction. This prescription has its own set of expanded management direction. A revised management plan for the NRA is in the works that will tier to the NRA prescription and management direction.

## VEGETATION DIVERSITY AND MANAGEMENT

Within the proclamation and purchase unit boundaries of the Monongahela National Forest are approximately 1.7 million acres. Of these, about 919,000 acres are in federal ownership, and about 881,000 acres are forested. The Forest is situated at the intersection of the southern reaches of some tree and plant species, and the northern extent of others. The Forest is mountainous, with a range in elevation from about 900 feet to a maximum of 4,863 feet, further contributing to the wide diversity in vegetation on the Forest. The general axis of the Forest is northeast to southwest.

This summary of Terrestrial Ecology and Special Forest Products AMS will cover: old growth, prescribed fire, and forest health (which includes insect and disease pathogens), altered disturbance regimes, ecological sustainability, and non-native invasive species.

**Old Growth**

Few areas of the Forest National Forest escaped the turn of the 20th century logging and are considered true old growth. These areas are protected by designation as candidate Research Natural Areas, Botanical Areas, or Scenic Areas and through specific Forest Plan standards and guidelines. These areas total around 300 acres and include the Gaudineer Scenic area (140 acres), Shavers Mountain Spruce-Hemlock Stand (68 acres), Virgin White Pine area (13 acres), and the Fanny Bennett Hemlock Grove (70 acres).

The 1986 Forest Plan calls for designating old growth in Management Prescriptions (MP) 3.0, 4.0, and 6.1. Old growth stands in these MPs were identified and designated during project development and analysis until the mid 1990s. Currently about 10,763 acres are given a land suitability code in the CDS database that identifies them as designated old growth. These designations are misleading because the areas are not likely true old growth and are more accurately described as future or potential old growth or mature habitat.

Currently, during project design and analysis, a pool of potential old growth stands is identified. Instead of designating stands as old growth and risk choosing less than optimal future habitat, the pool of potential old growth is treated as a resource, and impacts to this resource from proposed actions are assessed and documented. The pool of acres is often greater than the 5% called for in Forest Plan guidelines for MPs 3.0, 4.0, and 6.1, which are the only management prescriptions calling for designation of old growth.

The purpose of designating old-growth stands in MPs 3.0, 4.0, and 6.1 is different than the designation of large areas of forest where vegetation management is limited (5.0 and 6.2 MPs). MPs 5.0 and 6.2 areas serve as large areas of future old growth conditions. The small patches called for in the Forest Plan in other MPs were not meant to provide fully developed old growth habitat conditions, but rather to increase vegetative and structural diversity in areas where timber management is allowed.

About 98% of the Forest has been inventoried for age and forest type, including non-forested areas, as stored in the 2003 CDS database (although no age is associated with non-forested areas). The majority of the Forest is over 60 years old (84%), with 75% of the Forest between the ages of 60 and 104 years. About 9% of the forest is over 105 years old. The age of a stand can be considered an average as it is usually estimated from one or two trees representative of the majority of the stand. Many stands include multiple age classes depending on previous harvest or natural disturbances. Individual trees in a stand either older or younger than the given stand age are likely. These figures are for all management prescriptions and forest types.

Two internal reports were prepared to address and guide the management of old growth on the Forest since the adoption of the 1986 Forest Plan. The first in 1990, titled “Selection, Designation and Management of Old Growth”, provided direction, perspective, and a process for interdisciplinary teams to follow in selecting, designating, and managing areas to meet Forest Plan direction relating to old growth.

In the 1990 report a new term was used to describe the stands designated to meet Forest Plan old growth standards and guidelines under MP 3.0, 4.0, and 6.1. These areas are better described as “future old growth” and defined as areas of forest too young to be true old growth presently but set aside (designated) so that through time, proper management, and protection they will provide true old growth on the Forest. These stands do not necessarily exhibit old growth characteristics when designated as future old growth.

Before 1990, interdisciplinary teams identified a pool of the oldest stands within an analysis area but did not take the next step of designating 5% of the area as old growth. The 1990 report outlined steps for

interdisciplinary teams to take to identify a pool of possible old growth for designation. The report suggests that waterhole development, foot trail construction, stream improvement, and wildfire suppression should not be allowed in designated old-growth stands. All other activities should not normally be appropriate or permitted, including firewood collection, commercial thinning, regeneration harvest, salvage sales, timber stand improvement, wildlife openings, savannahs, prescribed fire, grazing, mineral activity, temporary road construction, log landings, permanent road construction, and right-of-way construction.

In 1995, the Forest reviewed the Forest Plan intent for designation and management of old growth areas in another internal report. In this report, titled "Clarification of Forest Plan Intent for Designated Old Growth Areas on the Forest", the Forest Plan intent for old growth designation was described as providing small, dispersed elements of old growth vegetation and structural diversity throughout the Forest in order to help maintain a wide variety of species. The intent was not to provide large tracts of contiguous forest habitat for forest interior-dependant species.

This report provided a set of guidelines to use in determining areas to designate as old growth, in accord with the generic guidelines developed at the national scale. The guidelines or criteria are: age, species composition, structural diversity, woody debris, gap formation, patch size, and adjacency.

## Need for Change

Forest wildlife biologists have recognized that with the long rotation ages and small percentage of forest regenerated or thinned during each entry, conservation of old growth habitat when the stands have not yet developed mature forest characteristics may lead to less than optimal habitat. This change in application of the 1986 Forest Plan needs to be considered during revision.

The 1986 Forest-wide direction allowing for old growth patches to be harvested and replaced by other stands needs to be reconsidered during Plan revision.

Identification and conservation of potential old growth is desired by the Forest as part of the overall vegetation management strategy for age class and ecological diversity. One way to conserve potential old growth in MP 3.0, 4.0, and 6.1 areas is to assign individual areas, one at a time, to a separate management prescription. However, since these areas are likely to be small and subject to change, they may or may not provide a desired amount or distribution of areas over time. The conservation strategy should be expanded to identify and conserve a range of patch size and distribution of old growth across the Forest. It is the intent of the Forest to have a distribution of late successional stage forests that is representative of major forest types and ecological subsections, and comprised of large, medium, and small patches. The designation of old-growth stands called for in MPs 3.0, 4.0, 6.1, and 6.3 in the 1986 Forest Plan as amended needs to be revised to reflect desired conditions for potential old-growth conservation.

## Changes under the Revised Forest Plan

Existing small patches of old growth are still protected in special area (8.0) designations. A strategy for identifying and conserving potential old growth has been developed for the Revised Plan. This strategy is more fully described in Appendix B to the Revised Plan, and is briefly summarized here.

Rather than try to protect or create old growth conditions through piecemeal, one-area-at-a-time designation, the Forest identified a broad-scale strategy during revision based on management prescription (MP) allocation and management direction constraints. The key assumption in this strategy is that where intensive vegetation management is prohibited or substantially constrained, ecological

processes will dominate vegetation change on the landscape, and forest stands will continue to age and develop old-growth characteristics over time.

Large patch sizes (>10,000 acres) should develop in large MP areas—such as 5.0, 5.1, 6.2, and portions of 8.1—where commercial timber harvest is not featured. These prescription areas are fairly well distributed in various forest types and ecological subsections across the Forest.

Medium and small patches should develop in other MPs—including MPs that emphasize timber management—through management direction that constrains timber harvest in specific areas. These areas include channel and wetland buffers, suitable habitat for WV northern flying squirrel, Indiana bat key areas and hibernacula, Wild segments of eligible Wild and Scenic Rivers, and areas with a Very High Scenic Integrity Objective. Again, these areas are well distributed throughout the Forest. Where medium and small patches occur next to or connect large MP patches, they should increase the size and habitat effectiveness of each.

The Revised Plan has also incorporated desired conditions for late successional stages into MPs that emphasize vegetation management for age class diversity. The late successional stages should provide for structural and habitat diversity, and are the areas where old-growth characteristics would most likely develop over time.

## Prescribed Fire

The Forest is required to maintain an approved Fire Management Plan. In this document, fire management goals are given by MP. In all MPs, the suppression strategy is to control all fires. Because the Forest is relatively isolated from firefighting resources other than local crews and volunteer fire departments, the cost of suppression would increase exponentially once the capability of local resources is exceeded. The most cost-effective strategy is to safely control wildfires at the smallest possible size with local resources. The Forest used this same justification in 1997 to choose to not permit the management of unplanned ignitions.

The use of prescribed fire by MP is given in Forest Plan standards and guidelines. Dolly Sods and Dolly Sods North are unique in management due to the presence of unexploded ordnance. The management of fire in these areas is addressed in the MNF Fire Management Plan as a separate Fire Management Unit.

The 1986 Forest Plan does not recognize the role fire played in development of vegetation. An estimated 32% of the Forest is naturally suited to use of prescribed fire as a management tool based on landtype associations and existing forest types. The role of fire in the development of eastern forests before European settlement is still being discovered and is not well known for West Virginia and the Monongahela National Forest. The ecological role of fire in regeneration of oaks is better documented now, and silvicultural systems including prescribed fire have been developed.

In 1997, fires on the Monongahela from 1981 to 1995 were analyzed to predict size and intensity of future fires. The Forest has less than 10 fires a year. About seven occur at fire intensity level 1 (the lowest intensity level). For fires in this time period, 95% included a reported cause. Arson was the most reported cause at about 45%; hunters caused about 26% of the fires reported between 1980 and 1995, campfires caused 13%, smoking caused 9%, and lightning caused 7%. Distribution numbers have been similar since then.

Because of the low occurrence of natural fires, significant amounts of rain, and rapid decomposition, the issue of hazardous fuels on the Forest is secondary to the desire to reintroduce fire to ecosystems adapted to this natural disturbance. As gypsy moth damage and beech bark disease continue to cause morality,

hazardous fuels on the Forest may become a greater concern. The most common fire on the Forest is a surface fire that only partially consumes the duff layer; however, ladder fuels like pines, mountain laurel, and rhododendron can create localized areas of shrub crown fires, especially on steep slopes. Occasionally, conditions such as high winds or slash piles create conditions where a surface fire with mixed severity (some mortality of overstory trees) can occur.

The Forest continues to suppress and control all fires, regardless of ignition. To allow management of naturally ignited fires to accomplish specific vegetative goals and objectives, the Forest plan would need to be updated. An analysis would need to be made of the current fire fighting resources' ability to safely handle this use of fire. The Forest did not use prescribed fire as a management tool until 1998, but have averaged 139 acres/year since. The following table shows acres of prescribed fire by year since 1998.

**Table C- 2. Acres of Prescribed Fire on MNF – 1998 to 2005**

| Year | Acres | Year | Acres |
|---|---|---|---|
| 1998 | 85 | 2002 | 84 |
| 1999 | 220 | 2003 | 221 |
| 2000 | 95 | 2004 | 77 |
| 2001 | 152 | 2005 | 177 |

## Need for Change

While desirable in some parts of the Forest, using wildland fires to accomplish natural resource management goals is not likely to be effective because the Forest has a low occurrence of lightning strikes in dry season. Also, the Forest currently lacks qualified people to manage a wildfire to meet resource goals. Finally, the intermingled land ownership within the Forest proclamation boundary necessitates an aggressive fire suppression strategy. For these reasons, revised Forest Plan direction should reflect the low potential for wildland fire use.

To retain management options, the Forest Plan should be changed to allow prescribed fire in MP 6.2 areas. Not all MP 6.2 areas are suited to prescribed fire, however in some areas wildlife habitat goals and desired ecological conditions may be met through prescribed fire.

The fire regimes and condition classes (FRCC) of the Forest needs to be determined. As part of this determination the Forest should identify ecosystems where fire does not need to be re-introduced, where prescribed fire would not meet management goals, and where use of prescribed fire is essential or potentially effective. Current management direction requires the Forest to determine FRCC before proposing prescribed fire, regardless of resource objective. FRCC is more easily determined in western forests; however the Eastern Region is working to establish methodologies for determining FRCC in eastern forests. Currently the Forest uses a coarse-scale model developed for the contiguous United States and is creating a local model.

## Changes under the Revised Forest Plan

Revised Forest Plan direction expands the role of prescribed fire to be used for ecosystem restoration and fuels reduction. Prescribed fire is allowed in MP 6.2, and all other MPs except for Wilderness. In addition, MP 6.1 has been revised to emphasize the increased use of fire as an ecological tool for restoring oak ecosystems. Through consultation with USFWS, the Forest's annual limit on prescribed fire has been raised from 300 to 3,000 acres.

Aggressive fire suppression is emphasized throughout the Forest, and wildland fire use is not presented as a desirable option for the reasons discussed above.

Fire regimes and Fire Condition Classes have been determined for the Forest and integrated into fire planning at the Forest-wide scale.

## Forest Health

Because forest health issues differ by temporal and spatial scales, any definition of forest health is likely to be conceptual in nature. The use of the term "health" is controversial because although health is easy to comprehend in terms of the human body, it may not be appropriate for ecosystems such as a forest. However, some researchers and managers have determined characteristics of what are considered healthy forests. Kolb et al. (1995) propose the following characteristics as a definition of forest health: 1) physical and biotic resources to support forest cover; 2) resistance to dramatic change; 3) functional equilibrium between supply and demand of essential resources; and 4) diversity of seral stages and stand structures.

The AMS focuses on those elements of dramatic change acting on the Forest. The insects and diseases known to be affecting the forest at greater than historic levels are not native to the eastern United States. Endemic insects and diseases will not be discussed in this analysis.

**Insect and Disease Pathogens -** Beech bark disease, a disease complex formed by the combined action of a non-native scale insect and native fungi, was first described from the Forest in 1981 (Mielke et al. 1982). Beech bark disease is found across the Forest. Mortality and decline of beech trees is occurring. As beech trees die, they often sprout from stumps and roots, creating a beech thicket of sprouts in the understory. Large woody debris is being added to the forest floor and to stream channels from beech mortality. It is not yet known how composition changes in forest canopy, midstory, and understory would affect the long-term health of forested stands with beech bark disease.

Eastern hemlocks across the Forest are affected by the hemlock wooly adelgid, particularly in riparian areas. Decline of trees, mainly evident through thinning of the canopy, is noted across the Forest. This non-native insect has the potential to affect riparian ecosystems across the Forest through loss of shade and disruption of nutrient cycles. Small-scale bio-control of the adelgid is planned for 2004.

The gypsy moth caterpillar prefers to feed and lay eggs on species of oak. The populations of gypsy moth across the Forest are monitored, and spraying to control population levels has occurred. Gypsy moth has the potential to affect forest structure and composition through decline and mortality of overstory oaks trees. The risk of more frequent and more intense fires may also increase if tree mortality increases on drier parts of the Forest, and surrounding private forests are also affected.

All insects and diseases predispose trees to other stressors such as drought, freeze injury, acid precipitation, decay fungi, and other insects. Monitoring and controlling where possible these exotic stressors is needed to continue to have a healthy forest. The Forest also continues to cooperate with others in monitoring for new exotic pathogens and increases of native insects and diseases.

**Altered Disturbance Regimes -** As discussed under the "Old Growth" and "Prescribed Fire" sections, there are areas of the Forest with vegetation adapted to low-intensity surface fires. Also, after the near total clearing of the forest at the turn of the 20$^{th}$ century, some areas burned that normally would not experience this disturbance, or the intensity of fires was greater than would naturally have occurred. Another result of the extensive clearcutting that occurred is that the forests changed from a largely uneven-aged structure to one that is essentially even-aged.

**Ecological Suitability to Management -** The ecological suitability of certain areas and the management prescriptions assigned to them is a concern documented in the 2001 Timber Monitoring Report. For example, one goal of lands under MP 6.1 is to focus on manipulation of the naturally occurring tree species composition to optimize hard mast production, age class distribution, and ensure a continuous mast supply. Also in the description of the purposes, note is made of the lands in transition from a predominately hardwood overstory to a mixed oak-pine or northern hardwood-red spruce type. These areas are singled out for a management strategy to maintain the mast production in these areas. This issue has been dealt with through site-specific implementation so that mast production on a site is ensured through regeneration of existing oaks and hickories, sometimes through intensive measures.

Some areas of the Forest with a diversity of hard mast species (red oak, white oak, hickory, black cherry) are the result of near catastrophic disturbances at the turn of the century. Most of West Virginia was cleared of trees by the 1920s, and then areas were burned and often grazed before returning to forest cover. Also, the death of American chestnut trees helped oaks to gain dominance in some areas. Some areas of the Forest are more suited to northern hardwoods (for example, sugar maple, beech, birch, and yellow birch). To regenerate oaks on some areas has increased costs of management due to the need for planting and protection of oak seedlings. Also, during project-level analyses, some publics have opposed management practices such as herbicide, prescribed fire, and clearcutting necessary to maintain mast species in areas not ecologically suited to continued regeneration of oak species. The Forest has developed land delineations based on ecological land types to aid in the determination of where managers should and should not concentrate efforts to regenerate certain tree species.

**Non-native Invasive Species -** Non-native invasive species (NNIS) are known to occur on the Forest. Control efforts have focused on pastures on the Forest.

A list of known and expected non-native plant species and their risk ranking has been drafted for the Forest to use during botanical surveys. This list includes 91 species. Eighteen species are considered a severe threat and are known to invade natural habitats and replace native species. Thirty one non-native plants are less invasive than those just mentioned and have less impact on native plant communities, but are generally found in disturbed areas, are capable of spreading into adjacent undisturbed areas, and pose a significant threat. Twenty seven species pose a lesser threat, and are non-native plants normally established and spread in areas of ground disturbance with full sunlight or partial shade. An additional fifteen non-native plants are problematic elsewhere in parts of West Virginia, but their status is unknown within the Forest proclamation boundary.

Invasive species generally have high reproductive rates, are pioneering species, are long lived, reproduce vegetatively and rapidly, have high genetic variability, tolerate a wide range of conditions, and are abundant in their natural range.

## Need for Change

Bringing fire back into some ecosystems would help re-establish the ecological role of this disturbance. Allowing for prescribed fire in MP 6.2 areas is a change needed in the Forest Plan. This topic is covered in the Prescribed Fire section above.

The purpose statements for management emphasis under MP 6.1 need to be reworded if MP 6.1 is retained in the revised Forest Plan. The statements under the secondary purposes for these areas dealing with a management strategy for sites reverting from hardwood to conifer and the intermingled high site hardwood types needs clarification. In some areas, conversion to red spruce is desirable. The statement

that hard mast be optimized on all areas under MP 6.1 may not be feasible in those areas where oak species are being replaced by northern hardwoods or the costs to slow succession are high.

Monitoring of even-aged regeneration harvest units has shown that oaks sometimes do not compete well on sites with higher site indices without tubes to protect seedlings, or herbicides to reduce competition. The Forest Plan needs to be flexible enough to include consideration of the ecological setting when determining tree species to emphasize. During Plan revision, the interdisciplinary team needs to consider whether it makes sense from an ecological and economic perspective to implement intensive management techniques in order to perpetuate certain mast species in some areas. Also, the team should consider the impacts of succession on those areas of the Forest where vegetation management is not occurring. If not addressed specifically in Forest Plan revision, then the costs and benefits of retaining hard mast in some areas need to be addressed at the project level.

The Forest should develop ways to address non-native invasive species (NNIS) and other undesirable species. The Forest needs to detect invasive plants, control known species, avoid establishing non-native invasive species, and use native material for our revegetation projects. The list of non-native invasive plants likely found on the Forest should not be incorporated into the revised Forest Plan, as it is a work in progress. The revised Forest Plan should include a strategy for prioritizing treatment and monitoring. The Forest Plan should remain flexible for NNIS management. Some species on the list such as common chickweed and coltsfoot are older imports from colonial days. Having this fairly long list of species does not mean that all species will be controlled on all sites. A risk analysis is needed to determine which species to control and where, so that maximum benefits are gained from control efforts.

The 1986 Forest Plan lists recommended grasses and legumes for revegetating disturbed areas. Since 1986, some of the species listed in this table are considered noxious, invasive plants and a potential threat to natural plant communities that should be avoided. This list needs to be updated to remove these species and include species that are acceptable.

### Changes under the Revised Forest Plan

The MP 6.1 purpose statements have been revised to reflect desired changes in conifer (primarily red spruce) and oak ecosystem management. In particular, management intent has shifted somewhat to restoring oak ecosystems where ecologically appropriate, which should provide for sustainable wildlife habitat and mast production over time. MP 6.1 also now features more emphasis on using prescribed fire as an ecological tool to help restore oak ecosystems where appropriate. All tools are available to help achieve oak regeneration and ecosystem restoration.

The Revised Forest Plan includes new Forest-wide NNIS management direction in the Vegetation section, as well as revised direction for the use of native plants for revegetation and other purposes. The non-native invasive species list is dynamic and will therefore be updated outside of the Revised Plan to allow for maximum flexibility in addressing periodic changes.

## TIMBER MANAGEMENT AND SUPPLY

This summary will cover: silvicutural methods, rotation ages, forest types, and timber production with a discussion of allowable sale quantity (ASQ).

## Silvicultural Methods, Rotation Ages, and Forest Types

The 1986 Forest Plan predicted that during the first decade of implementation, the Forest would use both even-aged and uneven-aged regeneration harvest on an estimated 2,000 acres a year and thin an estimated 4,000 acres a year. As reported in the *Revised Biological Assessment* (USDA 2001), from 1987 to 1998 the annual average was an estimated 4,000 acres, both regeneration and thinning, managed by commercial timber harvest. This has been declining annually; from 1995 to 1998 the annual average was 2,031 acres managed by commercial timber harvest per year; from 1999 to 2003 the average annual harvest fell to about 1,469 acres (less than 0.2% of the total MNF acres). Table C-3 displays the amount of harvest per year for each silvicultural method, from 1986 through 2003.

**Table C-3. Acres of Timber Harvest by Harvest Method, 1986-2003**

| Fiscal Year | Regeneration Harvest | | | | Thinning | Uneven-Aged Harvest | | Salvage |
|---|---|---|---|---|---|---|---|---|
| | Clearcut | 2-Aged | Shelterwood Seed Tree | Totals | | Single Tree | Group Selection | |
| 1986 | 846 | 0 | 48 | 894 | 3,405 | 124 | 0 | 50 |
| 1987 | 1,347 | 0 | 122 | 1,469 | 3,958 | 234 | 39 | 5 |
| 1988 | 1,827 | 0 | 98 | 1,925 | 4,333 | 433 | 0 | 107 |
| 1989 | 1,574 | 0 | 19 | 1,593 | 2,459 | 239 | 0 | 0 |
| 1990 | 924 | 0 | 0 | 924 | 3,324 | 356 | 0 | 68 |
| 1991 | 1,404 | 21 | 53 | 1,478 | 2,241 | 848 | 31 | 892 |
| 1992 | 1,110 | 64 | 47 | 1,121 | 2,460 | 944 | 0 | 55 |
| 1993 | 1,253 | 60 | 90 | 1,403 | 1,655 | 27 | 0 | 31 |
| 1994 | 789 | 44 | 46 | 879 | 1,417 | 0 | 0 | 85 |
| 1995 | 646 | 272 | 53 | 971 | 1,093 | 0 | 164 | 538 |
| 1996 | 533 | 333 | 94 | 960 | 1,899 | 238 | 403 | 0 |
| 1997 | 356 | 341 | 58 | 755 | 1,529 | 313 | 97 | 0 |
| 1998 | 460 | 213 | 200 | 873 | 1,495 | 141 | 33 | 88 |
| 1999 | 433 | 488 | 104 | 1,025 | 1,410 | 214 | 137 | 11 |
| 2000 | 435 | 249 | 82 | 766 | 659 | 0 | 0 | 0 |
| 2001 | 56 | 385 | 21 | 462 | 534 | 79 | 0 | 0 |
| 2002 | 45 | 176 | 113 | 335 | 502 | 0 | 0 | 0 |
| 2003 | 90 | 156 | 184 | 430 | 776 | 0 | 14 | 0 |
| **Totals** | **14,129** | **2,802** | **1,432** | **18,363** | **35,149** | **4,191** | **913** | **1,930** |

The amount of area regenerated through clearcut with reserve tree harvesting has trended downward since 1991, with a peak of 1,827 acres in 1988. In the 18 years since the Plan was signed, about 68% of the acres regenerated through clearcut with reserve tree harvesting were under MP 6.1 and only about 29% of the acres under MP 3.0.

Before 1992, two-aged harvest method was not used on the Forest, even though the Forest Plan does allow for this harvest, then called deferred rotation. Since 1992, the Forest has treated an estimated 2,802 acres in two-aged harvest. The majority of acres (about 70%) regenerated through two-aged harvesting comes form lands managed under MP 6.1.

Table C-4 displays the acres that were harvested by Management Prescription (MP).

**Table C-4. Acres and Percent of Timber Harvest by Management Prescription and Harvest Method**

| Even-Aged Management | MP 2.0 | | MP 3.0 | | MP 6.1 | | MP 8.0 | |
|---|---|---|---|---|---|---|---|---|
| | Acres | Percent | Acres | Percent | Acres | Percent | Acres | Percent |
| Clearcut Reserve Tree | 128 | 1% | 4,170 | 29% | 9,558 | 68% | 273 | 2% |
| Two-Aged | 21 | 1% | 801 | 29% | 1,980 | 70% | 0 | 0 |
| Shelterwood/Seed Tree | 0 | 0 | 534 | 37% | 898 | 63% | 0 | 0 |
| Totals | 149 | 1% | 5,505 | 30% | 12,436 | 68% | 273 | 1% |
| Uneven-Aged Management | MP 2.0 | | MP 3.0 | | MP 6.1 | | MP 8.0 | |
| | Acres | Percent | Acres | Percent | Acres | Percent | Acres | Percent |
| Single Tree Selection | 780 | 19% | 2,238 | 53% | 263 | 6% | 910 | 22% |
| Group Selection | 724 | 79% | 60 | 7% | 98 | 11% | 31 | 3% |
| Totals | 1,504 | 29% | 2298 | 45% | 361 | 7% | 941 | 18% |
| Thinning | MP 2.0 | | MP 3.0 | | MP 6.1 | | MP 8.0 | |
| | Acres | Percent | Acres | Percent | Acres | Percent | Acres | Percent |
| | 936 | 3% | 11,919 | 34% | 22,278 | 63% | 0 | 0 |
| Salvage | MP 2.0 | | MP 3.0 | | MP 6.1 | | MP 8.0 | |
| | Acres | Percent | Acres | Percent | Acres | Percent | Acres | Percent |
| | 0 | 0 | 287 | 16% | 1,555 | 84% | 0 | 0 |

An estimated 18,363 acres have been regenerated through shelterwood or seed tree harvesting since 1986. The use of these regeneration harvests, mainly shelterwood, has generally increased over time as clearcutting has deceased. Under these even-aged regeneration harvest methods, the greatest residual basal areas are found, making these a good choice in areas where retention of vertical structure in the forest is important, while allowing for regeneration of shade intolerant or moderately tolerant tree species. Again, the majority of acres (63%) come from lands under MP 6.1.

The 18,363 acres that were regenerated on the Forest since 1986 are the acres harvested using clearcut, two-aged, shelterwood, and seed tree harvests. When all even-aged regeneration harvests are broken out by management prescription, MP 6.1 areas contributed about 68% of the acres regenerated.

Thinning is used on the Forest to improve the health and increase growth of the residual stand by reducing the density of trees in the stand. Thinning is part of an even-aged silvicultural system, and is often called an intermediate harvest as it occurs between regeneration harvests. Since 1986 it is estimated that 35,149 acres have been treated using the thinning silvicultural method. Lands under MP 6.1 have contributed about 63% of the area thinned in the last 18 years compared to about 34% from MP 3.0 lands. Total acres thinned have declined steadily over the life of the current Forest Plan.

Uneven-aged harvesting occurs on the Forest; both single tree selection and group selection are used. There have been areas managed by group selection, with thinning between clearings created through group selection. In either uneven-aged silvicultural system, both regeneration harvesting and thinning occur during the same entry into the stand. The regeneration openings range in size from the space of one tree to up to two acres (Forest Plan standard). An estimated 4,191 acres have been managed through single tree selection over the past 18 years. It is surprising that the majority of acres managed under this system, about 53%, have come from lands under MP 3.0. Uneven-aged silvicultural systems are to be used on MP 2.0 lands, and while the total acres managed under single tree selection from this MP seems low, these lands only make up about 3% of the Forest.

An estimated 913 acres have been harvested through group selection since 1986. These totals include group selection combined with thinning between group openings. The majority of acres (79%) managed through group selection have come from MP 2.0 lands.

Intermediate harvesting has been used to salvage mortality on the Forest. An estimated 1,930 acres have been treated since 1986. Again, the majority of management (80%) has occurred on MP 6.1 lands.

In 2001 the Forest held an interdisciplinary meeting to review Forest Plan direction on use of clearcutting and planting of oak and conifer. The group compared Forest Plan standards, guidelines, and management direction on these subjects, and discussed changes in legislation, scientific information, Forest Service policy, etc. that have occurred since the 1986 Forest Plan was authorized. The changes were discussed to determine impacts to the Forest's ability to implement the Forest Plan or achieve assigned outputs. The group also identified management direction, standards, or guidelines to address in Forest Plan revision.

In addressing Forest Plan direction on clearcutting, the group sought to answer the question, why are we clearcutting less than the Forest Plan projected? The group noted that there are two aspects to this question. First, why is the Monongahela National Forest harvesting less commercial timber in general? Second, why is the Forest using other even-aged methods instead of clearcutting?

As the fiscal year (FY) 1999 Monitoring Report for the Forest National Forest indicated, the volume of timber offered for sale has declined over the years. Several factors have contributed to the overall reduction in timber harvests since the Forest Plan was approved:

- National policy changes initiated by the Chief of the Forest Service
- Unexpected discovery of threatened and endangered species in management prescriptions suited and available for commercial timber production
- New mitigations for protection of riparian areas and reducing sediment movement to stream channels
- Fewer new roads have been built; with emphasis shifting to the use of existing roads
- Escalating complexity of National Environmental Policy Act (NEPA) analysis, including costs, time to complete analyses, and appeals of decisions

As mentioned previously, the area regenerated through clearcut harvesting has declined since 1993 from an average of an estimated 1,285 acres per year to 384 acres per year in 1994 – 2003; in 2002 only 46 acres were regenerated through clearcut harvesting. The use of alternative even-aged regeneration harvest methods has increased as a result of:

- In the early 1990s, Chief Robertson directed forests to reduce the use of clearcutting, and only use clearcutting when shown to be the optimal method for achieving specific management objectives.
- Emphasis on retaining leave trees to minimize visual effects of even-aged regeneration harvesting
- Efforts to provide structural diversity in regenerating stands to benefit various wildlife species.

The alternative even-aged regeneration harvests used on the Forest include shelterwood and two-aged harvests. The overstory in a shelterwood harvest should be removed after regeneration is established underneath, however this may not always occur. In the two-aged regeneration method, the residual basal area is reduced to 15 to 40 square feet per acre (including culls and den trees) and this age class is retained through to the next removal harvest (end of the rotation). There are concerns that the residual basal area in a two-aged harvest, or in a shelterwood harvest that is not removed will eventually shade the regeneration and inhibit growth.

Generally, commercial timber harvest has been the means by which the Forest manages age class distribution, and to some extent, forest types on lands available and suitable for commercial timber management. The Forest Plan allows commercial timber management on approximately 36% (~331,000

acres) of the Forest. The remaining 64% of the Forest is expected to change primarily through natural events and succession. On approximately 23% of the Forest (Wilderness and MP 6.2), natural forces are the disturbance factors expected to impact forest type and age class diversity.

A variety of tree species currently exists in forested stands of the Forest. The Forest contains stands with largely one tree species and stands that have a mix of hardwoods and conifers with a variety of shade tolerant and intolerant tree species.

Shade tolerant, intolerant, and moderately tolerant tree species are found on the Forest. For example, sugar maple, beech, and hemlock are considered shade tolerant, while black cherry, some oaks and hickories, yellow poplar, and birch are considered shade intolerant. Shade tolerance is based on the requirements of seeds to germinate and the young trees to grow into the upper canopy. Shade intolerant trees need full sunlight to maximize seed germination and growth. Shade tolerant trees have seeds that are able to germinate under the shade of a forest canopy and continue growing with only the partial sunlight that filters in below the shade of other trees.

Major forest types on the Monongahela are broken out as shown in the table below. More information on these types can be found in Appendix A.

**Table C-5. Current Major Forest Type Distribution for the MNF**

| Forest Community Type | Acres | Percent of Forest |
|---|---|---|
| Mixed mesophytic/cove hardwood | 360,000 | 39 |
| Mixed oak | 250,000 | 27 |
| Northern hardwood | 170,000 | 18 |
| Pine-oak | 51,000 | 6 |
| Spruce/fir/hemlock | 51,000 | 6 |
| **Totals** | **882,000** | **96** |

Brush or shrub lands comprise about 1% of the Forest (about 9,000 acres) and are classified as either upland or lowland. Open areas with grass, forbs, or other herbaceous ground cover comprise a little more than 2% of the Forest (about 20,000 acres). The brush, shrub, and open forest types do not include lands that are regenerating after a regeneration harvest; however, trees may not be filling in all of these areas.

A combination of even-aged and uneven-aged management or no active management of the timber resource perpetuates the current forest. Non-commercial methods and natural events contribute to diversity of forest types and age classes.

An estimated 2% of the Forest is comprised of stands of trees less than 15 years of age. The majority of the Forest trees are over 60 years old (84%). About 9% of the Forest trees are over 105 years old. The age of a stand can be considered an average as it is usually estimated from trees representative of the majority of the stand. Many stands include multiple age classes depending on previous harvest or natural disturbances. There may be individual trees in a stand either older or younger than the given stand age. These figures are for all management prescriptions and forest types.

## Need For Change

There is a need to update standards and guidelines to address silvicultural and resource protection methods. The following items need to be reviewed, and possibly modified, during Plan revision:

- Size of even-aged regeneration units – The maximum size of any even-aged regeneration unit is 25 acres in the 1986 Plan, although NFMA allows a maximum of 40 acres. There are provisions for exceeding this size; however it may be desirable to change the Forest Plan. Average unit size for the past 18 years has been about 15 acres. Wildlife habitat fragmentation concerns may be addressed by having fewer but larger regeneration harvest openings.

- Spacing of even-aged regeneration units – The 1986 Forest Plan standard is 1/8 of a mile between even-aged regeneration harvest units. The area between units should also be a manageable stand of trees. If the current trend of small-sized regeneration harvest units is likely to continue, then having the flexibility to group small harvest units closer to reduce edge effects may be desirable.

- Shape of even-aged regeneration harvest units – The 1986 Forest Plan (page 174) states that long, narrow clearcuts with an undulating perimeter are preferred. This guidance may not still be applicable given the current knowledge of wildlife habitat needs.

- Definition of openings – An opening is currently defined as a harvest area where the vegetation is less than 20% of the height of the surrounding vegetation by the 1986 Forest Plan. We may want to clarify terms used in the Forest Plan to differentiate between a temporary opening of a regeneration harvest unit and the grass and forbs dominated openings generally considered permanent or semi-permanent and created for wildlife habitat.

- Percent of size classes – If the size class guidelines for MP 3.0 areas are not being met, rotation ages may need to be adjusted.

- Frequency of entry – Vegetative management is not occurring as frequently as allowed, mostly because of the time to prepare NEPA documents and analysis, more appeals of decisions, and the longer time to complete timber sales. The implication of these delays needs to be examined and guidelines modified to consider these effects. The definitions of quiet time and major projects also need to be clarified or adjusted.

- Clearcutting as the normal regeneration harvest method – For reasons previously noted, clearcutting has not been the main even-aged regeneration harvest method for many years. The sections of the Plan where silvicultural systems are described need to be updated.

- Grapevine management – Grapevine management guidelines need to be evaluated for increased flexibility. Grapevine management was an issue in the development of the 1986 Forest Plan, is it still a concern of the public? Grapevines damage regenerating stands of young trees and some areas have not been regenerated because grapevines could not be treated before harvest. Are the effects to wildlife habitat greater if localized grapevines are lost or if mast-producing trees are not regenerated?

- Rotation ages – Current science should be reviewed to confirm appropriate rotation ages for tree species. For example, in MP 3.0 areas, should rotation ages be based on maximum age of tree species, or when loss from mortality is unacceptable, or when economic loss becomes unacceptable, or based on wildlife species needs?

- Age class distributions – Management direction may need to take into consideration that the distribution of age classes may vary depending on the ecological setting of an area.

## Changes Under the Revised Forest Plan

The direction on size restriction (25 acres maximum) of even-aged openings has been removed in the Revised Forest Plan, allowing the Forest to default to regional and national standards (40 acres maximum, unless Regional Forester approval is obtained). Although it is expected that most even-aged openings would remain relatively small, the elimination of the 25-acre restriction provides more flexibility at the project level to address wildlife and ecological concerns.

The direction on spacing of even-aged openings has been carried forward into the Revised Plan and combined with the definition of openings. It was felt that these were important considerations, not only from a vegetation management perspective, but also to provide for wildlife security and travel.

The direction on the shape of even-aged harvest units was changed to a guideline in the Revised Plan that focuses on areas of visual concern.

Size and age classes were not addressed through rotation ages in the Revised Plan. In fact, 1986 Plan rotation age requirements were dropped to provide more flexibility for vegetation management. One reason is that most management that occurs in the next couple of planning periods is only going to affect one size/age class, due to the current even-aged nature of forest stands. Age classes are addressed by desired conditions in the revised Plan. If younger size or age classes are desired on suitable timber land, they can be achieved through regeneration harvest, now that management is not constrained by rotation ages. If older size or age classes are desired, they can be achieved through natural succession over time on unsuited lands where commercial vegetation management is constrained or prohibited (wilderness, recommended wilderness, backcountry recreation, special areas, channel/wetland buffers, listed species habitat, etc.). Rotation ages can be more appropriately applied to individual stands at the project level through site-specific silvicultural prescriptions.

Frequency of entry is described for management prescription areas where timber harvest may occur. The quiet time and major project restrictions in MP 6.1 were replaced in the Revised Plan with one standard that limits the overall disturbance in a prescription area unit of the planning period. This change is designed to increase management flexibility while providing for wildlife security over time.

Clearcutting is no longer referred to as the “normal” cutting method for any prescription in the Revised Plan. It has to be the optimal method for the situation in which it is being applied.

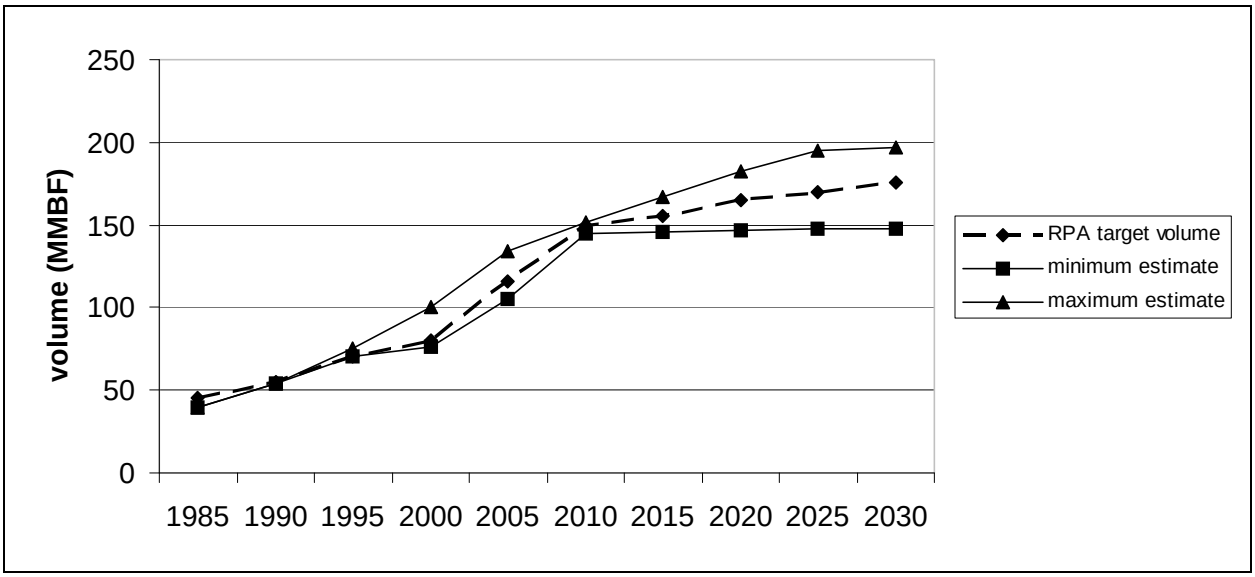
## Timber Production

For 1986 Forest Plan, a group knowledgeable of the timber markets in the state met to estimate future demands. The group represented the Monongahela National Forest, the West Virginia Division of Forestry, and the Research and State and Private branches of the USDA Forest Service. Of interest for this Plan revision are the group’s basic assumptions on timber markets and demands.

Essentially, the group agreed with the Regional Plan RPA (Resources Planning Act) target and felt that within 50 years from 1982, the timber industry would be using 60 to 80% of the annual growth. Figure 1 is an approximation of the timber demand projected by the group in 1982.

All the group’s assumptions were reviewed to determine if they have come true, continue to be logical assumptions, or whether conditions have changed such that they no longer apply. The group admitted to taking an optimistic viewpoint based on the fact that the wood products industry in the state has adjusted dramatically to supplies over the past century. Below are the group’s basic assumptions and discussion about whether the assumptions held true:

**Figure C-1. Timber Demand Projections for the Monongahela National Forest**




*1. The current state of the National's economy will not persist and a 2.5% to 3.5% annual increase in the gross national product (GNP) can be expected.*

In 1991, the U.S. Department of Commerce, Bureau of Economic Analysis began using gross domestic product (GPD) to describe the United States economy in place of GNP. GDP and GNP are generally similar numerically; GDP measures production in the US no matter who produces it and GNP measures production by US citizens regardless of where they are. According to the Bureau of Economic Analysis, the GDP increased and average of 3% per year from 1986 to 2002 based on chained 1996 dollars. This assumption held true.

*2. Total integrated harvesting and milling operations will become more commonplace. The technology for an integrated mill is currently available and will improve over time.*

From conversations with people knowledgeable of the wood industries in the state (Steve Milauskas, personal communication, Baumgras, et al. 2003), total integrated harvesting and milling operations have not become commonplace in West Virginia.

*3. Current utilization standards will change from a fixed top diameter to use of the total tree.*

Utilization standards for the Forest have not changed to include whole tree harvesting. Generally whole trees or the tops of trees (if removed from the harvest unit) are utilized as chips. The Forest is not offering sales for bid based on any demand or utilization of chipped wood. Based on conversations with people knowledgeable of the wood product industry in the State, there is not likely to be a demand for whole tree harvesting. The greatest value in West Virginia hardwoods is in the bole. Processors of engineered wood products are often species specific in their preferences and high-density species such as oaks are not desirable for these products. It is unlikely that whole tree harvesting will become common in Appalachia, unless the United States reverses the trend of declining domestic paper production, or implements policies favoring biomass fuels. Also, the topography of the Monongahela does not favor

high-tech or whole-tree logging systems, and with the emerging concern of soil nutrient loss through acid deposition, there is a growing recognition that tops and limbs high in calcium should be left on site where there is a demonstrated need.

*4. There will be a gradual shift from emphasis on quality sawlog production/demand to wood fiber thereby making smaller diameter trees more competitive.*

Smaller trees and smaller wood from the tops of larger trees are more often utilized than in the early 1980s. At the writing of the 1986 Forest Plan, there was little market for pulpwood. There is now an oriented strand board plant within trucking distance of the Forest. The hardwood industry in West Virginia is more diversified than other sates including markets for pulp, veneer, dimension lumber, oriented strand board, plywood, and laminated veneer lumber. As the trees on the Forest age, and since high-grading has not occurred, it is predicted we are heading into a period of high quality hardwood products (Luppold, personal communication). However, the highest value logs pay their way out of the woods. Consideration of lower grade material is secondary when determining sale economics but could add to the perceived value of a sale if economical end uses are present. Smaller diameter trees will not become more "competitive"; on steep terrain where high-tech processors cannot be used effectively, small trees cost more to harvest than do large trees.

*5. Exports of wood fiber from the eastern one-half of the USA to Europe will increase. The USA may eventually become a net exporter of wood fiber products.*

Exports of hardwoods from the eastern half of the United States to Europe have increased and the eastern United States is a net exporter of hardwood lumber. The United States continues to be a net importer of wood, but in 2000 was the third largest exporter of hardwood logs (www.bea.doc.gov). Asia has become the largest exporter of hardwoods in the world. This was probably not predicted when the Forest plan was written. Exports of high quality hardwoods from the eastern United States are expected to increase (Luppold, Milauskas, personal communication). For softwood wood fiber, there has been a decline in the amount of domestic wood consumed by the pulping industry in the northeastern United States. The United States as a whole will likely never be a net exporter of wood products (Baumgras 2003).

*6. More wood will be substituted for other materials such as steel, aluminum, etc., due to its low energy costs to produce.*

There is some market share pressure on wood in residential construction (from steel) and decking (from plastics). However, there are efforts underway to increase use of wood, particularly engineered wood products, in nonresidential building construction. The trend of lumber made from either recycled plastic or wood waste mixed with plastic was probably not considered when the Forest Plan was written. Demand for plastic and wood-plastic composite materials in U.S. construction is predicted to grow nearly 13 percent annually through 2006 (www.freedonia.ecnext.com/coms2/ summary_0285-228282_TM). The niche for Appalachian hardwoods in general, and West Virginia hardwoods in particular, seems to be the continued production of high quality hardwood lumber for applications not easily substituted by aluminum and steel.

*7. The shift of the wood industries from the West to the Southeast and Atlantic seaboard states will continue.*

The Southeast and Atlantic seaboard states are contributing more to the Nation's wood supply as the volume of harvests decline from western National Forests. The distribution of ownership of timberlands is not uniform across the country. In 1992, 55% of the industrial timberlands were in the South (Virginia to Texas and Oklahoma) and 23% in the North (Maine to Maryland to Missouri to Minnesota). Non-

industrial private timberlands are heavily concentrated in the East, with more than 87% in the eastern half of the country. About 75% of national forest timberlands are west of the 100th Meridian (Powell et al. 1994). With this distribution of ownership, the relationship to declines in federal timber harvests in the West and increases on industrial lands in the South and North is expected and likely to continue.

*8. The taxing structure on private timber lands will become less favorable thereby placing greater demands for the public lands to produce timber, especially large quality sawlogs which require longer rotations.*

The taxing structure of private lands has not become less favorable to timber harvest or forest management (Milauskas, personal communication), and greater demands have not been placed on public lands to produce large quality sawlogs. There are tax incentives in place for private landowners wishing to use the State's Forest Stewardship program. However, as practices such as diameter limit and logger's choice continue on private forest land, the number of high quality sawlogs will decline. Even though demand for large diameter, high quality timber may increase and much of this timber is on the Monongahela National Forest, most industry owners do not expect much of this wood to be available for harvest (Baumgras 2003).

*9. Wood fiber processing technology will continue to improve thereby making such processes as press drying, flake board, oriented stand board, etc., very competitive.*

This assumption came true for the region and the State. Two OSB plants are operating in the State, one within trucking distance to the Forest. It is likely that the State will see greater production of these types of products.

*10. Wood for energy (fuelwood) will not play a big role regarding demand from NFS lands because of limited urbanization and apparent adequate supplies from private lands.*

The Monongahela National Forest has not seen a significant removal of fuelwood. However, the relationship described in the assumption is confusing. Rural households are more likely to use fuelwood in large amounts for heating, as opposed to urban households.

*11. Timber demand is at fair market price levels. At other price levels it may be different.*

This assumption still holds true. At any given market price (assuming no price distortions) the quantity supplied will be in long-term equilibrium with the quantity demanded. Shifts in supply and/or demand can cause price fluctuations resulting in new equilibriums (Baumgras 2003). In effect, this assumption is more a general statement on the timber market than an assumption.

The Forest Plan estimated timber production by year for 10-year periods. For the first 10 years, the Forest Plan estimated a maximum of 57.1 million board feet (MMBF) could be harvested (see page 46). An estimated 57.9 MMBF was projected for the second 10-year period, and a maximum of 60.1 MMBF was projected for the third 10-year period, which has just begun.

Table C-6 shows the volume of commercial timber products offered for sale, sold, and harvested for fiscal years 1987 through 2005. The volumes differ because some portion of the sold volume in any fiscal year may have been offered in a previous fiscal year or harvested in a succeeding year. These volume figures exclude the volume of timber products sold through the permit system. These figures represent the volume of timber products sold through sealed bid and removed under timber sale contracts.

**Table C-6. Timber Volume (MMBF) Offered, Sold, and Harvested by Fiscal Year from the MNF**

| Fiscal Year | Volume Offered | Volume Sold | Volume Harvested |
|---|---|---|---|
| 1987 | 34.3 | 30.0 | 36.0 |
| 1988 | 40.1 | 36.0 | 50.7 |
| 1989 | 40.5 | 39.0 | 36.9 |
| 1990 | 39.1 | 34.0 | 28.3 |
| 1991 | 39.0 | 39.0 | 36.4 |
| 1992 | 38.7 | 35.4 | 36.6 |
| 1993 | 30.0 | 30.0 | 33.5 |
| 1994 | 32.8 | 26.7 | 20.9 |
| 1995 | 29.7 | 25.6 | 22.1 |
| 1996 | 15.2 | 12.2 | 28.3 |
| 1997 | 17.0 | 12.7 | 25.2 |
| 1998 | 14.6 | 9.9 | 24.5 |
| 1999 | 0.9 | 9.6 | 24.2 |
| 2000 | 15.2 | 3.9 | 13.9 |
| 2001 | 13.9 | 13.2 | 7.5 |
| 2002 | 2.0 | 12.8 | 7.8 |
| 2003 | 0.9 | 2.1 | 11.7 |
| 2004 | 1.1 | 2.1 | 9.0 |
| 2005 | 12.6 | 8.4 | 8.2 |

As the Forest Plan has been implemented, some land designations made in the Forest Plan have been determined to be not entirely appropriate. For example, some land designated as MP 3.0 on which the production of timber products is to be emphasized, support populations of threatened and endangered species, or are underlain by sensitive soils, or have limited access. All of these limitations on the commercial production of timber were not considered when the Forest Plan Allowable Sale Quantity (ASQ) was set. Land allocations will be reviewed in Forest Plan revision, and these concerns need to be considered. Objectives will be developed for management on both suited and unsuited lands.

The Forest Plan's final "timber base" of 331,160 acres was expected to remain constant regardless of any increase in the size of the Forest (e.g. via purchase), and would be the total acreage of the Forest that would be managed for timber over a 200-year period. Provided Forest Plan standards and implementation remain constant, the maximum volume of timber potentially available to industry, the ASQ, was expected to change each decade as the average volume per acre increases as stands mature. The ASQ provided in the first decade of the Forest Plan (1987-1996) was 43 MMBF per year, less than the projected 57 MMBF because there was no market at the time for the large volume of small timber. ASQ in the current decade (1997-2006), under constraints of the 1986 Forest Plan, is about 48 MMBF per year. Again this is less than the projected 57.9 MMBF because of a projected lack of market for small timber. Projected ASQ on the 331,160 acres was expected to increase gradually over the first five decades and then stabilize for a long period at an annual rate of 77 MMBF per year on the 331,160 acres of timber base. At the end of the first 200-year rotation, the long-term sustained yield of timber under the Forest Plan was projected to be approximately 85 MMBF per year.

## Need For Change

There is a need to re-visit suitable lands determinations, revise supply estimations, and recalculate ASQ based on the changes noted above.

### Changes under the Revised Forest Plan

Timberland suitability and ASQ have been assessed and updated for Forest Plan revision. See the Timber Supply section of Chapter 3 of the EIS. Spectrum modeling to achieve desired vegetation conditions given certain known constraints indicates that the ASQ is 10.5 MMCF or 63 MMBF per year. This amount represents the maximum amount of timber production that may occur in any given year, rather than the actual amount of production that will occur, which can be influenced by such factors as budget, personnel, appeals, litigation, natural events, or shifting Forest priorities. As seen in Table C-5, the actual amount of timber offered, sold, or harvested can vary greatly depending on many variables.

The Total Sale Program Quantity, or TSPQ, represents both the maximum amount of timber projected on suited timberlands (ASQ), plus the maximum amount of timber that could be produced on lands not suited for timber production. This latter amount is derived from Forest Plan objectives (Forest-wide objective VE03 and MP objectives 6136 and 4107) for vegetation management to enhance Indiana bat habitat and spruce/hardwood ecosystem restoration on 4,000 to 12,000 acres over the next decade. Using a combination of silvicultural treatments (thinning, uneven-aged, shelterwood, two-aged), the Spectrum model estimated that a maximum of 2.17 MCF of timber per acre may be produced. From a maximum of 12,000 acres treated, a projected maximum of 26,000 MCF per decade could be produced, or about 15.6 MMBF per year. Added to the ASQ, this amount would contribute to a modeled annual maximum of 13.1 MMCF or 78.6 MMBF of TSPQ that could be produced. As noted above, the actual amount produced will depend on many variables.

## SOIL, WATER, AND AIR

The Monongahela National Forest was established in 1920 with about 7,200 acres of land purchased through the Weeks Act. This Act authorized the purchase of land for long-term watershed protection and natural resource management following massive cutting of the Eastern forests in the late 1800s and at the turn of the century. Today the Forest has over 919,000 acres of public lands in 10 counties in West Virginia, making it the fourth largest National Forest in the 20 northeastern states.

The Forest is unique in that it contains the headwaters of five major river systems; the Monongahela, Potomac, Greenbrier, Elk, and Gauley. Twelve rivers on the Forest are considered eligible for potential inclusion in the National Wild and Scenic Rivers System. In addition, the Monongahela has 129 miles of warm water fishing and 576 miles of trout streams. About 90% of the trout waters of West Virginia are within the Forest.

The soils of the Monongahela National Forest are developed under a mesic climatic temperature regime where annual air temperatures are 48 degrees Fahrenheit and a soil and moisture regime where annual precipitation is 58 inches. The parent material that underlies the soils is comprised of sedimentary geology that makes up the Appalachia Ridge and Valley and the Allegheny Plateau.

The Forest lies near the industrial heart of the United States. It is within a day's drive of a large percentage of the United States population, and is surrounded by a high concentration of coal-fired electrical power production facilities; the leading source of sulfur dioxide (SO2) and nitrogen oxide (NO4) emissions. This network of coal-fired electrical power plants includes the generally defined "Ohio River Valley" and Tennessee Valley Authority (TVA) sources. Emissions created by the power plants, in combination with the population's use of fossil fuels, have a substantial impact on Forest air quality.

We strive to continue the tradition of watershed protection, restoration and stewardship that began on this National Forest over 80 years ago.

The health of the aquatic ecosystem across the Forest has been heavily influenced by the extensive clearcutting that occurred during the turn of the 20th century. Construction of railroads doubled in the 1880s and then doubled again in the 1890s, allowing access to and transportation of the timber resource. As a result, much of what is now the Monongahela National Forest had been clearcut by the late 1920s. Watershed and stream channel conditions still exhibit a number of impacts associated with the extensive logging that occurred.

Stream ecosystems continue to suffer from limited large woody debris, elevated sediment levels, and effects from substandard roads located within close proximity to stream channels. Recovery from the impacts of activities at the last turn of the century is a long-term process.

In 1994, the Forest adopted interim guidelines for managing riparian areas. The interim guidance established a riparian area strip width for perennial, intermittent, and ephemeral streams, lakes, and impoundments and wetlands. It also defined the management of the riparian area strip with respect to timber removal. The interim guidelines were established to give more protection to the aquatic resource and make the standards easier to implement.

A Riparian Working Group was formed in 1999 to address issues relating to riparian area management, watershed protection, and restoration. The group determined that riparian dependent resources were not being adequately protected with either the Forest Plan direction or the interim guidelines. New riparian management guidelines were developed to address the deficiencies. These new guidelines focused primarily on headwater channel protection, channel stability, large woody debris recruitment, and basal area retention. The 1986 Forest Plan was not amended to include these guidelines. Instead, the Forest applied these site-specifically as ground conditions warranted.

The primary effect of the new recommendations is that more protection is given to smaller intermittent and all ephemeral streams. These recommendations help protect the critical headwater channels form loss of stability, down cutting, and sedimentation.

The soils on the landscape of the Forest have been subject to the effects of excessive cutting and burning. This resulted in damaging floods, severe erosion, topsoil loss, and pollution of streams used for water supply. Severe fires further increased erosion. The fires at the turn of the century burned so hot that soil carbon was lost to the atmosphere and soil productivity in some areas on the Forest was irretrievable. Although there has been some recovery for the soil resource in the past century, many soils on forested landscapes on the Forest still have thin surface horizons and in some areas remain non-existent.

The 1986 Forest standards and guidelines for soil protection mainly center on soil disturbance, which could lead to erosion and the resulting sedimentation of streams. Soil erosion and sedimentation, and protection of water quality were the two primary concerns of the soil resource in the 1986 Forest Plan. However, soil erosion is still a significant issue at present. Data from recent water quality monitoring for sediment levels in streams on the Forest reveals that many streams have high levels of sediment.

Soil productivity is emphasized in the Forest Plan through direction that calls for fertilization and liming of disturbed soils (p. 79 and Appendix S). However, there is no reference to undisturbed soils that may be affected by base cation depletion that could result in loss of soil productivity. Also, the fertilization and liming practices are directed at reestablishing vegetation to prevent erosion or soil movement from the disturbed site, and not at benefiting growth of existing vegetation.

Historically high sulfate ($SO^4$) deposition from sources in the Ohio River Valley has contributed to acidification of streams and could affect soil productivity on parts of the Forest. In fact, research

scientists have found evidence of nutrient depletion occurring in certain soils on the Forest. Sulfates are also primary contributors to visibility impairment or regional haze.

Although the 1986 Forest Plan acknowledges these issues and provides for air pollution effects monitoring, new information indicates that acid deposition may be affecting soil productivity and water quality. Since the Plan was written we have more data showing that acid deposition may be affecting the base cation status of sensitive soils on the Forest.

## Need For Change

Key elements of the current 1999 riparian management standards and guidelines need to be incorporated into the revised Forest Plan. There is concern that the riparian management guidelines developed in 1999 are still difficult to implement on the ground. Distinguishing between different channel types in the field is often difficult even for hydrologists. Seasonal variations in flow and leaf cover are two factors that can influence channel identification. An error in the identification of channel type could result in a lower level of protection than is required by the guidelines. The basal area requirements in the guidelines may also need to be revisited. There is an opportunity to make riparian management guidelines easier to understand and implement.

Under the 1986 management direction, the level of woody debris in streams across the Forest is recovering at a very slow rate. The need for woody debris in the streams remains high. Riparian Management direction needs to address this issue in order to help streams recover. With increased knowledge over the past two decades about the importance of woody debris in streams and aquatic ecosystems, this revision provides an opportunity to re-evaluate our management direction for streamside zones. In addition, Geographic Information Systems (GIS) technology provides an opportunity to determine how changes in management will impact streams as well as timber production.

The 1986 Forest Plan does not address the issue of acid deposition. Plan Revision gives us the opportunity to look at areas that are highly susceptible to impacts caused by acid deposition and to develop management direction to address and minimize these impacts.

There is regional interest in soil productivity relating to atmospheric deposition and carbon cycling. Experiment stations and universities desire to continue cooperation for mutual benefit. The Forest is involved with numerous cooperators in a bio-complexity proposal on the issue of sustainability. Current science on soil nutrients, especially calcium, does not appear to support short rotation, whole-tree, biomass harvest on the Forest. The Forest does not allow whole-tree harvest; however, short rotation is a concern because it more rapidly takes calcium off-site than the traditional 90-120 year rotation where clearcutting is applied. The bole, bark, and roots of a tree represent about 50% of the calcium; leaves about 3%; and limbs and tops about 40%. These impacts need to be considered in the larger environmental setting, including other resource impacts.

Opportunity in Forest Plan Revision exists to address these concerns and to provide for monitoring soil productivity in relationship to base cation depletion and timber harvesting. Revision efforts should center on formulating a methodical approach to assessing risk, providing mitigation, and monitoring this issue.

## Changes under the Revised Forest Plan

Revised Forest Plan direction expands desired conditions and goals for the soil, water, and air resources in order to better address restoration, maintenance, and improvement of resource conditions. The Revised

Plan also includes objectives to restore aquatic and riparian habitat, and to decommission roads, both of which should help improve watershed conditions during the planning period.

Key elements from the 1999 interim guidelines were incorporated into Revised Forest Plan direction. More flexibility was also provided to adjust to variable on-site conditions. Basal area requirements were replaced with explicit direction as to when and where it is appropriate to manage vegetation within channel and wetland buffers. These buffer areas are not considered part of the suitable timber base, and the general lack of programmed harvest within them should provide for large woody debris.

Key elements for the 1986 Plan, including Appendix S, were incorporated into Revised Forest Plan direction for the maintenance of soil quality and productivity.

The revised Forest Plan provides management direction and a monitoring strategy to address the potential effects of acid deposition on soil nutrient depletion.

## BENCHMARKS

Benchmark analyses are included as part of the Analysis of the Management Situation (AMS). The purpose of the AMS is to "*provide a basis for formulating a broad range of reasonable alternatives*." The benchmarks define the range within which alternatives can be constructed. Hence, there is an emphasis on minimum and maximum conditions for national forests, e.g., minimum level of management, maximum timber potential, etc… Benchmarks themselves do not constitute alternatives since alternatives attempt to integrate management of all resources, and benchmarks do not.

Benchmarks approximated economic and biological resource production opportunities and were useful in evaluating the compatibilities and conflicts between individual resource objectives. The 1986 Forest Plan benchmarks were considered sufficient for some resources—including recreation and range—for the following reasons:

- Outputs and activities have not changed dramatically from 1986 projections.
- Outputs and activities are not projected to change dramatically in the next planning period.
- 1986 benchmark ranges were sufficiently broad in scope to address projected changes.

The following three benchmarks were re-analyzed during plan revision:

1. Minimum Level Management
2. Maximum Timber Production
3. Maximum Net Present Value

**Minimum Level Management** - The minimum level management benchmark defines actions needed to maintain and protect the unit as part of the National Forest System. The benchmark focuses on base levels of management sufficient to protect resource integrity; thus, outputs are possible but incidental in nature.

Minimum level management objectives were:

- Protect the life, health, and safety of incidental users,
- Protect against land and resource damage from and to adjoining lands of other ownership,
- Conserve soil and water resource,
- Prevent significant or permanent impairment to the productivity of the land,
- Administer unavoidable, non-Forest Service special uses and mineral leases, licenses, permits, contracts, and operating plans.

For the minimum level management benchmark, no scheduled harvesting activities occurred and vegetation followed natural succession. Developed campgrounds were closed, and maintenance was only for those facilities needed to support basic ownership activities. Dispersed recreation (hiking, hunting, fishing, etc…) was not promoted but was allowed. Cultural resources were identified and protected when being impacted by other resource activities.

The primary purpose of this benchmark was to develop a baseline for subsequent analyses and to be a building step for alternatives. Consideration of the objectives stated above aided in the development of resource management standards and guidelines.

**Maximum Timber Benchmark** - The maximum timber benchmark estimates the maximum physical and biological production of timber together with costs and benefits. There is no requirement to consider cost efficiency. The NFMA regulations, at 36 CFR 219, outline minimum specific management requirements to be met in accomplishing goals and objectives for a national forest. The requirements guide the development, analysis, and eventual implementation and monitoring of forest plans. The requirements set forth guidance on resource protection, vegetation manipulation, silvicultural practices, riparian areas, soil and water, and diversity of plant and animal communities.

A series of assumptions were used to define the analysis conducted with Spectrum:

- Objective function was maximum timber for ten periods
- All tentatively suitable lands were available for scheduling
- Harvest of existing stands occurred no earlier than Culmination of Mean Annual Increment
- Base sale schedule cannot exceed long-term sustained yield capacity
- No demand limitations placed on timber production.

Several key results of the maximum timber benchmark were:

- 753,000 tentatively suitable acres were allocated to timber production
- The long-term sustained yield capacity of 43 MMCF/year (258 MMBF/year) was never reached in the planning horizon
- Sale schedule for the first five decades.

**Table C-6. Maximum Timber Benchmark Sale Schedule**

| Indicator | Decade 1 | Decade 2 | Decade 3 | Decade 4 | Decade 5 |
|---|---|---|---|---|---|
| Volume (MMCF/year) | 41 | 41 | 41 | 41 | 41 |
| Volume (MMBF/year) | 246 | 246 | 246 | 246 | 246 |

**Maximum Net Present Value (NPV) Benchmark** - The maximum NPV benchmark estimates the maximum net present value of those resources having an established market or assigned value. Cost efficiency and revenue maximization are the focal points of this benchmark. Similar to the maximum timber benchmark, minimum management requirements are considered in formulating the model.

A maximum NPV benchmark was completed for the timber resource. A maximum NPV benchmark for minerals was not completed. The USDI Bureau of Land Management is responsible for issuing and administering federal mineral leases on NFS lands. Because the Forest cannot predict the nomination of areas for leasing, it is not possible to schedule the regulated production of mineral resources from the Monongahela.

The assumptions used for this analysis were similar to those for the Maximum Timber Benchmark. Results are shown in Table C-7

**Table C-7. Maximum Net Present Value Benchmark Sale Schedule**

| Indicator | Decade 1 | Decade 2 | Decade 3 | Decade 4 | Decade 5 |
|---|---|---|---|---|---|
| Volume (MMCF/year) | 40 | 40 | 40 | 40 | 40 |
| Volume (MMBF/year) | 240 | 240 | 240 | 240 | 240 |

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# Appendix D

# Management Indicator Species

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**Table D-1. Revised List of Management Indicator Species in the 2006 Forest Plan**

| Species | Global Abundance Rank | Federal Conservation Status | Reasons for Selection | Habitat Objective |
|---|---|---|---|---|
| Wild (naturally reproducing) brook trout (*Salvelinus fontinalis*) | G5 | None | High-interest game fish. Top-level predator, population changes reflect an integration of effects to water quality and stream conditions across aquatic ecosystems influenced by management on National Forest System lands. The Forest is developing an aquatic monitoring strategy that will include brook trout. | Maintain at least 560 miles of coldwater stream habitat capable of supporting wild, naturally producing brook trout, a MIS. |
| Cerulean warbler (*Dendroica cerulea*) | G4 | None | High-interest non-game species. Associated with large trees, gaps, and complex canopy layering characteristic of old-growth forests. A forest interior species that is believed to be sensitive to fragmentation. The Forest and WV DNR are cooperating on an ongoing songbird point count monitoring program that is expected to provide Forest-wide data on this species. | Maintain at least 50,000 acres of mid-late and late successional (>80 years old) mixed mesophytic and cove forest to meet habitat needs for cerulean warbler, a MIS. |
| Wild turkey (*Meleagris gallopavo*) | G5 | None | High-interest game species. In the Appalachians, strongly associated with oak mast. Requires herbaceous openings for brood range and is expected to reflect the effectiveness of the cooperative Forest-WV DNR wildlife opening management effort. Uses shrub/sapling stands for nest sites. Ongoing harvest data collected by WV DNR provides a Forest-wide population index. | Maintain at least 150,000 acres of 50-150 year old oak and pine-oak forest in MPs 3.0 and 6.1 to meet habitat needs for wild turkey, a MIS. |
| West Virginia northern flying squirrel (*Glaucomys sabrinus fuscus*) | T2 | Endangered | High-interest endangered species. Appears to be associated with certain late successional characteristics (snags, canopy gaps, moist microclimate, co-dominance by spruce). The Forest is developing a long-term, Forest-wide monitoring program in cooperation with WV DNR and USFWS. | Maintain at least 20,000 acres of mid-late and late successional (>80 years old) spruce forest, with a long-term objective of increasing this to at least 40,000 acres to provide optimum habitat for WVNFS, a MIS. |

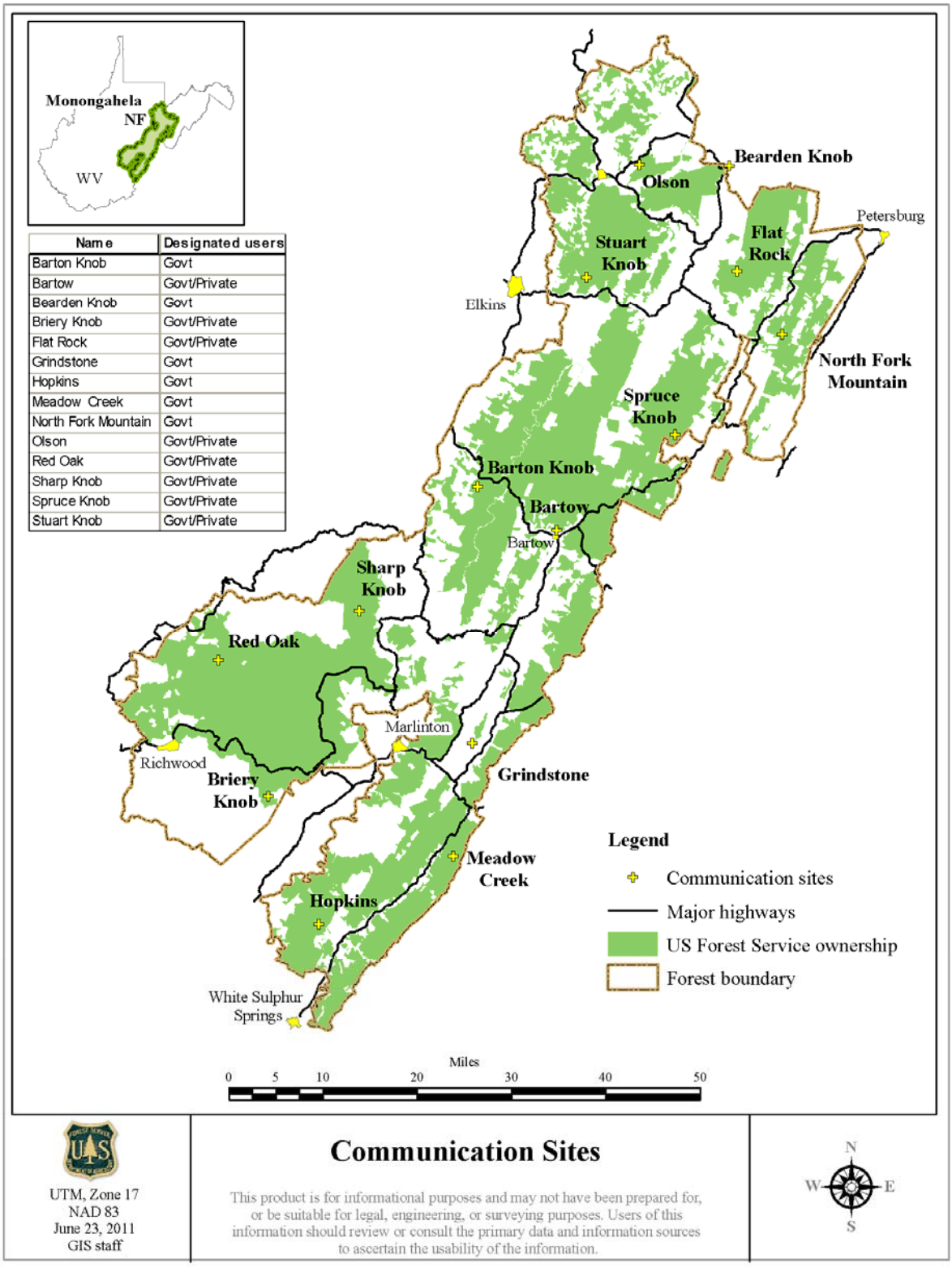
**Table D-2. Disposition of Management Indicator Species from the 1986 Forest Plan**

| Species | Disposition/Rationale |
|---|---|
| Virginia big-eared bat (*Corynorhinus townsendii virginianus*) | Not carried forward as an MIS. Habitat generalist; population changes may be difficult to relate to National Forest management activities. Very rare species that is difficult to monitor outside of hibernacula. Will still be included in TES bat monitoring at the project/watershed level. |
| Indiana bat (*Myotis sodalis*) | Not carried forward as an MIS. Forest habitat generalist; population changes may be difficult to relate to National Forest management activities. Very rare species that is difficult to monitor outside of hibernacula. Will still be included in TES bat monitoring at the project/watershed level. |
| Cheat Mountain salamander (*Plethodon nettingi*) | Not carried forward as an MIS. Occurs in isolated populations that are protected from management impacts. Potential for effects to populations will still be analyzed at the project level. Effects to high-elevation/spruce forest habitat will be monitored via West Virginia northern flying squirrel. |
| "Wild" trout | Brook trout carried forward as an MIS in the 2006 Forest Plan. |
| Black bear (*Ursus americanus*) | Not carried forward as an MIS. Wide-ranging species; difficult to relate population changes to specific National Forest management activities. Effects to this species are analyzed in the EIS. Effects to oak forest habitat will be monitored via wild turkey. |
| Wild turkey | Carried forward as an MIS in the 2006 Forest Plan. |
| White-tailed deer *(Odocoileus virginianus)* | Not carried forward as an MIS. Habitat generalist; population changes may be difficult to relate to National Forest management activities. Effects to this species are analyzed in the EIS. |
| Gray squirrel (*Sciurus carolinensis*) | Not carried forward as an MIS. Effects to oak forest habitat will be monitored via wild turkey. |
| Varying hare (*Lepus americanus*) | Not carried forward as an MIS. Cryptic species that is difficult to monitor effectively. Effects to high-elevation/spruce forest habitat will be monitored via West Virginia northern flying squirrel. |
| West Virginia northern flying squirrel | Carried forward as an MIS in the 2006 Forest Plan. |

# Appendix E

# Communication Sites

Appendix E is a map of communication sites currently found on the Forest. The map includes a table that lists the sites and whether the site is designated for use by the government and private entities, or by the federal government only.


Monongahela NF
WV
Name | Designated users
Barton Knob | Govt
Bartow | Govt/Private
Bearden Knob | Govt
Briery Knob | Govt/Private
Flat Rock | Govt/Private
Grindstone | Govt
Hopkins | Govt
Meadow Creek | Govt
North Fork Mountain | Govt
Olson | Govt/Private
Red Oak | Govt/Private
Sharp Knob | Govt/Private
Spruce Knob | Govt/Private
Stuart Knob | Govt/Private
Bearden Knob
Olson
Petersburg
Flat Rock
Stuart Knob
Elkins
North Fork Mountain
Spruce Knob
Barton Knob
Bartow
Bartow
Sharp Knob
Red Oak
Marlinton
Richwood
Briery Knob
Grindstone
Meadow Creek
Hopkins
White Sulphur Springs
Legend
Communication sites
Major highways
US Forest Service ownership
Forest boundary
Miles
0 5 10 20 30 40 50
Communication Sites
UTM, Zone 17
NAD 83
June 23, 2011
GIS staff
This product is for informational purposes and may not have been prepared for, or be suitable for legal, engineering, or surveying purposes. Users of this information should review or consult the primary data and information sources to ascertain the usability of the information.
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# Appendix F

# Climate Change and the Forest Plan

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## Changes to the Forest Plan Appendices Since 2006

**Appendix F –** This appendix is new. It describes how the Forest Plan addresses climate change.

## Forest Plan and Climate Change Crosswalk Tables

There are many ways in which Forest Plan prescriptions, direction, and monitoring would provide benefits related to counteracting effects or trends commonly described for climate change. Virtually all of these ways fall under the *Adaptation* or *Mitigation* strategies described in the "Forest Service Strategic Framework for Responding to Climate Change" (USDA FS 2008). The tables below indicate connections between Forest Plan components and the following potential beneficial effects that correspond to the Strategic Framework strategies:

1) Maintain, restore, or enhance ecosystem resiliency *(facilitated adaptation/mitigation)*
2) Promote carbon sequestration *(mitigation)*
3) Promote air or water quality, cooler temperatures, moister conditions *(facilitated adaptation)*
4) Reduce or prevent NNIS establishment and spread *(facilitated adaptation)*
5) Retain or promote biological diversity *(facilitated adaptation)*

### Forest Plan Management Prescriptions and Climate Change

| Management Prescription | Management Emphasis | Connection to Climate Change |
|---|---|---|
| 3.0 – Vegetation Diversity (196,900 acres or 21% of Forest) | Age class diversity, sustainable timber, variety of habitat and forest scenery | 1), 5) |
| 4.1 – Spruce and Spruce-Hardwood Ecosystem Restoration (155,700 acres or 17% of Forest) | Active and passive restoration of spruce-hardwood communities, spruce research, recovery of T&E and other rare species | 1), 2), 3), 4) |
| 5.0 – Designated Wilderness (116,500 acres or 13% of Forest) | Preserve wilderness attributes and natural environment | 2), 3), 5) |
| 5.1 – Recommended Wilderness (0 acres or 0% of Forest) | Maintain wilderness attributes and natural-appearing environment | 2), 3), 5) |
| 6.1 – Wildlife Habitat Emphasis (286,400 acres or 31% of Forest) | Enhance wildlife habitat through vegetation management, active restoration of oak communities | 1), 5) |
| 6.2 – Backcountry Recreation (96,400 acres or 10% of Forest) | Variety of non-motorized recreation opportunities in a semi-primitive setting and largely natural environment | 2), 3), 5) |
| 8.0 – Special Areas (73,600 acres or 8% of Forest) | Preservation of unique ecosystems or areas for scientific or recreational purposes, research areas, biodiversity | 1), 2), 3), 5) |
| • 8.1 – SKSR National Recreation Area (57,200 acres) | A variety of recreational settings and opportunities; conservation of scenic, scientific, historic and other values | 2), 5) |
| • 8.2 – National Natural Landmarks (2,460 acres) | Preservation of nationally significant ecological and geological natural areas | 2), 3), 5) |
| • 8.3 – Scenic Areas (2,470 acres) | Preservation of outstanding beauty and visual quality areas for public enjoyment | 2), 3), 5) |
| • 8.4 – Ecological Areas (3,080 acres) | Preservation of rare ecosystems to enhance biodiversity and provide for scientific or recreation activities | 2), 3), 5) |
| • 8.5 – Research Areas (6,840 acres) | Areas set aside for research purposes, includes Fernow Experimental Forest | 1), 2), 5) |
| • 8.6 – Grouse Management Areas (8,570 acres) | Establish and maintain habitat suitable for ruffed grouse and other species that need an early successional component in habitat | 1), 5) |

## Forest Plan Management Direction and Climate Change Connections

The following tables, presented by resource area, provide a variety of examples of how Forest-wide management direction in the Plan is connected to adaptation and mitigation strategies for addressing potential effects from climate change.

### Air Quality (p. II-8)

| Management Direction Type, Number and Description | Connection to Climate Change |
|---|---|
| **Goal AQ01** - Improve and maintain air quality and Air Quality Related Values (AQRVs) through a cooperative working relationship with agencies managing air quality, while achieving management goals and objectives.<br>a) Review, evaluate, and provide recommendations on Prevention of Significant Deterioration (PSD) permits that may affect current class I area AQRVs.<br>b) Provide comments to air quality agencies on regulatory efforts that impact air quality in Dolly Sods and Otter Creek class I areas.<br>c) Participate in regional planning organizations and efforts that are examining ways to reduce impacts to visibility and other AQRVs in Class I areas of the region. | 3) Promote improved air quality, cooler temperatures, and moisture retention. |
| **Objective AQ02 -** Reduce air pollution impacts to the AQRVs of the class I areas on the Forest to improve AQRV conditions over current adversely affected levels. | 3) Promote improved air quality, cooler temperatures, and moisture retention. |
| **Standard AQ04 -** Conduct management activities (including permitted activities) in a manner that does not result in a significant contribution to a violation of National Ambient Air Quality Standards, a violation of applicable provisions in the State Implementation Plan, or an adverse impact to AQRVs in Dolly Sods and Otter Creek Wildernesses. | 3) Promote improved air quality, cooler temperatures, and moisture retention. |

### Soils (pp. II-9 through II-11)

| Management Direction Type, Number and Description | Connection to Climate Change |
|---|---|
| **Goal SW01** - Maintain, restore, or improve soil quality, productivity, and function. Manage soil disturbances from management activities such that they do not result in long-term loss of inherent soil quality and function. | 1) Maintain, restore, or enhance ecosystem resiliency<br>2) Promote carbon sequestration |
| **Standard SW03** - Disturbed soils dedicated to growing vegetation shall be rehabilitated by fertilizing, liming, seeding, mulching, or constructing structural measures as soon as possible, but generally within 2 weeks after project completion, or prior to periods of inactivity, or as specified in contracts. Rip compacted sites when needed for vegetative re-establishment and recovery of soil productivity and hydrologic function. The intent is to minimize the time that soil is exposed on disturbed sites or retained in an impaired condition. | 1) Maintain, restore, or enhance ecosystem resiliency<br>2) Promote carbon sequestration |
| **Standard SW03** - Erosion prevention and control measures shall be used in program and project plans for activities that may reduce soil productivity or cause erosion. | 1) Maintain, restore, or enhance ecosystem resiliency<br>2) Promote carbon sequestration |
| **Standard SW08** - Management actions that have the potential to contribute to soil nutrient depletion shall be evaluated for the potential effects of depletion in relation to on-site acid deposition conditions. | 1) Maintain, restore, or enhance ecosystem resiliency |

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| **Guideline SW11** - Soil stabilization procedures should take place as soon as practical after earth-disturbing activities are completed or prior to extended periods of inactivity. Special revegetation measures may be required. | 1) Maintain, restore, or enhance ecosystem resiliency<br>2) Promote carbon sequestration<br>4) Reduce or prevent NNIS est. and spread |
| **Guideline SW14** - Mulch should be applied on severely eroded areas, or areas with high potential for erosion, such as new road cut and fill slopes. | 1) Maintain, restore, or enhance ecosystem resiliency<br>2) Promote carbon sequestration |
| **Guideline SW15** - Topsoil should be retained to improve the soil medium for plant growth on areas to be disturbed by construction. Topsoil should be salvaged from an area during construction and stockpiled for use during subsequent reclamation, or obtained from an alternate site. On some areas, soil material may have to be added to obtain vigorous plant growth. Soil to be used for this purpose should have chemical tests made to determine its desirability for use. | 1) Maintain, restore, or enhance ecosystem resiliency<br>2) Promote carbon sequestration |
| **Guideline SW19** - Management activities that may result in accelerated erosion and loss of organic matter should have one or more of the following practices applied to mitigate potential effects:<br>a) Limiting mineral soil exposure,<br>b) Appropriately dispersing excess water,<br>c) Ensuring sufficient effective groundcover,<br>d) Stabilizing disturbed soils through revegetation, mulching, or other appropriate means,<br>e) Preventing or minimizing excessive compaction, displacement, puddling, erosion, or burning of soils, and<br>f) Preventing or minimizing the initiation or acceleration of mass soil movement (e.g., slumps, debris flows, or landslides). | 1) Maintain, restore, or enhance ecosystem resiliency<br>2) Promote carbon sequestration<br>4) Reduce or prevent NNIS est. and spread |

**Water Quality and Hydrology (p. II-11)**

| Management Direction Type, Number and Description | Connection to Climate Change |
|---|---|
| **Goal SW20** - Manage watersheds to sustain healthy aquatic systems, achieve desired conditions, and meet state designated water uses. | 1) Maintain, restore, or enhance ecosystem resiliency |
| **Standard SW23** - Logging and construction equipment shall not be washed in stream courses, nor shall material from washed equipment be allowed to drain into surface waters. | 4) Reduce or prevent NNIS establishment and spread |

**Stream Channels, Lakes, and Wetlands (pp. II-11 through II-14)**

| Management Direction Type, Number and Description | Connection to Climate Change |
|---|---|
| **Goal SW29** - Maintain or restore riparian and floodplain function, including floodwater retention and storage. | 1) Maintain, restore, or enhance ecosystem resiliency |
| **Goal SW30** - Maintain surface and ground water sources to support healthy riparian and aquatic habitats, wetlands, channel function, and downstream uses. | 1) Maintain, restore, or enhance ecosystem resiliency |
| **Goal SW31** - Maintain, enhance, or restore vegetation conditions that provide:<br>a) Ecological functions of riparian, wetland, and aquatic ecosystems.<br>b) Canopy conditions that regulate riparian and stream temperature regimes for native and desired non-native fauna and flora.<br>c) Natural recruitment potential for large woody debris and other sources of nutrient inputs to aquatic ecosystems.<br>d) Bank and channel stability and structural integrity. | 1) Maintain, restore, or enhance ecosystem resiliency<br>2) Promote carbon sequestration<br>3) Promote air or water quality, cooler temperatures, moister conditions |

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| e) Habitat and habitat connectivity for aquatic and riparian-dependent species and upland species that use riparian corridors.<br>f) Buffers to filter sediment. | |
| **Standard SW34 -** No programmed timber harvest shall occur within the channel buffers identified in the table in SW37. Tree removal from the buffers may only take place if needed to meet aquatic or riparian resource management needs, or to;<br>a) Provide habitat improvements for aquatic or riparian species, or threatened, endangered, sensitive, and locally rare species;<br>b) Provide for public or worker safety;<br>c) Construct or renovate an approved facility;<br>d) Construct temporary road, skid road, or utility corridor crossings;<br>e) Conduct aquatic or riparian-related research, or<br>f) Allow for cable yarding. | 1) Maintain, restore, or enhance ecosystem resiliency<br>2) Promote carbon sequestration<br>3) Promote air or water quality, cooler temperatures, moister conditions |
| **Standard SW36 -** When stream crossing structures are removed, stream channels shall be restored to their near-natural morphology (width, depth, and gradient associations for streambeds, streambanks, floodplains, and terraces). Disturbed soil shall be stabilized. | 1) Maintain, restore, or enhance ecosystem resiliency |
| **Standard SW39 -** Use no-till cultivation methods for wildlife opening maintenance within channel buffers. | 1) Maintain, restore, or enhance ecosystem resiliency<br>2) Promote carbon sequestration |
| **Standard SW40** - Skid trails and landings shall not be constructed within 100 feet of perennial, intermittent, and ephemeral channels except at crossings or when location outside the 100-foot zone pose a greater risk to aquatic or riparian resources. The 100-foot filter strip may be modified based on site-specific conditions such as soil type, slope, and stability. | 1) Maintain, restore, or enhance ecosystem resiliency<br>3) Promote air or water quality, cooler temperatures, moister conditions |
| **Standard SW41** - Corralling or overnight tethering of horses or other livestock is not allowed within 100 feet of stream courses or lakes. Existing corral sites may be maintained until alternative sites are developed, provided impacts to water quality and stream channels are mitigated. | 1) Maintain, restore, or enhance ecosystem resiliency |
| **Standard SW42** - New trails, campsites, and other recreational developments shall be located, constructed, and maintained to minimize impacts to channel banks and other riparian resources. | 1) Maintain, restore, or enhance ecosystem resiliency<br>3) Promote air or water quality, cooler temperatures, moister conditions |
| **Standard SW43** - Channel buffers shall not be available for commercial mineral material development. | 1) Maintain, restore, or enhance ecosystem resiliency<br>3) Promote air or water quality, cooler temperatures, moister conditions |
| **Standard SW44** - New roads are allowed within channel buffers but are restricted to essential crossings. Construction of roads parallel to the channel shall be avoided within the channel buffer. | 1) Maintain, restore, or enhance ecosystem resiliency<br>3) Promote air or water quality, cooler temperatures, moister conditions |
| **Standard SW45** - New roads within the channel buffer shall be designed to minimize impacts on aquatic and riparian resources. | 1) Maintain, restore, or enhance ecosystem resiliency |
| **Guideline SW50** - Maintained wildlife openings and associated access routes identified as degrading riparian or aquatic conditions should be mitigated or closed and restored. New wildlife openings within channel buffers may occur where needed to provide habitat for riparian species, or TEP, RFSS, or locally rare species, and where maintenance for these openings and their access routes can be achieved without degrading riparian or aquatic conditions. | 1) Maintain, restore, or enhance ecosystem resiliency<br>3) Promote air or water quality, cooler temperatures, moister conditions<br>4) Reduce or prevent NNIS establishment and spread<br>5) Retain or promote biodiversity |
| **Guideline SW51** - Ground disturbance should be avoided within seeps, vernal pools, bogs, fens, and other wetlands during project | 1) Maintain, restore, or enhance ecosystem resiliency |

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| implementation. These areas should be managed to protect wet soils and rare plants and provide wildlife watering sources using the following protection:<br>a) No new system roads or skid roads should be located within these areas except at essential crossings. Such crossings should be designed to minimize disturbance to the extent practical.<br>b) Logs should not be skidded through these areas. Keep slash and logs out of them.<br>c) Where available, a canopy of 60-100 percent crown closure should be maintained within and adjacent to these areas, unless a more open canopy is needed for TEP species or RFSS management.<br>d) Mast trees or shrubs may be planted in seeps if mast plants are currently lacking. | 2) Promote carbon sequestration<br>3) Promote air or water quality, cooler temperatures, moister conditions<br>4) Reduce or prevent NNIS establishment and spread<br>5) Retain or promote biodiversity |
| **Guideline SW52** - Cable yarding that crosses channel buffers should avoid or mitigate adverse effects to the stream channel. Crossing should be at as near a right angle as possible, with full suspension preferred. Trees cut within channel buffers to provide cable corridors may be left on site for woody debris recruitment and erosion control. | 1) Maintain, restore, or enhance ecosystem resiliency<br>2) Promote carbon sequestration<br>3) Promote air or water quality, cooler temperatures, moister conditions |
| **Guideline SW53** - Use existing fire barriers, such as streams, roads, and trails for control lines where possible. | 1) Maintain, restore, or enhance ecosystem resiliency<br>2) Promote carbon sequestration |
| **Guideline SW54** - Hand lines, wet lines, or black lines should be used where appropriate within channel buffers to minimize soil disturbance from fire suppression or control. | 1) Maintain, restore, or enhance ecosystem resiliency<br>2) Promote carbon sequestration |
| **Guideline SW55** - New trails should not be located within channel buffers except at crossings, to control access to water bodies, or when location outside the buffer would pose greater risk to aquatic or riparian resources. | 1) Maintain, restore, or enhance ecosystem resiliency |
| **Guideline SW56** - Designated livestock stream crossings and watering points should be located, sized, and maintained to minimize impacts to aquatic and riparian resources. | 1) Maintain, restore, or enhance ecosystem resiliency<br>4) Reduce or prevent NNIS est. and spread |
| **Guideline SW57** - Improvements that invite concentrated livestock use—such as feed troughs, corrals, or salt/mineral blocks—should be located at least 100 feet from a channel, lake, or wetland. | 1) Maintain, restore, or enhance ecosystem resiliency<br>4) Reduce or prevent NNIS est. and spread |
| **Guideline SW58** - Watering troughs should be used where feasible to protect aquatic and riparian resources. | 1) Maintain, restore, or enhance ecosystem resiliency |
| **Guideline SW59** - Where private minerals are explored or developed within channel buffers, work with mineral developers to minimize disturbance to aquatic and riparian resources. | 1) Maintain, restore, or enhance ecosystem resiliency<br>4) Reduce or prevent NNIS est. and spread |
| **Guideline SW61** - Work with special use permittees to mitigate effects from their operations to soil, water, and aquatic resources within channel buffers. | 1) Maintain, restore, or enhance ecosystem resiliency<br>4) Reduce or prevent NNIS est. and spread |
| **Guideline SW62** - Stream crossing construction on temporary and permanent roads should be completed as soon as practical, with mitigation as needed to minimize the potential for sedimentation. | 1) Maintain, restore, or enhance ecosystem resiliency |

**Fire Management (pp. II-15 through II-16)**

| Management Direction Type, Number and Description | Connection to Climate Change |
|---|---|
| **Goal FM03** - Reduce wildfire risk to communities, municipal water supplies, and at-risk federal land by maintaining or restoring fire-resilient forest stands. | 1) Maintain, restore, or enhance ecosystem resiliency |
| **Goal FM04** - Maintain or restore late successional stands to a pre-fire suppression condition consistent with management prescription | 2) Promote carbon sequestration |

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| emphasis and desired conditions. | |
| **Goal FM08** - Design and implement prescribed fire projects so that emissions do not hinder the state from meeting air quality standards and attaining visibility goals. | 3) Promote air or water quality, cooler temperatures, moister conditions |
| **Objective FM09 -** Over the next 10 years use prescribed fire on 10,000 to 30,000 acres. Emphasize use in areas to reduce hazardous fuels and fire risk to property or investments, and/or in areas to maintain, restore, or enhance wildlife habitat or other ecosystem components. | 1) Maintain, restore, or enhance ecosystem resiliency |
| **Standard FM12 -** A prescribed burning plan must be prepared and approved prior to using prescribed fire as a management tool. The plan shall address protection or maintenance of TEP species and habitat, cultural resources, watershed resources, air quality, private property, and other resources or investments as needed or appropriate. | 1) Maintain, restore, or enhance ecosystem resiliency<br>5) Retain or promote biological diversity |
| **Guideline FM20 -** After a fire is controlled, rehabilitate those areas that have the potential to adversely affect soil, water, or other resources. Fire lines should be revegetated and water-barred, where necessary, to prevent erosion. Water diversions may be used to keep sediment out of channels. | 1) Maintain, restore, or enhance ecosystem resiliency<br>2) Promote carbon sequestration |

**Vegetation (pp. II-18 through II-20)**

| Management Direction Type, Number and Description | Connection to Climate Change |
|---|---|
| **Goal VE01** - Provide vegetative diversity through a mix of natural and maintained openings, wetlands, and early, mid, and late successional forests to support a wide variety of habitats, forage, scenery, recreational settings, and socio-economic opportunities. | 1) Maintain, restore, or enhance ecosystem resiliency<br>5) Retain or promote biological diversity |
| **Objective VE02** - Maintain or create age class diversity on suitable timberlands to provide for sustainable timber production and a variety of structure and wildlife habitat. Treat an estimated 20,000 to 40,000 acres over the next decade to move toward desired age class conditions. | 1) Maintain, restore, or enhance ecosystem resiliency<br>5) Retain or promote biological diversity |
| **Objective VE03** - Treat an estimated 4,000 to 12,000 acres over the next decade on lands not suited for timber production to help restore ecosystems and enhance wildlife habitat. | 1) Maintain, restore, or enhance ecosystem resiliency |
| **Guideline VE04** - Use lands unsuited for timber production (MPs 5.0, 6.2, 5.1, portions of 8.0) as patches of potential old growth. In MPs with suitable timberlands (MPs 3.0, 6.1, portions of 4.1), identify potential old growth areas based on management direction and emphasis, as well as information on delineating potential old growth in Appendix B. | 2) Promote carbon sequestration |
| **Goal VE07 -** Maintain or restore rare plant communities or individual populations to contribute to the biodiversity of the Forest. | 1) Maintain, restore, or enhance ecosystem resiliency<br>5) Retain or promote biological diversity |
| **Standard VE12 -** Allow collection of RFSS plants only for research or scientific purposes. | 5) Retain or promote biological diversity |
| **Standard VE13 -** For management actions that have been identified by the Forest as likely to cause a negative effect on RFSS populations, negative effects shall be avoided or minimized to the maximum extent practical while still accomplishing the purpose of the project or action. Unavoidable negative effects shall be mitigated to the extent practical and consistent with the project purpose. | 1) Maintain, restore, or enhance ecosystem resiliency<br>5) Retain or promote biological diversity |
| **Guideline VE14 -** Rare communities should be identified during project analysis. Management actions should avoid rare communities | 1) Maintain, restore, or enhance ecosystem resiliency |

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| unless management is necessary to maintain, enhance, or restore a particular community. Conservation and management measures for rare communities should be determined on a case-by-case basis. | 5) Retain or promote biological diversity |
| **Goal VE19 -** Manage NNIS with an Integrated Pest Management approach, using prevention, education, eradication, containment, and control strategies in a coordinated effort that includes potentially affected resources, users, funding sources, and activities.<br>a) Work to prevent new infestations of NNIS, with emphasis on areas where species have a high probability for establishment and spread.<br>b) Work with WVDNR, utility companies, and special use operators to control NNIS in openings, rights-of way, and other use areas.<br>c) During project-level analysis, identify and map areas of non-native invasive plants. Identify areas with extensive infestations where precautionary measures are necessary when planning and implementing management activities.<br>d) Develop a Forest Non-native Invasive Species Management Plan in coordination with county, state, and federal agencies, including USFWS.<br>e) Provide training to field-going personnel for detecting evidence of NNIS with potential for broad-scale vegetation impacts.<br>f) Use the Forest-wide database and map library of NNIS and susceptibility to develop site-specific Integrated Pest Management approaches and strategies to manage these species. | 1) Maintain, restore, or enhance ecosystem resiliency<br>4) Reduce or prevent NNIS est. and spread<br>5) Retain or promote biological diversity |
| **Standard VE22** - Projects that may contribute to the spread or establishment of noxious weeds shall be designed to include measures to reduce the potential for spread and establishment of noxious weed infestations. | 1) Maintain, restore, or enhance ecosystem resiliency<br>4) Reduce or prevent NNIS est. and spread<br>5) Retain or promote biological diversity |
| **Guideline VE25** - Special use permits should include language where appropriate to reduce the risk of NNIS invasion and spread. | 4) Reduce or prevent NNIS est. and spread |
| **Goal VE26** - Use Integrated Pest Management methods to minimize or prevent the development of pest problems (includes all pests, e.g., insects, disease, vegetative, or animal). Provide training to field-going personnel for detecting evidence of insect or disease activity. | 1) Maintain, restore, or enhance ecosystem resiliency<br>4) Reduce or prevent NNIS est. and spread |
| **Standard VE32** - Unless specifically registered for aquatic use, ground application of pesticides shall be conducted such that they do not enter surface waters, wetlands, or sink holes. | 1) Maintain, restore, or enhance ecosystem resiliency<br>5) Retain or promote biological diversity |

**Threatened, Endangered, and Proposed Species (pp. II-22 through II-24)**

| Management Direction Type, Number and Description | Connection to Climate Change |
|---|---|
| **Goal TE01** - Provide habitat capable of contributing to the survival and recovery of species listed under the ESA. Provide habitat that may help preclude Proposed species from becoming listed. | 5) Retain or promote biological diversity |
| **Goal TE04** - Within watershed-level planning units, identify TEP species habitat and opportunities to maintain, restore, or enhance habitat conditions. Design and implement management actions at the project level to address opportunities and provide for ecological conditions, population viability, reproductive needs, and habitat components for TEP species. | 1) Maintain, restore, or enhance ecosystem resiliency<br>5) Retain or promote biological diversity |
| **Goal TE29** - Manage naturally occurring tree species composition to provide a continuous supply of suitable roost trees and foraging habitat for Indiana bat. Achieve vegetative diversity that maintains or improves Indiana bat habitat. Where consistent with management | 2) Promote carbon sequestration<br>5) Retain or promote biological diversity |

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| prescription emphasis, use a variety of silvicultural methods to create desired age class diversity. | |
| **Objective TE30** - Provide a continuous supply of suitable roost trees by maintaining a minimum of 50 percent of each primary range on NFS lands in any combination of mid successional (40-79 years), mid to late successional (80-120 years), and late-successional (>120 years) age classes. | 2) Promote carbon sequestration<br>5) Retain or promote biological diversity |
| **Standard TE31 -** Management of vegetation 5 inches dbh or greater may only be implemented if activities:<br>a) Maintain or improve Indiana bat or other TEP or Sensitive species' habitat, or<br>b) Address public or worker safety concerns, or<br>c) Achieve research objectives. | 2) Promote carbon sequestration |
| **Standard TE36 -** Maintain a component of large over-mature trees, if available, in all uneven-aged harvest units to provide suitable roosting habitat. | 2) Promote carbon sequestration |

**Wildlife and Fish (pp. II-29 through II-31)**

| Management Direction Type, Number and Description | Connection to Climate Change |
|---|---|
| **Goal WF01** - Provide habitat diversity that supports viable populations of native and desired non-native wildlife and fish species, including Management Indicator Species (MIS), game species, and furbearers, and keeps RFSS from a trend toward federal listing.<br>a) During watershed or project-level analysis, identify and prioritize opportunities to maintain or restore habitat for RFSS, Birds of Conservation Concern, and other species of interest.<br>b) Within watershed-level planning units, maintain, enhance, or restore representative examples of habitats that would be expected under unmanaged conditions, to the extent allowed by land ownership patterns, existing conditions, and management prescription emphasis. | 1) Maintain, restore, or enhance ecosystem resiliency<br>5) Retain or promote biological diversity |
| Goal WF04 - Manage cold water streams to maintain or restore suitable habitat and native aquatic communities.<br>a) During watershed or project-level analysis, identify and prioritize opportunities to improve water temperature and other habitat conditions.<br>b) Restore connectivity in currently fragmented habitat where the risk of genetic contamination, predation, or competition from undesired fish species is not a concern.<br>c) Use stream improvement structures where desirable to maintain or improve pool/riffle ratios, stream cover, and bank stability. | 1) Maintain, restore, or enhance ecosystem resiliency<br>3) Promote air or water quality, cooler temperatures, moister conditions<br>5) Retain or promote biological diversity |
| **Objective WF08** - Actively restore aquatic and riparian habitat conditions in 30-50 miles of stream over the next 10 years. Activities that restore or improve the natural structure and function of channel and riparian conditions may include the installation of instream structures, large woody debris loading, riparian fencing, riparian planting, and bank and channel stabilization. | 1) Maintain, restore, or enhance ecosystem resiliency<br>3) Promote air or water quality, cooler temperatures, moister conditions<br>5) Retain or promote biological diversity |
| **Objective WF09** - Maintain at least 50,000 acres of mid-late and late successional (>80 years old) mixed mesophytic and cove forest to meet habitat needs for cerulean warbler, a Management Indicator Species. | 1) Maintain, restore, or enhance ecosystem resiliency<br>2) Promote carbon sequestration<br>5) Retain or promote biological diversity |
| **Objective WF10** - Maintain at least 150,000 acres of 50-150 year old oak and pine-oak forest in MPs 3.0 and 6.1 to meet habitat needs for | 1) Maintain, restore, or enhance ecosystem resiliency |

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| wild turkey, a Management Indicator Species. | 2) Promote carbon sequestration<br>5) Retain or promote biological diversity |
| **Objective WF11** - Maintain at least 20,000 acres of mid-late and late successional (>80 years old) spruce forest to provide optimum habitat for West Virginia northern flying squirrel, a Management Indicator Species. The long-term objective is to increase mid-late and late successional spruce forest to at least 40,000 acres. | 1) Maintain, restore, or enhance ecosystem resiliency<br>2) Promote carbon sequestration<br>5) Retain or promote biological diversity |
| **Objective WF12** - Maintain at least 560 miles of coldwater stream habitat capable of supporting wild, naturally producing brook trout, a Management Indicator Species. | 1) Maintain, restore, or enhance ecosystem resiliency<br>3) Promote air or water quality, cooler temperatures, moister conditions |
| **Standard WF13 -** For management actions that have been identified by the Forest Service as likely to cause a negative effect on RFSS or Birds of Conservation Concern populations, negative effects shall be avoided or minimized to the maximum extent practical while still accomplishing the purpose of the project or action. Unavoidable negative effects shall be mitigated to the extent practical and consistent with the project purpose. | 5) Retain or promote biological diversity |
| **Standard WF14 -** For protection of cold water fisheries, apply the following to the channel buffers of perennial trout streams (stocked and native) during the period of October 1 to June 1:<br>a) Potential sediment-producing ground disturbance exceeding two consecutive days shall only be initiated after consultation with a Forest fisheries biologist.<br>b) Sediment-producing ground disturbance during this period shall employ additional erosion control measures and seeding or mulching, applied concurrently with the activity. | 1) Maintain, restore, or enhance ecosystem resiliency<br>3) Promote air or water quality, cooler temperatures, moister conditions |

## Forest Plan Monitoring and Climate Change

This table displays monitoring items in the Forest Plan Monitoring Matrix (Chapter IV) and how they are connected to beneficial effects related to climate change *(facilitated adaptation)*.

| Monitoring Item Number and Description | Connection to Climate Change |
|---|---|
| 3. Are insect and disease populations compatible with objectives for restoring or maintaining healthy forest conditions? | 1) Maintain, restore, or enhance ecosystem resiliency |
| 4. To what extent is the Forest managing undesirable occurrences of fire, insect and disease outbreaks through prevention, suppression, and integrated pest management? | 1) Maintain, restore, or enhance ecosystem resiliency |
| 6. Are the effects of Forest management, including prescriptions, resulting in significant changes to productivity of the land? | 1) Maintain, restore, or enhance ecosystem resiliency |
| 7. Are harvested lands adequately restocked after five years? | 1) Maintain, restore, or enhance ecosystem resiliency |
| 9. Are even-aged harvest units, particularly clearcuts, exceeding the 40-acre size limit established under the NFMA? | 1) Maintain, restore, or enhance ecosystem resiliency 2) Promote carbon sequestration |
| 10. To what extent is Forest management moving toward desired habitat conditions for MIS and species associated with MIS habitats? | 5) Retain or promote biodiversity |
| 11. To what extent is Forest management contributing or responding to air pollution effects on ecosystems and visibility? | 3) Promote air quality |
| 12. Are Air Quality Related Values of the Dolly Sods and Otter Creek Wildernesses improving over current adversely affected levels? | 3) Promote air quality |
| 13. What are the trends in ambient air pollutant concentrations near the Forest? | 3) Promote air quality |
| 16. How, where, and to what extent is prescribed fire being used to mimic natural processes, or maintain/improve vegetation conditions, or restore natural processes and functions to fire-adapted ecosystems? | 1) Maintain, restore, or enhance ecosystem resiliency |
| 31. Is soil detrimental disturbance associated with land management activities below the 15% soil productivity loss threshold? | 1) Maintain, restore, or enhance ecosystem resiliency |
| 32. Is acid deposition affecting soil productivity loss and if so, is it affecting land sustainability? | 1) Maintain, restore, or enhance ecosystem resiliency |
| 34. To what extent is the Forest providing a range of vegetative communities that address diverse public interests and needs while contributing to ecosystem sustainability and biological diversity? | 1) Maintain, restore, or enhance ecosystem resiliency<br>5) Retain or promote biodiversity |
| 35. To what extent are Forest management, natural disturbances, and subsequent recovery processes changing vegetation composition and structure? | 1) Maintain, restore, or enhance ecosystem resiliency |
| 37. Are non-native invasive plants located and treated to prevent or limit further spread? | 3) Reduce or prevent NNIS est. and spread |
| 38. To what extent is Forest management contributing to the protection and recovery of threatened and endangered species? | 5) Retain or promote biodiversity |
| 39. To what extent is Forest management contributing to the conservation of sensitive species and maintaining or restoring their habitat conditions? | 5) Retain or promote biodiversity |
| 40. To what extent are Forest management and other external influences, such as acid deposition, beneficially or adversely affecting water quality or quantity? | 1) Maintain, restore, or enhance ecosystem resiliency |
| 43. To what extent is Forest management influencing the viability of native and desired non-native species, or otherwise affecting species composition and habitat productivity? | 5) Retain or promote biodiversity |
| 44. To what extent is management on Forest lands influencing populations of terrestrial or aquatic non-native species that threaten native ecosystems? | 3) Reduce or prevent NNIS est. and spread |

## Forest Service Strategic Framework for Responding to Climate Change

The Forest Service Strategic Framework for Responding to Climate Change (2008) includes seven key goals that will help the agency carry out its mission of sustaining forests for present and future generations under a changing climate. This section examines existing or potential connections between these goals and the Forest Plan for the Monongahela National Forest (MNF).

**1. Science** – Will be used to advance our understanding of the environmental, economic, and social implications of climate change and related forest adaptation and mitigation activities.

*National Forests are not mandated to specifically conduct research. However, the MNF does have research areas on the Forest, and we have collaborated on many research projects in the past. Collaborators include the Northern Research Station, West Virginia University, Marshall University, Virginia Tech University, USDA Forest Health Protection, and others. We are looking forward to working with the Northern Institute of Applied Carbon Science and other researchers on climate change issues and strategies in the near future. We intend to continue benefitting from scientific studies and research activities that provide opportunities to incorporate appropriate science into our Forest Plan and our management practices over time to help address climate change related issues and concerns.*

**2. Adaptation** – Will enhance the capacity of forests to adapt to the environmental stresses of climate change and maintain ecosystem services.

*The Forest Plan has management direction and prescriptions that are designed to maintain or enhance the capacity of our forest to adapt to environmental stresses, including climate change. Monitoring and evaluation in the Forest Plan can also play a key role in adaptive management related to climate change and maintaining ecosystem services. The monitoring and evaluation process can be used to change Forest Plan direction and management practices as needed.*

**3. Mitigation** – Will promote the management of forests to reduce the buildup of greenhouse gases, while sustaining the multiple benefits and services of these ecosystems.

*The Forest Plan has management direction and prescriptions that promote carbon sequestration and tree regeneration that would help reduce greenhouse gases. Sustainable operations (see #6, below) that would reduce emissions and conserve energy have also been identified in a Forest Sustainability Action Plan, which was developed in 2008 and is now being implemented independent of the Forest Plan.*

**4. Policy** – Will integrate climate change, as appropriate, into Forest Service policies, program guidance, and communications.

*The MNF does not set policy for the agency. However, the Forest Plan is an essential part of program guidance for the Forest, and opportunities to integrate climate change into the Plan will likely come from agency policy changes in the future.*

**5. Sustainable Operations** – Will reduce the environmental footprint of Forest Service operations and be a leading example of a green organization.

*The Forest completed a Sustainability Action Plan in 2008 that should help us reduce our environmental footprint. This Sustainability Action Plan is being implemented independent of the Forest Plan, as Forest Plans do not normally address day-to-day business or administrative actions of a Forest.*

**6. Education** – Will advance awareness and understanding of principles and methods for sustaining forests, and sustainable resource consumption, in a changing climate.

*There may be educational opportunities through incorporating climate change information into Forest planning documents and other Forest literature. However, many of our opportunities in this arena would likely come in training for Forest employees, and public outreach programs that the Forest already participates in, such as outdoor education classes, fishing derbies, public presentations, and volunteer teaching.*

**7. Alliances** – Will establish, enhance, and retain strong alliances and partnerships with federal agencies, state and local governments, tribes, private landowners, NGO's, and international partners to provide sustainable forests for present and future generations.

*The Forest Plan describes consultation, cooperation, and coordination relationships and opportunities with current partners on pages II-2 through II-4. We value these relationships and the many agreements and mutual benefits they have fostered. For example, we are now part of the Central Appalachian Spruce Restoration Initiative—along with the Northern Research Station, Fish and Wildlife Service, West Virginia Division of Natural Resources, The Nature Conservancy, and West Virginia University—a group that is pooling resources to restore spruce-hardwood ecosystems. We are also working with the Native Seed Bank of West Virginia to collect and store seed from native plants on the Forest for future adaptation needs. Another recent collaborative effort concerns the forming of Cooperative Weed and Pest Management Areas with the State, The Nature Conservancy, Appalachian Forest Heritage Area, the George Washington-Jefferson National Forest, Northeastern State and Private Forestry Office, Northern Research Station, US Fish and Wildlife Service, WV Department of Agriculture, WV Division of Forestry, WV Division of Natural Resources, WV Native Plant Society, WV Rivers Coalition, WV Tree Farm Committee, West Virginia University, and other partners.*