

NATURAL RESOURCES CONSERVATION SERVICE  
MONTANA CONSERVATION PRACTICE SPECIFICATION  
**FOREST STAND IMPROVEMENT (ACRE)**

**CODE 666**

**DEFINITION:** The manipulation of species composition, stand structure, and stocking by cutting or killing selected trees and understory vegetation.

**PURPOSE(S):**

- To increase the quantity and quality of forest products by manipulating stand density and structure.
- Timely harvest of forest products.
- Development of renewable energy systems.
- To initiate forest stand regeneration.
- To reduce wildfire hazard.
- Improve forest health reducing the potential of damage from pests and moisture stress.
- To restore natural plant communities.
- To achieve or maintain a desired native understory plant community for special forest products, grazing and browsing.
- To improve aesthetic and recreation, values.
- To improve wildlife habitat.
- Alter water yield.
- To increase carbon storage in selected trees.

**SCOPE:** This practice applies:

- All forest land where improvement of forest resources is needed.
- Where a stand of trees is overstocked or where less desirable trees and shrubs overtop desirable trees.
- Where removing part of a stand will improve growth and quality of forest products, forage production, or the recreation, wildlife, aesthetic or hydrologic values of an area.

**FOREST STAND IMPROVEMENT SPECIFICATIONS:**

Specifications for applying this practice shall be prepared for each site and recorded using approved specifications sheets, job sheets, and narrative statements in the conservation plan, or other acceptable documentation.

Use the attached [Forest Practice Decision Key](#) to help determine the appropriate forest stand improvement treatments (see pages Specification MT666-6/7).

Stocking guidelines shall contain stocking in terms of basal area, spacing or trees per acre by species and size class distribution.

## Specification MT666-2

### Stocking Guidelines by Species

Use the D+X spacing in even-aged stands. Use Basal Area in uneven-aged stand. Refer to the National Forestry Handbook, Part 636.2 for proper inventory methods.

D+X is defined as: Average stand diameter (D) after treatment plus a constant (X).

EXAMPLE: If D = 9" and X = 6, then average spacing is 9+6, or 15 feet. Stocking at 15'x15'=194 trees/acre.

#### Ponderosa pine.

Even-aged:	D+ 6 to 10*
Uneven-aged:	63-84 FEET <sup>2</sup> /ACRE*

#### Douglas-fir, Spruce, Fir, Cedar, Hemlock.

Even-aged:	D+ 7 to 9*
Uneven-aged:	65-88 FEET <sup>2</sup> /ACRE*

#### Western larch.

Even-aged:	D+ 8 to 10*
Uneven-aged:	56-75 FEET <sup>2</sup> /ACRE*

#### Lodgepole pine.

Even-aged:	D+ 5 to 7*
Uneven-aged:	78-110 FEET <sup>2</sup> /ACRE*

\* Use the *upper* stocking levels in healthy stands on more productive sites where understory production (grass, shrub, and tree seedlings) is not a concern.

Use the *lower* stocking levels on less productive sites, to encourage growth of established tree seedlings, to improve forage production on grazable forests, to reduce fire hazards, or where lower levels are necessary when removing undesirable species or infected trees.

Do not exceed desired stocking levels by +/-25 percent. Stocking may exceed the upper limit if thinning a very dense stand would result in losses due to bending or windthrow. Lower limits could be exceeded if needed to remove unhealthy or poorly formed trees.

EXAMPLE: If the desired stocking in an even-aged stand calls for 136 trees/acre, do not go below 102 or above 170 trees/acre, +/- 36 trees/acre. Likewise, in an uneven-aged stand where the desired stocking is 72 ft<sup>2</sup>/ac, do not go below 54 ft<sup>2</sup>/ac or above 90 ft<sup>2</sup>/ac, +/-18 ft<sup>2</sup>.

## Forest Stand Improvement – Thinning

The primary objective of thinning is to improve growth and quality of remaining trees with minimum disturbance to the site. Regeneration is not an objective. Wood products may or may not result.

1. Commercial Thinning is reducing forest stocking by harvesting a portion of the merchantable trees in a stand. This may include some non-merchantable trees in the thinning operation.
2. Pre-Commercial Thinning is reducing forest stocking in immature stands by removing a portion of the non-merchantable trees in a stand.

Species most suitable for pre-commercial thinning in order of priority are:

- Lodgepole pine, 15 to 30 years old
- Ponderosa pine
- Western larch
- Douglas-fir.

Young sapling and pole size stands respond better to thinning. Lodgepole pine stands should only be thinned between the ages of 15 and 30 years old since older stands do not respond well.

Where usable or salable specialty products (logs, post, poles, or Christmas trees) are to be cut, they will be removed in a manner that will maintain or improve the stand.

Use one or a combination of the following thinning methods:

1. Mechanical – Unwanted trees in a stand are removed by the use of a chainsaw, brush saw, feller-buncher, axes, loppers, or any other mechanical device. Cut the tree just below the lowest live limb or six inches above the ground (12 inches for commercial harvests) which ever is closest.
2. Chemical – Unwanted trees in a stand are removed by the use of a backpack pump sprayer. Use an appropriate, registered herbicide for the species being removed. Permit no chemicals to enter any waters and leave a buffer strip around any water or intermittent streams. Follow label instructions.

Thin ponderosa pine and lodgepole pine stands [greater than three inches Diameter Breast Height (DBH)] between October 1 and April 1 to avoid damage from bark beetles unless slash is to be removed from the site, chipped, or burned before spring. Pines less than three inches DBH can be thinned any time. Typically the smaller diameter material will dry out before the bark beetles can emerge.

## Forest Stand Improvement – Harvesting

The primary objective of harvesting is to remove wood products with a minimum disturbance to the site and to provide for regeneration of a new stand or perpetuation of the existing forest.

The harvest-regeneration strategy will be identified for all planned forest improvement harvesting:

1. Even-aged management (clear-cut, seed-tree, shelterwood, and coppice) refers to stands having – or planned to have – only one age class, i.e., trees within a 20-year age span.
2. Uneven-aged management systems (single-tree selection, group selection, and coppice selection) refer to stands having – or planned to have – several age classes.
3. Successful regeneration of a new stand is defined as 250 seedlings per acre at least five years old. Both natural and artificial regeneration may be needed to meet this goal or if a change of species is desired.

## Specification MT666-4

### 1. Even-aged Management Harvest Systems:

- a. Clearcut – All trees regardless of age or size are cut. This system is applicable to mature or over mature and decadent stands where natural or artificial regeneration of shade intolerant species is desired. These can be in patches or strips and should be at least an acre in size. Often clearcuts are configured to fit the natural shape, size and spacing of stands. This variability can also be recreated within large uniform stands for aesthetic reasons if desired. The shade intolerant species best suited to this system are lodgepole pine, ponderosa pine, western larch, western white pine and Douglas-fir. Some ground disturbance is desired for seedling establishment.
- b. Seed Tree – This system is similar to a clearcut with the following difference. The cutting unit is too large for adequate dispersal of seed from the edges or a change of species is desired. Leave about ten large trees per acre of the desirable species capable of producing seed. Remove all others. Seed trees should be wind firm, healthy and well distributed over the area. Since trees do not bear abundant seed every year the regeneration process may require six to ten years. Species best suited for this type of system are ponderosa pine, western larch, western white pine, and Douglas-fir. Some ground disturbance is desired for seedling establishment. After establishment the seed trees may be removed.
- c. Shelterwood – This system is best suited to natural regeneration of species with some shade tolerance. Shelterwood has some advantages such as retarding growth by shading unwanted brush, better reproduction on harsh sites, aesthetically pleasing, and less wind throw hazard.

Trees are removed in a series of cuts. Remove trees leaving about 40 large trees per acre of the best desirable species capable of producing seed. Remove all other undesirable species that may be a source of seed. Seed trees should be wind firm, healthy and should be well distributed over the area. After adequate regeneration is achieved, the remaining older stand is removed. Initiate uneven aged stand development, if desired, by harvesting only a portion of the overstory. Species best suited for this type of system are ponderosa pine, western larch, and Douglas-fir. Some ground disturbance is desired for seedling establishment.

- d. Coppice – Produces stands originating from vegetative sprouting following harvest. They may be in the form of stump sprouts or root suckers. Coppicing usually involves short rotations with dense stands of trees capable of suckering or sprouting. In even-aged management, patches of trees are cleared to allow for the stand to regenerate. Species best suited for this type of system are quaking aspen and cottonwoods.

Aspen stand restoration and management --

- 1) Remove competing conifers.
- 2) Select aspen stands that are vigorously growing in the 40-60 year age class.
- 3) Clear cut patches of aspen stands. Remove 1/3 to 1/2 of the aspen stand at a time.
- 4) Monitor and manage aspen suckering. Remove livestock for first three years following harvest to allow suckers to get above grazing and browse height.
- 5) Expand edges of existing aspen stands by clear cutting surrounding trees 100 to 300 feet around aspen stand.

## 2. Uneven-aged Management Harvest Systems:

- a. Single-tree selection – Involves the removal of individually selected trees from a stand. A succession of different age groups is present ranging from seedlings to sawlogs. Harvest individual mature trees from each age class. Also thin seedlings and saplings pre-commercially following the harvest. Follow basal area stocking guidelines described earlier. Remove poor condition, diseased, and any undesirable species that are interfering with the growth and development of the remaining stand. The process re-opens the stand and provides more growing space to the remaining trees, as they grow larger. The shade tolerant species best suited for this type of system are Engelmann and white spruce, grand and subalpine firs, and western redcedar.
- b. Group selection – Involves the removal of groups of trees from a stand to create small openings. The purpose is to regenerate different age groups of the desired species. The size of the openings is dependent upon the availability and location of the seed source. Openings can be one-quarter to one acre in size but should not exceed five acres. Species best suited for this type of system are Douglas-fir, western hemlock, western white pine, western larch, and lodgepole pine. Some ground disturbance is desired for seedling establishment.
- c. Coppice selection – Involves the removal of individual trees from a stand, which stimulates vegetative sprouting, or suckering of new shoots. Requires species capable of suckering or sprouting. The species best suited to sprouting from a partial removal of the overstory are quaking aspen and cottonwoods.

Where natural or artificial regeneration is intended, the method and degree of scarification during harvest will be described. Refer to Field Office Technical Guide (FOTG), Section IV, practice standard, Tree/Shrub Site Preparation (Code 490) for more detailed information and guidance regarding this practice.

**Forest Slash Treatment**

Slash will be treated such that it does not present an unacceptable fire, environmental or pest hazard. Comply with Montana's Hazard Reduction (Slash) Act. Slash that is lopped and scattered will not exceed an average slash height of 18 inches in height on any part of the treatment area. Refer to FOTG, Section IV, practice standard, Woody Residue Treatment (Code 384) for more detailed information and guidance regarding this practice.

**OPERATION AND MAINTENANCE:** The following actions shall be carried out to insure that this practice functions as intended throughout its expected life. These actions include normal repetitive activities in the application and use of the practice (operation), and repair and upkeep of the practice (maintenance):

- Periodic inspections during treatment activities are necessary to ensure that objectives are achieved and resource damage is minimized.
- A stocking survey should be performed following thinning to make sure that desired stocking rates are achieved. Acceptable stocking rates are plus or minus 25 percent of the desired rate.
- Maintain marking of sensitive areas and monitor equipment exclusion throughout harvesting operations.
- Follow-up and ongoing management activities will be needed to obtain desired results.
- Monitor stands for insect and disease outbreaks or new weed infestations.
- Monitor natural regeneration, planted seedling survival and effectiveness of site scarification.

**Specification MT666-6**

**FOREST PRACTICE DECISION KEY**

- STEP 1:** Determine land management objectives, i.e., wood production, forage production, wildlife habitat enhancement, aesthetics, etc. The more detailed the objectives are, the better.
- STEP 2:** Inventory the stand.
- STEP 3:** Define the desired future condition of the stand in light of the objectives and inventory.
- STEP 4:** Select the appropriate practices using the DECISION KEY below.

**NOTE:** The key is not an exhaustive list of things to consider. For example, tree form (a consideration for cutting sawlogs) is not. Also, depending on objectives, it may be desirable to have trees in unhealthy conditions to attract wildlife.

- 1a. Desirable species are growing at their potential or are able to release given adequate growing space... 2
- 1b. Desirable species are not able to release given adequate growing space .....REPLACE EXISTING STAND
- 2a. Desirable species are healthy ..... 3
- 2b. Desirable species are not healthy .....REPLACE EXISTING STAND
- 3a. Stand is overstocked (according to objectives) with desirable species .....MANAGE EXISTING STAND
- 3b. Stand is fully stocked (according to objectives) and ..... 4
- 3c. Stand is understocked (according to objectives) with desirable species ..... 5
- 4a. Undesirable species are overabundant (desirable species understocked) ..... 5
- 4b. Undesirable species absent or not significant ..... NO TREATMENT NEEDED
- 5a. Stocking level of desirable species is adequate to help meet objectives .....MANAGE EXISTING STAND
- 5b. Stocking level of desirable species is too low to help meet objectives .....REPLACE EXISTING STAND

**REPLACE EXISTING STAND**

- Clearcut
- Seed tree cut
- Shelterwood cut
- Selection (single tree or group) <DEFINE ALL TREATMENTS NOT DESCRIBED IN STANDARDS>
- Sanitation/salvage cutting
- Planting or natural regeneration
- Coppice cut

**MANAGE EXISTING STAND**

- Thinning (commercial, pre-commercial)
- Improvement cut
- Sanitation/salvage cutting
- Overstory/understory removal
- Coppice selection

**FOREST PRACTICE DECISION KEY** CONTINUED

## DEFINITIONS:

- Fully Stocked:** According to the FOTG, Section III – Quality Criteria: Recommended D + X plus or minus 25 percent.  
Example: The recommended spacing for a low-site Douglas-fir stand is D + 8. If average stand diameter is 10 inches, this translates into and 18 feet spacing or 135 trees per acre plus or minus 34 (25 percent) trees per acre. Outside of this range is considered over or under stocked stand of trees.
- Desirable Species:** The tree species suited to the management objective of the landowner.  
Example: A mixed forest of conifers and hardwoods. For wood production, the hardwoods may be undesirable; but for wildlife habitat, both may be desirable.
- Stand Health:** Stands with infestations of insects or disease, have reached old age, or have been suppressed for long periods, are poor health risks. Also included are stands with excessive amounts of dead material (branches, standing snags or downed logs) that pose a high fire hazard.
- Release:** The ability of trees to take advantage of additional sunlight, moisture, and nutrients and increase their rate of growth when surrounding trees are removed.
- Salvage cutting:** The harvest of dead, dying, damaged or deteriorating trees primarily to put the wood to use before it becomes worthless.
- Sanitation cutting:** The harvest of dead, dying, damaged or deteriorating trees as well as those susceptible to attack, but for the purpose of reducing the spread of biotic pests.
- Improvement cutting:** Partial or complete removal of any undesirable tree species in a mixed stand due to potential forest health problems, low productivity or marketability, or other management objectives.
- Overstory removal:** Cutting the remaining overstory left from a prior harvest after regeneration has been established; or removal of decadent or undesirable trees to release the understory stand.
- Understory removal:** Similar to improvement cut but restricted to understory species. This is common where regeneration following harvest is of an undesirable species.