APPENDIX C - OPTIMALITY OF EVEN-AGED MANAGEMENT

This appendix summarizes information about the site specific analysis conducted to determine the optimality of the clearcut and shelterwood harvest treatments proposed in the alternatives. Additional information and records for this topic are contained in the project record. Much of the tree species information in this Appendix is a summary of information compiled in a report titled Even-Aged Management Information for the Chequamegon-Nicolet National Forest (Mark Theisen, Forest Silviculturalist, October 2001). Other records used for this analysis (field exam notes, prescriptions, stand condition information) are contained in the project record.

Even-aged management is used to manage a variety of forest cover types in Northern Wisconsin including: aspen, jack pine, balsam fir, red pine, white spruce, white pine, hemlock, paper birch, oak and mixed northern hardwoods (in certain species combinations or locations). Regeneration is achieved either naturally through seeding or root sprouting; or artificially through planting or seeding. The following is the rationale for using clearcutting and shelterwood regeneration harvest for regeneration of trees by the species groups for this project area.

C1 Aspen

Aspen is common tree species in the forested ecosystems in the Lake States. Aspen is a shade intolerant species and is considered "pioneer" tree species on sites that are recovering from intense disturbance. Under natural conditions, aspen is regenerated by natural disturbance such as wildfire or windstorms or other events that leave a site devoid of vegetation. Ground conditions as a result of these events are favorable for aspen root suckering and seeding.

Aspen is not a long lived species. By age 50, decay pathogens start to become a concern. The fungus *Phellinus tremulae* is the chief cause of decay in aspen and is the major deterrent to growing aspen on long rotations. After 50-70 years, these stands will begin to deteriorate. The deterioration of the aspen stand begins when the crowns of older trees can no longer grow fast enough to fill voids in the canopy left by dying trees. By age 60-80 years, many aspen trees will have died and succession to more shade-tolerant species will begin. Deteriorating aspen will produce significantly fewer root suckers following harvest or catastrophic disturbances than their healthy counterparts.

In order to maintain aspen, in the absence of wildfire, management is needed. Without disturbance, stands currently dominated by aspen will be replaced by species that are more shade tolerant. Prescribed burning, as an alternative to natural disturbance is possible but not practical in many locations due to the concern for protection and safety of firefighters, landowners, and adjacent private properties.

Where regeneration of aspen types is the objective, clearcutting is the optimum method for regenerating fully stocked stands and maximizing growth. This stimulates suckering on the greatest number of roots and minimizes shade on the site. Aspen needs full sunlight for vigorous growth and successful competition with shade tolerant species. Soil temperature is the most critical environmental factor affecting suckering. As little as 10-15 square feet of basal area of residual overstory will slow aspen sucker growth by 35-40%.

The shelterwood, seed tree, and individual selection methods of harvest would not be effective in regenerating these stands. The overstory left behind in seed tree, shelterwood, and individual selection harvest methods shade the ground and reduce or eliminate suckering, reduce growth rates, and reduce the aspen's competitiveness with shade tolerant species such as sugar maple and other hardwood or conifer types. Group selection (a method that removes small groups of trees during harvest) would also not be as effective in regenerating aspen because with the small size of the openings (less than 2 acres) the perimeter trees shade the regeneration opening. In general, the number of suckers produced is proportional to the degree of cutting. More suckers develop and grow in full sunlight. For this reason, clearcutting is used to harvest and regenerate aspen.

Aspen types are generally scheduled for regeneration harvest at about 45 years of age. Aspen stands may be regenerated between 30 to 70 years of age when there is a need to balance age classes (Forest Plan, page IV-42).

In Alternative B, the following stands are proposed for aspen regeneration by clearcutting (also see Table D-1, Appendix D):

> 007001e, 001016, 002002a, 002005, 002008, 003032, 003034, 004002a, 004014, 005005, 005006, 005027, 005028a, 005031a, 005032, 005033a, 006005a, 006006a, 006014a, 006020a, 006025, 007001a, 007001b, 007001c, 007001d, 007002a, 007017a, 009016, 009035, 011002, 011011, 011016, 012001a, 012001b, 012013a, 012014, 012015a, 012021a, 012022, 012026a, 013005a, 013029a, 013030, 014020, 014022a, 014047, 014052, 015064a, 017003a, 017003b, 017006, 017011a, 017017, 071011, 071014a, 071014b, 071016, 071017, 071019a, 071026a, 072018, 072019a, 073006a, 073010, 073011, 073024, 086012a, 086013, 086024, 086025a, 086027a, 086044, 086045, 087007, 087011a, 087011b, and 087019.

In Alternative C, the following stands are proposed for aspen regeneration by clearcutting (also see Table D-2, Appendix D):

> 007001e, 002002, 002005, 003034, 004002, 005027, 005028, 005033, 006005a, 006006a, 006014a, 006020a, 006020b, 006025, 007001a, 007001c, 007002a, 007016, 009016, 009030, 011002, 011011, 011015, 011016, 012013a, 012015, 012022, 012023, 012026, 013005a, 013029, 014020, 014022a, 014047, 014054, 014055, 015006, 015037, 017003, 059004a, 060001, 061026, 071011, 071019, 071050, 072019, 086012, 086013, 086021, 086025, 086027, 086030, 086044, and 087007.

In Alternative D, the following stands are proposed for aspen regeneration by clearcutting (also see Table D-3, Appendix D):

> 007001e, 002002, 002005, 003034, 004002, 004007, 004014, 005005, 005006, 005027, 005028, 005032, 005033, 006005a, 006006a, 006014a, 006020a, 006020b, 006025, 007001a, 007001b, 007001c, 007001d, 007001f, 007002a, 007016, 009016, 009030, 011002, 011011, 011015, 011016, 012013a, 012015, 012022, 012023, 012026, 013005a, 013029, 014020, 014022a, 014047, 014054, 014055, 014061, 015006, 015037, 015064, 017003, 059004a, 060001, 060010, 061026, 071011, 071014, 071019, 071026, 071050, 072018, 072019, 073006, 086008, 086012, 086013, 086021, 086025, 086027, 086030, 086044, and 087007.

Clearcutting was determined to be the optimum method of regeneration for the above listed stands. These determinations were made by field examination and reviews of stand survey notes and are

consistent with the purpose and need for the proposal (Chapter 1) and the silvicultural information above.

C2 Balsam Fir

Balsam fir has a strong ability to become established and grow under the shade of larger trees. It is classified as very tolerant, more tolerant than black or white spruce which are common associates. Balsam fir can survive many years of suppression and still respond to release.

Both even-aged and uneven-aged silvicultural systems are applicable to the balsam fir type. Even-aged systems are preferred, but uneven-aged management is possible because the tree is tolerant of shade and seedlings can and do become established in the understory. Uneven-aged management should be limited to sites where balsam fir can maintain itself as a climax type without the need for excessive silvicultural practices. On all other sites, even-aged management is generally recommended.

Balsam fir stands break up at fairly young ages even though individual trees may live for 200 years. Root (or butt) rots begin entering balsam fir at about 25-30 years, eventually weakening the trees. Other tree weakening agents such as spruce budworm occur as years progress. Rotation ages are generally between 45 and 60 years of age depending on the site and risk factors.

Mature even-aged stands well stocked with advanced regeneration, can be harvested by the clearcut method. Balsam fir seedlings about 6 inches tall are well established and can be considered advanced regeneration, especially if secondary branching has occurred.

In mature stands that do not have adequate advanced regeneration, the shelterwood method applied in narrow strips, uniformily, or in groups can be used to stimulate seedling establishment. The remaining overstory of trees can be removed as soon as the seedling stand is established.

In Alternative B, the following stand is proposed for balsam fir regeneration by clearcutting (also see Table D-1, Appendix D): 014025.

In Alternatives C and D, the following stands are proposed for balsam fir regeneration by clearcutting (also see Table D-2 and D-3, Appendix D): 004003 and 014025.

In Alternatives C and D, the following stand is proposed for balsam fir regeneration by shelterwood harvest (also see Table D-2 and D-3, Appendix D): 014042.

Clearcutting and shelterwood harvest were determined to be the optimum method of regeneration for the above listed stands. These determinations were made by field examination and reviews of stand survey notes and are consistent with the purpose and need for the proposal (Chapter 1) and the silvicultural information above.

C3 Paper Birch

Paper birch is a pioneer type that revegetates land disturbed by natural catastrophe such as wildfire or human caused disturbance. In the absence of disturbance, paper birch is replaced by shade tolerant types. Paper birch normally reproduces from seed. Stumps of trees younger than 60 years produce vigorous sprouts that can be counted on to supplement seedling regeneration. Paper birch produces

good seed crops every other year with a bumper crop 1 year in 10. Paper birch seed retains limited viability for at least 2 years once it has fallen to the forest floor.

Seed dispersal is generally in the fall. Practical seeding distance is less than 100 yards although some seed may travel many times farther. Best seed germination occurs on mineral soil. Germination on humus is reduced by about 50 percent and germination on undisturbed litter is only 10 percent of that on mineral soil. Seeds germinate best at temperatures alternating between 68-86 degrees F. Newly germinated seedlings are fragile. They are sensitive to moisture, temperature, light, and seedbed conditions. Shaded sites can produce twice as many germinants as sites in direct sunlight. Seedlings can prosper in 50% shade and survive in up to 90% shade for a few years. However, they are easily suppressed by competing vegetation.

When paper birch is the forest type objective, even-aged management is the optimum method. A two-cut uniform shelterwood having 20 to 40% crown cover can be used to regenerate and establish paper birch. Regardless of the regeneration method, seedbed disturbance is required.

Uneven-aged management, such as selection harvest, keeps enough shade on the ground that germination is unlikely due to low ground temperatures until late in the summer. Paper birch seedlings and late season germinants would be susceptible to late summer drought and heat. In a selection method of harvest, it would also be difficult to do the site preparation needed to expose mineral soil and organic material (paper birch seedbed) without damaging the roots of the trees being left. Paper birch does not tolerate root disturbance well and would start to decline. Opening up the stand along with root damage that would occur in scarification would also increase the susceptibility for subsequent damage by other agents such as the bronze birch borer.

Even though fire is a potential tool for regenerating paper birch, existing paper birch stands do not generally have enough fuel to carry a fire that would produce an adequate seedbed. There is also a concern for the protection and safety of fire fighters, adjacent landowners, and the public with use of prescribed fire.

In Alternative B, the following stands are proposed for paper birch regeneration by shelterwood harvest (also see Table D-1, Appendix D): 003036a, 003036b, 003036c, 003036d, 003036e, 003036f, 006001, and 070026a.

In Alternative C, the following stands are proposed for paper birch regeneration by shelterwood harvest (also see Table D-2, Appendix D): 003036a and 006001.

In Alternative D, the following stands are proposed for paper birch regeneration by shelterwood harvest (also see Table D-3, Appendix D): 003036a, 003036b, 006001, and 070026.

Shelterwood harvest was determined to be the optimum method of regeneration for the above listed stands. These determinations were made by field examination and reviews of stand survey notes and are consistent with the purpose and need for the proposal (Chapter 1) and the silvicultural information above.

C4 Mixed Hardwoods

For purposes of this analysis, mixed northern hardwoods is a forest type with at least 25% of species other than sugar maple such as yellow birch, white ash, red maple, basswood, red oak, hemlock, or

aspen. Sugar maple, the most common member of the northern hardwood forest, regenerates prolifically under a wide variety of conditions and is therefore easily perpetuated after logging. Other associated species, such as yellow birch and white ash, can tolerate light or moderate shade only in the first few years after germination and then must then receive direct overhead sunlight for adequate growth. While selection harvest can be used to regenerate mixed northern hardwoods, it tends to favor sugar maple almost exclusively. For less shade tolerant species (ash, red maple, aspen), even-aged methods are preferred. A mixed northern hardwood stand is less susceptible to insect and disease attack than a pure sugar maple stand due to the diversity of species within the stand. Faster growing species such as basswood, white ash and northern red oak typically are larger in diameter, taller, have longer clear trunks, and are less subject to forking and branching caused defects than the maples of comparable age.

Young white ash is a shade-tolerant tree. Seedlings can survive under a canopy with less than 3% of full sunlight but grow little under these conditions. Seedlings develop best in 45% of full sunlight. White ash becomes less tolerant of shade with increasing age, and is classed as intolerant. The decrease in shade tolerance with increasing age is reflected in the fact that young white ash is abundant in the understory of northern hardwood stands, but few grow into the overstory unless provided with light from above. White ash responds readily to thinning and within a few years will increase its crown area to take full advantage of any reasonable release.

Red maple is a pioneer or subclimax species that is more shade tolerant and longer lived than other early successional species. Seedlings are more tolerant than larger trees and can exist in the understory for several years. Abundant 1- to 4-year old seedlings are often found under the canopy of older stands. Many of these seedlings die each year if they are not released by opening of the main crown canopy, but new ones replace them. Thus, a reservoir of seedlings and ungerminated seed is available to respond to increased sunlight resulting from disturbance. Seedlings respond rapidly to release and can occupy overstory space.

Aspen is a pioneer species with little shade tolerance (see above).

The mixed hardwood stands being proposed for clearcutting have a high degree of aspen and red maple within them. Other species mixed in are primarily basswood, balsam fir, and birch. Clearcutting these types of stands results in mixed stands with generally a higher component of aspen. Than the parent stand.

In Alternative B, the following stands are proposed for regeneration by clearcutting (also see Table D-1, Appendix D): 060015, 071020a, 087008a

In Alternative C, the following stands are proposed for aspen regeneration by clearcutting (also see Table D-2, Appendix D): 071020a, 087008

In Alternative D, the following stands are proposed for aspen regeneration by clearcutting (also see Table D-3, Appendix D): 060015, 071020a, 087008

Clearcutting was determined to be the optimum method of regeneration for the above listed stands. These determinations were made by field examination and reviews of stand survey notes and are consistent with the purpose and need for the proposal (Chapter 1) and the silvicultural information above.