SHEEP DIP PROJECT ENVIRONMENTAL ASSESSMENT

USDA Forest Service
Huron-Manistee National Forests
Cadillac-Manistee Ranger District
Wexford County, Michigan

ENVIRONMENTAL ASSESSMENT

for the

SHEEP DIP PROJECT

Huron-Manistee National Forests
Cadillac-Manistee Ranger District

Wexford County, Michigan
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Please note that this project is a project or activity implementing a land management plan and not authorized under the HFRA, that is subject to subparts A and B of 36 CFR 218.

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Organization of the Sheep Dip Project Environmental Assessment

Chapter 1 introduces the Purpose and Need for activities the Forest Service is proposing, the relevant issues surrounding the project, and other issues and management concerns.

Chapter 2 presents and compares the alternatives, activities that would be implemented with mitigation measures to protect the environment, and activities that would be monitored to document the effectiveness of the treatments and mitigation measures.

Chapter 3 describes the environmental, social, and economic effects including the direct, indirect, and cumulative effects likely to occur with implementation of each alternative.

Chapter 4 identifies the document's preparers and contributors, and literature cited.

Appendix A provides Treatment Unit descriptions.

Appendix B provides NNIP treatments.

Further project information is included in the Planning Record.

CHAPTER 1
PURPOSE AND NEED

The Cadillac-Manistee Ranger District of the Huron-Manistee National Forests (HMNF) has proposed various vegetative management activities in the Sheep Dip Project on National Forest System lands within the Sheep Dip Project Area (Project Area). The Sheep Dip Project proposes the following activities: red pine, aspen, and hardwood timber harvest treatments; wildlife habitat improvement projects, including upland opening maintenance; non-native invasive plant species control; aquatic habitat improvement; and, transportation system improvements.

This Environmental Assessment (EA) is a site-specific analysis of the proposed activities. It discloses the direct, indirect, and cumulative environmental effects of implementing the Proposed Action, alternatives developed following public scoping, and the No Action Alternative. An interdisciplinary team (IDT) of Forest Service managers and specialists prepared this EA (see Chapter 4).

Project Location and Size

The Project Area (see Map 1 at the end of this chapter) is located on the Cadillac-Manistee (CM) Ranger District of the HMNF in the following locations:

T21N, R11W, Sections 4-9 and 16-21, Henderson Township, Wexford County
T21N, R12W, Sections 1-3, 10-24, South Branch Township, Wexford County

The Sheep Dip Project Area occurs within compartments 11, 12, 13, 14, 15, 81, 83, 86, 87, and 88 of the CM Ranger District. The Project Area totals approximately 13,279 acres. Approximately 11,725 acres (88% of total) are National Forest System (NFS) lands, of which approximately 1,741 acres (15% of NFS acres and 13% of total acres) are treated with the Proposed Action. The remaining approximately 1,554 acres (12% of total) are in private ownership.

Management Direction

The Sheep Dip Project EA is tiered to the 2006 Huron-Manistee Land and Resource Management Plan as Amended (Forest Plan) (HMNF 2006a) and Final Environmental Impact Statement (HMNF 2006b). Relevant discussion from these documents would be incorporated by reference rather than repeated (40 CFR 1502.21). A portion of the Project Area occurs within the Pine National Scenic River corridor and the Forests' Old Growth design. The Sheep Dip Project activities would be consistent with the Pine River Management Plan and the Old Growth standards and guidelines (USDA 2006a, USDA 1995).

The management prescription areas (MA) of the Project Area are primarily in MA 2.1 with lesser areas in MA 8.1 and MA 8.3. Management directions for these areas are outlined in the Forest Plan standards and guidelines pages III-2.1-1-8 (MA 2.1), III-8.1-1-4 (MA 8.1), and III-8.3-1-5 (MA 8.3).

MA 2.1 is characterized by morainal hills and gently rolling plains where soils support northern hardwoods, aspen, and conifers, as outlined in the Forest Plan, page III-2.1-2. The primary purpose of MA 2.1 is as follows:

> "Management activities provide high volumes of quality hardwood timber products and firewood with special consideration for enhancing wildlife habitats. Emphasis is given to managing deer, grouse and wildlife emphasis areas, and fish habitat. A broad variety of recreational opportunities is available and visual diversity is high."

MA 8.1 is a designated wild and scenic river corridor, as outlined in the Forest Plan, page III-8.1-2. The primary purpose of MA 8.1 is as follows:

> "Management of the Congressionally-designated wild and scenic river corridors will protect unique areas that have outstandingly remarkable values such as scientific, biological, geological, historical or recreational characteristics of local, regional or national significance."

MA 8.3 is a designated experimental forest, as outlined in the Forest Plan, page III-8.3-1. One of the goals for MA 8.3 is as follows:

> "Provide a variety of management activities so that research opportunities exist to evaluate the effects of management practices."

The objective for the Project Area is that management activities would implement the standards and guidelines of the HMNF along with addressing land management issues. In addition, the development of this EA considers all pertinent environmental laws, regulations, and national direction.

Old growth stands are located within the Project Area. A single red pine thinning unit is prescribed for treatment as allowed for in the HMNF's Forest Plan concerning old growth (Forest Plan II-9). The same red pine unit is also located in the Pine National Scenic River Corridor. The Pine River Management Plan (River Plan) also allows for the treatment of red pine stands within the corridor (River Plan 1900 Vegetative Management page 9)

Purpose and Need

The Purpose and Need for a project is arrived at by addressing the differences between the existing condition and the desired future condition. All management activities that occur within the HMNF are directed by the objectives of the Forest Plan. The plan identifies how different areas of the HMNF are to be managed. The Purpose and Need of the Sheep Dip Project is to: sustain forest and ecosystem health and improve timber stand conditions; provide early successional habitat, maintain the aspen forest type, and improve aspen age-class diversity; improve aquatic habitat; manage the transportation system; and, meet the goals and objectives of the Forest Plan for MA 2.1. Management Areas 8.1 and 8.3 address designated wild and scenic river corridors and experimental forests respectively, but do allow for limited management activities.

Treatments are proposed to address the Purpose and Need and accomplish the following objectives:

Sustain forest and ecosystem health and improve timber stand condition

Existing Condition: Overstocked red pine stands and some hardwood stands are exhibiting reduced growth rates and are susceptible to insect and disease infestations. The overall vegetative and structural diversity in these stands is limited. Competition for sunlight, water, and nutrients is reducing the growth of the trees. Pine plantation stands are unnatural appearing and contain little horizontal and vertical diversity. Non-native, invasive plants, such as garlic mustard, autumn olive, leafy spurge, non-native bush honeysuckles, and black locust, have been identified within the Project Area.

Desired Condition: Red pine and hardwood stands contain vegetative and structural diversity and grow near maximum rates and native vegetation is established in the understory. The pine plantations are healthy, have a natural appearance, and native herbaceous and shrub vegetation occurs in the understory. The presence and spread of non-native, invasive plants is limited.

Need: There is a need to open the canopy in the red pine and hardwood stands proposed for treatment in the Project Area to sustain forest health, concentrate growth on larger trees, minimize insect and disease attacks, improve wildlife habitat, enhance vegetative diversity, and improve stand and visual quality. There is a need to reduce current populations and the future spread of non-native, invasive plants.

Provide early successional habitat, maintain the aspen forest type, and improve aspen age-class diversity

Existing Condition: Many of the aspen stands in the Project Area are over-mature and are gradually converting towards later successional species, such as maple, beech, and white ash. A variety of tree species are encroaching on the existing upland openings within the Project Area, contributing to the gradual loss of shrubs and grasses needed by many game and non-game species.

Desired Condition: The aspen forest type and the early successional habitat it represents, is sustained within the Project Area. The vegetative composition of upland openings consists primarily of grasses, forbs, and berry-producing shrubs.

Need: There is a need to maintain the aspen forest type and improve aspen age class diversity and early successional habitat in the Project Area, especially for ruffed grouse habitat needs. There is a need to maintain upland openings to prevent the encroachment of tree species, and stimulate the growth of opening vegetation, berry-producing shrubs, and mast producing trees for wildlife habitat diversity.

Improve aquatic habitat

Existing Condition: Dowling Creek within the Project Area contains a minimal amount of woody debris which reduces instream aquatic quality.

Desired Condition: High quality aquatic habitat occurs in the Project Area.

Need: There is a need to increase woody debris within Dowling Creek and improve instream aquatic habitat in the Project Area.

Manage the transportation system

Current Condition: The transportation system within the Project Area currently includes Forest Service roads (forest roads) that are not needed or are causing resource damage. Unauthorized (user-developed) roads and trails also occur in the Project Area. The current road density within the Project Area is approximately 3.2 miles of road per square mile on all lands within the Project Area, and approximately 2.8 miles of road per square mile on Forest Service lands.

Desired Condition: A transportation system is provided within the Project Area that is appropriate for administrative and public needs and minimizes resource damage. Abandoned roadways are landscaped and planted with native vegetation.

Need: There is a need for the transportation system in the Project Area to be modified by closing unneeded roads or roads causing resource damage. Other roads need to be reconstructed to allow for improved access to areas for both timber harvesting activities and general use. In addition, there are other roads that will need to be constructed, primarily to improve access for timber harvesting activities.

Proposed Action

The Sheep Dip Project's Proposed Action was described in the August 31, 2012, scoping letter. The range of activities has remained the same as those described in the scoping letter, but the acreages have changed in some instances due to updated information and the elimination of treatment units. The modified proposed activities are described below:

Thin and/or regenerate red pine and hardwood stands to provide current and future wood products, sustain forest health, reduce competition for sunlight, water, and soil nutrients, promote the establishment of hardwood regeneration, and improve wildlife habitat and visual diversity. The following treatments are proposed: approximately 697 acres of red pine thinning, approximately 119 acres of red pine and 17 acres of hardwood overstory removal, approximately 314 acres of red pine and 21 acres of hardwood shelterwood are proposed for treatment, and approximately 1 acre of Canada yew protection.

Non-native, invasive plant species are located in stands throughout the Project Area. Treat non-native, invasive plant populations or individuals to reduce current infestations and future spread in order to sustain forest productivity. Proposed invasive plant control methods include manual and mechanical removal, and spot treatment with herbicide. There are approximately 80 occurrences of invasive plant species covering approximately 23 acres that are proposed for treatment.

Harvest aspen stands by clearcutting to optimize aspen regeneration, maintain the aspen forest type, and improve wildlife habitat for early successional species. The individual size of these clearcuts would not exceed 40 acres. Approximately 244 acres of aspen clearcutting is proposed.

Maintain existing upland openings by brushing, mowing, prescribed burning, apple tree pruning, and shrub planting to provide vegetative diversity, promote plant and animal habitat diversity, and promote native species. Approximately 285 acres of upland opening improvement and 21 acres of upland opening creation are proposed.

Add woody debris to Dowling Creek to improve instream aquatic habitat. Woody debris would be added intermittently to an approximately 1 mile stretch of Dowling Creek.

Approximately 0.3 miles of road would be constructed and approximately 0.7 miles of road would be permanently closed. In addition, approximately 8.3 miles of road requiring some reconstruction activities or general maintenance would be modified.

Approximately 0.5 miles of road would be designated as suitable for public access and added to the Motor Vehicle Use Map. In addition, approximately 1.1 miles of road currently listed as open for public access would be closed to public use.

There are additional stands within the Project Area which would not be treated; however, we have limited this project to the acres that would be reasonable to complete in the next ten years. The Proposed Action is only one approach to meeting the Purpose and Need objectives for this project. Additional alternatives were developed in response to issues identified from comments received during scoping.

Decision to be Made

Based on the analysis of the environmental effects in the EA, the responsible official (the District Ranger of the Cadillac-Manistee District), must decide whether or not to implement the proposed management activities, including vegetation management, wildlife habitat improvement, and transportation management system, and decide on the amount, type, and location of these activities.

Implementation

All activities proposed in the Selected Alternative would be implemented within approximately ten years of the signing of the Decision Notice for this project. The decade-long timeframe is the amount of time the activities would likely start and finish within. It can take 3-5 years to conduct a timber harvest, after the preparation and administration of the sale has been completed. There are additional activities, such as site preparation and planting, that would follow the harvest in order to adequately regenerate the stands. The entire process would likely take place within this 10-year timeframe, although unforeseen circumstances could alter timelines.

Scoping and Public Involvement

The Forest Service uses public involvement and an IDT of resource specialists to determine issues of concern and develop possible solutions. Scoping is a process for gathering comments about a site-specific proposed federal action to determine the scope of issues to be addressed and for identifying unresolved issues related to the proposed action (40 CFR 1501.7). Opportunities for comments enable concerned citizens, resource specialists from other agencies, and local governments to express their ideas and views.

Public involvement for the project included listing in the HMNF's Schedule of Proposed Actions; a direct mailing on August 31, 2012 to approximately 217 individuals, organizations, and adjacent landowners; and, a listing on the HMNF's website. During the scoping period, 23 responses were received.

Relevant Issue

Issues result from discussion, debate, or disagreement regarding the effects of the proposed activities. They are developed from comments received from within and outside the Forest Service. In order to provide a concise analysis, the agency distinguished between those issues that were used in the analysis for formulating alternatives, developing mitigation, and tracking effects. Issues that drove the development of alternatives were identified as relevant issues. Other issues and management concerns are addressed in the Environmental Effects section in Chapter 3 of the EA, but were not used to develop alternatives. The relevant issue identified for this project is:

Conversion of red pine stands to northern hardwood stands (i.e. native forest composition)

This analysis will address the primary issue of red pine stand conversion in the Project Area. The analysis will look at the treatment of red pine stands, especially those being managed with overstory removal and shelterwood harvest, and the resulting conversion of these stands to the native forest composition of northern hardwoods in the Project Area. Comments were received that support the management of red pine stands to improve the diversity of the red pine stands, to utilize the resource before it naturally converts to northern hardwoods, and to improve habitat for wildlife species such as the American marten that was found in and near the Project Area. At the same time comments were received that questioned the efficacy of red pine management, specifically overstory removal and shelterwood treatments, and whether those treatments would result in the inadvertent conversion of these areas to hardwood stands.

Issue: This issue addresses the general concern about red pine stands being treated with overstory removal and shelterwood harvests, as well as red pine thinning units, and the resulting enhancement of hardwoods within the stands, in addition to the outright conversion of red pine stands to northern hardwoods within the Project Area.
Comments: Concerns were raised in regards with various aspects of red pine treatments in the Project Area. These included comments concerning the results of the various treatments on the residual stands and their impacts on wildlife, utilization of the resource, and the diversity of the red pine stands.
Measurement: Acres of red pine thinning, overstory removal, and shelterwood harvests of red pine stands in the Project Area.

Resource Areas Considered for Analysis

The following issues and management concerns were also used to analyze the alternatives. These issues were not used to develop alternatives, but their environmental and social effects are discussed in Chapter 3. The following issues and resources have been discussed and/or evaluated in past projects. Some may be determined to be minor because they would not be affected by the project design. Only issues and resources that would be implemented by an action alternative or vary greatly between alternatives would be used to evaluate the alternatives for this project.

Management Indicator Species and Wildlife

The effects of the proposed activities on Management Indicator Species and wildlife will be evaluated as part of the analysis. Comments were received that vegetative treatments may enhance wildlife benefits while others were concerned that treatments may have a negative effect

on wildlife species, especially the American marten. Other comments were received that supported the activities if they improve wildlife habitat in the Project Area.

Vegetation Resources

The current vegetative resources and the expected changes as a result of implementing the proposed vegetative treatments, including the timber harvest treatments and opening creation will be evaluated as part of the analysis. Comments on the proposed vegetative treatments varied: including support of the proposed vegetative treatments, support for red pine thinning, concern over harvest methods, the ability of stands to regenerate adequately, and concern that the roads and treated stands are left in an acceptable condition after the timber harvest operations. Measures to minimize impacts to wildlife and maintain and/or improve habitat conditions will be incorporated into the project.

Soil Productivity

Potential impacts to soil resources will be evaluated as part of the analysis. Measures to minimize impacts to soil resources will be incorporated into the project.

Air Quality

Potential impacts to air resources will be evaluated as part of the analysis. Measures to minimize impacts to air resources will be incorporated into the project.

Water Quality and Fisheries

Potential impacts to water resources and in particular impacts to the watersheds that comprise the Project Area will be evaluated as part of the analysis. In addition, the potential impacts to the fisheries will also be evaluated. Measures to minimize the impacts to the water resources and the fisheries will be incorporated into the project.

Threatened, Endangered, and Sensitive Species

Threatened, endangered, and sensitive plant and animal species have been identified in the Project Area. A Biological Evaluation has been completed as part of the analysis to determine the effects on threatened and sensitive plant and animal species. Mitigation measures and management for threatened and sensitive species will be incorporated into the design of the project. The analysis will address how the proposed activities protect endangered, threatened, and sensitive plant and animal species and maintain and/or improve habitat conditions.

Non-Native Invasive Plant Species

This analysis will address the measures taken for invasive plant control of species already present in the Project Area and measures to reduce additional spread or introduction of invasive plants in areas that are to be managed. One comment was received that questioned the need for NNIS treatments in the Project Area.

Heritage Resources

Heritage resources have been identified in the Project Area. Recommended protection measures for these resources will be incorporated into the design of the project.

Social Economics

The environmental analysis addresses the effects of the proposed vegetative treatments on social economics and evaluates the cost-revenue of the alternatives.

Recreation and Visual Quality

The analysis will evaluate how the proposed activities affect the visual quality and recreational use in the Project Area. Comments were received expressing a desire to see treated stands left in a good condition following harvesting and other proposed activities and that vegetative treatments be modified to protect the visual quality within the Project Area. One comment received inquired about expansion of recreational opportunities in the Project Area and another comment questioned the impact of recreational activities on the forest resource.

Transportation

The analysis addresses the effects of the management activities on the transportation system. Two comments were received concerning the management of roads: one commenter did not see the need to close roads in the Project Area, while another comment was received recommending additional site-specific road closures.

Civil Rights and Environmental Justice

The analysis addresses the civil rights and environmental justice impacts with implementation of the project.

Irreversible and Irretrievable Commitment of Resources

Potential irreversible and irretrievable impacts are disclosed with the implementation of the alternatives.

Availability of the Planning Record

An important consideration in preparation of this Environmental Assessment has been the reduction of paperwork as specified in 40 CFR 1500.4. In general, the objective is to furnish enough site-specific information to demonstrate a reasoned consideration of the environmental impacts of the alternatives and how these impacts can be mitigated. The planning record contains detailed information used in creating the Environmental Assessment. This and other reference documents are available at the Cadillac-Manistee District Office in Manistee, Michigan.

CHAPTER 2
ALTERNATIVES

Introduction

This chapter describes the alternatives for sustaining forest and ecosystem health, improving timber stand conditions, providing early successional habitat, maintaining the aspen forest type and aspen age-class diversity, improving aquatic habitat, and managing the transportation system in the Sheep Dip Project Area. The Proposed Action (Alternative 2), Alternatives 3 and 4 (the Action Alternatives), and the No Action Alternative (Alternative 1) for this project are described in this chapter. Table 2-1 displays the comparison of alternatives by issue and activity. The Sheep Dip Project vicinity is shown on Map 1 at the end of Chapter 1.

Alternative Development Process

To prepare this analysis, a group of resource specialists, known as an interdisciplinary team (IDT), met and discussed how best to accomplish the objectives described in the Purpose and Need section of Chapter 1. The IDT members and resource specialists consulted for this project are listed in Chapter 4. The IDT identifies issues raised in the public scoping process and from internal comments. In consideration of these issues, the IDT designs alternatives that also address the project's Purpose and Need. The National Environmental Policy Act regulations mandate consideration of all reasonable alternatives for a proposed action, including identification and discussion of alternatives eliminated from detailed study.

To develop alternatives, the IDT first reviewed all the comments and concerns expressed by the public and internal sources during the scoping process. These comments and concerns were then consolidated into a relevant issue. Once a relevant issue had been identified, the IDT develops strategies that can be used to resolve the issue while responding to the Purpose and Need objectives. The IDT also identified indicators or measurements used to compare how each alternative responds to the issues for which it was developed.

The Proposed Action and the two Action Alternatives were designed to meet the objectives and to address and resolve issues of public concern. Each alternative represents a site-specific mix of proposals that responds to these issues. From this range of alternatives, the Cadillac-Manistee District Ranger has a basis for judging the trade-offs between implementing each alternative, including the No Action Alternative.

Alternatives Considered in Detail

This assessment will evaluate the No Action Alternative (Alternative 1), the Modified Proposed Action (Alternative 2), and the two Action Alternatives (Alternatives 3 and 4), which are described below. All the action alternatives are consistent with the standards and guidelines of the Forest Plan. Table 2-1: *Treatment Activities by Alternative* displays a summary comparison of alternatives by activity (See Appendix A for specific treatment unit card prescriptions).

Treatment Activities by Alternative
Table 2-1

Treatment / Totals[1]	Alt. 1 - No Action	Alt. 2 - Proposed Action	Alt. 3	Alt. 4
Mechanical				
Commercial Thin - acres	0	697	621	621
Overstory Removal - Hardwood - acres	0	17	17	0
Overstory Removal - Conifer - acres	0	119	107	0
Shelterwood - Hardwood - acres	0	21	21	21
Shelterwood - Conifer - acres	0	314	176	0
Total	**0**	**1,168**	**942**	**642**
Wildlife/Plant/Aquatic				
Opening Maintenance - Mechanical - acres	0	234	228	234
Opening Maintenance - Burning - acres	0	56	56	56
Opening Creation - acres	0	21	21	21
Aspen Clearcut with Reserves - acres	0	244	244	181
NNIP Treatment - acres	0	23	23	0
Total[2]	**0**	**573**	**567**	**487**
Acres removed from HMNF's timber base[3]	0	21	21	21
Waterholes Constructed	0	1	1	1
Aquatic Habitat Improvement - miles	0	1	1	0
Road System Activity[4]				
Construction - Level 2	0	0.3	0.3	0.3
Reconstruction - Level 1	0	0.8	0.8	0.8
Reconstruction - Level 2	0	7.5	7.5	7.5
Closure - Level 2	0	0.7	1.2	0
Redesignation - Level 1 to Level 2	0	0.5	0.5	0.5
Redesignation - Level 2 to Level 1	0	1.1	1.1	0
Total		**10.9**	**11.4**	**9.1**

[1]*All acres and miles are approximate.*
[2]*One 5 acre opening would be either mechanically treated or burned. For the table the stand is accounted for in both Opening Maintenance - Mechanical and Opening Maintenance - Burning.*
[3]*Stands would be changed from a land suitability classification (LSC) 500 - land suitable for timber production, to an LSC 200 - non-forested land.*
[4]*Level 1 roads are permanent roads that are used only for Forest Service administrative purposes and Level 2 roads are permanent roads open to all.*

Alternative 1
No Action

Alternative 1 is the No Action Alternative. Under Alternative 1, none of the proposed vegetative treatments or other management activities would occur in the Project Area on National Forest System (NFS) lands. Some activities, such as resource protection, would continue within the Project Area. Selection of Alternative 1 does not preclude future analysis or implementation of on-going management proposals within the Project Area.

Alternative 1 Summary:

- Under Alternative 1, none of the proposed vegetative treatments or other management activities would occur in the Project Area on NFS lands.
- Provides a baseline against which to describe the environmental and social effects of the action alternatives.
- Responds to those who want no management activities to take place in the Project Area, such as clearcutting and other harvesting activities.
- Does not achieve the project's Purpose and Need objectives.
- Does not achieve the Forest Plan's desired condition for vegetative management, wildlife habitat improvements, and transportation system management.

Alternative 2
Proposed Action

Alternative 2 is the Proposed Action that was described during scoping with minor changes to the original proposal. These changes are the result stands being dropped or acreage reduced due to circumstances such as wildlife and access issues. This alternative would implement the most vegetative treatments and the most wildlife habitat improvement activities in the Project Area. Also, the greatest amount of activity on the road system would take place.

Alternative 2 Summary:

- Conducts vegetative, wildlife, and road system activities that include approximately:
  - 697 acres of pine thinning
  - 17 acres of hardwood overstory removal harvesting
  - 119 acres of conifer overstory removal harvesting
  - 21 acres of hardwood shelterwood harvesting
  - 314 acres of conifer shelterwood harvesting
  - 234 acres of opening maintenance - mechanical
  - 56 acres of opening maintenance - burning
  - 21 acres of opening creation
  - 244 acres of aspen clearcut with reserves harvesting
  - 23 acres of non-native invasive plant (NNIP) treatment
  - 1 waterhole constructed
  - 1 mile of stream improvement activities
  - 0.3 miles of new road construction
  - 8.3 miles of road reconstruction
  - 0.7 miles of road closures
  - 0.5 miles of existing roads opened to the public
  - 1.1 miles of existing roads closed to the public
- Achieves the project's Purpose and Need objectives.
- Achieves the Forest Plan's desired condition for vegetation management, wildlife habitat improvements, and road system activities.
- The 21 acres of opening creation would be removed from LSC 500, land suitable for timber production, to an LSC 200, non-forested land.

Alternative 3
Action Developed from Comments

Alternative 3 was developed from comments received during the scoping period and from IDT members. It responds to comments regarding the amount and locations of conifer shelterwood and overstory removal harvesting and pine thinning. As a result the amount of pine thinning, conifer overstory removal, and conifer shelterwood harvesting has been reduced. In addition, one opening has been dropped from treatment. Also, comments were received that some additional road closures would be beneficial, and a road that was going to have a portion closed had the remainder of the road closed.

Alternative 3 Summary:

- Conducts vegetative, wildlife, and road system activities that include approximately:
  - 621 acres of pine thinning
  - 17 acres of hardwood overstory removal harvesting
  - 107 acres of conifer overstory removal harvesting
  - 21 acres of hardwood shelterwood harvesting
  - 176 acres of conifer shelterwood harvesting
  - 228 acres of opening maintenance - mechanical
  - 56 acres of opening maintenance - burning
  - 21 acres of opening creation
  - 244 acres of aspen clearcut with reserves harvesting
  - 23 acres of NNIP treatment
  - 1 waterhole constructed
  - 1 mile of stream improvement activities
  - 0.3 miles of new road construction
  - 8.3 miles of road reconstruction
  - 1.2 miles of road closures
  - 0.5 miles of existing roads opened to the public
  - 1.1 miles of existing roads closed to the public
- Achieves the project's Purpose and Need objectives.
- Achieves the Forest Plan's desired condition for vegetation management, wildlife habitat improvements, and road system activities.
- The 21 acres of opening creation would be removed from LSC 500, land suitable for timber production, to an LSC 200, non-forested land.

Alternative 4
Action Developed from Comments

Alternative 4 was developed from comments received during the scoping period and from IDT members. It responds to comments regarding the amount and locations of conifer shelterwood and overstory removal harvesting and pine thinning. As a result the amount of pine thinning has been reduced. In addition, all overstory removal harvests and all pine shelterwood harvesting has been eliminated. The opening that had been dropped under Alternative 3 has been reinstated and the maximum size of aspen clearcuts has been reduced to 10 acres. Also, comments were

received questioning the need to close any roads and the need to treat any NNIS. As a result all road closures have been dropped, as well as the treatment of NNIS.

Alternative 4 Summary:

- Conducts vegetative, wildlife, and road system activities that include approximately:
  - 621 acres of pine thinning
  - 21 acres of hardwood shelterwood harvesting
  - 234 acres of opening maintenance - mechanical
  - 56 acres of opening maintenance - burning
  - 21 acres of opening creation
  - 181 acres of aspen clearcut with reserves harvesting
  - 1 waterhole constructed
  - 0.3 miles of new road construction
  - 8.3 miles of road reconstruction
  - 0.5 miles of existing roads opened to the public
- Achieves the project's Purpose and Need objectives, except it does not improve the aquatic habitat in the Project Area.
- Achieves the Forest Plan's desired condition for vegetation management, wildlife habitat improvements, and road system activities.
- The 21 acres of opening creation would be removed from LSC 500, land suitable for timber production, to an LSC 200, non-forested land.

Activities Common to All Action Alternatives

The following mitigation measures would be required to implement treatment activities throughout the Project Area. Mitigation measures are designed to counteract environmental impacts or to make impacts less severe. These may include: avoiding an impact by not taking a certain action or part of an action; minimizing an impact by limiting the degree or magnitude of an action and its implementation; rectifying the impact by repairing, rehabilitating, or restoring the affected environment; reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; or compensating for the impact by replacing or providing substitute resources or environments. Some mitigation measures may apply only to specific treatment unit(s). Mitigation measures specific to a treatment unit are described in detail in the treatment unit cards (Appendix A).

Resource Protection

- Recommendations included in the State of Michigan Sustainable Soil and Water Quality Practices on Forest Land (BMPs) (MDNR 2009) and (USDA-Forest Service Handbook 2550, supplement No. R9 RO 2550-2012-1 would be incorporated to provide protection of soil and water resources.
- Protect known heritage resource sites in accordance with State Historic Preservation Office guidelines. Mitigation measures used to avoid site disturbance would be applied to all action alternatives. Site specific heritage resource mitigation measures are incorporated into the individual treatment units cards (see Appendix A). If any unknown heritage resource sites would be found when ground disturbing activities are taking place

on the project, the activity would stop until a professional heritage resource specialist is informed and adequate protection measures are applied to avoid potential impacts.

- Protect known threatened, endangered, or sensitive species and the immediate habitat in which they are found. If any additional ETS species are found during project implementation, the project would stop until the District Wildlife Biologist or Botanist is informed and adequate protection measures applied if needed to avoid potential impacts.

Operating Requirements

- Reserve existing snags that are not a safety hazard in all treatment units to maintain cavity nester habitat.
- Clearcut, overstory removal, and shelterwood harvest unit cutting would occur between October 1 and March 31. Where these units have operating requirements to comply with dedicated snowmobile trail use, cutting would occur between September 1 and November 30.
- Retain topwood (< 4.0" diameter inside bark) in clearcut, shelterwood, and overstory removal harvest areas to facilitate organic matter retention and mitigate soil compaction and displacement. The amount retained would depend on other management considerations, but the goal would be to retain as much as practicable.

Rehabilitation

- Rehabilitate landings after harvest activities are completed to reduce the amount of logging residue, reduce compaction, reduce non-native invasive species colonization, and promote revegetation. Plant only native species or non-persistent non-native species where revegetation is needed.

Monitoring

Monitoring would be conducted to determine if resource management objectives for the Project Area have been met. Monitoring results would be used to verify the effectiveness of selected mitigating and protective measures in a timely manner. This process ensures that project elements are implemented as designed and that standards and guidelines are implemented to protect soil, water, and other resources. The following monitoring would be performed for all action alternatives:

Implementation Monitoring

Mitigation Measure Implementation

Objective: Ensure mitigation measures for each treatment unit are being implemented.
Desired Results: Mitigation measures are effective in addressing resource issues.
Methods: All treatment units would be visited by district personnel. Reviews would be documented in inspection reports regarding contract compliance.
Responsibility: District assistant rangers for timber, recreation, and wildlife.

Contract Administration

Objective: Ensure that mitigation measures are implemented for treatment units with commercial harvesting.
Desired Results: All contract requirements are met.
Methods: All treatment units would be visited by the timber sale administrator.
Responsibility: District timber sales administrator.

American Marten

Objective: The effects of the timber harvest activities would be monitored before and after the red pine treatments in Compartment 83 occur to document the changes in marten use and dispersal in this area and determine the effects of the harvest activities on marten habitat.
Desired Result: The Mitigation Measures designed to protect and improve American marten habitat within the Sheep Dip Project Area, as described in the BE and in Appendix A of the EA, have been effective in maintaining or improving marten habitat.
Methods: Track martens in this area before and after the red pine treatments occur.
Responsibility: District Wildlife Biologist. (Grand Valley State University and Little River Band of Ottawa Indians would assist with this monitoring effort.)

Invasive Plants

Objective: Ensure that the spread of invasive plants is minimized.
Desired Result: No spread of invasive plants due to treatments would occur.
Methods: Ocular inspection within the first two years after the treatment of a unit.
Responsibility: District botanist.

Effectiveness Monitoring

Reforestation

Objective: Ensure that reforestation occurs within five years of treatment.
Desired Result: Adequately reforested stands.
Methods: Stocking surveys within the first five years after the treatment of a unit.
Responsibility: District silviculturist.

Forest Plan Monitoring

The National Forest Management Act requires that national forests monitor and evaluate their forest plans. Forest plan monitoring is conducted over the entire forest on a periodic basis. Samples for Forest Plan monitoring may or may not be taken in the Project Area; however, monitoring results are designed to answer questions regarding the implementation and effectiveness of mitigation. Forest Plan monitoring results can be found in the 2008 Monitoring and Evaluation Report found on the HMNF's website.

Alternatives Considered but Eliminated from Detailed Study

The IDT considered a range of alternatives during the analysis before a reasonable set of alternatives was considered for detailed study. Alternatives that were eliminated from detailed study are described as follows:

Original Proposed Action - The Sheep Dip Project Proposed Action was described in the August 31, 2012 scoping letter and in Chapter 1. After additional site-specific resource information became available on the project, some of the proposed treatments were dropped, modified, or added. Portions of stands were dropped from treatment or modified because of resource concerns.

Developing additional motorized trails within the Project Area - A comment was received expressing a desire to see motorized trails increased in the Project Area and an alternative which considered increasing motorized trails was discussed.

The reason there was not any recreational trail projects proposed in the Sheep Dip Project is that the Purpose and Need for the project is to: 1) Sustain forest and ecosystem health and improve timber stand condition; 2) Provide early successional habitat, maintain the aspen forest type, and improve aspen age-class diversity; 3) Improve aquatic habitat; and, 4) Manage the transportation system. Enhancing and expanding trails or recreational opportunities are not part of the objectives for the Sheep Dip Project. In addition, the Project Area currently contains 3.6 miles of the MCCCT Trail and 15.5 miles of snowmobile trails.

Increasing the amount of aspen treated within the Project Area - Multiple comments were received that expressed a desire to see additional aspen clearcuts added to the Project Area in order to enhance wildlife benefits.

The reason the acreage of aspen treatments was not increased is due to the original list of stands initially proposed for treatment, and which had subsequent botanical, wildlife, and archaeological surveys conducted on them. When a project is initially proposed a number of stands are considered for treatment within the confines of what can be surveyed within a given amount of time. These stands must also reflect the needs of all the purposes and needs proposed for the project. For example, although aspen regeneration is an important consideration in the Sheep Dip Project, not all aspen stands appropriate for treatment could be considered when accounting for other needs identified in the Project Area.

Sheep Dip Project Alternative 1 Map

T21N, R11W (Henderson Township)
T21N, R12W (South Branch Township)
Wexford County, Michigan

N
W E
S

Legend

- Project Area Boundary
- Open Public Roads
- Rivers & Streams
- Snowmobile Trails
- MCCCT Trail
- Ski and Bike Trails
- Sections

Management Areas (USFS Land)

- 2.1 - Roaded Natural
- 8.1 - Wild and Scenic River
- 8.3 - Experimental Forest
- Old Growth

38 Road
11 1/2 Rd
7 Road
13 Road
FR 7875
FR 9944
FR 5407
FR 7443
FR 5405
FR 5421
FR 9930
Mackenzie Ski and Bike Trails
Caberfae Peaks Resort
FR 7374
FR 7371
FR 9941
2.1
M-55
3 1/2 Rd
FR 5131
FR 7323
44 1/2 Rd
FR 5804
FR 7322
FR 7320
FR 5659
FR 5272
FR 5273
FR 5274
FR 5642
FR 7861
FR 5275
Coyote Crossing Resort
FR 5578
FR 7325
8.3
FR 5321
FR 7321
FR 7328
5054
Peterson Bridge
46 Rd
8.1
FR 7004
FR 5429
FR 5427
FR 5654
FR 5552
FR 7842
FR 5406
46 Road
48 Road
7 1/2 Road
11 Road
3 Road
7 Rd
FR 5233
M-37
Dobson Bridge
48 1/2 Road
5 1/2 Rd
9 Road
11 1/2 Road
15 Road
17 Road

0 0.25 0.5 1 1.5 2 Miles

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Sheep Dip Project Alternative 2 Map

T21N, R11W (Henderson Township)
T21N, R12W (South Branch Township)
Wexford County, Michigan

N W E S

Legend

- Opening Maintain/Create
- Red Pine Thinning
- Red Pine Shelterwood
- Red Pine Overstory Removal
- Aspen Clearcut
- Hardwood Shelterwood
- Hardwood Overstory Removal
- Project Area Boundary
- Open Public Roads
- Road Closure
- Rivers & Streams
- Snowmobile Trails
- MCCCT Trail
- Ski and Bike Trails
- Sections

38 Road
11 1/2 Rd
7 Road
13 Road
FR 7875
FR 9944
FR 5407
Caberfae Peaks Resort
Mackenzie Ski and Bike Trails
FR 7443
FR 5405
FR 5421
FR 7374
FR 9930
FR 7371
FR 9941
FR 7320
FR 5659
FR 5272
FR 5274
FR 5642
FR 7861
FR 5273
FR 5275
FR 5406
FR 7323
FR 5804
FR 5131
FR 7322
FR 5578
FR 7325
FR 5321
FR 7321
FR 7328
FR 7304
FR 5233
FR 7004
FR 5654
FR 5552
FR 7842
FR 5429
FR 5427
44 1/2 Rd
46 Rd
48 Road
48 1/2 Road
15 Road
M-55
M-37
Peterson Bridge
Dobson Bridge
Coyote Crossing Resort
3 1/2 Rd
5 1/2 Rd
7 1/2 Road
9 Road
11 Road
11 1/2 Road
17 Road

0 0.25 0.5 1 1.5 2 Miles

BJB 26-Feb-2013

Sheep Dip Project Alternative 3 Map

T21N, R11W (Henderson Township)
T21N, R12W (South Branch Township)
Wexford County, Michigan

N
W E
S

Legend

- Opening Maintain/Create
- Red Pine Thinning
- Red Pine Shelterwood
- Red Pine Overstory Removal
- Aspen Clearcut
- Hardwood Shelterwood
- Hardwood Overstory Removal
- Project Area Boundary
- Open Public Roads
- Road Closure
- Rivers & Streams
- Snowmobile Trails
- MCCCT Trail
- Ski and Bike Trails
- Sections

38 Road
11 1/2 Rd
7 Road
13 Road
FR 7875
FR 9944
FR 5407
Caberfae Peaks Resort
Mackenzie Ski and Bike Trails
FR 7443
FR 5405
FR 5421
FR 7374
FR 7371
FR 9930
M-55
3 1/2 Rd
FR 5131
FR 5804
FR 7323
44 1/2 Rd
FR 7320
FR 3941
FR 5659
FR 5272
FR 5274
FR 5642
FR 7861
FR 5273
FR 5275
FR 5406
Coyote Crossing Resort
FR 7322
FR 5578
FR 7325
FR 5321
FR 7321
FR 7328
FR 7004
FR 5429
FR 5427
FR 5654
FR 5552
FR 7842
Peterson Bridge
46 Rd
FR 7304
FR 5233
7 1/2 Road
11 Road
M-37
Dobson Bridge
3 Road
7 Rd
48 Road
48 1/2 Road
5 1/2 Rd
9 Road
11 1/2 Road
15 Road
17 Road

Miles
0 0.25 0.5 1 1.5 2

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Sheep Dip Project Alternative 4 Map

T21N, R11W (Henderson Township)
T21N, R12W (South Branch Township)
Wexford County, Michigan

N
W E
S

Legend

- Opening Maintain/Create
- Red Pine Thinning
- Aspen Clearcut
- Hardwood Shelterwood
- Project Area Boundary
- Open Public Roads
- Rivers & Streams
- Snowmobile Trails
- Ski and Bike Trails
- MCCCT Trail
- Sections

38 Road
11 1/2 Rd
7 Road
13 Road
FR 7875
FR 9944
FR 5407
Caberfae Peaks Resort
Mackenzie Ski and Bike Trails
81 / 34
FR 7443
FR 5405
83 / 28
83 / 1
83 / 63
83 / 23
FR 5421
83 / 71
FR 7374
81 / 21
83 / 35
83 / 16
81 / 6
81 / 4
83 / 19
FR 9930
81 / 2
83 / 18
83 / 37
83 / 47
81 / 1
83 / 38
M-55
83 / 55
83 / 51
FR 7371
FR 7323
14 / 20
FR 3941
86 / 34
86 / 18
86 / 5
86 / 20
12 / 38
FR 5131
11 / 18
11 / 5
3 1/2 Rd
7 Road
FR 5804
12 / 46
12 / 28
12 / 11
12 / 32
12 / 10
12 / 44
12 / 6
44 1/2 Rd
12 / 16-A
FR 7320
86 / 16
86 / 35
86 / 2
87 / 40
87 / 34
87 / 3
FR 5659
87 / 16
FR 5274
FR 5642
FR 7861
87 / 33
87 / 23
14 / 10
86 / 17
86 / 24
86 / 38
86 / 45
86 / 50
Coyote Crossing Resort
FR 5272
FR 5273
FR 7322
FR 5578
FR 7325
86 / 15
86 / 12
86 / 11
11 / 19
11 / 14
12 / 56
12 / 13
12 / 16-B
12 / 16-C
14 / 12
14 / 14
86 / 7
86 / 6
87 / 4
87 / 21
5054
87 / 20
FR 5321
12 / 29
12 / 33
12 / 65
12 / 7
FR 7321
12 / 45
12 / 27
FR 7328
86 / 10
86 / 30
Peterson Bridge
46 Rd
7 1/2 Road
FR 7004
13 Road
88 / 11
87 / 24
FR 5275
FR 5406
13 / 12
FR 7304
FR 5233
FR 5654
88 / 25
88 / 27
88 / 30
46 Road
88 / 39
FR 5552
FR 7842
88 / 6
88 / 15
88 / 14
88 / 18
48 Road
11 Road
FR 5427
FR 5429
13 / 21
13 / 19
M-37
3 Road
7 Rd
88 / 16
88 / 17
88 / 20
48 1/2 Road
5 1/2 Rd
9 Road
11 1/2 Road
15 Road
17 Road
Dobson Bridge

0 0.25 0.5 1 1.5 2 Miles

BJB 26-Feb-2013

CHAPTER 3
AFFECTED ENVIRONMENT AND ENVIRONMENTAL EFFECTS

Introduction

This chapter presents information on the existing conditions in the Sheep Dip Project Area (henceforth referred to as the Project Area) and an analysis of the effects of the No Action Alternative (Alternative 1), the Proposed Action (Alternative 2), and two additional Action Alternatives (Alternatives 3 and 4) on the environment. This chapter is divided into two sections: 1) relevant issue and 2) other issues and management concerns. The affected environment for this project is the Project Area within the Huron-Manistee National Forests (HMNF). Resource-specific information, existing condition, and environmental effects are discussed together under each issue. This chapter presents a summary of the analysis and the data utilized in completing the analysis. The information used to prepare this analysis is in the Project Planning Record and is available for review at the Cadillac-Manistee Ranger District.

Area of Analysis

The area of analysis for this project includes all the compartments that make up the Project Area including private lands. In the discussion of the relevant issue and other resource areas and their effects that follows, some resources require a larger area of analysis. An example would be air quality issues that could impact areas outside the Project Area. In those cases, the area of analysis is discussed or defined under the relevant issue or other resource areas.

Conversion of Red Pine Stands to Northern Hardwood Stands (i.e. native forest composition)

The area of analysis for this issue includes all the National Forest System (NFS) lands within the Project Area. The Project Area is made up of Management Areas (MA) 2.1, 8.1, and 8.3. Approximately 77% of the Project Area is in MA 2.1. According to the Forest Plan, MA 2.1 is characterized by morainal hills and gently rolling plains where the soils support northern hardwoods, aspen, and conifers. Among the goals and objectives stated in the Forest Plan is to provide core northern mesic northern hardwood habitat. The desired future condition (DFC) includes timber stands dominated by red oak, sugar and red maples, beech, ash, black cherry and aspen, with conifer inclusions of red and white pines. The dominant trees in stands are the same age and about the size. Stands differ in age and are irregular in size and shape, giving the landscape a mosaic appearance (Forest Plan III-2.1-2-3). There is no information in the Forest Plan that describes the current forest characteristics or desired future forest characteristics for MAs 8.1 or 8.3.

Currently, the Project Area has approximately 2,712 acres (23% of NFS lands in the Project Area) of long rotation conifers, the vast majority of which are red pine stands. The hardwood forest types described in the Forest Plan that are found in the Project Area include: northern red

oak (1,551 acres/13% of NFS lands); northern hardwood forest types (4,468 acres/38% of NFS lands); and, aspen (1,759 acres/15% of NFS lands) (Table 3-1).

Vegetation of the Project Area - Pine vs. Hardwood Types (NFS Lands Only)
Table 3-1

Vegetation Type	Total Acres	% of NFS Lands
Red Pine	2,617	22%
Easter White Pine / EWP-Hemlock	79	<1%
Northern Red Oak	1,551	13%
Northern Hardwoods	4,468	38%
Aspen Birch	1,759	15%

Red pine have been recorded that were in excess of 300 years old. However, after 150 years height growth almost stops, although diameter growth continues at a slower rate for several more years (Burns and Honkala 1990).

Cone production per tree improves as stand density decreases. A result of high density red pine stands, such as those found in the pine plantations of the Project Area, is that fewer than 20% of trees produce cones and seedfall may average less than 10 seeds per tree (Burns and Honkala 1990). Those seeds that are produced may germinate, but seedlings have a difficult time growing on the heavy litter layer found beneath a pure red pine plantation.

Red pine is considered a shade intolerant species, meaning that it not able to successfully regenerate in a fully stocked stand of either other species, such as northern hardwoods, or in stands of mature red pine, such as are found in the pine plantations of the Project Area.

In the Lake States, in the absence of disturbances such as fire or other factors, the succession of a site would historically been from red pine to white pine to hardwoods. This rate of succession is likely more rapid on better sites (Burns and Honkala 1990). In the case of the red pine stands presently found in the Project Area this succession would likely be from red pine to hardwoods given the overall lack of white pine stands in the area, and the large percentage of hardwoods found. The table above shows that less than 1% of all the stands found on NFS lands within the Project Area has a white pine component. This does not mean inclusions, groups, or individual white pine may be found throughout the Project Area, but stands dominated by this species have not been identified and thus are unable to provide large quantities of seed to regenerate adjacent red pine stands. Red pine does not compete well with northern hardwoods on better sites (Ek et al. 2001). It has been found that historically red pine grows only sporadically on heavier soils, due to its inability to compete with more aggressive species. In addition, its typical associates are sugar maple, red maple, American basswood, American beech, yellow and white birch, and northern red oak. Therefore, the large portions of the Project Area dominated by more shade tolerant species that are better able to compete in an existing stand would likely convert existing red pine stands to a more stable, shade tolerant forest cover type. Referencing Table 3-1, more than one-third (approximately 38%) of the Project Area is currently typed as northern hardwood

stands. A northern hardwood stand in this area would typically consist of sugar maple, beech, basswood, and red maple. Sugar maple and beech are considered very tolerant of shade, while basswood is tolerant, and red maple has an intermediate tolerance for shade. The aspen-birch type referenced in the Forest Plan is very intolerant of shade and would likely only regenerate following some kind of stand disturbance.

The Direct and Indirect Effects of Implementing Alternative 1

If no activity were undertaken there would be no harvesting of existing pine stands, especially red pine stands, and the pine stands would continue to occupy the same amount of acreage throughout the Project Area. As individual trees within these unthinned and untreated red pine plantations began to crowd one another out, the natural gaps would most likely be occupied by more shade tolerant northern hardwoods already present in the understory. It is also worthwhile to note that the majority of these plantations are overwhelmingly monospecific and of genetically similar planting stock (Ek et al 2001). As described above the typical lifespan of a red pine is normally around 150 years depending on the site. Currently, approximately two-thirds of the existing red pine stands in the Project Area are from 60 to 80 years old, giving them an additional 70 to 90 years of additional growth under natural conditions (refer to age class table - Project Record). However, most of the red pine stands in the area were established under plantation conditions with very close spacing both within rows and between rows. In these types of stands the competition for water, light, and nutrients is greater than in a natural red pine stand and therefore the potential for stress induced loss of trees is greater. As the competition in these untreated red pine plantations increases with increasing age, individual red pine would decline and shade tolerant northern hardwoods would begin to supplant them in the stand. This would take place over a relatively long time span, considering the potential for 70 to 90 years of additional growth, although maximum life span under the intense competition of unthinned plantation conditions is likely shorter.

Therefore, the prognosis for the future of the red pine plantations in the Project Area would be that the untreated stands would continue to grow, although they have already or will very soon surpass there maximum economic rotation of roughly 60 to 90 years (Ek et al 2001). If left untreated they would continue to grow at a slower rate for the next approximately 70 to 90 years, where they would eventually succumb to competition and naturally convert to a northern hardwood forest type.

The Cumulative Effects of Implementing Alternative 1

Projects have been conducted in the vicinity of the Sheep Dip Project Area involving red pine thinning and other intermediate treatments (refer to *Vegetation Resources* pages 3-21,22). While some of these treatments have exhibited some damage to the residual stand of trees, due to unforeseen and unforeseeable events, many of the red pine treatments in the area have been successful. These surrounding stands would also eventually succeed to northern hardwoods which are the natural forest type on these soils in this terrain. The overall result of the management or lack of management in the area would be a conversion of these red pine plantations to northern hardwood stands as a result of natural succession. The major difference would be the time frame under which this change would take place. Without active management the stands would take longer to convert, but would eventually become northern hardwood dominated stands.

The Direct and Indirect Effects of Implementing Alternative 2

Under Alternative 2 there would be 119 acres of overstory removal harvesting, 314 acres of shelterwood harvesting, and 697 acres of pine thinning, all primarily in red pine stands. All together there would be 1,130 acres of harvesting activity in the red or white pine forest type. As can be seen in Table 3-1 there is a total of 2,696 acres or red and white pine found in the Project Area. This means that approximately 42% of all the long-lived pine in the Project Area would be treated.

The result of these treatment activities would be different depending upon which method of harvesting would take place. In the overstory removal harvesting taking place in the red pine forest type, six of the seven stands (approximately 90% of the stands) had significant enough amounts of northern hardwood and/or aspen regeneration, or advanced regeneration, to be noted either in the compartment narratives prepared for the area or in notes made following additional field reviews (see Project Record). The majority of this regeneration was maples, beech, or inclusions of aspen clones. Therefore, it can be assumed that after the stands are harvested by the overstory removal method, the advanced hardwood regeneration would assume a significant role in the future of those stands. There would be some damage to the advanced regeneration present, but mechanical site preparation to the hardwood regeneration would ensure desirable growth form. However, the hardwood regeneration would still have an advantage over any potential red pine regeneration now present or what might be established following the opening of the stand to increased sunlight. The likely scenario for these red pine overstory removal harvests would be that the overstory red pine is removed, the advanced regeneration, consisting primarily of hardwoods, would then outcompete any existing red pine regeneration, and the stand would be converted to a northern hardwoods, sometimes with an aspen component. This action would further be enhanced by the fact that these sites would have historically been northern hardwood stands based on topography and soil type. This would follow the natural path of succession described above, whereby red pine converts to northern hardwoods over time, while the intermediate stage of white pine would be negated due to the lack of a seed source. Therefore, the 119 acres of red pine overstory removal harvests would result in a conversion of these stands to a northern hardwood dominated forest type.

In the shelterwood harvesting taking place in the red pine forest type, eight of the nine stands (approximately 90% of the stands) had significant enough amounts of northern hardwood and/or aspen regeneration, or advanced regeneration, to be noted either in the compartment narratives prepared for the area or in notes made following additional field reviews (see Project Record). The majority of this regeneration was maples, beech, or inclusions of aspen clones. The future forest type expected for these stands would be similar to those anticipated following the overstory removal harvesting discussed previously. A shelterwood harvest is typically the first stage of the harvesting technique in which a partial removal of the overstory is followed at a later date by the removal of the remaining overstory, referred to as the overstory removal harvest. The expectation is that the stand, after having a portion of its closed canopy removed and leaving a remaining sheltering layer of mature red pine intact, would then revert to a northern hardwood dominated stand. There would be some damage to the advanced regeneration present, and like the overstory removal harvest, mechanical site preparation to the hardwood regeneration would ensure desirable growth form. Therefore, the likely result of the 314 acres of shelterwood harvesting would be similar to the results of the overstory removal harvests with the red pine stands succeeding to a northern hardwood forest type.

In the thinning taking place in the red pine forest type, ten of the twenty-seven stands (approximately 40% of the stands) had significant enough amounts of northern hardwood and/or aspen regeneration, or advanced regeneration, to be noted either in the compartment narratives prepared for the area or in notes made following additional field reviews (see Project Record). The majority of this regeneration was maples, beech, or inclusions of aspen clones. The conversion of these red pine stands to a northern hardwood forest type would be less widespread and take place over a longer period of time as compared to the previous two treatment types. The silvicultural prescription for these thinnings calls for the retention of most hardwood species found in the pine stands. The shading in these stands would still likely discourage red pine regeneration from taking place in the stand, while at the same time the residual hardwood components left would act as a vector for hardwood regeneration to take place or in the case of stands where it is already present, to increase the amount of hardwood regeneration likely to be established in the understory. Therefore, the likely result of the 697 acres of red pine thinning would be that current stocking levels of hardwood regeneration would increase in all the stands, thus setting the stage for future conversion to the northern hardwood forest type as the remaining overstory red pine are removed in subsequent treatments, and advanced hardwood regeneration succeeds them as the dominant forest type.

The Cumulative Effects of Implementing Alternative 2

Projects have been conducted in the vicinity of the Sheep Dip Project Area involving red pine thinning and other intermediate treatments. While some of these treatments have exhibited some damage to the residual stand of trees, due to unforeseen and unforeseeable events, most red pine treatments in the area have been successful. These surrounding stands would also eventually succeed to northern hardwoods which are the natural forest type on these soils in this terrain. The active management within the Project Area combined with the past activities in the surrounding area, as well as future red pine management likely to continue across the forest, but especially in areas surrounding the Project Area would contribute to an overall succession or the red pine forest type to a northern hardwood forest type. This would likely only be the case where historically, due to soils and topography, northern hardwoods are the historical forest type. In those areas where red pine would have filled the ecological niche, the succession would be less prevalent. This natural succession would occur in a shorter timeframe as compared to the cumulative effects anticipated as a result of taking no action under Alternative 1.

The Direct and Indirect Effects of Implementing Alternative 3

Under Alternative 3 there would be 107 acres of overstory removal harvesting, 176 acres of shelterwood harvesting, and 621 acres of pine thinning, all primarily in red pine stands. All together there would be 904 acres of harvesting activity in the red or white pine forest type. As can be seen in Table 3-1 there is a total of 2,696 acres or red and white pine found in the Project Area. This means that approximately 34% of all the long-lived pine in the Project Area would be treated.

The result of these harvesting activities would be different depending upon which method of harvesting would take place. In the overstory removal harvesting taking place in the red pine forest type, seven of the eight stands (approximately 90% of the stands) had significant enough amounts of northern hardwood and/or aspen regeneration, or advanced regeneration, to be noted either in the compartment narratives prepared for the area or in notes made following additional field reviews (see Project Record). The direct and indirect effects would be similar to those described for Alternative 2 above, but due to the reduction in the amount of overstory removal

harvesting from approximately119 acres to approximately 107 acres, the area affected would be slightly less (approximately 9% fewer acres).

In the shelterwood harvesting taking place in the red pine forest type, all seven of the stands (100% of the stands) had significant enough amounts of northern hardwood and/or aspen regeneration, or advanced regeneration, to be noted either in the compartment narratives prepared for the area or in notes made following additional field reviews (see Project Record). The direct and indirect effects on the acres treated would be similar to those described for Alternative 2 above, but due to a large reduction in the amount of shelterwood harvesting from approximately 314 acres to approximately 176 acres, the area affected would be reduced by approximately 44% as compared to Alternative 2. The remaining 138 acres (the remaining approximately 56%) would be similar to the effects described in the direct and indirect effects for Alternative 1.

In the thinning taking place in the red pine forest type, nine of the twenty-six stands (approximately 40% of the stands) had significant enough amounts of northern hardwood and/or aspen regeneration, or advanced regeneration, to be noted either in the compartment narratives prepared for the area or in notes made following additional field reviews (see Project Record). The direct and indirect effects would be similar to those described for Alternative 2 above, but due to the reduction in the amount of thinning from approximately 697 acres to approximately 621 acres, the area affected would be slightly less (approximately 11% fewer acres).

The Cumulative Effects of Implementing Alternative 3

The cumulative effects would be similar to those described for Alternative 2. The primary difference being a reduction in the acres treated from approximately 1,130 acres to approximately 904 acres, a difference of approximately 226 acres. On these approximately 226 acres, the cumulative effects would be similar to those described for Alternative 1.

The Direct and Indirect Effects of Implementing Alternative 4

Under Alternative 4 there would be only 621 acres of pine thinning, all primarily in red pine stands. No overstory removal or shelterwood harvests would take place under this alternative. As can be seen in Table 3-1 there is a total of 2,696 acres or red and white pine found in the Project Area. This means that approximately 23% of all the long-lived pine in the Project Area would be treated.

No overstory removal harvesting would be taking place in the red pine forest type. Therefore, the acres that would not be treated as compared to Alternative 2 (119 acres) or Alternative 3 (107 acres) would have similar direct and indirect effects as those described for Alternative 1.

No shelterwood harvesting would be taking place in the red pine forest type. Therefore, the acres that would not be treated as compared to Alternative 2 (314 acres) or Alternative 3 (176 acres) would have similar direct and indirect effects as those described for Alternative 1.

The thinning taking place is the same as that described for Alternative 3. Therefore, the direct and indirect effects would be the same as those described for Alternative 3.

The Cumulative Effects of Implementing Alternative 4

The cumulative effects would be similar to those described for Alternative 2. The primary difference being a reduction in the acres treated from approximately 1,130 acres to approximately 621 acres, a difference of approximately 509 acres. On these approximately 509 acres, the cumulative effects would be similar to those described for Alternative 1.

Management Indicator Species and Wildlife

Area of Analysis

The analysis area for direct and indirect effects on wildlife resources includes an area of approximately a half mile from where the proposed project activities in each alternative would occur on the ground. This area was chosen because this is the distance that the disturbance from the proposed activities could possibly affect most wildlife species.

The cumulative effects area (CEA) for wildlife resources encompasses the Project Area and all lands within approximately a half mile from the Project Area boundary. The buffer around the Project Area would include the majority of the habitat utilized in the home ranges of wildlife species found within or immediately adjacent to the Project Area. Dispersal of most wildlife species from or into the Project Area would likely be contained within the CEA. Management of NFS lands adjacent to the Project Area but within the CEA has been similar to that in the Project Area. Private lands generally include lakes, forest lands, agricultural lands, and residential areas. The timeframes for the cumulative effects analysis are generally from 2003 through 2023.

Existing Condition

The HMNF provides habitat for about 382 species of breeding vertebrate animals. In addition, there are numerous numbers of invertebrates and habitat for many migratory species (USDA 2006a and b). The HMNF considered the effects of forest management on these species through species viability evaluations and the development of the Forest Plan. A list of the wildlife Management Indicator Species (MIS) and management direction for these species on the HMNF are found in the Forest Plan (page II 31-34) and Final Environmental Impact Statement (FEIS) (pages III-179 to III-192).

Trends for wildlife MIS on the HMNF are discussed in the 2009 Monitoring and Evaluation Report (USDA 2010). Generally, ruffed grouse populations seem to have a 10-year population cycle in Michigan and it appears that the statewide grouse population is currently at or near the high end of the cycle (Frawley and Stewart 2009). Breeding Bird Survey (BBS) population trends for the State of Michigan for the years 1999-2009 indicate that grouse population levels were likely steady or increasing slightly (Sauer et al. 2011). The monitoring information for grouse indicates that the HMNF population trend is likely decreasing (USDA 2010). Monitoring has also indicated that bald eagle and Kirtland's warbler populations are increasing on the HMNF while Karner blue butterflies may be declining (USDA 2010).

The BBS trends for breeding birds in Michigan from 1999-2009 have shown that most species that prefer mature forests on the HMNF are stable or increasing (Sauer et al. 2011). Species that prefer successional or scrub habitats show mixed trends. Trends in the BBS also indicate that a significant proportion of grassland bird species are declining. The HMNF has participated in the North American BBS by conducting one route per year, for over ten years. Several other routes

are within or adjacent to the HMNF's boundary and are being completed by USGS volunteers. MIS status in the Project Area is described in Table 3-2. The effects of the activities on the MIS are summarized for each alternative in Table 3-2.

Comparison of Effects on Management Indicator Species
Table 3-2

Management Indicator Species	Principal Habitat Characteristics	Existing Condition in Project Area	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Bald Eagle *(Haliaeetus leuco-cephalus)*	Super-canopy trees within a mile of large water bodies; secluded settings with abundant rough fish nearby.	Suitable habitat limited within Project Area. Discussed in the Biological Evaluation	No change	Red pine thinning would assist in future development of perching or nesting habitat. Aquatic habitat improvement would improve potential foraging habitat.	Red pine thinning would assist in future development of perching or nesting habitat. Aquatic habitat improvement would improve potential foraging habitat.	Red pine thinning would assist in future development of perching or nesting habitat. Aquatic habitat improvement would improve potential foraging habitat.
Kirtland's Warbler *(Dendroica kirtlandii)*	Large blocks of young jack pine, age 6-23 years old, in LTA 1.	Suitable habitat not present within Project Area. Discussed in Biological Evaluation.	No change	No change	No change	No change
Karner Blue Butterfly *(Lycaedes melissa samuelis)*	Savanna or barrens habitat with an abundance of wild lupine and other nectar sources.	Suitable habitat not present within Project Area. Discussed in Biological Evaluation.	No change	No change	No change	No change
Ruffed Grouse *(Bonasa umbellus)*	Aspen and aspen-alder mixes, 5-25 years old provide brood habitat and cover, with older age classes for nesting and winter food sources.	Aspen is a small habitat component of the Project Area (about 15%). Aspen from 0-9 year old currently totals 109 acres. Species present in Project Area in moderate numbers. Early successional oak and oak/ pine types not present.	Populations would decline as aspen age class diversity is reduced and begins to convert to other types. In ten years there would be no early successional forest types within the Project Area.	Provides 244 acres of 0-9 year old aspen, improves age class diversity, and creates or maintains 306 acres of opening habitat. Would assist meeting Forest Plan objectives. Grouse would benefit.	Provides 244 acres of 0-9 year old aspen, improves age class diversity, and creates or maintains 300 acres of opening habitat. Would assist meeting Forest Plan objectives. Grouse would benefit.	Provides 181 acres of 0-9 year old aspen, improves age class diversity, and creates or maintains 306 acres of opening habitat. Would assist meeting Forest Plan objectives. Grouse would benefit.

According to the 2009 Monitoring and Evaluation Report (USDA 2010), the status of most of the vegetation types currently represented on the HMNF is generally consistent with projections in the Forest Plan. However, there is less early successional habitat than was projected in the Forest Plan. This is due to limitations on Forest Service activities from declining budgets, wetland protection, access restrictions, and old growth designation. The amount of late successional habitat is increasing proportionally as the forest grows older. These trends influence the diversity and abundance of wildlife on the HMNF.

The Sheep Dip Project occurs within MAs 2.1, 8.1, and 8.3 and has the following project objectives: sustain forest and ecosystem health and improve timber stand condition, provide early successional habitat, improve aquatic habitat, and manage the transportation system. Wildlife species diversity is directly related to diversity of vegetative communities. The Project Area is located primarily on northern hardwoods, red pine, mixed oaks, and non-forested forest types, but a few areas are on alluvial and organic soil areas (Table 3-2). This ecological diversity also provides for a diverse wildlife resource in the Project Area. Also, the more forest and non-forest types and forest age classes present, the greater the species diversity in a given area. Measuring, comparing, and projecting diversity within and between vegetative communities is complex. For this analysis, community type diversity and age-class of stands in the Project Area would be used to establish a baseline of landscape diversity. The NFS lands in the Project Area are largely within a forested ecosystem and the current forest types are approximately 73% deciduous and 23% conifer (Tables 3-1, 3-3). The majority of the forested stands (approximately 75%) are over 60 years of age. Early successional habitat (age class 0-9) accounts for approximately 1% of the NFS lands in the Project Area and non-forest habitat types account for approximately 4%. The Project Area currently has minimal forest fragmentation from timber harvesting and some fragmentation from a high density of trails and roads. However, fragmentation exists from a "checker board" effect of the private and federal ownerships on the HMNF within the Project Area. Forest fragmentation affects species to different extents and at different scales.

Wildlife surveys were conducted in the Project Area within stands proposed for treatment on various dates from 2010-2013 (see Planning Record). These surveys found no federally listed species. Regional Forester's Sensitive Species (RFSS) documented and observed in the Project Area are described in the Biological Evaluation (BE) and Planning Record. Fifty-two species of birds were observed. The most common were ovenbirds, red-eyed vireo, indigo bunting, and black-capped chickadee. The diversity of bird species is indicative of the diversity of forest and non-forest types found in the Project Area. The majority of the bird species found are associated with maturing to mature deciduous and conifer forest types. The most common mammals noted were American marten, white-tailed deer, chipmunks, black bear, and squirrels, which are largely species associated with maturing to mature forests. This would be expected, as the stands proposed for treatment in the Project Area are largely maturing/mature forest types. Raptor species observed during the 2010 wildlife surveys in the Project Area include the red-shouldered hawk, sharp-shinned hawk, saw-whet owl, and barred owl. No raptor breeding activity was observed. Historical records documented nesting northern goshawk and red-shouldered hawks in the Project Area. Wildlife MIS documented in the Project Area included the ruffed grouse and bald eagle (see Planning Record). Species of wildlife commonly hunted or trapped within the Project Area include but are not limited to white-tailed deer, wild turkey, ruffed grouse, fox and gray squirrels, black bear, and coyote.

The Direct and Indirect Effects of Implementing Alternative 1

There would be no direct effects to wildlife populations under Alternative 1. Implementation of Alternative 1 would generally maintain current forest types and habitat conditions within the Project Area, as there would be no additional management activities at this time. The current wildlife populations would not likely change in the near future. Populations of wildlife species preferring late successional habitats, such as eastern gray squirrels, scarlet tanagers, and pileated woodpeckers would generally benefit over time with this alternative, as the forested stands become older and develop mature or over mature characteristics. Wildlife populations preferring early successional or upland opening habitats for parts of their life cycles, such as ruffed grouse, mourning warbler, and eastern towhee, would likely decline over time under this alternative. The early successional habitat types are currently approximately 1% of the NFS lands in the Project Area and the opening types are approximately 4%. Without management or catastrophic events such as a wildfire, it is expected that there would be a further loss in amount or a decline in quality of the aspen and upland opening habitat types over time due to succession.

Failure to control the invasive plants in the Project Area would not directly result in immediate adverse impacts to local populations of wildlife. However, failure to successfully control certain infestations would allow the continued infestation and degradation of more areas of wildlife habitat. Aggressive invasive plants species such as leafy spurge tend to replace native plants upon which wildlife generally depend for food and cover. In general, species having relatively specific habitat requirements are more susceptible to adverse effects from the continued spread of invasive plants than would habitat generalists.

This alternative does not assist with meeting the Forest Plan objectives for maintaining aspen habitat, creating early successional forest habitat, maintaining upland opening habitat, and maintaining viable populations of certain wildlife species. This alternative does not assist with meeting the Forest Plan objective for ruffed grouse habitat (page II-33) and populations of 1,000 breeding pairs and 2,500 acres of 0-9 year old aspen adjacent to mature aspen.

The Direct and Indirect Effects of Implementing Alternative 2

Alternative 2 could have direct effects to wildlife through timber harvest, wildlife management activities, prescribed burning, road construction, invasive plant control, etc. Implementation activities might temporarily increase the risk of injury or mortality from vegetation treatments and/or temporarily displace, alter the movement, or disrupt the normal behavior of certain wildlife species. It may also limit the use of foraging areas and potentially affect productivity. Approximately 1,741 acres of NFS lands would be impacted by project activities or about 13% of the total land base in the Project Area and about 15% of NFS lands in the Project Area. Activities from this alternative would likely be spread out over a 10+ year period as would the potential direct effects to wildlife populations. Seasonal restrictions to protect sensitive species have been placed on selected stands and these restrictions would also reduce impacts to other wildlife species (see Treatment Unit Cards - Appendix A). The direct effects of this alternative are related to the type of action, timing, duration, and distance.

Approximately 697 acres of red pine thinning is proposed under Alternative 2. The average size for stands proposed for thinning equals approximately 26 acres. Timber harvesting during the breeding season has the potential to destroy or damage nests, small young and less mobile species. Larger and more mobile species could travel to escape these activities. Wildlife diversity and densities in red pine stands are generally low due to less vegetative diversity within

the stands, less mast production, and acidic soils and duff. Six bat species have been recorded across the HMNF during summer bat surveys in the 1990s and 2000s (Kurta 2000, Tibbels 2002, and Kurta 2007). These species commonly roost in trees or buildings. Proposed harvests that could occur during the breeding season under this alternative could disturb individuals if they were occupying a roost tree being cut or damaged. Red pine thinning has no seasonal restrictions for the protection of bats because red pine plantations are considered to be poor bat habitat (Tibbels and Kurta 2003).

Road management within the Project Area, including road construction or reconstruction and could directly affect small numbers of small, less mobile animals. Because of the small area (8.6 miles of road activity including construction/reconstruction in the Project Area) that could be impacted over multiple years, there would not likely be adverse direct impacts to wildlife populations. Road closure consisting of 0.7 miles would restore habitat over time and reduce disturbances to wildlife.

Regeneration harvests (clearcut, overstory removal, and shelterwood treatments) within the Project Area amount to 715 acres. These harvest types would occur in 26 stands with an average size of 26 acres. Harvesting in the clearcut, overstory removal, and shelterwood stands would primarily be conducted from October 1 through March 31 to promote regeneration. A seasonal restriction would be applied for regeneration stands with snowmobile trails near them. Cutting in these stands would occur from September 1 through November 30. These seasonal restrictions would assist in protecting certain wildlife species such as martens, breeding birds, bats, and reptiles as they would less likely be in the treated areas at this time or they would be in areas that would be less affected (underground). These mechanical vegetation treatments, depending on the timing, could directly impact small numbers of wintering animals in the Project Area.

Upland opening habitat mechanical improvements would occur on approximately 285 acres of the approximately 395 acres of this habitat on NFS lands in the Project Area. A variety of treatments would be used to improve habitat conditions within these acres, including brushing, brush pile creation, waterhole construction, and snag creation. Most of these activities would have minimal direct effects to wildlife as they impact small acreages in scattered locations and less heavy equipment is used. The opening creation project would create an additional 21 acres of early succession habitat that would benefit early successional wildlife species. The aquatic habitat improvement project that would add woody habitat to Dowling Creek would benefit aquatic wildlife, such as amphibians.

Upland opening controlled burns totaling approximately 56 acres could directly impact small numbers of wildlife, especially small and less mobile individuals. Plow lines for prescribed burning could also directly affect certain individuals. Prescribed burning is proposed for seven openings with an average size of 8 acres. The prescribed burns would occur primarily from September 1 through May 31. This timing would assist in protecting wildlife species such as breeding birds, bats, amphibians, and reptiles as they would less likely be in the treated areas at this time or they would be in areas that would be less affected (underground). However, fires generally kill or injure a relatively small proportion of animal populations as they generally flee from burning areas or seek shelter (Russell et al. 1999, Lyon et al. 2000, Renken 2006). The proposed prescribed burns under this alternative would not directly impact the viability of wildlife species within the Project Area. There are usually no changes in the composition or total breeding population of bird communities (White et al. 1999, Greenberg et al. 2007). Burning may result in short-term reductions in the suitability of habitat for ground and low-shrub-nesting birds, but may improve habitat for foraging birds, such as wild turkeys and grouse, and deer (Euler and Thompson 1978, Main and Richardson 2002, Jones et al. 2008). Local variation in

fire intensity and moisture levels would tend to maintain some suitable nesting habitat within burned areas. Total small mammal biomass generally increases following wildfires and presumably does after prescribed burning. Some studies have suggested that some amphibian populations may experience short-term benefits from fire (Hossack and Corn 2007).

One of the major vegetation changes that would occur with Alternative 2 are the regeneration harvests; clearcut (244 acres), overstory removal (136 acres), and shelterwood harvests (335 acres). These harvests would be mainly in red pine, hardwood, and aspen types and would remove the majority of the mature trees within the stands. This would change the habitat characteristics of these stands and subsequently change the wildlife species using these stands. Some wildlife species that prefer mature forest types especially mature conifer or mixed hardwood conifer habitat, may be impacted by these treatments, such as the American marten. Marten are agile animals and adults can move readily out of the way of mechanical equipment used for harvesting, road construction, or habitat improvement. But, young animals in den trees could be susceptible to harvesting or other mechanical actions if they were present. The red pine overstory removal treatments with documented marten den sites would be conducted from September 1 through November 15. This timing restriction would provide some protection to denning females and young. Seasonal restrictions in the other clearcut, overstory removal, and shelterwood treatments would be conducted from October 1 through March 31 and would also provide some protection to martens, and other wildlife species, that may include denning females and young. Although the Speed Dip Project Area and the CEA is not included in primary or secondary marten habitat, implementing the Stand Management Guidelines described in the American Marten Conservation Strategy for the HMNF (USDA 1996) for snags, den trees, and dead/down would provide and protect these important habitat components for the marten. Retaining hardwood trees, snag/den components, diurnal resting sites, and creating coarse woody debris (downed logs) and snags would benefit the marten and other cavity nester wildlife species.

These regeneration treatments would indirectly benefit wildlife diversity by temporarily providing early successional habitats in the Project Area (Trani et al. 2001, Swanson et al. 2010). Continually creating early successional habitats is important for maintaining certain bird populations (Roth and Lutz 2004, Schlossberg and King 2009, North American Bird Conservation Initiative 2011). Species that require this type of habitat generally have peak populations immediately after harvest up to ten years after harvest. Then populations decline until they are virtually gone by age 20. Some species of bats use clearcut areas for foraging and it may improve seasonal availability of insect prey for bats (Erickson and West 1996). Early successional habitats are important as post-fledgling, molting, and migration habitat for some species of birds that typically use mature forests for breeding (Anders et al. 1998, Vega Rivera et al. 1999, Suthers et al. 2000, Vega Rivera et al. 2003, Vitz and Rodewald 2007). Early-successional forests are important for a wide diversity of land birds during fall migration stopovers because they tend to have greater production of fruits, which indicates the potential importance of those habitats for migratory landbird conservation (Suthers et al. 2000, Rodewald and Brittingham 2004, Smith et al. 2007). Some species of turtles prefer edges of early successional areas for foraging habitat (Compton et al. 2002). Early successional habitats are also important for prey species for many carnivores (Litvaitis 2001).

Clearcut harvests may provide diverse habitats for small mammals through different stages of succession much as wildfires formerly did (Sullivan et al. 1999). The clearcuts and shelterwood harvests may reduce the populations of some species in the Project Area that prefer older age classes or closed canopies. For example, amphibian populations within these stands would likely decrease within two years of regenerating the stand due to leaf and moisture loss, but populations would likely rebound to normal levels after 20 years (Ash 1997). Regeneration harvests with

reserve trees such as proposed in this alternative (see Treatment Unit Cards - Appendix A) generally sustain populations of the species that prefer mature age classes, especially birds (Conner and Adkisson 1975, Merrill et al. 1998, Boardman and Yahner 1999, Thompson and DeGraaf 2001). Regeneration harvests can affect movement patterns of some wildlife species for short periods of time (usually until the canopy redevelops). However, these small regeneration units scattered over a Project Area of approximately 11,725 acres of NFS lands, would not disrupt movement patterns in general nor would it isolate any wildlife populations.

Another vegetation change that would occur with Alternative 2 is opening creation (21 acres). This treatment would indirectly benefit wildlife diversity by increasing the amount of upland opening habitat in the Project Area. Currently approximately 4% of the Project Area is in opening habitat which is below the amount suggested by the Forest Plan. This alternative would increase this habitat type slightly.

This alternative would decrease the amount of mature forest habitat on NFS lands within the Project Area by approximately 736 acres. Approximately 715 acres would be a short-term decrease as the regenerating forest stands would return to mature forest conditions within 60+ years after harvest. Approximately 21 acres would be a long-term reduction due to the opening creation. This effect on wildlife populations would be balanced somewhat by approximately 699 acres of forest types currently in the 30-39 and the 40-49 year age classes in the Project Area moving towards maturity over time. The decrease in mature forest would not likely impact the overall numbers of mature forest habitat dependent species such as martens, pileated woodpecker, and squirrels. The regeneration harvests, road construction, and opening creation proposed in this project would increase the amount of edge. This may reduce avian nesting success due to the effects of forest fragmentation (higher rates of predation, higher rates of parasitism, and reductions in pairing success) (Faaborg et al. 1995). However, recent studies have shown that the impacts from fragmentation created by logging are less than those created by permanent edges, such as agriculture and development (Suarez et al. 1997) especially in largely forested landscapes (Barber et al. 2001). Some species of birds, such as ovenbirds, may react to edge effects by laying more eggs and having higher nesting densities, thus offsetting the negative effects. Edges from forestry practices such as clearcutting produce only temporary edges and fragmentation. Aspen regenerates quickly and within approximately 5-10 years, the stands would have closed canopies, and in about 20+ years, tree heights approach the original stands. The rates of nest parasitism from brown-headed cowbirds would not likely increase from this project as they are primarily dependent on the amount of agricultural lands in the Project Area (Moris and Thompson 1998). Any adverse effects from regeneration harvests from the proposed project would likely be short-term for species favoring forest interior conditions.

Management of the aspen type is important for maintaining wildlife diversity and populations in the Project Area (Turchi et al. 1995, Crampton and Barclay 1998, Yahner 2003). Even with small acreages of this habitat type in the Project Area, maintaining different age classes of aspen in the Project Area would benefit wildlife. Since aspen is a shade intolerant species it is best regenerated by clearcut harvests or it would eventually convert to other species. The Project Area currently has approximately 109 acres of aspen in the 0-9 age class. Alternative 2 would provide for 244 acres of this habitat and would assist in maintaining the type. This alternative assists with meeting the Forest Plan objective (page II-33) for ruffed grouse (an MIS) habitat and populations of 1,000 breeding pairs and providing 2,500 acres of 0-9 old aspen of habitat dispersed across the Forest.

Red pine thinning would occur on approximately 697 acres. Thinning appears to have little or no negative effects to the habitat of neotropical birds in a largely forested landscape (Barber et al.

2001) and may benefit habitat conditions for bird species such as the black-throated green warbler. The thinning would benefit other species such as the black bear and deer by increasing cover, understory diversity, and forage. Populations of squirrels and pileated woodpeckers, which prefer mature forest communities, would not likely be impacted by the pine thinning treatment, as the majority of the hardwoods in the stands would be retained. Red pine thinning would likely not affect bats because they do not prefer red pine stands (Tibbels 2002, Tibbels and Kurta 2003). Reptile and amphibian habitat would not likely be adversely impacted by the red pine thinning harvest, as it is generally not a preferred habitat type.

Snags, mast/den trees, and downed wood would be retained or created in all harvest units as they are important for wildlife habitat, and to meet Forest Plan guidelines (page II-23, Table II-12). These activities would maintain and provide roosting and foraging habitat, mast production, future den and snag trees, habitat, bird diversity, and stand diversity within the proposed stands. Retaining woody debris in the harvest units would provide down woody material for turkey nesting habitat, small mammal cover, reptile and amphibian habitat, and prey habitat that benefits predators such as the marten and woodland raptors. Regeneration harvests that maintain biological legacies and naturally regenerate to native forest species provide ecologically beneficial results (Swanson et al. 2010). This alternative assists in meeting Forest Plan direction for snag, den, and mast trees to maintain viable vertebrate populations (pages II-22-23).

Suitable bat roost trees are considered abundant throughout the HMNF and the percentage of roost tree habitat that would be lost in the Project Area is minimal. The Forest Plan Guidelines to protect snags and retain wildlife trees would also minimize potential loss of roosting habitat. Upon completion of harvesting, the residual stand condition of harvest units would still retain live and dead trees that could provide roosting habitat for bats. In addition, some of the harvest treatments proposed would be beneficial to all bat species in the Project Area by increasing foraging habitat. Research has found that bats often forage near water bodies, trails, roads, and forest openings (Krusic and Neefus 1996), presumably because insect prey may be more abundant in more open habitats and maneuvering in the air is easier. In addition, some bat species may rely on solar radiation to help keep warm (e.g. bats are often found in home attics or in snags in openings where they are exposed to direct sunlight for much of the day). Many HMNF stands have closed canopies with very shaded conditions (and consequently cooler temperatures). Some of the treatments proposed (regeneration harvests, maintaining permanent wildlife openings, and reconstruction of roads and landings) would benefit forest bats by providing an additional food source and exposing more suitable roosting sites.

Habitat improvements in existing upland openings would assist in maintaining the quality of upland open habitat within the Project Area by setting back succession, providing a diversity of foraging habitats, promoting nectar sources from wildflowers and shrubs, and providing other features important to wildlife, such as sunning areas. Prescribed burning in upland openings encourages native vegetation which helps support greater insect and bird abundance and diversity (Burghardt et al. 2009). Upland openings benefit species such as the ruffed grouse (Jones et al. 2008), eastern bluebird (Pinkowski 1991), golden-winged warbler (Rossell et al. 2003), wild turkey (Wunz and Pack 1992), small mammals (Tucker 1992), and various insects such as native bees and butterflies (Collinge et al. 2003). Maintaining upland openings provides habitat for shrubland birds that are not present in mature forest landscapes (Chandler et al. 2003). This alternative assists in meeting Forest Plan direction for managing openings to meet species viability needs (pages II-4, III-2.1-3). An upland waterhole would provide drinking water in an area that has limited amounts and is beneficial for a variety of wildlife species such as bats and amphibians (Biebighauser 2002, Taylor 2006). The Forest Plan goals and objectives include providing for waterhole developments where conditions permit (pages II-26, III-2.1-6).

Invasive plants that replace native vegetation result in a loss of native plant food and habitat sources for wildlife, and result in a loss of species richness and biodiversity. Non-native invasive plants (NNIP) treatments under this alternative would affect approximately 23 acres. Where non-native invasive fruit-bearing shrubs are removed (autumn olive, honeysuckle), alternate native fruit-bearing shrubs, such as hawthorn, dogwood, blackberry, raspberry, and serviceberry, would be replaced. Although autumn olive and honeysuckle serve as a nectar sources for bees and other insects, the native shrubs that would be planted in its place would also provide a nectar source.

Herbicide toxicity and risk data for mammalian, aquatic, avian, and terrestrial wildlife species suggest glyphosate, triclopyr,2,4-D, and imazapic are generally safe if used in accordance with the manufacturer label (Tu et al. 2001, USDA 2003a, USDA 2003b, USDA 2004, USDA 2004a, USDA 2006d). These herbicides would be applied on a limited basis at ground level and would not likely come into direct contact with wildlife. In addition, glyphosate, triclopyr, 2,4-D, and imazapyr are not expected to bioaccumulate in the food chain (USDA 2003a, USDA 2003b, USDA 2004, and USDA 2004a). Because of the small area of treatment, foods eaten by wildlife would not likely come in direct contact with herbicide spray or recently treated foliage, and would not be likely to feed solely on plant parts recently treated with herbicide sprays. Thus, chemical removal of non-native invasive species is not expected to adversely affect suitable foraging habitat for wildlife. In the long term, mechanical and chemical removal of non-native invasive species would likely benefit wildlife by improving biodiversity, suitable foraging habitat, and prey availability within the Project Area.

There are no expected impacts to any wetland, riparian, or aquatic species from this project due to the distance from riparian areas to the vegetation treatment units. This alternative would protect important amphibian and reptile habitats (Dupuis et al. 1995).

This alternative assists with meeting the Forest Plan objectives for maintaining aspen habitat, creating early successional forest habitat, maintaining and creating upland opening habitat, and maintaining viable populations of certain wildlife species as described above. Alternative 2 would have greater benefits to overall wildlife populations and habitat, including the ruffed grouse (an MIS), than Alternative 1.

The Direct and Indirect Effects of Implementing Alternative 3

Alternative 3 would directly affect less wildlife and habitat than Alternative 2 as fewer total acres (1,741 vs. 1,509 acres) would have treatments, but would have similar direct and indirect effects. Alternative 3 would affect fewer total acres with treatments, especially with a reduction of approximately 232 acres of thinning, shelterwood and overstory removal harvests, and opening maintenance. Seasonal restrictions for regeneration harvests within the Project Area would be the same as Alternative 2 and would provide the same protection to wildlife from direct impacts. Mitigation measures would be the same as in Alternative 2. Under this alternative the size of two red pine stands that were documented marten den and rest areas (Stands 83/9 and 83/11) would be cut in half to reduce the direct impacts on marten habitat. The effects of the timber harvest activities would be monitored before and after the treatments occur to document the changes in marten use and dispersal in this area and the effects of the harvest activities on marten habitat. Grand Valley State University and Little River Band of Ottawa Indians would assist with this monitoring effort.

This alternative assists with meeting the Forest Plan objectives for maintaining aspen habitat, creating early successional forest habitat, maintaining upland opening habitat, and maintaining

viable populations of certain wildlife species. Alternative 3 would have greater benefits to overall wildlife populations and habitat than Alternative 1. Alternative 3 would have similar effects to wildlife resources than Alternative 2.

The Direct and Indirect Effects of Implementing Alternative 4

Alternative 4 would directly affect slightly less wildlife and habitat than Alternative 2 and 3 as approximately 1,129 acres would have vegetation treatments. However, less wildlife habitat would be enhanced by the proposed activities. The red pine thinning and aspen clearcut acres would be reduced and the red pine overstory removal and red pine shelterwood treatments would be eliminated. This would impact less potential marten habitat and result in less disturbance to wildlife that may inhabit these stands. The seasonal restrictions for regeneration harvests and the red pine stands with documented marten observations within the Project Area would be the same as Alternative 2 and would provide some protection to this species from direct and indirect impacts.

This alternative would provide the least amount of early successional habitat as compared to Alternative 2 and 3 and would have fewer overall benefits to wildlife populations and habitat. Alternative 4 has the least amount of aspen clearcuts, shelterwood harvests, and overstory removal harvests compared to the other two Action Alternatives. This alternative assists with meeting the Forest Plan objectives for maintaining aspen habitat, creating early successional forest habitat, maintaining and creating upland opening habitat, and maintaining viable populations of certain wildlife species, but to a less extent than Alternative 2 and 3.

The Cumulative Effects of Implementing Alternatives 1, 2, 3, and 4

In general, wildlife populations on the HMNF have recovered since the early 1900s. The exceptions to this statement are the total extinction of the passenger pigeon, the eastern elk, and the continued absence of species such as the fisher and the gray wolf. The wild turkey was successfully reintroduced into Michigan in the mid-1900s and is now considered a game species on the HMNF. The American marten and the trumpeter swan, also extirpated on the HMNF years ago, have been recently reintroduced and are currently present in small numbers.
The overall forest ecosystem on the HMNF is predominately favorable to wildlife species requiring maturing to mature forest types, as is the Project Area (HMNF 2001). Reforestation efforts in the 1930s by the HMNF have influenced the wildlife habitat in the Project Area by providing maturing conifer habitat that was previously logged at the turn of the century. This habitat restoration has been beneficial to wildlife species such as the marten. Without current or future forest management through timber harvests, wildlife habitat improvement, fire protection, or major natural disturbances, the Project Area would provide increasing amounts of mature and over mature forest habitat and improve habitat conditions for later successional species, such as the pileated woodpecker and marten. Early successional habitats and species would decline. Overall reduced forest harvesting in the past 10-15 years has lowered the representation of early-successional stages in some forest types to below-historical levels (The Wildlife Society 2005). Particularly in southern and eastern forests, the shift has reduced the availability and condition of habitats for early-successional wildlife such as woodcock, ruffed grouse, and prairie warblers. In these situations, a well-balanced program of vegetation-management activities is required to maintain the mix of successional stages and vegetation conditions that provides for the full diversity of habitats and species.

Factors such as wildlife management, forest management, fire suppression, ecological succession, agriculture, and development have influenced wildlife populations within the CEA and continue to do so. In general, the overall forest ecosystem within the CEA favors wildlife species preferring maturing forest types. Aspen regeneration, pine thinning, prescribed burning, and upland opening improvements have occurred on NFS lands within the CEA since 1986. These activities have improved wildlife habitats and habitat diversity. Based upon the direction in the Forest Plan, vegetation management would continue to occur within the CEA in the foreseeable future. Future management in the CEA would likely include additional red pine, aspen, hardwood, and upland opening treatments.

The vegetative treatments proposed in Action Alternatives along with future management direction from the Forest Plan would meet or move the Project Area towards Forest Plan objectives (DFC) and provide for stable or improved habitat conditions for most of the wildlife species currently found within the CEA.

There are no major expected changes in land uses on non-federal lands within the CEA. Minor increases in development on private lands are expected in the future. This would slowly increase the amount of residences in the area, slowly decrease the amount of undeveloped wildlife habitat, and increase wildlife populations associated with human development such as starlings and raccoons. Agriculture and old-field habitats are present on private lands. These areas may cause fragmentation effects such as increased predation and parasitism to Neotropical migratory birds in the CEA. They also provide habitat for grassland birds that are not generally found on the HMNF. Wildlife habitats may be changed on non-federal lands through future forest product harvests within the CEA. The amount and types of timber harvests on private lands within the CEA are likely to remain similar to current harvests in the foreseeable future.

White-nose syndrome (WNS) is a new condition recently found in bats in the northeastern United States. Affected bats may have a white fungus on their noses and occasionally other hairless parts of their bodies including arms, wings, and ears. The exact cause of WNS is still being investigated, but has been associated with high mortality rates at some sites. WNS was first identified in 2006 and has since been confirmed in hibernating bats in New York, Vermont, Connecticut, Oklahoma, New Jersey, Pennsylvania, West Virginia, Virginia, and Massachusetts. WNS has been detected in Indiana bats, little brown bats, northern long eared bats, small-footed myotis, and eastern pipistrelles. The Northeast Region of the US Fish and Wildlife Service (USFWS) is maintaining a web site on WNS with some of the most recent scientific information on this syndrome (USDI 2011). The USFWS is working in close cooperation with the States and many university and research laboratories to identify the cause and possible mechanisms in which WNS may be spread. The HMNF would follow the lead of the USFWS and take appropriate action as needed. Bat species that may forage or roost in or near the Project Area that have been affected by WNS in other states include the little brown bat and northern long eared bat.

The vast majority of bats with WNS have been found during the winter in caves where the bats hibernate. No bat hibernacula are known to exist on NFS lands within the HMNF as there are no caves or mines, although there is a known hibernaculum on private lands at Tippy Dam (Wellston, MI) in the overflow structure. Recent surveys of this hibernaculum in 2012 found no evidence of WNS (personal communication with Kurta). To date no confirmed cases of WNS have been found on or near the HMNF or anywhere else in Michigan. At this time, the only recommendations developed by the USFWS and their partners are aimed at preventing the spread of WNS. Efforts focus on human visitation or research in affected hibernacula, human visitation between affected and unaffected caves and mines, and human handling of affected bats (see

above USFWS website for details). Bat swarming surveys at Tippy Dam have been suspended due to the WNS precautions (Kurta 2010).

There would not be cumulative effects from timber harvest and WNS because WNS is not currently known to occur in Michigan. Forest Plan guidelines that reserve suitable roost trees would minimize potential loss of roost habitat for tree-roosting species. Harvest activities that create small openings, as well as reconstruction of roads and landings, would provide additional foraging habitat for all woodland bats. Currently, it is difficult to predict what the potential threats might be to bat populations on the HMNF and impossible to take action to limit the spread of this disease except at hibernacula. The HMNF is in close contact with the USFWS to stay informed about this issue and take appropriate actions as needed regarding WNS.

Vegetation Resources

Resource-Specific Information, Existing Condition, and Area of Analysis

The analysis area for direct and indirect effects on vegetation resources includes NFS lands within the boundaries of Forest Service management units designated as Cadillac-Manistee District compartments 11, 12, 13, 14, 81, 83, 86, 87, and 88, located in Henderson and South Branch Townships of Wexford County. The analysis area for cumulative effects of vegetation composition includes NFS lands, and other public and private lands, within the Manistee National Forest. This large area allows for a comparison to be made on current and future vegetative patterns on similar forest ecosystems, in response to market and non-market forces.

Age Classes, Species, and Structure

The vegetation of the Project Area is dominated by large areas of northern hardwoods, northern red oak, aspen, and plantation red pine; other forest types are infrequent and occur as isolated patches. Most of the conifer and oak stands were established 30 to 100 years ago by natural regeneration (oak) or planting (pine). Non-forested, or upland openings, have declined during this period because of tree planting and tree encroachment (natural succession), in conjunction with fire suppression. Age classes greater than 120 years are rare for two reasons: (1) hardwood forests were all regenerated in the early 1900s, and (2) because the majority of red pines were planted 10 to 70 years ago.

The current age class distribution by forest type is displayed in Table 3-3: *Existing Acres of Forest Type in the Project Area by Age Class*. Vegetation Classes are also summarized and displayed in Table 3-4: *Desired, Existing, & Project Area Vegetative Classes*. The vertical structure of the existing vegetation is predominantly even-aged, with most trees having similar diameters, heights, and ages in any particular stand. Seedlings and saplings are numerous, especially in older red pine plantations, but one canopy layer predominates over shorter or taller canopy layers. The herbaceous layer is dominated by forbs and hardwood tree and shrub species in the understory of forested stands, grass species in the uplands, and leather-leaf and sedge species in wetland areas.

Groups of Similar Vegetation

The Forests' Plan provides objectives for the desired amount of vegetation classes, based on the natural capability of the land for all of the Manistee National Forest. These amounts are displayed in Table 3-4, along with the existing amounts of these classes within the Manistee National Forest and the Project Area. Based on these recommendations, short lived conifers,

Existing Acres of Forest Type in the Project Area by Age Class (NFS lands only)
Table 3-3

Veg Name	No Age	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100-110	110-119	120-129	Total Acres
Jack pine	0	0	0	0	17	0	0	0	0	0	0	0	0	0	**17**
Scotch pine	0	0	14	0	0	0	0	0	0	0	0	0	0	0	**14**
SLC - Vegetation Class	**0**	**0**	**14**	**0**	**17**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**31**
Red pine	0	0	110	24	64	294	246	835	1044	0	0	0	0	0	**2617**
Eastern white pine	0	0	0	0	0	0	3	25	23	0	0	0	0	0	**51**
Eastern white pine-hemlock	0	0	0	0	0	0	0	0	0	0	0	0	12	16	**28**
Hemlock	0	0	0	0	0	0	0	0	0	0	0	0	0	9	**9**
White spruce-balsam fir	0	0	0	0	0	0	7	0	0	0	0	0	0	0	**7**
LLC - Vegetation Class	**0**	**0**	**110**	**24**	**64**	**294**	**256**	**860**	**1067**	**0**	**0**	**0**	**12**	**25**	**2712**
Oak-eastern white pine	0	0	0	0	0	0	0	0	63	0	0	0	0	0	**63**
Oak-aspen	0	0	0	0	0	0	0	0	0	0	96	144	0	0	**240**
White oak	0	0	0	0	0	0	0	0	0	20	0	0	0	0	**20**
Northern red oak	0	0	43	27	27	0	0	0	8	630	484	326	6	0	**1551**
Mixed oaks	0	0	0	4	10	0	0	0	43	47	55	15	67	0	**241**
HSO - Vegetation Class	**0**	**0**	**43**	**31**	**37**	**0**	**0**	**0**	**114**	**697**	**635**	**485**	**73**	**0**	**2115**
Red maple (wet site)	0	0	0	0	0	0	0	0	10	0	114	0	0	0	**124**
Mixed lowland hardwoods	0	0	0	0	0	0	0	0	8	22	16	0	0	0	**46**
LH - Vegetation Class	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**18**	**22**	**130**	**0**	**0**	**0**	**170**
Mixed northern hardwoods	0	0	0	80	0	0	0	0	0	778	160	14	0	0	**1032**
Sugar maple-beech/yellow birch	0	0	67	39	0	0	0	0	23	1072	692	479	24	0	**2396**
Sugar maple-basswood	0	0	0	0	0	0	0	0	0	0	695	126	0	0	**821**
Black cherry-white ash	0	0	18	12	0	0	0	0	0	0	0	0	0	0	**30**
Red maple (dry site)	0	0	0	0	0	0	0	0	0	0	0	27	0	0	**27**
Sugar maple	0	0	10	0	0	0	0	0	0	0	0	83	69	0	**162**
NH - Vegetation Class	**0**	**0**	**95**	**131**	**0**	**0**	**0**	**0**	**23**	**1850**	**1547**	**729**	**93**	**0**	**4468**
Quaking aspen	0	0	60	29	44	9	206	34	0	16	49	0	0	0	**447**
Bigtooth aspen	0	109	304	150	99	135	197	5	37	127	65	84	0	0	**1312**
AB - Vegetation Class	**0**	**109**	**364**	**179**	**143**	**144**	**403**	**39**	**37**	**143**	**114**	**84**	**0**	**0**	**1759**
Lowland shrubs	6	0	0	0	0	0	0	0	0	0	0	0	0	0	**6**
Upland shrubs	37	0	0	0	0	0	0	0	0	0	0	0	0	0	**37**
Open	386	0	4	5	0	0	0	0	0	0	0	0	0	0	**395**
OPENINGS - Vegetation Class	**429**	**0**	**4**	**5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**438**
Total	**429**	**109**	**630**	**370**	**261**	**438**	**659**	**899**	**1259**	**2712**	**2426**	**1298**	**178**	**25**	**11693**

Desired, Existing, & Project Area Vegetative Classes by Percentage
Table 3-4

Vegetation Class	Forests' Plan Desired	Existing Manistee National Forest	Existing Project Area
Short-Lived Conifers	2 - 8	8	1
Long-Lived Conifers	17 - 23	23	23
Lowland Conifers	0 - 5	2	0
Aspen/Birch	10 - 16	13	15
Low-Site Oaks	13 - 19	7	0
High-Site Oaks	15 - 21	22	18
Northern Hardwoods	8 - 14	10	38
Lowland Hardwoods	4 - 10	8	1
Openings	4 - 10	7	4
Barrens and Savannahs	2 - 5	None qualify yet	0

barrens and savannahs, lowland hardwoods, and low-site oaks are under-represented; aspen, long lived conifers, high-site oaks, and openings are adequately represented; northern hardwoods are over -represented. Northern hardwoods are over-represented because of the high productivity of the land; lowland hardwoods and low-site oak vegetation classes are under-represented because either because large areas of low productivity do not exist, or wet soils are infrequent, within the Project Area.

The Direct and Indirect Effects of Alternative 1

Age Classes, Species, and Structure

No action would be taken to commercially thin, regenerate, or non-commercially treat conifer, aspen, and oak stands. Individual tree growth and survival, and stand succession, would be subject to environmental and biological factors. The longer-lived species, red oak, northern hardwoods, and red and white pine, would tend to persist as recognizable stands and individual trees. Forest succession would alter the stand structure from even-age canopies to uneven-age canopies, with aspen and oak areas having the greatest amount of change. The population of northern hardwoods trees in all sizes would remain relatively stable, but increase in population and becoming larger where pines, aspen, and oak continue to mature or die out. Forest succession to northern hardwoods would be influenced by the emerald ash borer and beech bark disease, which would reduce the population of all ash species (spp.), and reduce or deform beech trees of all sizes. Openings would decrease in abundance primarily due to encroachment by

hardwoods, and by the infrequent occurrences of fire and windstorms that promote early successional habitat. Overall, northern hardwood and red pine plantations would become the oldest forest types, and red oak stands would decline in abundance and occupy age classes over 100 years. The dominant herbaceous species in openings (Rubus spp. and mesic forbs) would persist, with little opportunity for new desirable species to become established or regenerated. NNIP would persist adjacent to roads and in open areas and become established where natural and human disturbances provide new habitat opportunities.

Groups of Similar Vegetation

Long rotation conifers, aspen, openings, and high-site oaks would decline, and northern hardwoods would increase and naturally succeed these groups. The other vegetative groups would remain at current levels, limited by the physical capability of the land to grow and sustain these groups.

The Cumulative Effects of Alternative 1

The principle effect of taking no action would be to change the structure of individual and aggregate forested stands from even-aged to uneven-aged canopies. This would occur as the number of long-lived species such as sugar maple and beech increase, and the number of aspen, red oak, and red pine decrease. The remaining upland, non-forested areas would be invaded with pines and hardwoods, and gradually attain forest qualities as these species mature and continue to regenerate in open areas. Infrequent native insect, fire, and wind-induced mortality events would interact with natural succession, and result in succession at a local scale (i.e. one to several acres, and less frequently, at scales larger than 10 acres). The long-term effects of emerald ash borer and beech bark disease would reduce ash spp. and cause mortality and deform beech trees. The dominant herbaceous species would persist; existing NNIP would colonize a larger percentage of the Project Area utility and road rights-of-way. New introductions of NNIP would likely become established, especially adjacent to roads and open areas on both public and private lands.

District records show that between 1972 and 2012, the vegetation activities on NFS lands within the Project Area have been:

- tree planting 468 acres;
- insect and disease control on 1,494 acres;
- non-native invasive species control on 36 acres;
- non-commercial treatments to improve young tree growth 676 acres;
- hardwood and pine thinning 3,808 acres;
- mature forest regeneration and dead tree salvage harvesting 1,454 acres;
- upland opening wildlife habitat improvements, maintenance and creation 1,823 acres; and,
- fish habitat improvements on 49 acres.

The expected level of vegetation treatments on NFS lands in future decades would most likely increase over historic treatment amounts of red pine thinnings, tree planting, mature forest regeneration, and dead tree salvage as the emphasis on timber production treatments increase. Only a few acres of private lands in the Project Area receive similar vegetation harvest treatment; the most common activity would be mature forest and dead tree salvage harvesting. New residential and commercial structure building would reduce the amount of total forest cover.

The release of emerald ash borer parasitoids planned for 2013+ would establish populations of three non-native species that prey on this insect, and help to restore and maintain a population of ash species. The spread of beech bark disease would continue, with increasing mortality to mature trees, and the deformation of younger stems. The salvage of 15 acres of dead and declining red oaks (from oak decline) in Henderson Township would be completed in 2013; additional salvage harvests are likely in this area, hastening conversion of red oak to northern hardwoods. In addition, one mechanical treatment to control the below ground spread of oak wilt was initiated in 2012.

Conclusion

The duration and magnitude of taking no action would incrementally add to past, present and reasonably foreseeable vegetation patterns within the Manistee National Forest, primarily by allowing the existing vegetation to mature or be replaced by late-seral stages of forest vegetation. This effect would be most pronounced on NFS lands. Private forest lands would be expected to be further subdivided for housing development. This fragmentation would reduce the likelihood of private forest management in the Project Area. Native and non-native diseases and insects would increase the natural rates of tree mortality, especially in oaks, ashes, and beech. NNIP and their negative impacts on native vegetation would become more widespread and pronounced.

The Direct and Indirect Effects of Implementing Alternative 2

Under Alternative 2, vegetative treatments would occur, as displayed in Table 2-1. Many red pine stands, with an average tree diameter greater than 6 inches and stocking levels exceeding 95%, would be thinned using commercial harvests. Numerous red pine, aspen, and oak dominated areas would be commercially harvested to promote the regeneration of hardwoods, aspen, and oaks, and decrease the abundance of red pine. Hand tool site preparation and white pine or red oak planting would occur in some areas to sustain productivity of regenerated forestland. Existing upland, non-forest areas would be maintained using non-commercial methods, and one young red pine plantation would be converted to an upland opening using mechanical and hand tools.

Prescribed burning would occur in a few upland vegetation areas, either separately or in combination with mechanical or hand tool treatments. The effect of this burning would be to reduce the overall amount of small tree stems, by directly killing seedlings and saplings, and increase rubus spp. and other forbs and grasses. The effects of fire on hardwood regeneration, primarily oaks and hardwoods, would result in the top-killing of seedlings and saplings. However, hardwood regeneration, and especially oak seedlings and saplings, are able to survive and thrive following burning, by sprouting and suckering from roots that are able to survive low-intensity burns.

All forested stands proposed for regeneration harvest (clearcut, overstory removal, and shelterwood establishment), except those listed in Table 3-5: *Exception to Rotation Length Guidelines*, have reached or exceeded the rotation age guidelines of the Forest Plan (II-17). Clearcutting has been determined to be the optimum method for regeneration of aspen in the Forest Plan (B-10).

Some NFS lands, currently identified as suitable for timber management, would be identified for ginseng conservation, or identified as areas suitable for an upland opening in order to achieve other Forest Plan goals, or identified as non-forest land that would become forest land. The

Exception to Rotation Length Guidelines
Table 3-5

Compartment	Stand	Acres	Current Age	Exception
14	26	6	65	Promote age class and forest type diversity
81	3	34	63	Promote age class and forest type diversity
83	9	25	48	Promote age class and forest type diversity
83	11	36	59	Promote age class and forest type diversity
86	7	21	27	Promote forest type diversity
87	5	7	63	Promote age class and forest type diversity

accompanying changes in land suitability class (LSC) are displayed in Table 3-6: *Changes in Land Suitability Class*. Stands in LSC 500 are forested lands suitable for timber management; stands in LSC 600 are forested lands that are suitable for timber production, but are proposed for other emphasis that precludes regulated timber production in order to achieve other multiple-use objectives (in this case, RFSS conservation); stands in LSC 200 are developed for non-forest uses, including improved openings (Forest Plan D-1).

Changes in Land Suitability Class
Table 3-6

Compartment	Stand	Resource Concern	Acres	Current LSC	New LSC
11	18	Tree cover exceeds 20%	9	200	500
11	19	Tree cover exceeds 20%	7	200	500
13	9	Core ginseng habitat	27	500	600
83	26	Tree cover exceeds 20%	6	200	500
83	33	Core ginseng habitat	16	200	600
88	19	Core ginseng habitat	38	500	600
86	7	Wildlife habitat creation	21	500	200

Desired, Existing, & Projected Project Area Vegetative Classes by Percentage
Table 3-7

Vegetation Class	Forests' Plan Desired	Existing Manistee National Forest	2023 Project Area
Short-Lived Conifers	2 - 8	8	1
Long-Lived Conifers	17 - 23	23	22
Lowland Conifers	0 - 5	2	0
Aspen/Birch	10 - 16	13	17
Low-Site Oaks	13 - 19	7	0
High-Site Oaks	15 - 21	22	16
Northern Hardwoods	8 - 14	10	39
Lowland Hardwoods	4 - 10	8	1
Openings	4 - 10	7	4
Barrens and Savannahs	2 - 5	None qualify yet	0

Age Classes, Species, and Structure

Vegetation classes are summarized and displayed in Table 3-7: *Desired, Existing, & Projected Project Area Vegetative Classes*. The projected 2023 age class distribution by forest type is displayed in Table 3-8: *Projected 2023 Acres of Forest Type in the Project Area by Age Class*.

Reducing the number of trees per acre would improve residual tree vigor and growth rates, modify structural diversity, and promote understory diversity by opening up the canopy and reducing competition for water, nutrients, and sunlight. Commercial harvests would reduce the number of trees per acre based on the objectives of maintaining adequate growing conditions (thinning), creating adequate regeneration conditions (shelterwood or overstory removal), or establishing non-forest conditions (clearcut).

Thinning red pine plantations to 80% of full stocking would satisfy individual tree growing needs for 15-20 years, and perpetuate the dominance of red pine in an even-age structure. These stands would continue to age and retain an even-age canopy structure. Retained mature oak and maple individuals would provide some species and structural diversity.

Regenerating pine and oak areas would remove approximately 50% of the smaller and less desirable tree species (shelterwood), and retain sufficient seed bearing and shade providing mature trees to establish and promote the growth of new and/or existing desired tree species. Some pine and oak areas already have sufficient quantities of desired seedlings; in these cases,

Projected 2023 Acres of Forest Type in the Project Area by Age Class (NFS lands only)
Table 3-8

Veg Name	No Age	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100-110	110-119	120-129	Total Acres
Jack pine	0	0	0	0	0	17	0	0	0	0	0	0	0	0	**17**
Scotch pine	0	0	0	14	0	0	0	0	0	0	0	0	0	0	**14**
SLC - Vegetation Class	**0**	**0**	**0**	**14**	**0**	**17**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**31**
Red pine	0	0	0	110	3	64	294	221	786	979	0	0	0	0	**2457**
Eastern white pine	0	0	0	0	0	0	0	3	25	23	0	0	0	0	**51**
Eastern white pine-hemlock	0	0	0	0	0	0	0	0	0	0	0	0	0	28	**28**
Hemlock	0	0	0	0	0	0	0	0	0	0	0	0	0	9	**9**
White spruce-balsam fir	0	0	0	0	0	0	0	7	0	0	0	0	0	0	**7**
LLC - Vegetation Class	**0**	**0**	**0**	**110**	**3**	**64**	**294**	**231**	**811**	**1002**	**0**	**0**	**0**	**37**	**2552**
Oak-eastern white pine	0	0	0	0	0	0	0	0	0	63	0	0	0	0	**63**
Oak-aspen	0	0	0	0	0	0	0	0	0	0	0	67	80	0	**147**
White oak	0	0	0	0	0	0	0	0	0	0	20	0	0	0	**20**
Northern red oak	0	0	0	43	27	27	0	0	0	8	630	484	239	6	**1464**
Mixed oaks	0	0	0	0	4	10	0	0	0	43	47	55	15	67	**241**
HSO - Vegetation Class	**0**	**0**	**0**	**43**	**31**	**37**	**0**	**0**	**0**	**114**	**697**	**606**	**334**	**73**	**1935**
Red maple (wet site)	0	0	0	0	0	0	0	0	0	10	0	114	0	0	**124**
Mixed lowland hardwoods	0	0	0	0	0	0	0	0	0	8	22	16	0	0	**46**
LH - Vegetation Class	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**18**	**22**	**130**	**0**	**0**	**170**
Mixed northern hardwoods	0	139	0	0	80	0	0	0	0	0	778	160	14	0	**1171**
Sugar maple-beech/yellow birch	0	0	0	67	39	0	0	0	0	23	1072	692	479	24	**2396**
Sugar maple-basswood	0	0	0	0	0	0	0	0	0	0	0	695	126	0	**821**
Black cherry-white ash	0	0	0	18	12	0	0	0	0	0	0	0	0	0	**30**
Red maple (dry site)	0	0	0	0	0	0	0	0	0	0	0	0	27	0	**27**
Sugar maple	0	0	0	10	0	0	0	0	0	0	0	0	83	69	**162**
NH - Vegetation Class	**0**	**139**	**0**	**95**	**131**	**0**	**0**	**0**	**0**	**23**	**1850**	**1547**	**729**	**93**	**4607**
Quaking aspen	0	0	0	60	29	44	9	206	34	0	16	49	0	0	**447**
Bigtooth aspen	0	243	109	304	150	99	135	165	0	37	127	39	84	0	**1492**
AB - Vegetation Class	**0**	**243**	**109**	**364**	**179**	**143**	**144**	**371**	**34**	**37**	**143**	**88**	**84**	**0**	**1939**
Lowland shrubs	6	0	0	0	0	0	0	0	0	0	0	0	0	0	**6**
Upland shrubs	58	0	0	0	0	0	0	0	0	0	0	0	0	0	**58**
Open	386	0	4	5	0	0	0	0	0	0	0	0	0	0	**395**
OPENINGS - Vegetation Class	**450**	**0**	**4**	**5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**459**
Total	**450**	**284**	**113**	**631**	**344**	**261**	**438**	**602**	**856**	**1194**	**2712**	**2371**	**1234**	**203**	**11693**

approximately 90% of trees greater than 5 inches in diameter would be cut to promote optimum growing conditions (overstory removal). Trees between 1 and 5 inches in diameter would be non-commercially treated to promote natural regeneration, and supplemental white pine or red oak seedling planting would be used where adequate natural seedling densities are not obtained within the first decade, in the overstory removal and shelterwood treatments. Tree diversity among overstory red pine and oak species would be maintained, but even-age structure would result when these pine and oak areas are regenerated using these treatments. Shelterwood treatment areas would develop two canopy layers within 10-20 years as the seedlings and sprouts develop. These areas would advance into the next 10-year age class. Removal treatment areas would develop one canopy layer within 10-20 years as the seedlings and sprouts develop. These areas would advance into the 0-9-year age class. Dominant tree species in both these treatment types would be oaks and other hardwoods. Juneberry, forbs, and oak and hardwood seedlings and saplings would dominate the lowest canopy layers.

A clearcut, removing 95% of all trees greater than 5 inches in diameter, would be used to regenerate aspen. This treatment would retain the existing overstory species composition, and promote numerous herbaceous species. The dominant canopy layer would have an even-age condition, dominated by aspen suckers and individuals/groups of mature non-aspen trees to retain some diversity. Trees between 1 and 5 inches in diameter would be non-commercially treated to promote natural regeneration and supplemental seedling planting would be used where adequate natural seedling densities are not obtained within the first decade. These areas would enter the 0-9-year age class immediately after the clearcut treatment.

Prescribed fire would be used separately, or in conjunction with non-commercial treatments, to generate or maintain herbaceous and low woody vegetation species diversity and structure. Prescribed fire would alter species diversity, promoting herbaceous and woody vegetation favored by fire disturbance, and reduce target species (i.e., pine and maples) depending on the intensity and frequency of the fire. Supplemental seeding of herbaceous species would be used to re-introduce or increase herbaceous and shrub desired species.

The Cumulative Effects of Implementing Alternative 2

The expected level of vegetation treatments on NFS lands in future decades would most likely increase over historic treatment amounts of red pine thinnings, tree planting, mature forest regeneration, and dead tree salvage as the emphasis on timber production treatments increase. The release of emerald ash borer parasitoids planned for 2013+ would establish populations of three non-native species that prey on this insect, and help to restore and maintain a population of ash species. The spread of beech bark disease would continue, with increasing mortality to mature trees, and the deformation of younger stems. The salvage of 15 acres of dead and declining red oaks in Henderson Township would be completed in 2013; additional salvage harvests are likely in this area, hastening conversion of red oak to northern hardwoods. Only a few acres of private lands in the Project Area receive similar vegetation harvest treatment; the most common activity would be mature forest and dead tree salvage harvesting. New residential and commercial structure building would reduce the amount of total forest cover.

The principle effect of Alternative 2 would be to retain the even age structure of individual and aggregate forest areas where commercial harvests occur. Where no treatments occur, infrequent insect, wildfire, and wind induced mortality events would interact with natural succession, and result in succession at a local scale (i.e. one to several acres, and less frequently at scales larger

than 10 acres) and thereby slowly develop uneven-age canopy structures. Within the Project Area, species such as red pine, decrease, and northern hardwood and red oak increase.

The occasional use of fire as a disturbance element in upland openings would reduce woody encroachment, regenerate desired shrubs, and change herbaceous growing conditions to favor desired species. The use of fire in openings would be used to reduce pine and maple encroachment, and eventually result in the establishment of a diverse, native, herbaceous flora. These herbaceous species would become established through seed bank stimulation and/or direct seeding, and become self-sustaining. Existing NNIP would not measurably increase within the Project Area, and would be confined to utility and road rights-of-way. New introductions of NNIP would have less opportunity to become established on open lands frequently disturbed by prescribed fire; however, new introductions are likely adjacent to roads and open areas on both public and private lands.

Conclusion

The duration and magnitude of Alternative 2 would incrementally add to past, present and reasonably foreseeable vegetation patterns within the Manistee National Forest, primarily by allowing approximately 15% of the existing vegetation to be replaced by early-seral stages of forest vegetation; the balance of the existing vegetation would continue to mature. This effect would be most pronounced on NFS lands. Private forest lands would be expected to be further subdivided for housing development. This fragmentation would reduce the likelihood of private forest management within the Project Area. Native and non-native diseases and insects would increase the natural rates of tree mortality, especially in mature oaks, ashes, and beech. NNIP and their negative impacts on native vegetation would become more widespread and pronounced.

The Direct and Indirect Effects of Implementing Alternative 3

Under Alternative 3, vegetative treatments would occur, as displayed in Table 2-1. Many red pine stands, with an average tree diameter greater than 6 inches and stocking levels exceeding 95%, would be thinned using commercial harvests. Numerous red pine, aspen, and oak dominated areas would be commercially harvested to promote the regeneration of hardwoods, aspen, and oaks, and decrease the abundance of red pine. Hand tool site preparation and white pine or red oak planting would occur in some areas to sustain productivity of regenerated forestland. Existing upland, non-forest areas would be maintained using non-commercial methods.

Prescribed burning would occur in a few upland vegetation areas, either separately or in combination with mechanical or hand tool treatments. The effect of this burning would be to reduce the overall amount of small tree stems, by directly killing seedlings and saplings, and increase rubus spp. and other forbs and grasses. The effects of fire on hardwood regeneration, primarily oaks and hardwoods, would result in the top-killing of seedlings and saplings. However, hardwood regeneration, and especially oak seedlings and saplings, are able to survive and thrive following burning, by sprouting and suckering from roots that are able survive low-intensity burns.

All forested stands proposed for regeneration harvest (clearcut, overstory removal, and shelterwood establishment), except those listed in Table 3-9: *Exception to Rotation Length Guidelines*, have reached or exceeded the rotation age guidelines of the Forest Plan (II-17).

Clearcutting has been determined to be the optimum method for regeneration of aspen in the Forest Plan (B-10).

Exception to Rotation Length Guidelines
Table 3-9

Compartment	Stand	Acres	Current Age	Exception
14	26	6	65	Promote age class and forest type diversity
81	3	34	63	Promote age class and forest type diversity
83	9	25	48	Promote age class and forest type diversity
83	11	36	59	Promote age class and forest type diversity
86	7	21	27	Promote forest type diversity
87	5	7	63	Promote age class and forest type diversity

Age Classes, Species, and Structure

The projected 2023 age class distribution by forest type, displayed in Table 3-8: *Projected 2023 Acres of Forest Type in the Project Area by Age Class* would change: there would be 11 fewer acres of mixed northern hardwoods in the 0-9-year age class, as two overstory removal harvests would be smaller in size. In addition, there would be fewer acres of red pine shelterwood establishment harvests, but these changes would not affect the age class table prior to 2023. Vegetation classes are also summarized and displayed in Table 3-7: *Desired, Existing, & Projected Project Area Vegetative Classes*. The net effect of fewer overstory removal and shelterwood establishment harvest acres would not appreciably affect Projected Vegetation Classes in this table. The amounts of aspen regeneration harvest and opening creation are the same as proposed in Alternative 2; 76 fewer acres of red pine thinnings, and 6 fewer acres of upland opening maintenance are proposed than in Alternative 2. Therefore, Tables 3-7 and 3-8 are not updated to reflect these changes in age class and vegetation class diversity.

The other direct and indirect effects on vegetation in Alternative 3 are the same as discussed in Alternative 2.

The Cumulative Effects of Implementing Alternative 3

The cumulative effects discussed in Alternative 2 are essentially the same as the cumulative effects of Alternative 3, except that the magnitude and scale of commercial harvests is slightly smaller by affecting approximately 226 fewer acres.

Conclusion

The duration and magnitude of Alternative 3 would incrementally add to past, present and reasonably foreseeable vegetation patterns within the Manistee National Forest, primarily by

allowing approximately 13% of the existing vegetation to be replaced by early-seral stages of forest vegetation; the balance of the existing vegetation would continue to mature. This effect would be most pronounced on NFS lands. Private forest lands would be expected to be further subdivided for housing development. This fragmentation would reduce the likelihood of private forest management within the Project Area. Native and non-native diseases and insects would increase the natural rates of tree mortality, especially in mature oaks, ashes, and beech. NNIP and their negative impacts on native vegetation would become more widespread and pronounced.

The Direct and Indirect Effects of Implementing Alternative 4

Under Alternative 4, vegetative treatments would occur, as displayed in Table 2-1. Many red pine stands, with an average tree diameter greater than 6 inches and stocking levels exceeding 95%, would be thinned using commercial harvests. Numerous aspen dominated areas would be commercially harvested to promote the regeneration of aspen. Hand tool site preparation and white pine or red oak planting would occur in some areas to sustain productivity of regenerated forestland. Existing upland, non-forest areas would be maintained using non-commercial methods.

Prescribed burning would occur in a few upland vegetation areas, either separately or in combination with mechanical or hand tool treatments. The effect of this burning would be to reduce the overall amount of small tree stems, by directly killing seedlings and saplings, and increase Rubus spp. and other forbs and grasses. The effects of fire on hardwood regeneration, primarily oaks and hardwoods, would result in the top-killing of seedlings and saplings. However, hardwood regeneration, and especially oak seedlings and saplings, are able to survive and thrive following burning, by sprouting and suckering from roots that are able survive low-intensity burns.

Exception to Rotation Length Guidelines
Table 3-10

Compartment	Stand	Acres	Current Age	Exception
14	26	6	65	Promote age class and forest type diversity
81	3	34	63	Promote age class and forest type diversity
83	9	25	48	Promote age class and forest type diversity
83	11	36	59	Promote age class and forest type diversity
86	7	21	27	Promote forest type diversity
87	5	7	63	Promote age class and forest type diversity

All forested stands proposed for regeneration harvest (clearcut, overstory removal, and shelterwood establishment), except those listed in Table 3-10: *Exception to Rotation Length Guidelines*, have reached or exceeded the rotation age guidelines of the Forest Plan (II-17).

Clearcutting has been determined to be the optimum method for regeneration of aspen in the Forest Plan (B-10).

Age Classes, Species, and Structure

The projected 2023 age class distribution by forest type, displayed in Table 3-12: *Projected 2023 Acres of Forest Type in the Project Area by Age Class* would closely resemble the age class distribution under Alternative 1: the hardwood shelterwood establishment harvest would not affect the age class table prior to 2023. Vegetation classes are also summarized and displayed in Table 3-11: *Desired, Existing, & Projected Project Area Vegetative Classes*. The amounts of aspen regeneration harvest and opening maintenance and creation are the same as proposed in Alternative 2; 76 fewer acres of red pine thinnings are proposed than in Alternative 2.

The other direct and indirect effects on vegetation in Alternative 4 are the same as discussed in Alternative 2.

The Cumulative Effects of Implementing Alternative 4

The cumulative effects of Alternative 4 are smaller in magnitude and scale (essentially limited to commercial thinning harvests), as compared to Alternatives 2 and 3. The principle effect of less regeneration harvesting in conifers and hardwood forests is that developed hardwood understories

Desired, Existing, & Projected Project Area Vegetative Classes by Percentage
Table 3-11

Vegetation Class	Forests' Plan Desired	Existing Manistee National Forest	2023 Project Area
Short-Lived Conifers	2 - 8	8	1
Long-Lived Conifers	17 - 23	23	23
Lowland Conifers	0 - 5	2	0
Aspen/Birch	10 - 16	13	17
Low-Site Oaks	13 - 19	7	0
High-Site Oaks	15 - 21	22	16
Northern Hardwoods	8 - 14	10	38
Lowland Hardwoods	4 - 10	8	1
Openings	4 - 10	7	4
Barrens and Savannahs	2 - 5	None qualify yet	0

Projected 2023 Acres of Forest Type in the Project Area by Age Class (NFS lands only)
Table 3-12

Veg Name	No Age	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100-110	110-119	120-129	Total Acres
Jack pine	0	0	0	0	0	17	0	0	0	0	0	0	0	0	**17**
Scotch pine	0	0	0	14	0	0	0	0	0	0	0	0	0	0	**14**
SLC - Vegetation Class	0	0	0	14	0	17	0	0	0	0	0	0	0	0	**31**
Red pine	0	0	0	110	3	64	294	246	835	1044	0	0	0	0	**2596**
Eastern white pine	0	0	0	0	0	0	0	3	25	23	0	0	0	0	**51**
Eastern white pine-hemlock	0	0	0	0	0	0	0	0	0	0	0	0	0	28	**28**
Hemlock	0	0	0	0	0	0	0	0	0	0	0	0	0	9	**9**
White spruce-balsam fir	0	0	0	0	0	0	7	0	0	0	0	0	0	0	**7**
LLC - Vegetation Class	0	0	0	110	3	64	301	249	860	1067	0	0	0	37	**2691**
Oak-eastern white pine	0	0	0	0	0	0	0	0	0	63	0	0	0	0	**63**
Oak-aspen	0	0	0	0	0	0	0	0	0	0	0	67	80	0	**147**
White oak	0	0	0	0	0	0	0	0	0	0	20	0	0	0	**20**
Northern red oak	0	0	0	43	27	27	0	0	0	8	630	484	239	6	**1464**
Mixed oaks	0	0	0	0	4	10	0	0	0	43	47	55	15	67	**241**
HSO - Vegetation Class	0	0	0	43	31	37	0	0	0	114	697	606	334	73	**1935**
Red maple (wet site)	0	0	0	0	0	0	0	0	0	10	0	114	0	0	**124**
Mixed lowland hardwoods	0	0	0	0	0	0	0	0	0	8	22	16	0	0	**46**
LH - Vegetation Class	0	0	0	0	0	0	0	0	0	18	22	130	0	0	**170**
Mixed northern hardwoods	0	0	0	0	80	0	0	0	0	0	778	160	14	0	**1032**
Sugar maple-beech/yellow birch	0	0	0	67	39	0	0	0	0	23	1072	692	479	24	**2396**
Sugar maple-basswood	0	0	0	0	0	0	0	0	0	0	0	695	126	0	**821**
Black cherry-white ash	0	0	0	18	12	0	0	0	0	0	0	0	0	0	**30**
Red maple (dry site)	0	0	0	0	0	0	0	0	0	0	0	0	27	0	**27**
Sugar maple	0	0	0	10	0	0	0	0	0	0	0	0	83	69	**162**
NH - Vegetation Class	0	0	0	95	131	0	0	0	0	23	1850	1547	729	93	**4468**
Quaking aspen	0	0	0	60	29	44	9	206	34	0	16	49	0	0	**447**
Bigtooth aspen	0	275	109	304	150	99	135	123	0	37	127	49	84	0	**1492**
AB - Vegetation Class	0	275	109	364	179	143	144	329	34	37	143	98	84	0	**1939**
Lowland shrubs	6	0	0	0	0	0	0	0	0	0	0	0	0	0	**6**
Upland shrubs	58	0	0	0	0	0	0	0	0	0	0	0	0	0	**58**
Open	386	0	4	5	0	0	0	0	0	0	0	0	0	0	**395**
OPENINGS - Vegetation Class	450	0	4	5	0	0	0	0	0	0	0	0	0	0	**459**
Total	**450**	**188**	**113**	**631**	**344**	**261**	**445**	**578**	**894**	**1259**	**2712**	**2381**	**1234**	**203**	**11693**

would continue to grow beneath the mature red pines and other hardwoods, and thereby slowly develop uneven-age canopy structures, dominated by and maples and beech.

The other cumulative effects on vegetation of Alternative 4 are the same as discussed in Alternative 2.

Conclusion

The duration and magnitude of Alternative 4 would incrementally add to past, present and reasonably foreseeable vegetation patterns within the Manistee National Forest, primarily by allowing approximately 2% of the existing vegetation to be replaced by early-seral stages of forest vegetation; the balance of the existing vegetation would continue to mature. This effect would be most pronounced on NFS lands. Private forest lands would be expected to be further subdivided for housing development. This fragmentation would reduce the likelihood of private forest management within the Project Area. Native and non-native diseases and insects would increase the natural rates of tree mortality, especially in mature oaks, ashes, and beech. NNIP and their negative impacts on native vegetation would become more widespread and pronounced.

Soil Productivity

Resource-Specific Information & Existing Condition

Soil Productivity

The Forests' Ecological Classification system describes its landscapes at various inventory scale units, from the largest, Landtype Association/Group (LTA, thousands of acres) to the smallest, Ecological Landtype Phases (ELTP, one to perhaps a few hundred acres). LTAs correspond with how large scale topographical features (hills, plains, lowlands) were generated by the retreating glaciers. ELTPs descriptions include more specific information on local soil and vegetation properties, (including site index) and reflect potential late succession forest vegetation cover types. LTA and ELTP descriptions for the Project Area and the Forest are summarized in Cleland et al. (1993). The geomorphology of the Project Area is comprised principally of sandy morainal hills, LTA 3, with LTAs 1, 4, 5, 6 and 7 also represented.

The effects on the soil productivity from past management activities vary by location and activity. Generally, the topography, proximity to open water, depth to the water table, and the ownership objectives throughout the area has dictated the types and locations of historic management. In this area, soils that are located on well-drained sites have been repeatedly impacted by timber management or other agricultural practices. Soils in the lowland areas or adjacent to water were not extensively developed for agriculture and are not intensively managed for timber products. In upland locations on NFS lands, hardwood forests and pine plantations are inter-mixed with private lands; harvesting of these forestlands has occurred intermittently since the 1950s. Some plantations have been thinned before, while others have not. As a result, the landscape consists of areas that have received moderate to heavy impacts, and other areas which have received little to no impacts to soil productivity.

The soils of the Project Area are derived from coarse sands and gravels; the depth to the water table ranges from >15 feet to the surface, depending on subsoil and surface soil textures and arrangements. Soil productivity is largely determined by parent material, climate, and the amount of soil organic matter; of the three, only organic matter can be managed in forest soils. The overall amount of soil organic matter is important because this is the primary source of plant

nutrients (Pritchett and Fisher 1987). Soil reaction is in the top 60 inches of the dominant soil series, representing ELTPs 30-47, ranges between 3.5-6.5 pH (Soil Conservation Service 2008). Soil productivity can be expressed as the average annual increment of wood produced for each combination of ELTP and Dominant Vegetation Group (USDA-Forest Service Compartment Prescription Handbook FSH 2409.21d). Table 3-13 summarizes the important landscape characteristics in the Project Area.

Major Landtype Associations and Related Features in the Project Area

Table 3-13

LTA Number	Landtype Association	Soil Features	Dominant Vegetation Group(s)	Representative ELTPs	% of Project Area
1	Outwash Plains	Poorly-developed, excessively well to restricted drained sand.	Short and long rotation conifers and oaks, non-forested.	20-23: Mixed oaks-red maple/starflower on excessively well drained sands of outwash plains; sandy clay loam bands 3-6” thick.	2
3	Sandy Morainal Hills	Moderately developed, well to well-drained sand to sandy loam.	Long rotation conifers and hardwoods, non-forested.	40-44: Sugar maple-beech/maianthemum on well drained sands; sandy clay loam bands and water tables 3.5’-15’ may occur. 30-35: Mixed oaks-red maple/viburnum on well drained sand; sandy clay loam bands and water tables 3.5’-15’ may occur.	85
4	Wet Sand Plains	Moderately developed, poorly-drained sand to sandy loam.	Long rotation hardwoods and conifers, non-forested.	72: Red oak-red maple/leatherleaf and vaccinium on poorly drained acid sands, organic horizon <8” thick.	2
6	Clay Hills and Plains	Moderately developed, moderately to well-drained sandy loam to clay loam.	Long rotation hardwoods and conifers, non-forested.	45-47: Sugar maple-white ash/osmorhiza on well to moderately well drained sands with sandy clay loam bands >6” thick.	11

For this project, the characteristics of the various soils and their capacity to sustain productivity following the various proposed activities were evaluated. The potential impacts from equipment use (e.g., compaction, rutting, erosion, and transportation system) are evaluated, as well as the potential impacts from prescribed fire and herbicide use on soil productivity. Areas sensitive to mechanical disturbance were dropped from treatment considerations or conservation measures were established for protection.

The Direct and Indirect Effects of Implementing Alternative 1

The analysis area for the direct and indirect effects of the treatments on soil productivity is confined to the individual areas where ground disturbing treatments using mechanical equipment and prescribed fire activities are proposed.

Soil Organic Matter, Compaction, Rutting and Displacement, Erosion, Transportation System, Prescribed Fire, and Herbicide Use

There would be no changes to soil resources caused by mechanical treatments under Alternative 1. Total biomass levels would continue to increase without harvesting. Soil productivity levels would remain similar, or increase, as organic matter accumulated within the upper soil profile. This would occur as the forested stands mature, and no events occur that export or reduce litter and biomass. Taking no action would result in the highest above and below ground biomass levels (Pritchett and Fisher 1987).

This alternative would cause no additional forested areas to be affected by soil compaction and erosion. Soil compaction would continue to recover from past management activities as surface and below ground biomass is accumulated, natural wetting-drying-freezing events occur, and soil micro-fauna activity reduce the bulk density of affected areas (Greacen and Sands 1980). Compacted soils lose productivity because of diminished water-holding capacity and organic matter reductions; the amount of productivity loss depends on the soil texture, as well as the depth and persistence of the compaction. Recovery from compaction could take from 8 to 12 years following commercial harvests that used tree-length skidding, and up to 40 years on roads intermittently used to remove timber products (Greacen and Sands 1980). Soil erosion would continue at locations, such as roads and recreation trails, where the slope exceeds 2% and ground vegetation is sparse or non-existent (Pritchett and Fisher 1987).

However, if a large, high-intensity wildfire were to occur, the effects on the soils could become extensive. There would be an increased potential for soil erosion (from equipment use and lack of ground cover), loss of nutrients (volatilization of leafy and small woody vegetation), changes to above and below ground carbon stocks, and local soil sterilization from extreme temperatures (Hurteau and Brooks 2011).

There would be no direct or indirect impacts on soil productivity from prescribed fire and herbicide use.

The Cumulative Effects of Implementing Alternative 1

The analysis area for cumulative effects on soil productivity includes NFS lands where proposed activities would occur and vehicle use on Forest and County roads.

The soil resources in the Project Area were impacted in the late 1800s and early 1900s through logging practices, the conversion of portions of this area to agriculture and rangelands, periodic fire events, and local wind erosion. Reforestation efforts, including tree planting furrows and mechanical harvesting operations, also impacted the soils from 1935 to 2004. Since the early 1930s, soil productivity has generally been stabilized or improved; in general, soil organic matter has been increasing as permanent vegetative cover was established. Based on the site-specific soil characteristics, the nutrients supplied by decaying organic matter is either available to the vegetation or are leached to deeper soil layers. The overall effects of forest vegetation growth

and atmospheric inputs that have occurred have generally increased levels of nutrients available for plant use and storage as compared to the 1930s, but reduced soil productivity has diminished on degraded areas, e.g. gravel pits and some upland non-forest areas, compared to native soil.

Alternative 1 would incrementally increase soil productivity on NFS lands within the Project Area. Dead and down timber, especially near roads and on private lands, would be removed for use, principally as firewood. As individual groups of trees, shrubs, and herbaceous species complete their life cycles, general levels of biomass and soil organic matter accumulation would exceed removals and slightly benefit soil productivity.

Currently, there are areas of eroding and compacted soils occur on public and private road locations, motor-use recreation trails, and on areas where past and future timber harvest areas (especially skid trails and landings) have received concentrated equipment use. Soil compaction, rutting, puddling, and erosion would continue to occur on areas subject to motor vehicle use. The areas affected by past harvesting and other mechanical equipment use, landings, and skid trails would continue to slowly recover through natural processes if critical physical thresholds were not exceeded in the past, and if vegetative cover were maintained (Greacen and Sands 1980); no herbicide use is proposed. The most severely affected locations, such as permanent roads, gravel pits, and legal and illegal motorized vehicle use areas, would continue to be adversely effected unless maintained within design standards, relocated, or eliminated.

Conclusion

Soil organic matter inputs on NFS lands and legacy soil impacts would incrementally add to the effects of past, present and reasonably foreseeable activities on soil productivity. Soil productivity on public roads could be impaired unless maintained within design standards, relocated, or eliminated.

The Direct and Indirect Effects of Implementing Alternative 2

Table 3-14 lists potential soil property changes associated with proposed management activities. The risk of a soil property change happening is rated low, medium, or high. Potential ecosystem responses to these soil changes are also listed along with their risk of happening. Applicable ratings are based on specific project/site conditions. Once the risk ratings are determined, suitable mitigation may be developed and applied to reduce the risk to an acceptable level.

Soil Organic Matter

Under Alternative 2, the effects on the amount of soil organic matter would be local in scale and minor in severity. The residual level of soil organic matter would vary based on the type of harvest (regeneration vs. thinning) and prescribed fire intensity and frequency. Stone (1999 and 2000) has documented loss of site productivity effects for similar harvest sites on the Huron National Forest. Unless the majority of woody material greater than 4 inches in diameter from harvested trees in regenerating areas is retained on site, adverse effects on soil productivity could occur. Retaining all woody material greater than 4 inches in diameter would allow this organic material to reduce the negative effects of soil compaction and nutrient export, help retain above and below-ground organic matter, and provide a substrate for fungi, bacteria, and other micro-organisms in the soil (Gingras 1994, Lanford and Stokes 1995). Harvesting during periods of non-saturated soil conditions and plant dormancy would also sustain site productivity (Hallett and

Potential Soil Property Changes Associated with Proposed Management Activities
Table 3-14

Soil Property Change	Soil Property Change Indicator	Soil Property Change Risk Rating	Ecosystem Response to Soil Property Change	Ecosystem Response Risk Rating
Compaction	Bulk density Pore space loss Water infiltration rate	Medium	~Increased erosion/sediment ~Increased surface runoff ~Productivity gain ~Plant community changes	~Low ~Low ~Low ~Low
Exposed Mineral Soil	% of area with mineral soil exposed	Medium	~Increased erosion/sediment ~Increased sediment ~Plant community changes ~Spread of invasive species	~Low ~Low ~Medium ~Medium
Rutting/Puddling	Surface layer mixing	Medium	~Increased erosion/sediment ~Surface water flow pattern ~Plant community changes ~Spread of inv. species	~Low ~Medium ~Low ~Medium
Soil Displacement	Sheet, rill & gully Pedestals /terracettes Mass movement	Low	~Increased erosion/sediment ~Plant community changes ~Ecosystem replacement	~Low ~Low ~Low
Nutrient Loss	Litter layer loss Harvest Leaching	Low	~Plant community changes ~Change in productivity	~Low ~Low
Increased Soil Temperature	Soil temperature Soil surface color Vegetation cover	Low	~Plant community changes ~Plant regeneration changes	~Medium ~Low
Litter Layer Loss or Displacement	Loss in tons/acre	Low	~Plant community changes ~Spread of invasive species ~Increased erosion/sediment ~Change in productivity	~Medium ~Medium ~Low ~Low

Hornbeck 2000). Monitoring of recent timber sale projects has shown this to be an effective mitigation measure.

Tree-length harvesting of pine trees would be permitted to facilitate reduction of fuel less than 4 inches in diameter. Removing the majority of conifer woody material less than 4 inches in diameter for all treatment areas would export approximately 23% more nutrients than a stem only harvest (Alban 1988). Inherent soil reserves, atmospheric inputs, the residual mature trees, natural and planted ground seedlings, and herbaceous cover recovery and establishment would maintain the productivity of all except shallow and highly siliceous sites (Pritchett and Fisher 1987). Retention of woody material helps to maintain above and below-ground organic matter and provide a substrate for fungi, bacteria, and other micro-organisms in the soil. Organic matter processes and organic matter decomposers would mitigate the presence of retained woody debris as part of the fuel load within 5 years of the harvest.

Individual timber stands would experience an immediate export of site nutrients, being stored and utilized by the trees at the time of harvest, through the removal of trees. Within regeneration areas (clearcut, overstory removal, and shelterwood seed harvests) and conversion of forests to upland openings, this loss would be greater than in the thinnings; however, woody and herbaceous vegetation re-growth would occur rapidly. This would increase the ability of the site to recycle nutrients prior to leaching. In addition, Lederle and Mroz (1991) determined that bracken fern contributes to nutrient retention and cycling, especially if the harvests occur prior to frond maturation, i.e., mid to late summer. Tree regeneration would begin the first year after harvest. This, coupled with the extensive root systems left from the previous stand, would reduce the susceptibility of a site to short-term nutrient loss due to the erosive properties of wind and water.

In thinning harvests, fewer nutrients would be exported from the system. Nutrient recycling would occur more slowly through the additive processes of crown expansion in residual trees and understory vegetation re-growth. Skid trails, low standard roads, and landings would occupy a small percentage of the treatment sites; organic matter removal or relocation would not decrease inherent soil productivity, provided that post-treatment vehicle traffic is excluded and prompt re-growth of herbaceous and woody vegetation occurs. Regeneration harvests would also promote increased soil temperatures due to the increase in direct solar radiation reaching the soil surface. This condition would promote an increase in short-term nutrient mineralization, and provide for smaller amounts of residual organic matter in these areas (Brady and Weil 2002).

Soil productivity in areas subject to commercial harvest regeneration and upland opening treatments would not be reduced where stem wood and/or a large portion of branch wood and leafy materials are retained on site, and if revegetation occurs promptly (Ranger and Turpault 1999). Soil productivity in areas subject to commercial regeneration and upland opening treatments would be reduced in the short-term where stem wood and the majority of branch wood and leafy materials are removed; no measurable decline in long-term productivity would occur where these sites occur on ELTP units 23-47; on ELTP unit 20, no measurable decline would occur if revegetation occurs promptly, and if rotation lengths mimic natural nutrient replenishment (Ranger and Turpault 1999). Soil productivity in areas affected by prescribed fire and/or prescribed fire and other treatments would be reduced in the short-term, if, in addition to the retention mitigation, mineral soil is exposed on more than 15% of the area. Monitoring of recent prescribed fire projects has shown that the amount of exposed mineral soil would be <15%, and that the prescribed burns would be low to moderate-intensity fires and, therefore, are not expected to burn the humus layer.

Treatments associated with heavy equipment uses would comply with the State of Michigan Sustainable Soil and Water Quality Best Management Practices on Forest Land (BMPs) (MDNR 2009) and (USDA-Forest Service Handbook 2550, supplement No. R9 RO 2550-2012-1; see

Table 3-14 above). Site specific conservation measures to retain soil organic matter are in Chapter 2; therefore, the effects on soil productivity would be local in scale and minor in severity.

Compaction, Rutting and Displacement

Heavy equipment use would occur on approximately 20% of thinning harvest areas, and 40% of all regeneration harvest areas, and would not cause a measurable loss of inherent soil productivity if properly mitigated. In general, harvesting equipment traffic in thinning treatments make more trips over a skid trail, as compared to the regeneration treatments where skidding would be dispersed. Soil disturbance would be greater on collector skid trails, where more passes occur than with only single-pass tree felling and loading. This would not be detrimental to soil productivity if a small percentage of the area (i.e. <15%) received collector trail traffic. As the root systems of the felled trees decay, water infiltration would increase due to channeling, and would provide increased nutrient and microorganism mobility in these areas. The effects related to this would work to slowly reverse the effects of compaction present as a result of harvesting activities. The soils that dominate the Project Area where harvesting is proposed, e.g. ELTPs 20-44, are not as susceptible to compaction as finer clay soils, due to the reduced aggregate surface area that results from large individual particle size and the depth of the sand layer in these areas. The effects of harvesting activities in balance of the Project are dependent on the amount and location of clay layers (Pritchett and Fisher 1987). Greater soil compaction and mineral soil exposure and displacement would occur using tree-length harvesting equipment, especially on collector skid trails and landing sites (Gingras 1994, Lanford and Stokes 1995), as compared to cut-to-length equipment. The effects on landing areas and temporary access roads would be increased due to the intense use of harvesting equipment. If soil disturbance is less than 15% of each treatment area (as measured by a bulk density increase of <15%, a rutting depth of <6", and displacement of the forest floor in which <1" of the subsoil is at the surface layer), then its effects would be local in scale and minor in severity. Recovery from compaction would occur over a period of many years, but have fewer adverse effects on sandy soils than in other soils (Stone 1999, 2000). Mechanical equipment use to till and seed herbaceous species would have small, temporary soil compacting and disturbing effects, principally within areas not impacted by heavier equipment.

Treatments associated with heavy equipment uses would comply with the State of Michigan BMPs (MDNR 2009) and (USDA-Forest Service Handbook 2550, supplement No. R9 RO 2550-2012-1; see Table 3-22 above). Chapter 2 contains conservation measures to reduce the adverse effects of soil compaction, rutting, and displacement; therefore, the effects of compaction, rutting, and displacement would be local in scale and minor in severity.

Erosion

There would be very small amounts of soil erosion resulting from this alternative. Mechanical equipment would be used for harvest operations and for prescribed fire control line construction. Lighter equipment used for mechanical treatments of upland openings, such as farm tractors, ATVs, and attachments would cause negligible soil erosion because disking and tilling on these level areas result in rapid herbaceous re-vegetation following the treatment. These sites would become re-vegetated within one growing season, which would restore ground cover and reduce the effects of the disturbance to be minor in scale and local in extent. The planned location for skid trails and temporary roads and landings for the treatment units would not be placed near riparian areas, and would be placed on slopes less than 15% and 5%, respectively. Prompt revegetation of these sites, using either natural or supplemental methods (e.g., traffic barriers, water-bars, and herbaceous seeding) would stabilize the disturbed areas and reduce erosion.

Treatments associated with heavy equipment uses would comply with the State of Michigan BMPs (MDNR 2009) and (USDA-Forest Service Handbook 2550, supplement No. R9 RO 2550-2012-1; see Table 3-14 above). Mitigation for skid trails and landings can also be found in Chapter 2; therefore, the effects of erosion would be local in scale and minor in severity.

Transportation System

Under this alternative, roads and landings constructed for timber harvest activities would temporarily remove vegetation, compact soil, and expose soil to erosion. Amacher and O'Neill (2004) demonstrated through the use of a small penetrometer that soil compression in compacted trails and areas were 2 and 3 times as great as adjacent undisturbed areas. Temporary roads and landings would begin to be re-vegetated after use or rehabilitation is concluded; this would begin to restore ground cover one growing season later. Vegetation re-growth would reduce the effects of the disturbance to be minor in scale, local in extent, and temporary in nature. Permanent county and forest roads would also be affected by the traffic from hauling timber products, resulting in periods where increased compaction and rutting would occur on non-paved roads.

Road and landing construction activity reduces existing amounts of soil organic matter by removal and erosion. Areas of unimproved roads (county, local, and HMNF maintenance Level 1 and 2) would continue to be the most susceptible to erosion, as these areas are typically void of vegetation and decaying organic matter. Construction activities in these locations typically include gravel surfacing and local drainage controls, such as culverts and ditches; afterwards, these roads receive very little maintenance. Susceptibility to erosion and compaction and rutting would vary by location due to site-specific conditions and the amount of vehicle traffic received. On most of these roads, topography plays a key role, where the surface soil horizons from higher elevations is washed off by precipitation and settles in lower elevations. This, in conjunction with the erosive forces of vehicle tire treads, leads to the formation of gullies and wash-out in areas where the slope exceeds 2%. Compaction would continue to increase the bulk density of the soils in and along roadways open to vehicle use. In some areas, the affected sites would expand due to the development of by-pass roads to avoid wet pockets in the roadbed and the expansion of roads from the current NFS road system.

The Project Area is served by County and State highways that are intended for passenger car vehicles; these roads are improved and maintained to protect the integrity of the roadbed and drainage investments. Compaction, rutting, and erosion occur on these roads, but are mitigated by routine maintenance; however, long-term compaction and erosion of the roadbed into riparian areas and drainages occur. Operating off-highway vehicles (OHVs) causes soil compaction and displacement; within the Project Area, use of these vehicles occurs on the Michigan Cross Country Cycle Trail (MCCCT).

Treatments associated with temporary road, landing uses and road construction would comply with the State of Michigan BMPs (MDNR 2009) and (USDA-Forest Service Handbook 2550, supplement No. R9 RO 2550-2012-1; see Table 3-14 above). Mitigation for skid trails, landings, and road construction can also be found in Chapter 2.

Prescribed Fire

Prescribed fire activities in Alternative 2 would have larger effects on the soil resource than non-forest vegetation activities alone. Prescribed burning and upland opening maintenance would alter organic matter processes by reducing the total amount of live woody vegetation (e.g. stems,

leaves) and below ground biomass (e.g. roots, rhizomes), and contributing to the short-term leaching of nutrients.

The sites proposed for burning are all upland openings (non-forest). These are found on soils associated with ELTPs 20-43, all having sandy surface profiles. The depth to the water table in these soils is 3.5-15 feet or more. The depth of the organic layer is variable, but averages less than 1 inch in most areas. There is some variation among these ELTPs regarding nutrient availability based on historic treatments. The establishment of these species is dependent on the soil moisture in the first few feet of soil. Retaining humus and retaining/restoring herbaceous vegetation within 1 or 2 years of the mechanical and prescribed fire treatments is critical to sustaining soil productivity. Dense herbaceous vegetation, a more efficient user of moisture in the upper soil layers, is more easily obtained than tree regeneration.

An estimated 2-2.5 miles of control lines would be required to conduct all the broadcast burns; the control lines would be established using mechanical equipment. Soils in the proposed treatment areas are typical of ELTPs 20, 30-31, and 40-43, and erosion would primarily be limited to areas of mechanically constructed fire control lines and isolated locations where slopes exceed 2%. However, this potential for erosion would be mitigated because the topography of the areas are generally flat and erosion potential would be reduced by the lack of slope, existing roads frequently serve as control lines, control lines would be temporary and be established shortly before ignition, and after the prescribed burn has been conducted the control lines would be rehabilitated.

The effects of prescribed burning would vary due to site-specific soil conditions, frequency, and fire intensity. In most areas, the desired range of fire intensity would be 90-200 BTU/ft/sec. These intensity levels would be sufficient to top-kill the majority of woody shrubs and trees less than 2 inches in diameter at the ground line (Bova and Dickinson 2005), and reduce the load of dead fuels less than 1 inch in diameter. Prescribed fire monitoring on areas having this level of intensity on similar sites of the HMNF have resulted in less than 15% mineral soil exposure.

Prescribed fire effects on soil physical and chemical properties depend on the amount and duration of soil heating and soil moisture content when the fire occurs. These effects include increasing temperature of surface layers, reducing infiltration rates and the organic component of the surface layers, loss of volatile and leached nutrients, and reducing microbe populations in the soil profile (Choromanska and DeLuca 2002). Areas exposed to this level of fire intensity (300-520 BTU/ft/sec.) would have an immediate and short-term increase of nutrients at the soil surface through the deposition of nutrient-rich ash on the upper soil layers, and the volatilization of nitrogen in the humus layer. Prescribed fire activities of this intensity generally increase the availability of calcium, magnesium, and potassium via combustion of soil organic matter; nitrogen (N), and phosphorus (P) are modestly decreased from volatilization, but the majority of soil organic component of these nutrients are converted to forms that are either readily available to plants or soon lost through leaching. In acid soils, P chemically binds to aluminum, iron, and manganese oxides (Certini 2005). This change in nutrient status and chemical status would be of short duration (1-3 years) as the nutrients are used by the existing vegetation, adhere to soil particles, are leached through the soil profile, or lost to transport (i.e. wind and water). Boerner and Brinkman (2003) found that, especially on more mesic sites, prescribed fire could slow nutrient recycling by increasing the amount of recalcitrant organic matter (i.e. charcoal effects). Prompt revegetation with permanent woody and/or herbaceous vegetation would restore physical properties (temperature, infiltration) and nutrient leaching (calcium, magnesium, potassium) similar to that of pre-fire conditions (Pritchett and Fisher 1987). If nitrogen-fixing species are included in the re-growth, burning activities may restore the original nitrogen pool in the soil

(Certini 2005). Natural recovery of microorganisms (invertebrates, fungi, bacteria) would occur over a period of one to three years (Ahlgren and Ahlgren 1965). Soil carbon levels and profiles would be affected by the type of vegetation dominating after the fire: where woody species dominate, carbon balances are restored to pre-fire conditions as the trees mature. In contrast, where herbaceous species are dominant, both the amount and location of soil carbon are changed (Miller and Donahue 1990). Total nitrogen losses, incurred by volatilization and leaching, are compensated by increased mineral forms (available to plants) of nitrogen due to increased mineralization rates (Pritchett and Fisher 1987) and atmospheric inputs (Boerner and Brinkman 2003).

A short-term impact to soil productivity would occur under this alternative, but the intensity would vary by site-specific soil characteristics, site preparation, and the seeding methods employed. Prescribed burning and hand and/or no-till mechanical seeding would be used for both seed bed preparation and seeding. The amount of disturbance would depend on the amount of the residual vegetation, the physical obstacles of each site (e.g., stumps and slash), and the growing requirements of the plants being seeded. Treated sites would be expected to become fully vegetated within two growing seasons of the activity.

Treatments associated with prescribed fire and fire control equipment uses would comply with the State of Michigan BMPs (MDNR 2009) and (USDA-Forest Service Handbook 2550, supplement No. R9 RO 2550-2012-1; see Table 3-14 above). Chapter 2 contains conservation measures to reduce the adverse effects of prescribed fire treatments; therefore, the effects of broadcast burning in upland non-forest areas would be local in scale and minor in severity.

Herbicide Use

The herbicides and adjuvants identified for application in the Project Area (glyphosate, imazapyr, triclopyr, and 2,4-D) are known to degrade within the soil profile through various photochemical, chemical, or biological (microbial metabolism) reactions. Herbicides may be immobilized by adsorption to soil particles or uptake by non-susceptible plants. These processes isolate the herbicide and prevent it from moving in the environment. Adsorption is often dependent on the soil/water pH, and generally increases with increasing soil organic content, clay content, and cation exchange capacity. Adsorption is also dependent on water solubility, with less soluble herbicides being more strongly adsorbed to soil particles. Ester formulations are generally the least water solvent, and are therefore more strongly adsorbed by soil particles. In addition, ester formulations are more volatile than salt or acid formulations, and are therefore more easily evaporated from soil and plant surfaces or leached down into the soil (Tu et. al. 2001).

The commercial formulation of glyphosate (including the surfactants and inert ingredients) has a benign effect on the microbial community structure when applied at the recommended field rate in forest soils having clay loam and sandy loam textures (Ratcliff et.al. 2006). There does not appear to be any adverse effects on soil microorganisms from applications of imazapyr when used as an herbicide; however, it may persist in soils of arid regions, and does not bind tightly to alkaline soils with low organic matter (Syracuse Environmental Research Associates 2004a). The effects of triclopyr on soil microorganisms suggest that a transient inhibition in the growth of some bacteria or fungi could be expected. This could result in a shift in the population structure of microbial soil communities, but substantial impacts on soil (i.e., gross changes in capacity of soil to support vegetation) would not be likely (Syracuse Environmental Research Associates 2004b).

An herbicide's persistence in the soil is often described by its half-life, or the time it takes for one-half of the herbicide applied to the soil to degrade from its original chemical structure. The half-life can vary depending on soil characteristics (i.e. texture, pH), weather (i.e. temperature and soil moisture), and the existing vegetation at the application site (Syracuse Environmental Research Associates 2004b).

Table 3-15 illustrates the interaction that the herbicides proposed to be used have within the soil, and pertains to both Alternatives 2 and 3.

These herbicides, principally glyphosate, would be used for spot-treatment of numerous small, dispersed locations of NNIP, as described in the NNIP section of this document. Application would occur using ground-based mechanical and hand-tools; most treatment locations would be augmented by using hand tools to remove NNIP species.

Chapter 2 contains conservation measures to reduce the adverse effects on soil microorganisms from organic chemical applications. Therefore, the effects on the Project Area's soil resource would be local in scale and minor in severity.

Herbicide Mobility and Persistence in the Soil[1]
Table 3-15

Herbicide	Mechanism of Degradation	Half-life in the Soil	Mobility
Glyphosate	Degradation is primarily due to soil microbes	Average of 47 days	Glyphosate has an extremely high ability to bind to soil particles, preventing it from being mobile in the environment.
Imazapyr	Degraded primarily by microbial metabolism	1 to 5 months	Below pH 5, the adsorptive capacity of imazapyr increases and limits its movement in soil. Above pH 5, greater concentrations of imazapyr become negatively charged, fail to bind tightly with soils, and remain available for plant uptake and/or microbial breakdown.
Triclopyr	Rapidly degraded to triclopyr acid by photolysis, microbes in the soil, and hydrolysis	30 days	Ester formulation binds readily with the soil, giving it low mobility. The salt formulation binds only weakly in soil, giving it higher mobility (%). However, both formulations are rapidly degraded to triclopyr acid, which has an intermediate adsorption capacity, thus limiting mobility.
2,4-D Acetic acid	Degradation is primarily due to microbes in the soil	7 to 10 days (EXTOXNET-2,4-D, 1996)	Most formulations do not bind tightly with soils, and therefore have the potential to leach down into the soil and migrate off-site. However, in many instances, extensive leaching does not occur, most likely because of the rapid degradation of the herbicide.

[1] *Tu et al., 2001*

The Cumulative Effects of Alternative 2

The soil resources in the Project Area were impacted in the late 1800s and early 1900s through logging practices, the conversion of portions of this area to agriculture and rangelands, periodic fire events, and local wind erosion. Reforestation efforts, including tree planting furrows and mechanical harvesting operations, also impacted the soils from 1935 to 2004. Since the early 1930s, soil productivity has generally been stabilized or improved; in general, soil organic matter has been increasing as permanent vegetative cover was established. Based on the site-specific soil characteristics, nutrients supplied by decaying organic matter is either available to the vegetation or are leached to deeper soil layers. The overall effects of forest vegetation growth and atmospheric inputs that have occurred have generally increased levels of nutrients available for plant use and storage as compared to the 1930s, but reduced soil productivity has diminished on degraded areas, e.g. gravel pits and some upland non-forest areas, compared to native soil. Live vegetation on NFS lands would be treated with a variety of management activities; most of the red pine plantations proposed for treatment have had prior commercial harvests; two of the other areas proposed for treatments have had woody vegetation removals since inception of the existing forest cover. The majority of the existing forest vegetation has red pine, oak, aspen, or northern hardwood forests suited for future timber production using the same suite of treatments as proposed; dead and down timber could also be removed for use as firewood. Those cover types containing red pine, aspen, northern hardwoods, and oaks are likely to be managed for timber products in the foreseeable future.

As individual groups of trees, shrubs, and herbaceous species are felled or otherwise complete their life cycles, general levels of biomass and soil organic matter accumulation would exceed removals, except for commercially regenerated areas. Soil productivity would not be affected by intermediate i.e., thinning treatments, because the remaining vegetation would retain and replenish nutrients sufficient to offset biomass removals (Pritchett and Fisher 1987). Soil productivity in areas subject to repeated, intensive (short-rotation) commercial treatments, e.g., thinning and regeneration treatments, would be reduced in the short-term where stem wood and the majority of branch wood and leafy materials are removed (Stone 2002). However, the proposed treatments would be implemented on a sufficiently long rotation i.e., 45+ years, and would therefore mitigate organic matter depletion. As these forested areas regenerate and/or continue to mature during the ensuing decades, organic matter would accumulate and replenish exported nutrients. Long-term productivity of upland opening sites would be mitigated by maintaining adequate tree and herbaceous vegetation cover to retain and modestly enhance organic matter in mineral soil horizons. All areas, including stands to be less intensively treated, would receive atmospheric inputs (especially nitrogen) and biotic accruals that would sustain soil productivity and further mitigate nutrient depletions (Ranger and Turpault 1999); in addition, retention of hardwood topwood and some conifer topwood would conserve organic matter. Soil productivity would be protected or slightly enhanced by ensuring that continuous vegetation canopies, dominated by either forest or herbaceous species, follow natural or anthropological disturbances.

The range of rotation lengths for lands suited for timber management in MAs 2.1 and 8.3 range between 45 to 100 years; however, final harvest may occur when the culmination of mean annual increment is attained at the stand level (HMNF 2006). Rotation lengths in this range, which would be typical for mesic sandy sites, should allow for natural recovery of soil productivity.

Currently, areas of eroding and compacted soils occur on public roads and timber harvest areas, especially skid trails and landings that have received concentrated equipment use. Soil

compaction, rutting, puddling, and erosion effects would continue to occur on those areas unless otherwise restored to the natural range of soil bulk density. These impacts, caused by harvesting, mechanical planting, prescribed fire and wildfire control, landings, skid trails, and streamside access, would recover, at various rates, through natural processes if critical physical thresholds were not exceeded during historic periods, or are not exceeded in the future, and vegetation cover is maintained. The most recent timber harvests occurred 10-20 years ago; some forest and county roads have been affected by previous harvests, and would be affected by future harvests. The most severely affected locations are permanent roads, gravel pits, and legal and illegal motorized vehicle use areas; these would continue to be adversely affected unless maintained within design standards, relocated, or eliminated.

Prescribed fire treatments cumulatively affect four small areas previously broadcast burned; these locations are upland openings. These treatments and incidents have been of short duration with low to moderate fire intensities, and have not impaired soil productivity.

Conclusion

The duration and magnitude of the proposed treatments in Alternative 2 would incrementally add to past, present, and reasonably foreseeable capability of the soil resource to produce specified plants or plant succession (soil productivity), primarily by conserving soil organic matter and top-soil, retaining sufficient amounts of these features so that existing soil productivity is sustained following intensive treatment, and by promoting/retaining continuous herbaceous and forest canopy vegetation. Soil productivity is likely to suffer declines where the effects of past and on-going erosion, compaction, and organic matter retention are not ameliorated.

The Direct and Indirect Effects of Implementing Alternatives 3 and 4

Alternatives 3 and 4 differ from Alternative 2 in location and scale of effects. The types of treatments in Table 2-1, *Treatment Activities by Alternative*, are otherwise similar among the 3 Action Alternatives. Therefore, only the relative effects will be addressed in this section; other direct and indirect effects are the same as addressed in Alternative 2. The basis for relative impact ratings are explained below.

Prescribed Fire

An estimated 2-2.5 miles of control line would be required to conduct all the broadcast burns; the three Action Alternatives would have a similar potential for soil erosion. While not all burn units, and their accompanying control lines, would be burned at the same time, it can be assumed that control lines established using mechanical equipment would increase the potential for soil erosion. However, this potential for erosion would be mitigated because the topography of the areas are generally flat and erosion potential would be reduced by the lack of slope, existing roads frequently serve as control lines, control lines would be temporary and be established shortly before ignition, and after the prescribed fire has been conducted the control lines would be rehabilitated.

Prescribed fire effects on soil physical and chemical properties are equivalent in all three Action Alternatives, and are confined to upland non-forest areas.

Chapter 2 contains conservation measures to reduce the adverse effects on soil microorganisms from prescribed fire applications. Therefore, the effects on the Project Area's soil resource would be local in scale and minor in severity.

Comparison of Treatment Effects on Soil Productivity for All Action Alternatives
Table 3-16

Soil Productivity Impact(s)	Generator of Effect	Alternative	Measurement Factor	Relative Impact[5]
Organic matter accumulation	Removing and establishing vegetation	2	697:1034 = 0.67[1]	High
		3	621:878 = 0.71[1]	Medium
		4	621:584 = 1.06[1]	Low
Compaction, rutting, erosion	Mechanical equipment use	2	(715 x .4) + (697 x .2) = 425[2]	High
		3	(565 x .4) + (621 x .2) = 350[2]	Medium
		4	(265 x .4) + (621 x .2) = 230[2]	Low
Soil chemistry and physical properties	Broadcast burn, mechanical treatments	2	42:298 = 0.14[3]	Low
		3	42:292 = 0.14[3]	Low
		4	42:298 = 0.14[3]	Low
Soil chemistry and physical properties	Herbicide application: average soil persistence	2	150:47:30:10[4]	Equivalent
		3	150:47:30:10[4]	Equivalent
		4	N/A	None

[1]*Ratio of all intermediate treatments to regeneration plus all mechanical opening treatments.*
[2]*Net % of all treated acres where equipment >2 tons GVW is used (excludes opening maintenance).*
[3]*Ratio of broadcast burn acres to mechanical treatments in openings.*
[4]*Average soil persistence.*
[5]*Level of impact refers to the relative impacts among the three Action Alternatives only*

Soil Organic Matter, Compaction, Rutting and Displacement Erosion, and Herbicide Use

Under Alternative 3, the effects on the Project Area's soil resource would be local in scale and minor in intensity; approximately 13% fewer total acres could be harvested using tree-length

harvesting equipment than in Alternative 2. The difference in acres would occur in regeneration harvesting, plantation pine thinnings, and upland opening maintenance.

Under Alternative 4, the effects on the Project Area's soil resource would be local in scale and minor in intensity; 30% fewer acres could be harvested using tree-length harvesting equipment as compared to Alternative 2. The difference in acres would occur mostly in regeneration harvesting, with slight reductions in upland opening maintenance and plantation pine thinnings.

The soil productivity impacts in Table 3-16 displays the effects of proposed treatments on soil productivity among Action Alternatives. The principal differences among Alternatives 2, 3 and 4 are the total amounts and spatial arrangement of regeneration and intermediate harvests and upland opening treatments, and short and long term transportation system changes.

Relative impact comparisons rank soil productivity impacts by alternative based on the following:

- Organic matter accumulation on treated (all commercial and non-commercial activities) vs. non-treated acres.
- Compaction, rutting, and erosion use an estimate of felling and forwarding equipment coverage of all commercially harvested areas, including landings and temporary roads; regeneration harvests average 40%, and intermediate harvests average 20% ground disturbance, using either cut-to-length or whole-tree equipment.
- Herbicide application is ranked by ratio of active ingredients soil persistence among products that would be applied.

Transportation System

Table 3-17 displays the amount of soil disturbing activity generated by mechanical equipment.

Estimated Lengths of Roads and Acres of Landings for all Action Alternatives
Table 3-17

Alternative	Miles / Number of Locations Permanent Construction	Miles / Number of Locations Temporary Construction	Acres of Landings / Number
Alternative 2	7.0 / 25	0.27 / 6	15 / 30
Alternative 3	6.85 / 24	0.26 / 5	14.5 / 29
Alternative 4	6.80 / 23	0.26 / 5	11 / 22

Under Alternatives 3 and 4, the effects on soil resource would be local in scale and minor in intensity; approximately 2-3 % fewer miles of county local and Forest Maintenance Level 1 and 2 would be constructed in Alternatives 3 and 4 as compared to Alternative 2. The small difference in lengths and number of locations would occur, despite fewer harvesting locations, because the majority of permanent roads provide access to harvest locations common to all Action Alternatives.

Alternatives 3 and 4 propose approximately 4% fewer miles, and 2 fewer locations of temporary road construction than Alternative 2. The small difference in lengths and number of locations would occur, despite fewer harvesting locations, because permanent roads provide the majority of access to harvest locations common to all Action Alternatives, except along the west side of S #13 Rd, north of M-55.

Alternatives 3 and 4 propose approximately 4-27% fewer acres, and 1-8 fewer locations of landings respectively, than Alternative 2. These reductions are proportionally greater than road access disturbances because the harvest areas in Alternatives 3 and 4 would not use as many landings common to harvest areas in Alternative 2.

Treatments would comply with the State of Michigan BMPs (MDNR 2009) and (USDA-Forest Service Handbook 2550, supplement No. R9 RO 2550-2012-1; see Table 3-14 above). Mitigation for soil compaction, mineral soil displacement, and nutrient export can be found in Chapter 2. Mitigation for skid trails, landings, and low standard roads can also be found in Chapter 2.

The Cumulative Effects of Implementing Alternative 3

Under Alternative 3, 13% fewer acres of live vegetation on NFS lands would be treated, as compared to Alternative 2. Therefore, Alternative 3 provides for marginally greater protection of the soil resource than does Alternative 2. NFS lands on outwash plains and sandy morainal hills containing conifer or hardwood forests within and adjacent to the Project Area are likely to be managed for timber products in the foreseeable future, e.g., Henderson Salvage, Johnson Creek Stewardship, EAB Parasitoid Release, and NNIP treatments. Other cumulative effects on soil productivity are the same as discussed in Alternative 2.

The effects of herbicide applications on soil physical and chemical properties are equivalent in Alternatives 2 and 3, and are confined to numerous small infestations, using the same application rates and application methods, including manual removal. The effects of herbicide applications on soil physical and chemical properties are equivalent in Alternatives 1 and 4, where no herbicide applications would occur.

Soil productivity impacts, such as compaction, rutting, puddling, and erosion would continue to occur throughout the Project Area where vehicle use occurs; smaller impacts would occur under Alternative 3 as compared to Alternative 2 because fewer acres would be harvested. The number and length of forest roads open to vehicle use are otherwise the same between these two alternatives. A segment of Forest Road (FR) 5406 would receive drainage improvements in 2013-2015; other erosion and drainage improvements to FRs 9930, 5131, and 5578 were completed in 2011-2012. Other locations contributing to loss of soil productivity are segments of permanent public roads and legal and illegal motorized vehicle use areas; these would continue to be adversely affecting soil productivity unless maintained within design standards, relocated, or eliminated.

The Project Area has a mixed ownership of NFS and private lands. Private lands are expected to be further subdivided, developed, and be owned primarily for residential and recreational purposes. The primary effect on NFS lands would be the use of vehicles and OHVs for overland travel because of greater opportunity, e.g. more open areas, and reduced tree density. Two designated snowmobile trail segments have been established to facilitate access to commercial services during the past decade and reduce overland travel and improve public safety. The potential for illegal off road vehicle use is equivalent for Alternatives 2 and 3, because NFS lands proposed for regeneration harvests (greatest reduced tree density) areas adjacent to private lands are identical and limited to one location.

Conclusion

The duration and magnitude of the proposed treatments in Alternative 3 would incrementally add to past, present, and reasonably foreseeable capability of the soil resource to produce specified plants or plant succession (soil productivity), primarily by conserving soil organic matter and top-soil, retaining sufficient amounts of these elements so that existing soil productivity is sustained following intensive treatment, and by promoting/retaining continuous herbaceous and forest canopy vegetation. Soil productivity is likely to suffer declines where the effects of past and on-going erosion, compaction, and nutrient export are not ameliorated.

The Cumulative Effects of Implementing Alternative 4

Soil Productivity

Under Alternative 4, the amount of live vegetation on NFS lands to be treated is the smallest, as compared to Alternatives 2 and 3; therefore, Alternative 4 provides for marginally greater protection of the soil resource. NFS lands on outwash plains and sandy morainal hills containing conifer or hardwood forests within and adjacent to the Project Area are likely to be managed for timber products in the foreseeable future, e.g., Henderson Salvage, Johnson Creek Stewardship, EAB Parasitoid Release, and NNIP treatments. Other cumulative effects on soil productivity are the same as discussed in Alternative 2.

Soil productivity impacts, such as compaction, rutting, puddling, and erosion would continue to occur throughout the Project Area where vehicle use occurs; smaller heavy equipment impacts would occur under Alternative 4 as compared to Alternatives 2 and 3 because fewer acres would be harvested. However, the number and length of forest roads open to vehicle use is somewhat greater in Alternative 4, and would contribute a proportional negative effect on soil productivity. A segment of FR 5406 would receive drainage improvements in 2013-2015; other erosion and drainage improvements to FRs 9930, 5131, and 5578 were completed in 2011-2012. Other locations contributing to loss of soil productivity are segments of permanent public roads and legal and illegal motorized vehicle use areas; these would continue to be adversely impact soil productivity unless maintained within design standards, relocated, or eliminated.

The Project Area has a mixed ownership of NFS and private lands. Private lands are expected to be further subdivided, developed, and be owned primarily for residential and recreational purposes. The primary effect on NFS lands would be the use of vehicles and OHVs for overland travel because of greater opportunity, e.g. more open areas, and reduced tree density. Two designated snowmobile trail segments have been established to facilitate access to commercial services during the past decade and reduce overland travel and improve public safety. The potential for illegal off road vehicle use is the least for Alternative 4, because no NFS lands proposed for regeneration harvests (greatest reduced tree density) areas adjacent to private lands.

Conclusion

The duration and magnitude of the proposed treatments in Alternative 4 would incrementally add to past, present, and reasonably foreseeable capability of the soil resource to produce specified plants or plant succession (soil productivity), primarily by conserving soil organic matter and top-soil, retaining sufficient amounts of these elements so that existing soil productivity is sustained following intensive treatment, and by promoting/retaining continuous herbaceous and forest

canopy vegetation. Soil productivity is likely to suffer declines where the effects of past and on-going erosion, compaction, and nutrient export are not ameliorated.

Air Quality

Resource-Specific Information & Existing Condition

The Project Area is not in a priority I or II area regulating emissions of particulate matter into the air shed (Michigan Department of Environmental Quality (MDEQ) 2002). The primary air pollutants that would be generated by the Project's proposed activities are fine particulates ($PM_{2.5}$ and PM_{10}), less than 10 micrometers in diameter and nitrogen oxides, carbon monoxide, and volatile organic compounds contained in the smoke from open burning sources, the majority of which are transported from distant point and non-point sources to the Project Area (MDEQ 2002).

The analysis area for the direct and indirect effects on air quality are areas within a 1-2 miles of broadcast burning activities; this range coincides with the dispersal and mixing of smoke within the lowest levels of the atmosphere.

The Direct and Indirect Effects of Implementing Alternative 1

Air quality would be slightly affected by exhaust emissions which contain particulates and oxides of nitrogen and sulfur; and by similar emissions, including ozone, generated from distant sources, primarily by fossil fuel power plants, vehicles, and subsequently transported to the Project Area.

If a wildfire were to occur, the effects on the air shed could be extensive, but of relatively short duration. There would be an input of smoke into the air shed commensurate with the wildfire scale, resulting in negative impacts from fine particulates ($PM_{2.5}$ and PM_{10}) less than 10 micrometers in diameter and nitrogen oxides, carbon monoxide, and volatile organic compounds (MDNR 1998). These impacts negatively affect the air quality for those people located downwind from the fire and produce large amounts of smoke on roadways throughout the downwind area. While these impacts have the potential to be quite extensive, the longevity of the impacts would be temporary, i.e., a few hours to one or two days.

The Cumulative Effects of Implementing Alternative 1

The analysis area for cumulative effects on air quality is Wexford County. This area was selected because the small amount of particulates and gases that affect air quality are transported and diluted within this county after smoke is dispersed into higher levels of the atmosphere.

Taking no action would not affect air quality within the Project Area. Motor vehicle use associated with transportation and motorized recreation would likely increase in the future, increasing emissions from these vehicles throughout the Project Area. There would be no emissions generated by proposed vegetation and prescribed fire treatments; however, downwind transport of pollutants generated elsewhere would continue to affect these counties.

If a substantial wildfire were to occur, large amounts of smoke, with accompanying particulates and pollutants, would impact adjacent downwind (short distance) and smoke dispersal (long distance) areas, but of relatively short duration. There would be an input of smoke into the air shed commensurate with the wildfire scale, resulting in negative impacts to the atmosphere from

fine particulates ($PM_{2.5}$ and PM_{10}) less than 10 micrometers in diameter, nitrogen oxides, carbon monoxide, and volatile organic compounds (MDNR 1998). Such an event would likely happen during the period March-November and could impact any area in the vicinity of the Project Area, depending on environmental factors such as wind speed and direction and atmospheric stability (inversions). These impacts negatively affect the air quality for those people located downwind from the fire and produce smoke on roadways throughout the downwind area. While these impacts have the potential to be quite extensive, the longevity of the impacts would be temporary, i.e., a few hours to one or two days.

Conclusion

Alternative 1 would not incrementally add to the effects of past, present, and reasonably foreseeable activities within the Project Area.

The Direct and Indirect Effects of Implementing Alternative 2

Implementing the harvesting activities of Alternative 2 would have minor adverse, local effects on air quality (Liu 2004). Exhaust emissions and some additional road dust from logging equipment would affect short-term air quality. Public roads, residences and commercial services are adjacent to treatment sites, e.g., less than 50 yards. Approximately 1% of the area affected by mechanical vegetation treatments would receive a broadcast burn treatment.

Implementing the prescribed burning activities of Alternative 2 during the months of March-September would have temporary negative effects on the air quality. This impact on air quality would be dependent on a number of factors including type of burn, fuel moisture, weather conditions, the number of acres treated per prescribed burn (USDA 2002), and an individual's exposure to the smoke.

Broadcast Burn

The effects of broadcast burning (burning of surface fuels over a specific area), on air quality would be small, and these impacts would be limited in time and scale. Broadcast burning typically takes place in either the spring or the fall, when a combination of wind speed and fuel moisture content conditions are appropriate for the goals of the prescribed burn. Broadcast burns create a relatively large volume of particulate and gas in the smoke, and the direction and dispersal pattern of the smoke is critical to implementing the prescribed burn and mitigating undesirable effects.

Broadcast burning for upland non-forest areas would comprise all three combustion stages: flaming, smoldering, and residual. Flaming combustion is the most efficient type of combustion and usually tends to emit the least amount of pollutants compared with the mass of fuel consumed. Smoldering combustion is common in duff and woody material with high fuel moisture content; consequently, combustion efficiency is lower, resulting in more particulate emissions generated than during the flaming stage. Residual combustion is an independent process following the flaming stage, and is characterized by little smoke and is composed mostly of carbon dioxide and carbon monoxide (USDA 2002). The flaming combustion phase would be more pronounced than smoldering and residual combustion in the non-forest areas to be treated because there is only a minor amount of duff and woody material in these locations in which these combustion phases could occur.

A prescribed burn plan is developed for each area to be treated that includes acceptable and unacceptable burning conditions, including wind factors, which would minimize the impacts downwind of the prescribed fire. Prior to any prescribed burn ignition, actual fuel and weather conditions are compared to those identified in the prescribed burn plan and used to assess the direction the smoke would travel, how high in the atmosphere the smoke would be lifted, and how it would be dispersed by surface and transport winds. The air quality would be reduced immediately downwind from where the smoke is generated, and where it contacts the ground again, if little smoke dilution in the atmosphere occurs prior to this settling.

Number of Acres Treated per Prescribed Burn

Each prescribed burn may be conducted in part or whole, separately, or in conjunction with other burn treatments. There is also the possibility that a series of prescribed burns on the same stands would be needed to achieve fuel reduction goals. It is important to note that the daily number of acres to be burned would be predetermined in the Project Area; however the actual number of acres each day would determine how much smoke is produced in each burning period and how much smoke is produced from individual treatment sites. Smoke production and its effect on local air quality would, therefore, be related to the amount of prescribed fire treatment, from ignition until residual combustion is completed. Planned prescribed burn conditions usually coincide with short-term weather patterns, thus producing a pulse of smoke that would impact air quality for 1-2 days in a row. If all three combustion stages are of short duration, local air quality may be impacted once in a week; conversely, 3-5 prescribed fires may occur during prolonged periods of favorable weather conditions. In addition, each prescribed fire is influenced by ability of firefighters/equipment to simultaneously conduct prescribed burns and respond to wildfires, the number of on-going wildfires, and those prescribed fires remaining in the smoldering and residual stages of combustion. Therefore, distribution of air quality effects can vary within the analysis area, and direct effects would range from pronounced within new prescribed fire ignitions, to less where combustion is ongoing.

Exposure to Smoke

The effects of smoke inhalation are detrimental, primarily from breathing air containing particulate matter smaller than 10 microns, and also from carbon monoxide. Negative effects can be reduced or eliminated by wearing protective devices if directly exposed to smoke (self-contained breathing apparatus), by minimizing direct exposure to smoke (remain out of direct contact or contact smaller concentrations of particulates and gases), or by eliminating exposure to the smoke.

Bush et al.(2000) found that residues of herbicides applied following label rates of imazapyr, triclopyr, and 2,4-D were thermally degraded by hot fires (flaming activity > 500 F^o); smoldering fires (< 500 F^o) have the potential to volatilize some pesticides. They found that significant human health risks were no greater than smoke exposure risks from fire alone when pesticides incorporated into or on forest fuels were burned, even if the fire occurs immediately after application. While glyphosate was not specifically included in Bush et al., Durkin (2003) concluded that there is no basis to believe that the presence of glyphosate residues would have a significant impact on human health if fire consumes vegetation treated with this herbicide. The time between the proposed herbicide application(s) and prescribed fire treatment(s) is expected to be at least 60 days.

Mitigation measures for broadcast burning and smoke exposure would be incorporated into the burn plans prepared for the Project Area.

The Cumulative Effects of Implementing Alternative 2

Under Alternative 2, there would be short-term adverse effects to air quality, primarily for those areas downwind from prescribed broadcast treatments. There would also be short-term increases in emissions (Liu 2004) related to NFS land treatments, with Alternative 2 generating the most emissions among the Action Alternatives as largest number of acres harvested would result in proportionally more heavy equipment use. The prevailing transport winds (1500'+ elevation) in this part of Michigan come from the west during the growing season. Residences and individuals downwind, i.e. east or south of areas to be burned, would have the air quality reduced below ambient standards. Those individuals closest to the prescribed fire areas would potentially be more exposed to microscopic particles and carbon monoxide and other gasses than those persons in areas where mixing with the atmosphere dilutes these pollutants. Other prescribed fires and wildfires would also reduce local air quality; however, because of the proximity of the treatment locations to Lake Michigan, adjacent land vegetation patterns, and prevailing winds, these events are unlikely to occur and diminish local air quality beyond ambient conditions (MDEQ 2002).

Motor vehicle use associated with transportation and motorized recreation would likely increase in the future, increasing emissions from these vehicles throughout the Project Area. There would be short-term increases in emissions (Liu 2004) related to NFS land treatments; however, downwind transport of pollutants generated elsewhere would continue to be the prevalent impact on air quality. Smoke management plans that incorporate Environmental Protection Agency (EPA) guidelines (MDNR 1998) would reduce emissions from individual and aggregate prescribed fire treatments. The emissions generated by the proposed prescribed fire treatments would be generated within a county currently in attainment for carbon monoxide and particulates smaller than10 microns in size (MDEQ 2002). It is likely that other private and public activities, such as commercial and residential developments that emit pollutants, would occur in the future that could diminish local air quality.

Conclusion

The duration and magnitude of prescribed fire and mechanical equipment use activities would incrementally add to the effects of past, present and reasonably foreseeable activities in the air shed.

The Direct and Indirect Effects of Implementing Alternatives 3 and 4

Implementing the proposed mechanical treatments to forests and upland opening of Alternatives 3 and 4 would have relatively smaller, but minor adverse, local effects on air quality than would Alternative 2. Alternatives 3 and 4 differ from Alternative 2 in location and scale of effects, with fewer exhaust emissions and additional road dust from logging equipment affecting short-term air quality generated from 13-30% fewer acres (Table 2-1). The types of treatments in Table 2-1, *Treatment Activities by Alternative*, are otherwise similar among the three Action Alternatives. Therefore, only the relative effects will be addressed in this section; other direct and indirect effects are the same as addressed in Alternative 2.

Implementing the harvesting activities of Alternative 4 would have the smallest, but still minor, adverse, local effects on air quality, as compared to Alternatives 2 and 3. Exhaust emissions and additional road dust from logging equipment would affect short-term air quality, and be generated from a slightly different set of locations than under Alternative 2 (Table 2-1), and over similar time period of years.

Implementing the prescribed burning activities of Alternatives 3 and 4 during the months of March-September would have temporary negative effects on the air quality. This impact on air quality would be dependent on a number of factors including type of burn, fuel moisture, weather conditions, the number of acres treated per prescribed burn (USDA 2002), and an individual's exposure to the smoke.

Mitigation measures for broadcast burning and smoke exposure would be incorporated into the burn plans prepared for the Project Area.

The Cumulative Effects of Implementing Alternatives 3 and 4

Under Alternatives 3 and 4, there would be short-term adverse effects to air quality within the Project Area, primarily for those areas downwind from prescribed broadcast burning treatments. The prevailing transport winds (1500'+ elevation) in this part of Michigan come from the west during the growing season and from the north during the non-growing season months. Residences and individuals downwind, i.e. east or south of areas to be burned, would have the air quality reduced below ambient standards. Those individuals closest to the prescribed fire areas would potentially be more exposed to microscopic particles and carbon monoxide and other gasses than those persons in areas where mixing with the atmosphere dilutes these pollutants. Other prescribed burning and wildfires would also reduce local air quality; however, because of the proximity of the Project Area to Lake Michigan, private land features, and prevailing winds, these events are unlikely to occur and diminish local air quality beyond ambient conditions (MDEQ 2002). Motor vehicle use associated with transportation and motorized recreation would likely increase in the future, increasing emissions from these vehicles throughout the Project Area.

There would be short-term increases in emissions (Liu 2004) related to NFS land treatments, with Alternative 4 generating the least emissions among Action Alternatives as fewer acres harvested would result in proportionally less heavy equipment use; however, downwind transport of pollutants generated elsewhere would continue to be the prevalent impact to air quality in the Project Area. Smoke management plans that incorporate EPA guidelines (MDNR 1998) would reduce emissions from individual and aggregate prescribed fire treatments. The emissions generated by the proposed prescribed fire treatments would be generated within counties currently in attainment for carbon monoxide and particulates <10 microns in size (MDEQ 2002). It is likely that other private and public activities, such as commercial and residential developments that emit pollutants, would occur in the future that could diminish local air quality.

Motor vehicle use associated with transportation and motorized recreation would likely increase in the future, increasing emissions from these vehicles throughout the Project Area. There would be short-term increases in emissions (Liu 2004) related to NFS land treatments; however, downwind transport of pollutants generated elsewhere would continue to be the prevalent impact on air quality. Smoke management plans that incorporate EPA guidelines (MDNR 1998) would reduce emissions from individual and aggregate prescribed fire treatments. The emissions generated by the proposed prescribed fire treatments would be generated within a county currently in attainment for carbon monoxide and particulates <10 microns in size (MDEQ 2002). It is likely that other private and public activities, such as commercial and residential developments that emit pollutants, would occur in the future that could diminish local air quality.

Conclusion

The duration and magnitude of prescribed fire and mechanical equipment use activities would incrementally add to the effects of past, present and reasonably foreseeable activities in the air shed.

Water Quality and Fisheries
Resource-Specific Information & Existing Condition

Watershed Condition

The Sheep Dip Project Area occurs within four 6th code sub-drainages of the Manistee River basin; Pine River-Poplar Creek, Pine River-Lower, Manistee River at Peterson Creek, and the North Branch Pine River. The North Branch Pine River 6th code sub-watershed barely overlaps the Project Area and does not contain any aquatic habitats, nor does it contain any proposed treatments under any proposed alternative, and as such it is not included under any of the watershed condition analyses below. There are no lakes or large ponds occurring within the Project Area.

The rivers and tributaries within the Project Area are typically ground water fed with stable flow, high water quality, and generally carry a relatively low-to-moderate sediment load dominated by sand-sized particles. Historic human uses such as timber harvest, log drives, removal of wood debris, draining of wetlands and loss of beaver habitat, along with the more recent development of agricultural lands and road density have impacted channel function to varying degrees.

The watersheds in the Project Area exist within a fragmented landscape, in regard to both hydrology (dams, increasing road density, loss of wetlands, etc.,) and forest cover. Most forms of hydrologic fragmentation tend to narrow and heighten the flood hydrograph, increasing the risk of damage to stream bank integrity, channel morphology, aquatic habitat, and facilities located in the riparian/floodplain zone. Dams and constructed features that function to dam water and sediment (i.e., road crossings) are one form of fragmentation that generally reduce the risk of flood impacts, but do have considerable impacts upon sediment regimes and biological processes, particularly species migration/population connectivity, timing of water delivery, and water temperature.

Forest cover fragmentation occurs over space and time as a result of natural processes (wildfire, wind events, other natural disturbances), but can be augmented when human management (timber harvest, agricultural and urban land clearing, road building, etc.) increases the quantity and rate of fragmentation. Typically, mature forested stands protect watershed integrity, whereas increasing proportions of open land cover and immature stands (<15 years old) have negative impacts to watershed function and biological function (Verry 2001). Such impacts particularly affect the rate of runoff, leading to flashier flows and changes in channel morphology. The 2006 Forest Plan addresses this issue of forest cover impacts to watershed function with a DFC of no more than 66% of any 6th level watershed on the forest being in early successional (open or immature) forest cover types. The existing percent open area in all four 6th code hydrologic unit codes (HUC) of the Project Area are less than the DFC (Table 3-18).

Roads (open and closed to the public) and trails (motorized and snowmobile) are another form of fragmentation that negatively impact streams and wetlands in a number of ways. As with open space, roads can accelerate the rate of runoff, and may also intercept and divert subsurface flow,

Early Successional Forest Cover (Open Area) in the Four 6th Code HUCs of the Project Area - Alternative 1

Table 3-18

6th Code Watershed	Watershed Acres	Watershed Acres in the Project Area	Existing Open Acres	Existing Percent Open Area
Pine River - Poplar Creek	32,138	1,536	5,787	18
Pine River - Lower	20,120	5,088	3,625	18
Manistee River - Peterson Creek	19,121	14,060	2,402	13
Manistee River - Tippy Pond	29,145	446	4,043	14

Existing Miles and Densities of Roads and Trails Managed by the USFS, MDOT, and Wexford County, Stratified by 6th Code HUC within the Project Area

Table 3-19

6th Code HUC	USFS Roads	County Roads	State Roads	Total Roads	Trails
Pine River - Poplar Creek (50.2)[1]	68.9[2] / 1.37[3]	59.1 / 1.18	1.8 / 0.04	129.8 / 2.59	37.9 / 0.75
Pine River - Lower (31.4)	30.2 / 0.96	43.0 / 1.37	4.1 / 0.13	77.3 / 2.46	8.6 / 0.27
Manistee River @ Peterson Creek (29.9)	98.6 / 3.30	54.0 / 1.81	12.6 / 0.42	165.2 / 5.53	22.3 / 0.75
Manistee River - Tippy Pond (45.5)	116.4 / 2.56	127.8 / 2.81	8.9 / 0.20	253.1 / 5.56	63.7 / 1.40
Total (157.0)	314.1 / 2.00	283.9 / 1.81	27.4 / 0.17	625.4 / 3.98	132.5 / 0.84

[1] *Numbers in parentheses are watershed area in square miles.*
[2] *Total miles*
[3] *Density*

reduce groundwater recharge and indirectly lead to the conversion of wetland vegetation types to upland types (Jones and Grant 1996). Where roads or trails cross streams, upstream migration of aquatic organisms and channel function can be limited where inappropriately designed or constructed crossing structures create physical barriers. There are a number of such barrier

culverts in the Project Area, particularly in Peterson, Johnson, and Dowling Creeks. Road and trail crossings also act as point sources of fine sediment delivered to streams that can impact habitat important to a wide range of aquatic biota. The density of roads and trails (miles per square mile) is a relative index of the impacts of roads/trails to aquatic resources.

Across the four 6th code HUCs of the Project Area, the density of roads and trails is 4.82 miles per square mile of land, with the highest density occurring in the Tippy Pond (6.96 mi/mi^2) and Peterson Creek (6.28 mi/mi^2) watersheds, and the lowest density occurring in the Lower Pine River watershed (2.73 mi/mi^2).

National direction for assessing watershed condition (Potyondy 2011) rates road densities less than 1 mile per square mile as "Good", 1-2.4 miles per square mile as "Fair", and greater than 2.4 miles per square mile as "Poor". Using the criteria described by Potyondy, watershed condition relative to road density is poor in all four of the six 6th code HUCs (Table 3-19).

Biological Resources

The Forest Plan recognizes 118 fish species and 16 mollusk species occurring within lakes and streams of the Forests' boundaries. Within the Project Area, state designated trout streams on NFS lands include the three mile segment of the Pine River from M-37 to the High School Bridge, Dowling Creek, and the uppermost half-mile of Peterson Creek including Johnson Creek. There are no lakes occurring within the Project Area.

Pine River

The Pine River is known as one of the most productive trout streams in the state of Michigan. Fish surveys of Pine River in the Project Area are difficult due to depth and velocity of flow of the river. However, the community can be described based on past fisheries reports from Michigan Department of Natural Resources (DNR), and more recently post-graduate work evaluating the effect of the Stronach Dam removal downstream of the Project Area. Surveys by DNR biologists near the Project Area in 1951 and in 1952 describe a cold/cool-water community including brook trout and rainbow trout, white sucker, blacknose dace, longnose dace, blacknose shiner, American brook lamprey, largemouth bass, pumpkinseed sunfish, and both the slimy and mottled sculpin. The dam removal study (Burroughs 2007) sampled fish downstream of Peterson Bridge (M-37) in 1997 and again in 2006. Their sampling reach closest to the Project Area is described as their Reference Zone, where 16 species were recorded in total for the two years (Table 3-20). Notable changes in the species abundance over this period is the relative increase in white sucker, brown and rainbow trout, and the relative decrease in slimy sculpin and brook trout.

Dowling Creek

Dowling Creek is a tributary to Poplar Creek and the Pine River and its fisheries have been surveyed upstream of the 48 Road in 1995 (850 ft) and 2004 (400 ft) and found to support moderate densities of brown trout, brook trout, and sculpin. During the 1995 survey "amphibians" were noted as abundant (>100 observed); walkthrough surveys conducted in 2010 and 2012 observed numerous northern leopard frogs that were not counted. The 48 Road and FR5406 each have road crossings that function as either a full or partial barrier, impacting passage of aquatic organisms and channel function (Table 3-21).

Number of Fish Caught and Their Numeric Proportions, Reference Zone Downstream of Peterson Bridge, Pine River, 1997 and 2006

Table 3-20

Common name	Number caught 1997	Percent of total abundance	Number caught 2006	Percent of total abundance
White sucker	33	5.39	266	28.85
Slimy sculpin	368	60.13	258	27.98
Brown trout	78	12.75	143	15.51
Rainbow trout	38	6.21	102	11.06
Logperch darter	0	0.00	85	9.22
Brook trout	68	11.11	10	1.08
Longnose dace	23	3.76	17	1.84
Shorthead redhorse	0	0.00	3	0.33
Pumpkinseed sunfish	0	0.00	3	0.33
American brook lamprey	2	0.33	10	1.08
Bluegill	0	0.00	15	1.63
Yellow perch	0	0.00	5	0.54
Blackside darter	0	0.00	2	0.22
Black bullhead	1	0.16	0	0.00
Creek chub	1	0.16	0	0.00
Emerald shiner	0	0.00	1	0.11
Central mudminnow	0	0.00	1	0.11
Golden shiner	0	0.00	1	0.11
TOTAL	**612**		**922**	

Comparison of Numbers of Fish in Dowling Creek, 1995 and 2004

Table 3-21

	July 1995	July 2004
Brook trout	8 (9.4)[1]	4 (4.7)
Sculpin	60 (70.6)	3 (3.5)
Brown trout	2 (2.4)	4 (4.7)

[1]*Numbers in parentheses are densities (fish/1000 feet).*

Peterson Creek

The first electrofishing survey of Peterson Creek within the Project Area was conducted by state biologists upstream of the 7 Road in September 1966. Species caught included brook trout and sculpin. Water temperature at 9 am was 53° F and air temperature was 73° F. The next survey at this site was made in August of 1989 in response to a flood event downstream, unfortunately battery failure precluded a complete survey and only one brown trout and three sculpin were captured; numerous trout were noted but uncaught. Water temperature was 54° F. More recent surveys were conducted by Forest Service staff in August of 1995 and again in August of 2005. In both surveys, a 1000 foot reach was shocked immediately downstream of the 7 Road. The fish community in 1995 included low densities of brook trout, brown trout, and creek chub, with moderate densities of sculpin and blacknose dace. In the August 2005 survey, no trout or sculpin were sampled; however, the fish community was dominated by warmer water species, including blacknose dace, creek chub, unidentified shine species, bluntnose minnow, and white sucker. Water temperature on that date was recorded as 68 °F, considerably higher than previously observed in 1966 and 1989. On 12 June 2008 DNR sampled two 100 foot reaches of Peterson Creek, one at the 7 Road and another immediately upstream of the confluence with Johnson Creek upstream. Water temperature was 59°F (air = 80°F). Brook trout were numerous with moderate numbers of brown trout and sculpin (Table 3-22).

About five miles downstream of the Project Area, Peterson Creek becomes much colder (45-60 °F) due to ground water inputs and has been sampled in the vicinity of Warfield Road on numerous occasions and found to support abundant populations of brown trout and sculpin. In 2011, tissue samples were collected from about 400 sculpin and molecular analyses indicate that species occurring in Peterson Creek at that site are slimy sculpin.

Comparison of Numbers of Fish Relative to Water and Air Temperature in Peterson Creek
Table 3-22

	Sept 1966	August 1989	August 1995	August 2005	DNR 2008 7 Road	DNR 2008 #2
Water temperature (°F)	53	54	NA	68	59	59
Air temperature (°F)	73	NA	NA	NA	80	80
Brook trout	6	NA	3 (3)[1]	0	17 (170)	1
Sculpin	1	NA	50 (50)	0	6 (60)	0
Brown trout	0	NA	4 (4)	0	7 (70)	0
Blacknose dace	0	NA	30 (30)	36 (36)	1 (10)	0
White sucker	0	NA	0	1 (1)	1 (10)	0
Bluntnose minnow	0	NA	0	1 (1)	0	0
Sand shiner	0	NA	0	25 (25)	0	0
Creek chub	0	NA	3 (3)	36 (36)	0	0

[1]*Numbers in parentheses are densities (fish/1000 feet).*

Johnson Creek

Johnson Creek is a headwater tributary of Peterson Creek and the northwest boundary of the Project Area runs parallels to it. The first survey of Johnson Creek was performed by state biologist in July 1966 in an unreported length of channel downstream of the 38 Road. They captured one brook trout, one common shiner, and six sculpin. Subsequent surveys were made more than one mile downstream by Forest Service staff in July and August 1983 in a 195 foot long reach located in Section 10 near the confluence with Peterson Creek. These surveys enumerated moderate densities of brook trout, brown trout, and creek chub, and also noted the presence of sculpin. Water temperature was fairly consistent among all three survey dates. DNR surveyed 100 feet upstream of the confluence with Peterson Creek in 2008 and found high densities of brook trout and moderate densities of brown trout and sculpin (Table 3-23).

There is an unnamed creek that flows into the Pine River at the junction of the 7-1/2 Road and the 48 Road locally referred to as Yates Creek that by definition (i.e., is tributary to the Pine River) is a state designated trout stream. The lower 1.5 miles of Yates Creek occurs on private lands and probably supports trout and other cold/cool-water species in the vicinity of its confluence with the Pine River, however the upper 0.5 miles of this stream on NFS lands is dry and does not support fish. The 7-1/2 Road culvert in Yates Creek also functions as a complete barrier to aquatic organism passage. As the portion of the Project Area occurring in the North Branch Pine River watershed is also a dry land environment far from any river, stream (perennial or seasonal), or lake, aquatic biota from this drainage are not described here.

Comparison of Numbers of Fish Relative to Water and Air Temperature in Johnson Creek
Table 3-23

	25 July 1966 Section 2	28 June 1983 Section 10	31 August 1983 Section 10	12 June 2008 Section 10
Water temperature (°F)	57	54	56	59
Air temperature (°F)	85	NA	NA	80
Brook trout	1	16 (82.1)[1]	3 (15.4)	21 (210)
Sculpin	6	0[2]	0[2]	1 (10)
Brown trout	0	8 (41.0)	20 (102.6)	6 (60)
Common shiner	1	0	0	0
Creek chub	0	4 (20.5)	0	0

[1]*Numbers in parentheses are densities (fish/1000 feet).*
[2]*Presence of this species noted on survey sheets.*

Aquatic Endangered Species Act Listed and Region 9 Sensitive Species

As identified by the USFWS, there currently are no federally listed (threatened, endangered, proposed, or candidate) aquatic species on the Manistee National Forest. The Regional Forester has identified nine sensitive aquatic species that may occur in surface waters of the HMNF: redside dace (*Clinostomus elongatus*), channel darter (*Percina copelandi*), lake sturgeon (*Acipenser fulvescens*), river redhorse (*Moxostoma carinatum*), greater redhorse (*Moxostoma*

valenciennesi), pugnose shiner (*Notropis anogenus*), slippershell (*Alasmidonta viridis*), black sandshell (*Ligumia recta*), and creek heelsplitter (*Lasmigona compressa*).

On the HMNF, the channel darter is only known to occur in surface waters draining east into Lake Huron. In Michigan, self-sustaining populations of redside dace only occur in the extreme southeast portion of the state, with disjunct populations in the extreme western Upper Peninsula. The Michigan Natural Features Inventory (MNFI) reports an additional population somewhere in Osceola County, however its exact location has not been described, and to date there is no documented occurrence of this species in the waters of the HMNF. Both the redside dace and the channel darter are considered to be absent from the waters of the Manistee National Forest.

Lake sturgeon is a large migratory fish native to the Great lakes and connected large river systems. Currently, lake sturgeon is known to occur in the Manistee River below Tippy Dam with some reports of individuals in the segment downstream of the Hodenpyl Dam. Lake sturgeon is not known to occur in the Pine River or other surface waters in the Project Area. The river redhorse is identified as occurring in Michigan but not in Wexford County; Rozich (1998) does not describe river redhorse as present in the Manistee River system, and hence this species is determined not to occur in the Project Area. The greater redhorse (*M. valenciennesi*) is not identified in the MNFI database, however Rozich (1998) does recognize its presence in the lower two-thirds of the Manistee River, but not in the Pine River or any tributaries, hence this species is not considered present in the Project Area. The MNFI database identifies the pugnose shiner as absent from Wexford County; Rozich (1998) identifies this species as existing from one site near Bear Creek in the lower Manistee River, hence this species is considered absent from the Project Area.

The creek heelsplitter and the slippershell are Region 9 (R9) sensitive freshwater mussels both known to prefer headwater stream habitats and potentially could occur in smaller streams of the Project Area. The black sandshell is an R9 sensitive mussel known to occur in rivers and larger streams of northern Michigan. A query of the MNFI database for all three mussel species in Wexford County identified one observation of the slippershell from an unknown site recorded in 1926, with no other specific documentation.

Considerable taxonomic skill is required to identify freshwater mussels species and recent surveys have been conducted in the Pine River and tributaries of the Manistee River within and outside of the Project Area by an experienced malacologist in 2011 (Badra 2012, 2012a). Of a total of six sites formally surveyed and about 20 miles of visual survey from canoe/kayak, no live mussels or shell middens were found in the Pine River from Lincoln Bridge downstream to Low Bridge. One non-sensitive fatmucket (*Lampsilis siliquoidea*) shell was observed at the first survey site just downstream of Lincoln Bridge, about eight miles upstream of the Project Area. Additional survey of 16 tributary sites in Hinton and Pine Creeks, the closest located about three miles outside of the Project Area, detected no live mussels, although shells of non-sensitive spike (*Elliptio dilatata*) were observed in Pine Creek in the transition zone at the confluence of Pine Creek with the Manistee River (Badra 2012a), well outside the Project Area boundary. To date, none of the R9 sensitive mussel species have been documented in surface waters of the Project Area during various walk-through surveys or float trips over the last three years, and it is reasonable to conclude that none of these three R9 sensitive mussels occur within the Project Area.

Aquatic MIS Species

There are two MIS identified in the Forest Plan, brook trout and mottled sculpin (Table 3-24). Recent survey data from within the Project Area is organized for brook trout and sculpin in Table 3-25.

Past surveys indicate that brook trout and sculpin are present at variable densities in streams across the Project Area. In a study evaluating the probability of brook trout extirpation, Thieling (2006) identified a threshold range of 1.8-2.0 miles per square mile for predicting extirpation at the watershed scale. Thieling's criteria suggest that road/trail densities in the Project Area are high enough to cause concern for brook trout populations, which are an MIS species on the HMNF. It should be noted that Thieling's criteria were developed for a wide variety of watershed types; given the relatively low relief and the natural groundwater hydrology of the Project Area, brook trout populations may not be at as high a risk of extirpation. Continued monitoring at the forest scale would help better understand the distribution and health of brook trout populations.

Thieling also found that managers should be concerned when agricultural land cover (a subset of open space) is in the 12-19% range, or higher. While data describing agricultural land cover is not available in the HMNF GIS database and precludes such an analysis, Thieling's recommendation reflects how open space can impact brook trout and potentially other aquatic species and is worth considering.

Aquatic Management Indicator Species
Table 3-24

MIS Species	Habitat	Status	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Brook trout (*Salvelinus fontinalis*)	Cold, spring fed streams	Brook trout are common in the Project Area	No change	Possible impacts to watershed function, but not likely to impact population.	Possible impacts to watershed function, but not likely to impact population.	Possible impacts to watershed function, but not likely to impact population.
Mottled sculpin (*Cottus bairdii*)	Cold, spring fed streams	Mottled sculpin are abundant in the Project Area	No change	Possible impacts to watershed function, but not likely to impact population.	Possible impacts to watershed function, but not likely to impact population.	Possible impacts to watershed function, but not likely to impact population.

The Direct and Indirect Effects of Implementing Alternative 1

The area of analysis for direct and indirect effects is defined by the combined outer boundary of the four 6th code HUCs that the project occurs in. Under this alternative poorly maintained roads and stream crossings would continue to contribute non-point source pollution, particularly fine sediments, to bodies of water within the Project Area. Poorly designed and/or installed stream

crossings would continue to block passage of aquatic organisms. The high density and poor design of many of the roads and trails would continue to fragment the watersheds and degrade their conditions. Early successional habitat within these watersheds would continue to have a moderate impact upon watershed function.

The Cumulative Effects of Implementing Alternative 1

The area of analysis for cumulative effects is defined by the combined outer boundary of the four 6th code HUCs that the project occurs in. This area was selected because all proposed activities occur within these watersheds and the effects of these activities should be limited to these areas. Cumulative effects are discussed for the foreseeable future, which is approximately 10 years.

Descriptive Survey Data Describing Densities of MIS Brook Trout and Sculpin from HMNF Fisheries Files

Table 3-25

Species	Brook trout		Sculpin[1]	
	Number fish per 1000 ft	Size range	Number fish per 1000 ft	Size range
Dowling Creek (July 1995)	9.4	6-10“	70.6	No Data
Dowling Creek (July 2004)	4.7	5-9”	4.7	2-4”
Peterson Creek (1966)	No Data	5.7-6.8”	No Data	No Data
Peterson Creek (1995)	3.0	6-8”	50.0	No Data
Peterson Creek (7 Road 2008)	170.0	1-9”	60.0	1-2”
Peterson Creek (Site #2 2008)	10.0	4”	0.0	No Data
Johnson Creek (June 1983)	82.1	1-8”	No Data	No Data
Johnson Creek (August 1983)	15.4	3-8”	No Data	No Data
Johnson Creek (2008)	210.0	1-10.3”	10.0	2”
Pine River (High School 1951)	5.2	3.7-12.4”	58.3	1.4-4.3”
Pine River (Peterson 1951)	1.1	11.7”	73.6	1.5-4.3”
Pine River (Peterson 1952)	3.1	3.6-8.3”	269.3	1.1-3.9”

[1]*Mottled sculpin (Cottus bairdii) and slimy sculpin (C. cognatus) are combined due to the difficulty of taxonomic identification in the field.*

Watershed management in these areas would continue to concentrate on erosion control by upgrading road stream crossings and maintaining riparian buffer zones. Restoration of wood debris in stream channels, along with improving old growth conditions in riparian corridors that are a source of wood debris to channels, would also be an additional focus of future watershed management activities. Overall, water quality and aquatic habitat in these watersheds would remain stable or improve slightly over time. Competition and predation by other fish species upon MIS fish populations in these watersheds would likely remain stable.

The Direct and Indirect Effects of Implementing Alternative 2

The area of analysis for direct and indirect effects to aquatic resources includes the four 6th code HUCs where treatment occurs. Under Alternative 2, a total of 1,731 acres of treatment is proposed within the Project Area, the majority of which (44%) is located in the Lower Pine River HUC (Table 3-26), followed by the Peterson Creek (39%), Poplar Creek (14%), and Tippy Pond (3%) HUCs drainages. Implementation of BMPs, particularly buffers of all stream corridors, is expected to mitigate direct impacts to aquatic resources from the harvest or treatment of trees or vegetation. The red pine thinning located west of Dowling Creek is a good example of where a buffer would protect aquatic resources.

Vegetation treatments would create pockets of non-forest cover (i.e. open acres) in each of the 6th code HUCs, resulting in indirect effects to the flood hydrograph, stream bank integrity, channel geomorphology, and sediment budget. The greatest potential change in non-forest cover would occur in both the Lower Pine River and Peterson Creek HUCs (3% increase each), followed by the Poplar Creek HUC (1%), and less than 1% increase in the Tippy Pond HUC. For all four 6th code HUCs, increases in non-forest cover resulting from implementation of Alternative 2 would not exceed the DFC of 66% described in the Forest Plan. Adherence to the Forest Plan watershed management standards and guidelines (pages II-18 to II-22), particularly the Streamside Management Zone (SMZ) guideline should protect aquatic resources from any direct and/or indirect impacts to habitat from various vegetation treatments.

Early Successional Forest Cover (Open Area) in the Four 6th code HUCs of the Project Area - Alternative 2

Table 3-26

6th Code Watershed	Watershed Acres	Existing Open Acres	Alternative 2 Open Acres Created	Alternative 2 Percent Open Area[1]
Pine River - Poplar Creek	32,138	5,787	234	19
Pine River - Lower	20,120	3,625	767	21
Manistee River - Peterson Creek	19,121	2,402	672	16
Manistee River - Tippy Pond	29,145	4,043	45	14

[1]*Percent open area is quantified from current HMNF GIS data.*

Alternative 2 would construct 0.3 miles of new road, reconstruct 8.3 miles of existing road, and close and revegetate 0.7 miles of Level 2 road, a net loss of 0.4 miles of road and associated impacts to hydrologic function. Given the generally flat topography in the Project Area along with implementation of BMPs during road construction and/or reconstruction, the risk of increase in sediment delivery resulting from this net increase is very low.

Under Alternative 2, backpack spraying and painting of herbicides (glyphosate, triclopyr, and imazapyr, etc.) are proposed for 23 acres within the Project Area to control unwanted vegetation and NNIP in the Project Area. There are not expected to be any direct or indirect effects to aquatic species from herbicide application as guidelines/BMPs/mitigation measures for chemical applications near surface waters would be implemented.

The Cumulative Effects of Implementing Alternative 2

Watershed management in these areas would continue to concentrate on reducing erosion introduction and routing into streams, upgrading road stream crossings in Dowling, Peterson, and Johnson Creeks to provide for aquatic organism passage and stream function, lowering road densities, maintaining/restoring riparian buffer zones, restoring stream habitat. These types of projects should lead to improved water quality and aquatic habitat.

The trend in human-caused deforestation was at its worst after the intense period of logging the late 1800s, followed by a period of re-forestation and agricultural and urban development. By 2013, approximately 20% of the drainage area in the Project Area is considered non-forested (cropland, open field, or early successional forest). Loss of wetland/swamp habitat in the Project Area due to drains as part of agricultural/urban development is considered to be relatively minor. Combined, the above types of land conversion can impact the flood hydrograph, increasing the rates of flow delivery and bank erosion, changing channel morphology, and reducing groundwater recharge. As the human population continues to increase within the watershed, the patterns of development would continue to expand, further aggravating these impacts to hydrologic function and aquatic resources.

Vegetation treatments proposed under this Action Alternative would further increase open space within the affected HUCs, and while relatively minor, is a concern in their respective river basins. The creation of additional non-forest area within this basin would further exasperate impacts to the flood hydrograph and other aquatic resources, but do not exceed the DFC in the Forest Plan. Forest management on the large tract of state lands to the east of the Project Area likely has a cumulative effect upon watershed condition; however the magnitude of this effect at any point in time is unknown. Similar impacts to hydrologic function likely continue downstream and may impact aquatic resources outside the Project Area, but are difficult to monitor, much less quantify.

The Direct and Indirect Effects of Implementing Alternative 3

The area of analysis for direct and indirect effects to aquatic resources again includes the four 6th code HUCs where treatment occurs. Under Alternative 3, a total of 1,520 acres of treatment is proposed within the Project Area, the majority of which (43%) is located in the Lower Pine River basin (Table 3-27), followed by the Lower Pine River (38%), Poplar Creek (14%), and Tippy Pond (3%) drainages. Implementation of BMPs, particularly buffers of all stream corridors, is expected to mitigate direct impacts to aquatic resources from the harvest or treatment of trees or vegetation. The red pine thinning located west of Dowling Creek is a good example of where a buffer would protect aquatic resources.

Early Successional Forest Cover (Open Area) in the Four 6th code HUCs of the Project Area - Alternative 3

Table 3-27

6th Code Watershed	Watershed Acres	Existing Open Acres	Alternative 3 Open Acres Created	Alternative 3 Percent Open Area[1]
Pine River - Poplar Creek	32,138	5,787	216	19
Pine River - Lower	20,120	3,625	577	21
Manistee River - Peterson Creek	19,121	2,402	657	16
Manistee River - Tippy Pond	29,145	4,043	45	14

[1]*Percent open area is quantified from current HMNF GIS data.*

Vegetation treatments would create pockets of non-forest cover (i.e. open acres) in each of the 6th code HUCs, resulting in indirect effects to the flood hydrograph, stream bank integrity, channel geomorphology, and sediment budget. The greatest potential change in non-forest cover would occur in both the Lower Pine River and Peterson Creek HUCs (3% increase each), followed by the Poplar Creek HUC (1%), and less than 1% increase in the Tippy Pond HUC. For all four 6th code HUCs, increases in non-forest cover resulting from implementation of Alternative 3 would not exceed the DFC of 66% described in the Forest Plan. Adherence to the Forest Plan watershed management standards and guidelines (pages II-18 to II-22), particularly the SMZ guideline should protect aquatic resources from any direct and/or indirect impacts to habitat from various vegetation treatments.

Alternative 3 would construct 0.3 miles of new road, reconstruct 8.3 miles of existing road, and close and revegetate 1.2 miles of Level 2 road, a net loss of 0.9 miles of road and associated impacts to hydrologic function. While relatively small, this net decrease to road density would be beneficial to watershed condition.

Under Alternative 3, backpack spraying and painting of herbicides (glyphosate, triclopyr, and imazapyr, etc.) are proposed for 23 acres within the Project Area to control unwanted vegetation and NNIP in the Project Area. There are not expected to be any direct or indirect effects to aquatic species from herbicide application as guidelines/BMPs/mitigation measures for chemical applications near surface waters would be implemented.

The Cumulative Effects of Implementing Alternative 3

The cumulative effects are similar to those discussed for Alternative 2.

The Direct and Indirect Effects of Implementing Alternative 4

The area of analysis for direct and indirect effects to aquatic resources includes the four 6th code HUCs where treatment occurs. Under Alternative 4, a total of 1,205 acres of treatment is proposed within the Project Area, the majority of which (44%) is located in the Peterson Creek

basin (Table 3-28), followed by the Lower Pine River (39%), Poplar Creek (13%), and Tippy Pond (3%) drainages. Implementation of BMPs, particularly buffer of all stream corridors, is expected to mitigate direct impacts to aquatic resources from the harvest or treatment of trees or vegetation. The red pine thinning located west of Dowling Creek is a good example of where a buffer would protect aquatic resources.

Vegetation treatments would create pockets of non-forest cover (i.e., open acres) in each of the 6th code HUCs, resulting in indirect effects to the flood hydrograph, stream bank integrity, channel geomorphology, and sediment budget. The greatest potential change in non-forest cover would occur in the Peterson Creek and Lower Pine River HUCs (2% increase), with less than 1% increase in the Poplar Creek and Tippy Pond HUCs. For all four 6th code HUCs, increases in non-forest cover resulting from implementation of Alternative 4 would not exceed the DFC of 66% described in the Forest Plan. Adherence to the Forest Plan watershed management standards and guidelines (pages II-18 to II-22), particularly the SMZ guideline should protect aquatic resources from any direct and/or indirect impacts to habitat from various vegetation treatments.

Alternative 4 would construct 0.3 miles of new road and reconstruct 8.3 miles of existing road. No road closure would occur under Alternative 4, resulting in a net gain of 0.3 miles of road and associated impacts to hydrologic function. Given the generally flat topography in the Project Area, this very small increase of road density would not result in any appreciable risk of increase in sediment delivery to surface waters.

Early Successional Forest Cover (Open Area) in the Four 6th code HUCs of the Project Area - Alternative 4

Table 3-28

6th Code Watershed	Watershed Acres	Existing Open Acres	Alternative 4 Open Acres Created	Alternative 4 Percent Open Area[1]
Pine River - Poplar Creek	32,138	5,787	159	18
Pine River - Lower	20,120	3,625	470	20
Manistee River - Peterson Creek	19,121	2,402	533	15
Manistee River - Tippy Pond	29,145	4,043	31	14

[1]*Percent open area is quantified from current HMNF GIS data.*

Under Alternative 4, backpack spraying and painting of herbicides (glyphosate, triclopyr, and imazapyr, etc.) are proposed for 23 acres within the Project Area to control unwanted vegetation and NNIP in the Project Area. There are not expected to be any direct or indirect effects to aquatic species from herbicide application as guidelines/BMPs/mitigation measures for chemical applications near surface waters would be implemented.

The Cumulative Effects of Implementing Alternative 4

The cumulative effects are similar to those discussed for Alternative 2.

Endangered, Threatened, and Sensitive Species

Resource-Specific Information & Existing Condition

The area of analysis for direct and indirect effects to endangered, threatened, and sensitive (ETS) species is the NFS lands where treatments are proposed. The cumulative effects analysis area for threatened, endangered, and sensitive species is the Project Area plus all lands within a half mile buffer around the Project Area.

A BE was prepared for the Sheep Dip Project (see Planning Record). The BE evaluated the effects of this project under all alternatives on federally listed or proposed species, designated critical habitat, and RFSS that may inhabit the Project Area.

The RFSS analyzed in the BE were species that had the potential to occur within or near the Project Area based upon suitable habitat and known occurrences. Sources of occurrences were MNFI, Forest Service Natural Resource Information System Wildlife database, and Project Area surveys.

Sensitive plant species were included in analysis for the Project Area if they had been documented within a county occupied by the Manistee National Forest or if the Project Area was within the species' distribution in Michigan. If there were no records of a sensitive species within a county occupied by the Cadillac-Manistee Ranger District or if the Project Area was outside of the species' distribution, it was assumed that the species was unlikely to be present within the Project Area. In addition to field surveys for sensitive species within the Project Area, several sources were checked to determine if a sensitive species had ever been documented in the area, including the Cadillac-Manistee ETS database, Biota of North America Program (*www.bonap.org*), MNFI, and Michigan Flora Online (*http://herbarium.lsa.umich.edu/website/michflora/*).

The Direct, Indirect, and Cumulative Effects of Implementing Alternatives 1, 2, 3, and 4

The BE documented the determinations of effects of the Sheep Dip Project activities on proposed, endangered, and threatened species and critical habitat, and on RFSS by each alternative. The cumulative effects of other activities are considered minimal in the near future. It is anticipated there would be no significant changes in activities of any kind in the Project Area. The Forest Service has no authority over private land use, use of state or private accesses, and use of waterways. Additionally, any future local or private actions that would occur in the area on NFS lands would require a permit from the Forest Service and would require compliance with the ESA and Forest Service Manual. Biological Assessments and Evaluations would be prepared for future activities on NFS lands in the vicinity of the Project Area as well as across the HMNF in order to evaluate potential effects to ETS species and, if needed, to make habitat or species protection recommendations related to the proposed projects. Management for federally listed species and RFSS on the HMNF has generally increased the population or habitats of these species (M&E Report 2009).

The BE determined that there are no federally threatened or endangered species known to occur in the Sheep Dip Project Area or would be impacted by the proposed activities. The determinations for RFSS wildlife and plant species that could occur within the Project Area are listed below in Tables 3-29 and 3-30. The determinations were made contingent on

implementation of the mitigation measures listed in the BE. The mitigation measures in the BE would be implemented with the Action Alternatives. All other RFSS wildlife and plant species for the HMNF were considered but were not expected to occur within the Project Area. Therefore, they would not be affected by the proposed alternatives.

Determination of Effects for Wildlife RFSS
Table 3-29

Scientific Name	Common Name	Alternative	Determination
Glaucomys sabrinus	Northern flying squirrel	1 2,3,4	No impact MINT[1], would have some beneficial effects
Martes americana	American marten	1 2,3,4	No impact MINT, would have some beneficial effects
Myotis lucifugus	Little brown myotis	1 2,3,4	No impact MINT, would have some beneficial effects
Myotis septentrionalis	Northern myotis	1, 2,3,4	No impact MINT, would have some beneficial effects MINT
Accipiter gentilis	Northern goshawk	1 2,3,4	No impact MINT, would have some beneficial effects
Ammodramus savannarum	Grasshopper sparrow	1 2,3,4	MINT Beneficial effects
Buteo lineatus	Red-shouldered hawk	1 2,3,4	No impact MINT, would have some beneficial effects
Haliaeetus leucocephalus	Bald eagle	1 2,3,4	No impact Beneficial effects
Melanerpes erythrocephalus	Red-headed woodpecker	1 2,3,4	No impact MINT, would have some beneficial effects
Glyptemys insculpta	Wood turtle	1 2,3,4	No impact MINT, would have some beneficial effects
Terrapene carolina	Eastern box turtle	1 2,3,4	No impact MINT, would have some beneficial effects

Atrytonopsis hianna	Dusted skipper	1 2,3,4	MINT Beneficial effects
Pyrgus wyandot	Southern grizzled skipper	1 2,3,4	MINT Beneficial effects

[1]*MINT - May impact individuals or sub-populations, but not likely to cause a trend towards federal listing or loss of viability.*

Determination of Effects for Plant RFSS
Table 3-30

Scientific Name	Common Name	Alternative	Determination
Arabis missouriensis	Missouri rock cress	1 2,3,4	MINT[1] MINT, would have some beneficial effects
Asclepias purpurascens	Purple milkweed	1 2,3,4	MINT MINT, would have some beneficial effects
Berula erecta	Wild parsnip	1 2,3,4	MINT MINT, would have some beneficial effects
Botrychium oneidense	Oneida grape fern	1 2,3,4	MINT, would have some beneficial effects MINT
Botrychium rugulosum	Ternate grape fern	1 2,3,4	MINT MINT, would have some beneficial effects
Carex schweinitzii	Schweinitz's sedge	1 2,3,4	MINT MINT, would have some beneficial effects
Cirsium hillii	Hill's thistle	1 2,3,4	MINT MINT, would have some beneficial effects
Cynoglossum virginianum var. boreale	Northern wild comfrey	1 2,3,4	MINT MINT, would have some beneficial effects
Dalibarda repens	False violet	1 2,3,4	MINT, would have some beneficial effects MINT
Dryopteris goldiana	Goldie's wood fern	1 2,3,4	MINT, would have some beneficial effects MINT

Eleocharis engelmannii	Engelmann's spike rush	1 2,3,4	MINT MINT, would have some beneficial effects
Geum triflorum	Prairie smoke	1 2,3,4	MINT MINT, would have some beneficial effects
Juglans cinerea	Butternut	1 2,3,4	MINT MINT, would have some beneficial effects
Juncus brachycarpus	Small-headed rush	1 2,3,4,	MINT MINT, would have some beneficial effects
Juncus vaseyi	Vasey's rush	1 2,3,4	MINT MINT, would have some beneficial effects
Linum sulcatum	Furrowed flax	1 2,3,4	MINT MINT, would have some beneficial effects
Lipocarpha micrantha	Dwarf bulrush	1 2,3,4	MINT MINT, would have some beneficial effects
Malaxis brachypoda	White adder's mouth	1 2,3,4	MINT, would have some beneficial effects MINT
Panax quinquefolius	American ginseng	1 2,3,4	MINT, would have some beneficial effects MINT
Platanthera hookeri	Hooker's orchid	1 2,3,4	MINT MINT, would have some beneficial effects
Pterospora andromedea	Pine drops	1 2,3,4	MINT, would have some beneficial effects MINT
Schoenoplectus torreyi	Torrey's bulrush	1 2,3,4	MINT MINT, would have some beneficial effects
Spiranthes ochroleuca	Yellow ladies' tresses	1 2,3,4	MINT MINT, would have some beneficial effects

Sporobolus heterolepis	Prairie dropseed	1 2,3,4	MINT MINT, would have some beneficial effects
Taxus canadensis	Canadian yew	1 2,3,4	MINT, would have some beneficial effects MINT
Trichostema brachiatum	False pennyroyal	1 2,3,4	MINT MINT, would have some beneficial effects
Trichostema dichotomum	Forked bluecurls	1 2,3,4	MINT MINT, would have some beneficial effects
Triplasis purpurea	Purple sand grass	1 2,3,4	MINT MINT, would have some beneficial effects

[1]*MINT - May impact individuals or sub-populations, but not likely to cause a trend towards federal listing or loss of viability.*

Non-Native Invasive Plant Species

Resource-Specific Information & Existing Condition

The analysis area for direct and indirect effects for this issue includes NFS lands within the Project Area. This area was chosen because these are the lands where NNIP treatments would occur. Invasive species are defined as "an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health" (Executive Order 13112 1999).

The cumulative effects analysis area includes the NFS and private lands included within and adjacent to the Project Area. This CEA was chosen because the adjacent lands could be impacted by NNIP spreading to them from the Project Area in the foreseeable future. The adjacent land could also act as a source for NNIP to continue to infest the Project Area. NNIP could also be treated with herbicide on adjacent lands, thereby adding to the overall amount of herbicide used within the area.

Twenty-seven species of NNIP were documented during surveys of the Project Area. Treatments are proposed for 15 species, concentrating on species that are either uncommon in the Project Area, have the potential to interfere with the success of proposed timber or wildlife activities, or occur close to RFSS plants. Additional NNIP may have invaded the Project Area since botanical surveys were conducted during 2010. If new NNIP species or new infestations of NNIP are found during project activities, they would be evaluated at that time and treated as necessary. A complete list of NNIP documented during botanical surveys of the Project Area can be found in the Project Record.

The HMNF have identified certain plants as NNIP. Each species has a priority ranking for treatment based on completed Risk Analyses. The Forest Service NNIP priority ranking is described below:

Forest Service Priority Ranking
1 = Not on Forest yet, eradicate new occurrences immediately upon discovery
2 = Eradicate wherever found
3 = Control source populations, eradicate outliers
4 = Prevent invasion of last areas not invaded, eradicate high priority areas
5 = Status on Forest uncertain, control/eradication site specific

Table 3-31 below lists the NNIP proposed for treatment, the Forest NNIP treatment priority, and the number of stands proposed for treatment. Treatment recommendations for each occurrence are located in Appendix B and in the Project Record.

NNIP Proposed for Treatment and Forest Priority Ranking
Table 3-31

Species	Forest Rank	Treatment Recommendations	Number of Stands
Garlic mustard	2	Eradicate wherever found	2
Burdock	3	Control source populations	16
Oriental bittersweet	2	Eradicate wherever found	3
Canada thistle	4	Prevent invasion	9
Bull thistle	4	Prevent invasion	21
Houndstongue	2	Eradicate wherever found	2
Autumn olive	4	Prevent invasion	2
Lathco flatpea	5	Control/eradication site specific	1
Morrow's honeysuckle	3	Control source populations	7
Wild parsnip	2	Eradicate wherever found	2
Scotch pine	3	Control source populations	5
Black locust	3	Control source populations	1
Purple crown vetch	2	Eradicate wherever found	7
Common tansy	3	Control source populations	4
Wild parsley	3	Control source populations	7

The management of NNIP is important because they have the capacity to alter or dominate native communities and quickly become established in areas that are frequently or severely disturbed, such as roadsides, landing sites, skid trails, and burned areas. They can then spread from these disturbed sites into the surrounding habitats and disrupt the ecology of natural communities. NNIP can reduce biodiversity, degrade habitat, and impact people. Some NNIP alter their environment by changing hydrology, soil chemistry, and fire regimes. They impact wildlife species by causing direct mortality, decreasing available food supplies, or providing nutritionally inferior food. They impact other plant species by competing for water, sunlight, nutrients, space, and pollinators; producing allelopathic compounds and disrupting mycorrhizal relationships; diluting gene pools through hybridization; causing declines in the growth rates of canopy trees; preventing natural tree regeneration; and displacing native plants. They also impact people by impeding industry, disrupting agriculture, endangering human health, and degrading recreational experiences (Tallamy 2007).

NNIP fail to support the insect diversity and biomass that native plants do. Most insects cannot or will not eat non-native plants. About 90% of herbivorous insects are specialists and will only feed on a few plant lineages. The remaining 10% of herbivorous insects are able to feed on multiple species and may adapt to a non-native plant if it is similar enough to their host plants. Unfortunately, many non-native plants are not closely related to any species in North America, making it unlikely that native insects would be able to use those species (Tallamy 2007). Preliminary study results indicate that native woody plants and vines support far more insect species and biomass than non-natives. Comparisons of Lepidoptera and sawfly caterpillar use of native versus non-native woody plants indicate that the natives support 35 times more caterpillar biomass. Since Lepidoptera and sawfly caterpillars are the largest component in the diets of insectivorous birds, this decline in caterpillar biomass could impact these species as well (Tallamy 2007). As NNIP displace native plants, fewer insects would be available to other members of the food web, causing a ripple effect throughout the animal community.

The NNIP species that were selected for treatment are those that are either not yet widespread throughout the Forest, have the potential for the biggest negative impact on native plant and animal communities, or are in close proximity to RFSS plants. Garlic mustard, Oriental bittersweet, autumn olive, Lathco flatpea, Morrow's honeysuckle, wild parsnip, black locust, and purple crown vetch would be treated with herbicide in Alternatives 2 and 3 because it is the most effective treatment for controlling these species. Burdock, Canada thistle, bull thistle, houndstongue, Scotch pine, common tansy, and wild parsley have the potential to be effectively controlled without herbicide so they would be treated with manual or mechanical methods such as hand pulling or girdling. Spot treatment, basal bark application, or injection with herbicides would be used instead of broadcast spraying wherever possible to minimize the amount of herbicide used and decrease the risk to non-target species.

Herbicides would be applied according to the product label (FSH 2109.14, 52.11), the specifications in the Forest Service Manual 2150, *Pesticide Use Management and Coordination*, and in the Forest Service Handbook 2109.14, *Pesticide Use Management and Coordination Handbook*. Also, compliance with all federal, state, and local regulations regarding herbicide use would be followed. Herbicide application would be conducted by State of Michigan pesticide applicator certified personnel.

The Direct and Indirect Effects of Implementing Alternative 1

Under Alternative 1, there would be no direct effects since no treatments would occur to control NNIP, however there would be indirect effects. The existing infestations would go unchecked and the diversity of native plants in the Project Area would decline over time as NNIP replace native plants and alter natural ecosystems. The diversity of native insects would likely decrease with the decline in the prevalence of native plants, which would eventually impact birds and other wildlife species (Tallamy 2007).

The consequence of unchecked NNIP spread in stands where RFSS species are present would be the reduction and degradation of RFSS habitat due to invasive plant competition and modification of site conditions. Multiple NNIP occur in stands that also contain Canada yew, ginseng, and Schweinitz's sedge, all RFSS plants. Allowing NNIP to continue spreading throughout these stands would eventually lead to the loss of habitat for these RFSS and eventually the displacement of these species. In addition, as NNIP spread through the Project Area, they would continue to degrade the habitat available for RFSS plants to colonize, thereby reducing the potential for RFSS populations to increase in the future.

The lack of mechanical activity associated with the proposed opening maintenance, logging, and prescribed fire proposed in Alternatives 2, 3, and 4 would result in slower or fewer invasions by NNIP than if mechanical treatments occurred, since soil disruption is a major avenue for the introduction and spread of NNIP. The lack of fuels reduction activities would increase the risk of high intensity wildfires. NNIP tend to invade areas fairly quickly after high intensity wildfires, so the lack of fuels treatments could lead to more invasions by NNIP, if a wildfire were to occur.

The Cumulative Effects of Implementing Alternative 1

Under Alternative 1, existing NNIP would colonize a larger percentage of the Project Area due to lack of NNIP treatment. NNIP would also spread to adjacent public and private land, especially in open areas or areas adjacent to roads.

Major highway corridors close to the Project Area would continue to bring visitors and vehicles into this area and promote the spread of invasive species. Disturbance associated with recreational use of an area contributes to the proliferation of invasive plant species. In addition to disturbing the soil, recreational activities also facilitate the dispersal of seeds and other propagules. Seeds and plant material are transported as vehicles move from one area to another. They are also transported in the shoes of hikers, the fur of dogs, and the hoofs, feed, fur, and feces of horses. In the future, the Project Area would continue to be used for recreational purposes, thus continuing to expose the area to new invasions of NNIP. Without treatment of NNIP, the Project Area would also continue to be a source of NNIP spread to other areas as recreationists, wildlife, vehicles, and equipment travel to relatively uninfested areas.

NNIP would continue to be introduced into the Project Area and current infestations would continue to spread. Over time these infestations would continue to spread to adjacent private and public land. At some point, an invasive species' population would reach a level at which it would no longer be as feasible to eliminate from the Project Area.

Several of the NNIP proposed for treatment, such as garlic mustard and Morrow's honeysuckle, impede tree seedling regeneration. Autumn olive, Morrow's honeysuckle, and black locust

change soil chemistry which could alter the growth rates of co-existing native species. Over the very long term, these species have the potential to affect future timber activities.

The Direct and Indirect Effects of Implementing Alternatives 2 and 3

Under Alternatives 2 and 3, 15 NNIP species are proposed for control (Table 3-31). NNIP control methods may include manual removal, mechanical control, or herbicide use. The goals of NNIP treatment include 1) the control or eradication of NNIP species that are not currently well established in the Project Area; 2) the reduced spread of these NNIP to non-infested locations by reducing source populations; and 3) the decreased loss or degradation of available habitat for native flora and fauna. Controlling NNIP would help maintain habitat for native plants, including RFSS. Multiple NNIP were located in stands that also contain Canada yew, ginseng, and Schweinitz's sedge. Treating NNIP near RFSS plants would help protect habitat for these species and keep the NNIP from displacing these RFSS.

Burdock, Canada thistle, bull thistle, houndstongue, Scotch pine, common tansy, and wild parsley have the potential to be effectively controlled with manual or mechanical methods such as hand pulling or girdling. Manual or mechanical techniques should be effective for these species since they do not rootsprout. Oriental bittersweet, Lathco flatpea, wild parsnip, black locust, and purple crown vetch would be treated with herbicide in Alternatives 2 and 3 because it is the most effective treatment for controlling these species. Garlic mustard seedlings would be spot-sprayed with herbicide even though they do not rootsprout because they are so numerous. Herbicide treatments would include using glyphosate, imazapic, or 2,4-d for spot spraying or stem injection methods or triclopyr for basal bark application. These methods minimize the amount of herbicide used as well as the potential for accidental application to non-target species. Approximately 23 acres are proposed for herbicide treatment in Alternatives 2 and 3. The actual herbicide application would only be to stems or individual plants, thus the actual area of herbicide application is much less than the approximate acres of infestation. Treatments would take place throughout the year as weather allows. Re-treatments of these species would depend on the results of the initial treatments. Any new discoveries of NNIP that are considered to be of high treatment priority would be treated as necessary. The proposed NNIP treatments were considered the most effective and cost efficient control measures for the specific NNIP.

Native berry-producing shrubs would be planted in stands where autumn olive and honeysuckle are removed to mitigate the loss of berry-producing shrubs for wildlife.

Activities associated with prescribed fires, fuels reduction, and logging would increase the opportunities for NNIP to invade new areas since equipment can transport NNIP seeds and propagules into new areas and the proposed project activities would also disturb the soil. Cleaning equipment before bringing it on-site as well as cleaning equipment between infested and non-infested sites would reduce the possibility of equipment acting as vectors for NNIP infestations. Revegetating disturbed areas with either native or non-persistent non-native species would also decrease the possibility of NNIP invading a disturbed area.

The Cumulative Effects of Implementing Alternatives 2 and 3

Under Alternatives 2 and 3 the currently known populations of NNIP would be reduced; however, other NNIP species would continue to be introduced or distributed by natural or human vectors. There would be more soil disturbance and greater presence of mechanical equipment in the Project Area, but equipment cleaning and revegetation mitigation measures should reduce the

risk of new infestations due to Project activities. Healthy plant communities resulting from prescribed fire and other management activities are more likely to resist invasion from NNIP. Controlling source populations of NNIP would also reduce the likelihood of additional areas becoming infested.

Increasing public awareness of the impacts of NNIP and emphasis on reducing populations of NNIP should also decrease the prevalence of NNIP in the cumulative effects analysis area. Many organizations have been created to address the impacts and decrease the populations of NNIP and have been increasing their eradication and educational efforts. The Northwest Michigan Cooperative Weed Management Area was established in 2005 to address garlic mustard and has added many other terrestrial invasive plants to their education and control repertoire. The Michigan Dune Alliance was established in 2004 to address the spread of baby's breath (*Gypsophila paniculata*) along the Lake Michigan shoreline and began tackling Lyme grass (*Lymus arenarius*) in 2007. The Michigan Dune Alliance has also increased their education and control efforts to many other NNIP. Sleeping Bear Dunes National Lakeshore, various land conservancies, Michigan Department of Transportation, Michigan DNR, and multiple watershed councils have been increasing NNIP control efforts on the lands they are responsible for managing. Through these combined efforts and continued public education, there would be increasing control of NNIP.

Private landowners may use chemical means to reduce the presence of weeds on their properties. NNIP also would be treated using herbicides in other HMNF project areas such as Udell Hills, Nixon-Ravine, Manistee Barrens, Wagon Wheel, etc. The proposed herbicide use in the Project Area would add incrementally to the herbicide use on adjacent lands since herbicide use is proposed on 23 acres of the approximately 11,725 acres of NFS lands within the Project Area. In addition, since spot spraying, basal bark application, and stem injection methods would be used instead of broadcast spraying; only a small portion of the 23 acres would actually be treated with herbicide.

Invasive plants are a concern for all current environmental analyses and are expected to become increasingly important over time and in all future projects. Therefore, it is likely that control of NNIP would continue to take place in the cumulative effects analysis area in the future.

The Direct and Indirect Effects of Implementing Alternative 4

Under Alternative 4 there would be no direct effects since no treatments would occur to control NNIP. The indirect effects would be similar to those of Alternative 1. However, since the proposed logging, wildlife opening maintenance, and prescribed fire activity would still occur, there would be more ground disturbance and more opportunities for NNIP to invade these disturbed areas. The diversity of native plants in the Project Area would decline over time as NNIP replace native plants and alter natural ecosystems. The diversity of native insects would likely decrease with the decline in the prevalence of native plants, which would eventually impact birds and other wildlife species (Tallamy 2007).

The Cumulative Effects of Implementing Alternative 4

Under Alternative 4, existing NNIP would colonize a larger percentage of the Project Area due to lack of NNIP treatment. NNIP would also spread to adjacent public and private land, especially in open areas or areas adjacent to roads.

Major highway corridors close to the Project Area would continue to bring visitors and vehicles into this area and promote the spread of invasive species. Disturbance associated with recreational use of an area contributes to the proliferation of invasive plant species. In addition to disturbing the soil, recreational activities also promote the dispersal of seeds and other propagules. Seeds and plant material are transported as vehicles move from one area to another. They are also transported in the shoes of hikers, the fur of dogs, and the hoofs, feed, fur, and feces of horses. In the future, the Project Area would continue to be used for recreational purposes, thus continuing to expose the area to new invasions of NNIP. Without treatment of NNIP, the Project Area would also continue to be a source of NNIP spread to other areas as recreationists, wildlife, and equipment travel to relatively uninfested areas.

NNIP would continue to be introduced into the Project Area and current infestations would continue to spread. Over time these infestations would continue to spread to adjacent private and public land. At some point, an invasive species' population would reach a level at which it would no longer be as feasible to eliminate from the Project Area.

Several of the NNIP proposed for treatment, such as garlic mustard and Morrow's honeysuckle, impede tree seedling regeneration. Autumn olive, Morrow's honeysuckle, and black locust change soil chemistry which could alter the growth rates of co-existing native species. Over the very long term, these species have the potential to affect future timber activities.

Heritage Resources

Resource-Specific Information & Existing Condition

The analysis area for the heritage resources encompasses all the NFS lands within the Project Area. Any heritage resource that could be affected by management activities would be limited to this area.

Section 106 of the National Historic Preservation Act requires federal agencies to take into account the effect of a project on any district, site, building, structure, or object that is included in, or eligible for inclusion in, the National Register of Historic Places. The Archeological Resources Protection Act covers the discovery and protection of historic properties that are excavated or discovered on federal lands. The federal government has trust responsibilities to tribes under a government-to-government relationship to ensure that tribal rights are protected. Consultation with tribes helps ensure that these trust responsibilities are met. The HMNF consulted with potentially affected tribes and no tribal concerns were identified for this project. A heritage resource survey was conducted in the Project Area, in accordance with the HMNF's heritage resource guidelines.

Heritage resources are the physical remains left by people who occupied or visited the forest in prehistoric or historic times. These are fragile, non-renewable resources. They include, but are not limited to prehistoric and historic Native American settlements, logging industry related resources, Euro-American pioneer farms or homesteads, and former villages and towns.

The Project Area has had at least 33 previous cultural resource surveys conducted within the Area of Potential Effect (APE). These previous surveys were conducted for other projects such as land exchanges, timber sales, and road easement special use permits. Nineteen cultural resources were identified within the APE during these surveys. Of the nineteen cultural resources identified all are historic sites, and include depressions, homesteads, dumps, and various other historic sites.

The Direct, Indirect, and Cumulative Effects of Implementing Alternatives 1, 2, 3, and 4

The known heritage resource sites would be protected as recommended by the HMNF's archaeologist, and in accordance with State Historic Preservation Office guidelines. Mitigation measures used to avoid disturbance to archaeological sites would be applied to all the Action Alternatives (Chapter 2). These heritage resource mitigation measures are incorporated into the Treatment Unit Cards (Appendix A). If additional heritage resource sites are found during project implementation, project work would cease, a heritage resource professional would be consulted, and adequate protection measures applied.
If these recommendations are implemented, any and all cultural resources within the Project Area will have been documented, protected, and/or removed from the APE. No cumulative effects to heritage resources are expected from these actions.

Social Economics

Resource-Specific Information & Existing Condition

Area of Analysis

The analysis area for this section includes Wexford County. The towns of Boon, Bristol, Dublin, Hoxeyville, Irons, Meauwataka, Skookum, Wellston, and Yuma occur within 10 miles of the Project Area. Only two communities, Boon and Wellston, appear in US Census data, and their combined populations are 478 people. Highways M-37, M-55, and M-115 are within 10 miles of the Project Area. People traveling on these heavily traveled highways provide support and income to Wexford County and nearby community businesses resulting in an economic benefit to the local economy.

The economic analysis for this project does not attempt to analyze all resource values or how economic benefits circulate through the economy indirectly affecting various industries. Many of the values generated by the alternatives (both positive and negative) involve goods and services that are not priced, such as the value of a hunting experience, a hike in the woods, mushroom gathering, etc. Many of the effects of the alternatives on these goods and services are discussed in the other sections of this environmental analysis.

The Project Area provides a mix of commercial and non-commercial uses to local communities. Local communities receive indirect social and economic benefits through direct employment, as well as products and services that are generated from management activities on NFS lands. The proposed timber harvest would generate revenue from timber sale receipts. Sale of the timber products enables forest management objectives to be met and provides local employment with logging and related forest product industries.

Wexford County would directly benefit from the project by receiving 25% payments, Transition payments, as well as Payment in Lieu of Taxes (PILT), as a result of the timber sales that would take place. It is likely that many of the additional economic benefits would occur in the county directly surrounding the Project Area and include all the cities and towns within this county, where contractors and other groups are likely to be drawn from. However, determination of additional economic benefits is difficult to determine since service contracts and other work could be completed by a large slate of operators.

The Forest Service (and the other federal land management agencies) makes payments to local units of government based on receipts from the NFS lands and other lands in federal ownership. Twenty five percent of the actual revenues generated from federal lands, or a formula that determines a transition payment, are returned to counties for roads and schools. In addition, PILT payments are appropriated each year by Congress to help compensate for property taxes due to nontaxable federal lands within the county boundaries. PILT is a means of sharing revenue with counties based on acres of NFS lands.

In fiscal year 2012, 25% payments, Transition payments and PILT payments made to the state of Michigan amounted to approximately $3,825,966. The total payments for fiscal year 2012 made to Wexford County amounted to approximately $185,589, for all three types of payments.

Non-commercial services include dispersed recreation opportunities such as driving for pleasure, hunting, and camping. Recreation is the most popular activity on the HMNF, and a wide range of recreational activities are available from areas across the HMNF that are primitive and non-motorized to those that are highly developed and motorized. High recreation use across the HMNF occurs at developed recreation sites, such as campgrounds and boat launches. Dispersed recreation at undeveloped recreation sites, such as hunting and camping, are also very popular. The nature of the dispersed recreation is that it is flexible and based on the needs of the user and the resources of a piece of land at a given time. The recreation user has an opportunity to choose and enjoy a wide variety of recreation experiences on the HMNF, an opportunity that is not offered on many other public lands.

Recreational opportunities, and other associated projects on NFS lands affects the local economy by promoting tourism. Past land management activities in or near the Project Area enhanced habitat for many game species. Snowmobilers use the motorized trails in the Project Area. The Project Area provides activities such as for hiking, cross-country skiing, mushroom hunting, game hunting, fishing, and horse-back riding for people seeking non-motorized recreation opportunities. These recreational forest users purchase a variety of goods and services in the local communities. Recreational users of the HMNF and the Project Area contribute to the local economy as they pass through or stay and recreate in the area.

The Direct and Indirect Effects of Implementing Alternative 1

Under Alternative 1, none of the proposed vegetative treatments or other activities would be implemented. Alternative 1 would produce no revenue for the federal treasury and would not return 25%, Transition, or PILT payments to Wexford County stemming from the Sheep Dip Project harvest activities (Table 3-32). There would be no monetary cost with implementation of Alternative 1 other than the typical costs associated with managing a national forest, and the administrative costs associated with preparing the environmental analysis for this project. There would be no employment opportunities generated for local people involved in logging or wood products industries.

In the short-term, no change in local jobs or income would result from implementation of Alternative 1. Recreation use of the area would remain the same and would not affect the local economy. The loss of early successional habitats could reduce population of game species which may indirectly affect the local economy through the loss of hunting generated revenue. Game hunting, mushroom hunting, and other recreation activities would continue to provide tourism and income to the local communities.

The Cumulative Effects of Implementing Alternative 1

Implementation of Alternative 1 and similar future actions within the Project Area would not provide an economic benefit to the local economy through timber sale receipts, employment, and income. Implementation of no timber harvesting on the HMNF would represent a change in the current trend of providing jobs to local economies and payments to the county. No harvesting would also result in decreased numbers of game animals with the loss of early successional habitats, resulting in loss of revenues from sport hunters in the area in the long-term.

The Direct and Indirect Effects of Implementing Alternatives 2, 3, and 4

Table 3-32 displays the estimated revenues and costs for activities proposed for the alternatives; however, it does not include the cost of conducting the environmental analysis. These costs are broad estimates and may fluctuate depending on specific treatments. The project costs and revenue estimates are used a comparison of alternatives.

Under Alternatives 2, 3, and 4, timber harvested would provide an economic benefit to the local communities. Direct benefits of the project are the timber products provided, revenue to Wexford County from the timber volume, and the number of people employed to harvest the timber. Costs to the government associated with these alternatives include timber sale planning and preparation, road improvements and reconstruction costs, and wildlife habitat improvement projects. Timber harvest activities would return revenue to the federal treasury and would fund other project activities associated with the timber sale. In Table 3-32, costs for road construction/reconstruction and surveying landlines are included as part of the costs for conducting the timber harvesting activities. While these two activities are crucial to the ability to conduct timber harvesting operations, they also serve larger forest-wide goals of improving and clarifying the Forest's transportation system and of finalizing boundaries between private and federal land.

Because of the limited size of the wildlife habitat treatments and invasive plant control activities, these alternatives would result in little or no effect on local or regional social conditions such as traffic, overcrowding, school size, or crime rates. Similarly, these projects would have no substantial direct or indirect effect on local or regional infrastructure requirements and would create local contract treatment opportunities. The local economy may experience reduced indirect economic costs when short-term visual disturbances results in reduced visitation to an area as the result of road reconstruction and timber harvest activities. The long-term benefit from the timber harvest is that early successional habitat is improved, thereby improving hunting opportunities.

Access to the NFS lands in and surrounding the Project Area and the nearby vicinity provides recreational opportunities and promotes tourism. The snowmobile trail would remain open under all alternatives. This motorized trail provides motorized access and motorized recreation in the Project Area which consequently promotes tourism. Individuals who use this motorized trail likely contribute income to the local businesses resulting in an economic benefit to the local communities. In contrast, forest users who prefer non-motorized recreational activities, such as berry picking, hiking, cross country skiing, hunting, and horseback riding, would be attracted to the non-motorized recreational opportunities in the Project Area. These users would also contribute income to the local businesses as they pass through or stay overnight in the area, resulting in an economic benefit to local communities.

The Cumulative Effects of Implementing Alternatives 2, 3, and 4

Alternatives 2, 3, and 4 would produce revenue for the federal treasury and would return 25 percent payments for schools and roads to Wexford County from the Sheep Dip Project harvest activities (Table 3-32). The HMNF would continue to contribute economically to Wexford

Estimated Costs and Revenues of Alternatives
Table 3-32

Economic Indicator	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Estimated Harvest Acres	0	1,412	1,186	823
Estimates Harvest Volume (ccf)	0	14,120	11,860	8,230
Timber Sale Preparation Costs @ $35/acre	0	$49,420	$41,510	$28,805
Estimated Road Reconstruction Costs	0	$164,800	$164,800	$164,800
Estimated Landlines Costs	0	$60,000	$60,000	$60,000
Total Timber Sale Costs	0	$274,220	$266,310	$253,605
Estimated Sale of Stumpage	0	$296,520	$249,060	$172,830
Net Timber Sale Revenue	0	$22,300	-$17,250	-$80,775
25% Payments to Counties from Timber Sales	0	$5,575	NA	NA
Additional Proposed Costs[1]				
Invasive Plant Control@$200/acre	0	$4,600	$4,600	NA
Waterhole Development@$1,000/per	0	$1,000	$1,000	$1,000
Mechanical Opening Maintenance@$200/acre	0	$20,000	$20,000	$20,000
Broadcast Burning Opening Maintenance@$125/acre	0	$5,250	$5,250	$5,250
TOTALS	NA	**$30,850**	**$30,850**	**$26,250**

[1]*Costs directly related to timber sale activities are shown separately from other project costs.*

County through payments resulting from timber harvesting, thereby providing a continued economic benefit to local communities (Table 3-32). Implementation of Alternatives 2, 3, and 4 would result in positive effects to local economy by continuing current trends of providing timber

products and jobs related to timber harvesting on the HMNF. These actions when considered with past, present, and future actions would continue the trend of providing timber products, employment, recreational opportunities, and income to the local economy. Recreational opportunities are provided under all alternatives within and adjacent to the Project Area and would continue to promote tourism and provide income to local businesses.

Outdoor Recreation

Resource-Specific Information & Existing Condition

Area of Analysis

The analysis area for the direct and indirect effects on outdoor recreation is NFS lands located within the Project Area boundary (identified on the Alternative Maps, Chapter 2). This includes portions of Sections 4-9 and 16-21 of Henderson Township and Sections 1-3, 10-18, and 20-24 of South Branch Township, Wexford County. The activities associated with this project would not be anticipated to have direct or indirect effects on outdoor recreational activities or opportunities outside of this area. The area of analysis for the cumulative effects on outdoor recreation for this project is all lands within the Manistee National Forest. This area was selected as it would be within a one day commuting distance for those using the Forest for outdoor recreation.

Forest Plan Management Direction

The following are excerpts from the HMNF Forest Plan and provide guidance on the management of the resources for outdoor recreation within the specific management areas located within the Project Area.

Management Area 2.1 (Roaded Natural Rolling Plains and Morainal Hills)
(Forest Plan, III-2.1-1 through 1-3)

Purpose: A broad variety of recreational opportunities is available.

Goals and Objectives:

- Provide moderate amounts of motorized recreational opportunities.
- Provide moderate amounts of non-motorized recreational opportunities and a moderate number of developed recreation sites.
- Provide a roaded natural recreational experience.

Desired Future Condition: "…Human activities are evident and interaction among users is moderate. There are restrictions and controls on the area's use. Users are aware of services provided, such as developed recreation sites, law enforcement and visitor information…The area will provide roads and trails appropriate for motorized and non-motorized uses. Road closures are evident."

There are approximately 9,023 acres of NFS lands within MA 2.1 in the Project Area.

Management Area 8.1 (Wild and Scenic Rivers)
(Forest Plan, III-8.1-1 through 1-4)

Pine National Scenic River Description: In March 1992, 26 miles of the river were classified as a National Scenic River. The classified segment is located in the northern part of the Manistee National Forest, 20 miles southwest of Cadillac…. The National Scenic River Management Plan also includes a segment of the Pine River from the terminus of the designated section to Low Bridge (2.5 miles of river)….Direction for the Pine National Scenic River (designated by Act of Congress in 1991, P.L. 102-249), Standards and Guidelines and possible projects are contained in the Pine River Management Plan, dated September 1, 1995, or as updated.

Purpose: Management of the congressionally designated wild and scenic river corridors will protect unique areas that have outstandingly remarkable values such as scientific, biological, geological, historical, or recreational characteristics of local, regional, or national significance.

Goals and Objectives:
- Maintain the outstandingly remarkable values of each river for which they were designated under the Wild and Scenic Rivers Act.
- Management direction is established by each river's management plan.

Desired Future Condition: "Management direction will follow approved management plans for designated Wild and Scenic Rivers protecting the unique features of the rivers…"

There are approximately 570 acres of NFS lands within MA 8.1 in the Project Area.

Management Area 8.3 (Experimental Forests)
(Forest Plan, III-8.3-1 through 3-2)

Pine River Experimental Forest Description: This 2,785 acre unit was established in December 1954. This area provides a land base for research to study various timber management techniques.

Purpose: Management of designated Experimental Forests will provide a land base for research activities.

Goals and Objectives:
- The experimental forests will be managed as a roaded natural setting.

Desired Future Condition: "Management direction for Experimental Forests is established by the North Central Research Station, St. Paul, MN.

In addition, the Standards and Guidelines related to recreation are listed in the Forest Plan (II-11 thru II-15, III-2.1-4, and III-8.1-4).

There are approximately 2,125 acres of NFS lands within MA 8.3 in the Project Area.

Recreation Opportunity Spectrum

To ensure that Forest users are provided with a variety of outdoor recreational opportunities the Forest Service utilizes the Recreation Opportunity Spectrum (ROS). The ROS system classifies NFS lands as either primitive, semiprimitive non-motorized, semiprimitive motorized, roaded

natural, or rural. The majority of NFS lands within the Project Area are classified as Roaded Natural. This classification is the most common on the HMNF (FEIS, III-275) and has the characteristics outlined in Table 3-33.

Characteristics of Roaded Natural
Table 3-33

ROS Class	Setting	Activities - Facilities
Roaded Natural	• Opportunity to affiliate with other users in developed sites but with some chance for privacy. Self-reliance on outdoor skill of only moderate importance. Little challenge or risk. • Mostly natural-appearing environment as viewed from sensitive trails and roads. • Interaction between users at campsites is of moderate importance. • Some obvious on-site controls of users. • Access and travel is conventional motorized including sedans, trailers, recreational vehicles, and some motor homes. • Vegetative alterations done to maintain desired visual and recreational characteristics.	• Access for people with disabilities is of only "MODERATE" challenge. • Rustic facilities providing some comfort for the user as well as site protection. Use native materials, but with more refinement in design. Synthetic materials should not be evident. • Moderate site modification for facilities. • Interpretation through simple wayside exhibits. Use native-like materials with some refinement in design. Some casual interpretation by Forest staff.

Existing Condition

In comparison to other portions of the Manistee National Forest, this Project Area is unique, in that, it consists primarily of contiguous NFS lands, on highly productive morainal hills, with the major developments dedicated to outdoor recreation. The opportunities within the Project Area exist throughout the year and offer a wide variety of experiences.

Dispersed recreation is that which is not associated with the development, maintenance, or use of facilities designed for outdoor recreational use. Within the Project Area, the use of NFS lands for dispersed recreation is commonplace and occurs throughout the year. These uses include mushroom gathering and wildflower viewing in the spring, berry collecting, paddling, and hiking in the summer, hunting for deer and small game in the fall, and snowshoeing and cross-country skiing in the winter. During the non-winter months, driving for pleasure (especially during the fall color tour) and dispersed camping are also popular recreational activities throughout the Project Area.

Developed recreation is that which is associated with the development, maintenance, and use of facilities designed for outdoor recreational use. Within the Project Area, the largest investment by the Forest Service is associated with the day-use site along the Pine River (Peterson Bridge, Dobson Bridge). Capital improvement funds were obtained and used in 2009 to improve the parking lot, install a new boat launch, place a new pit toilet, and upgrade the existing infrastructure for accessibility and to support the high levels of use that occur on the river during the summer months. The Pine is a congressionally designated Wild and Scenic National River

that is a destination for paddlers and anglers alike and these sites serve as primary access points on the river for liveries and the public. Within the Project Area, the majority of the outdoor recreational use during the summer months is associated with the Pine River and occurs within its corridor. The portion of the Pine River that is within the Project Area is approximately 4 miles. This represents approximately 15% of the 26 miles within the Forest boundary (FEIS, III-276).

In addition to the day-use site at Peterson Bridges, the Forest Service also maintains the Caberfae Trailhead. This trailhead is at the intersection of M-55 and 13 Road and includes two pit toilets, a parking lot, and the associated features to service those accessing the snowmobile and motorcycle trails.

There are approximately 15.5 miles of snowmobile trail within the Project Area. This represents approximately 4.7% of the 332 miles of snowmobile trail on the Manistee National Forest. This portion of the trail is referred to as MDNR Trail #6 and #37 and is maintained and groomed by Cadillac Winter Promotions and Wellston Winter Trails and Promotions through funding provided by the State of Michigan. The trails in this area serve as part of a larger trail network that connects to Wellston, Irons, Baldwin, Manistee, and Cadillac. The snowmobile trail is open from December 1 through March 31, occurs primarily on forest roads, and receives moderate to high amounts of use when snow conditions allow. The portion of the trail within the Project Area is particularly popular due to the rolling hills and contiguous NFS lands.

Also associated with the Caberfae Trailhead is the MCCCT, an approximately 1,200 mile motorcycle trail that runs through the lower peninsula of Michigan. There is approximately 3.6 miles of this trail with the Project Area, which is maintained by the West Michigan Trail Riders through funding provided by the State of Michigan. This is 1.6% of the approximately 226 miles of motorcycle trail on the Manistee National Forest. This single-tread trail is maintained for a tread of 24 inches, a handlebar width of 40 inches, and a height of 10 feet. The trail is designed for highly-skilled technical riders and receives low to moderate amounts of use during the riding season (April through October). In addition to the designated motorcycle trail, Wexford County approved the use of OHVs on their county road system in 2009. This has provided a recent increase in recreational opportunity throughout the county for OHV enthusiasts.

The Forest Service also maintains the Mackenzie Cross Country Ski and Mountain Bike Trail System in the northwest portion of the Project Area. This approximately 10 mile (9.5 miles within the Project Area) trail system receives low amounts of use throughout the year, with most of the use related to local seasonal residents or those associated with the adjacent resort. Other infrastructure associated with the site includes signage, a gravel parking lot, a pit toilet, a picnic table, a bulletin board, and a grill. There are currently no groups associated with the maintenance or grooming of this trail system, though the Forest Service would consider this should a group be identified.

Within the Project Area there are two private resorts which provide services to recreationists throughout the year. In addition to food and lodging, the resorts offer formal opportunities for downhill skiing, cross-country skiing, snowshoeing, and hiking. Additional private businesses in the Project Area include campgrounds, boat liveries, restaurants, and a gas station. Other private property in the Project Area include small tracts along the Pine River that are used seasonally or as year round residential properties and larger blocks and larger tracts that are mostly undeveloped and used for hunting.

Conclusion

As it relates to recreation on NFS lands within the Project Area, the primary purpose is to make a broad variety of opportunities available. This purpose is currently being met through a combination of motorized, non-motorized, dispersed, and developed opportunities. The existing setting and facilities are consistent with the Roaded Natural classification.

The Direct and Indirect Effects of Implementing Alternative 1

As identified in Chapter 1, the Purpose and Need for this project is not related to the creation, modification, or enhancement of outdoor recreation opportunities within the Project Area. As a result, no actions were proposed relating specifically to these opportunities under any of the alternatives. Therefore, any effects on recreation on NFS lands within the Project would occur as a result of the actions proposed to meet other resource objectives.

Under Alternative 1, the use of NFS lands for dispersed recreation would continue to be commonplace and occur throughout the year. Activities would continue to include mushroom gathering and wildflower viewing in the spring, berry collecting, paddling, and hiking in the summer, hunting for deer and small game in the fall, and snowshoeing and cross-country skiing in the winter. During the non-winter months, driving for pleasure (especially during the fall color tour) and dispersed camping would continue to be popular recreational activities throughout the Project Area.

Within the Project Area, the largest investment by the Forest Service would continue to be associated with the day-use site along the Pine River (Peterson Bridge, Dobson Bridge). Within the Project Area, the majority of the outdoor recreational use during the summer months would be associated with the Pine River corridor.

Under Alternative 1, the Forest Service would continue to maintain the Caberfae Trailhead and there would continue to be approximately 15.5 miles of snowmobile trail within the Project Area. MDNR Trails #6 and #37 would continue to be maintained and groomed by the Cadillac Winter Promotions and Wellston Winter Trails and Promotions with funding provided by the State of Michigan. The snowmobile trail would continue to be open from December 1 through March 31 and occur primarily on forest roads.

The MCCCT would continue to be associated with the Caberfae Trailhead. The mileage and characteristics of this trail within the Project Area would remain the same and it would continue to be maintained by the West Michigan Trail Riders through funding provided by the State of Michigan.

There would be no changes to the Mackenzie Trail System. The mileages, types, and amounts of use would remain similar to what they have been in the past. Administrative changes in the existing infrastructure would continue to occur based on the recreational use patterns. The FS would continue to seek out potential partners to assist in the maintenance and grooming of the trails.

The Direct and Indirect Effects of Implementing Alternatives 2, 3, and 4

Under all of the Action Alternatives, those that utilize NFS lands within the Project Area for dispersed recreational activities would be directly impacted during the period of time that

management activities occur. The timing, location, and activities associated with dispersed recreation would continue to be highly variable. Due to this variability in use patterns, dispersed recreationists would be displaced from specific areas during timber harvest operations, opening maintenance activities (prescribed burning), herbicide applications, and due to the changes in the management of the transportation system. These effects would be more pronounced under Alternatives 2 and 3, less pronounced under Alternative 4, and not last beyond the length of time required to complete the management actions.

Indirectly, the proposed activities would also impact dispersed recreationists, as the resulting changes to other resources would displace users from one location within the Project Area and provide for them in another. While those recreationists relying on early-age successional habitat would be provided for under the Action Alternatives and would likely come into the area to recreate, those who rely on contiguous blocks of more mature forest types would be displaced to other areas. In specific treatment areas, those recreationists with a favorite dispersed campsite, hunting spot, or mushroom gathering area would be affected based on how the individual treatments would affect their particular activity and/or sense of place. These effects would be more pronounced under Alternatives 2 and 3, less pronounced under Alternative 4, and last beyond the duration of the management actions under all of the Action Alternatives.

Under all of the Action Alternatives, the largest investment within the Project Area by the Forest Service would continue to be associated with the day-use sites along the Pine River (Peterson Bridge, Dobson Bridge). Within the Project Area, the majority of the outdoor recreational use during the summer months would be associated with the Pine River corridor. The activities associated with these alternatives would not impact this use.

The Forest Service would continue to maintain the Caberfae Trailhead and there would continue to be approximately 15.5 miles of snowmobile trail within the Project Area. MDNR Trails #6 and #37 would continue to be maintained and groomed by the Cadillac Winter Promotions and Wellston Winter Trails and Promotions with funding provided by the State of Michigan. The snowmobile trail would continue to be open from December 1 through March 31 and occur primarily on forest roads. Under all of the Action Alternatives, there would be approximately 3 miles of trail that would have timber harvesting activities occurring adjacent to the trail. It would be likely that the snowmobile trail would be needed for the hauling of timber products throughout the Project Area. Trails utilized for this purpose would be brought up to standard prior to the start of the snowmobile seasonal and mitigation measures would be used in these areas to minimize the impacts to the trail and to prevent mixed traffic on the trails during the snowmobile season (see Treatment Unit Cards - Appendix A).

The MCCCT would continue to be associated with the Caberfae Trailhead. The mileage and characteristics of this trail within the Project Area would remain the same and it would continue to be maintained by the West Michigan Trail Riders through funding provided by the State of Michigan. Approximately 0.5 miles of trail would have timber harvesting or opening maintenance activities occurring adjacent to the trail. During these activities, posting and signage would be used along the trail and mitigation measures would be used to reduce conflicts and protect the integrity of the trail (see Treatment Unit Cards - Appendix A).

There would be no changes to the Mackenzie Trail System. The mileages, types, and amounts of use would remain similar to what they have been in the past. Administrative changes in the existing infrastructure would continue to occur based on the recreational use patterns. The FS would continue to seek out potential partners to assist in the maintenance and grooming of the trails.

The Cumulative Effects of Implementing Alternatives 2, 3, and 4

Combined, the HMNF consists of approximately 970,000 acres within a proclaimed boundary of approximately 2,021,000 acres. The proclaimed boundary of the Manistee National Forest is approximately 1,328,000, with about 535,000 acres (40%) being NFS lands. The majority of these lands were purchased from private landowners under the Weeks Act in the 1930s. Other portions were acquired through state and private land-for-land exchanges. At the time of acquisition, the primary activities associated with the management of the Forest were focused on reforestation. Recreation on the Forest consisted primarily of hunting and fishing. Private lands consisted mainly of large tracts dedicated to agriculture.

In addition to hunting and fishing, outdoor recreation on the Forest now includes a wide variety of other dispersed opportunities and developed sites. Across the Forest, dispersed opportunities include such activities as camping, hiking, forest product gathering, wildlife watching, snowmobiling, cross-country skiing, hiking, mountain biking, horseback riding, and canoeing. Developed sites include various types of trailheads, boating sites, camping facilities, beaches, picnic areas, fishing sites, information and observation sites, and others. To assist in determining the type and amount of recreational opportunities and facilities in a particular area, the Forest utilizes the ROS (discussed above) in conjunction with the Forest Plan's management area direction and the associated Standards and Guidelines. Currently, in addition to recreation, the primary activities on the Forest include timber and fuels management, wildlife and fisheries habitat management, and special-uses. The private property within the proclaimed boundary has become more fragmented, as larger parcels are divided and sold.

The interface between the implementation of the management activities on NFS lands and recreational use has occurred historically and would continue to occur in the future. These are considered on an individual basis and mitigation measures are established accordingly. Recent and upcoming examples of this include timber harvesting within Seaton Creek Campground, adjacent to the Mackenzie Cross-Country Ski and Mountain Bike Trail parking lot and trail, and adjacent to the Big M Cross-Country Ski and Mountain Bike Trail, the North Country National Scenic Trail, and the Marzinski Horse Trail. Partner groups and individuals are accustomed to working and recreating in an environment where multiple-uses are occurring simultaneously on NFS lands. The activities proposed in this project are similar to those that have occurred in the past, with the mitigation measures serving to protect against user-conflicts, while preserving user-enjoyment.

In the reasonably foreseeable future, recreational opportunities on the Forest will be provided based on ROS classes, emerging recreational trends, and operational budgets. Within the Roaded Natural Class, the Forest will continue to provide dispersed opportunities and developed sites with an emphasis on the areas of highest use. Impacts from recreational use and the demand for additional facilities and amenities are expected to continue to increase. Other activities on the Forest (such as timber and fuels management, wildlife and fisheries habitat management, and special-uses) will continue and there will continue to be a need to mitigate for recreational use during the implementation of these activities. The development of private land to commercial and residential uses throughout the Forest is expected to increase. With this increase in development there will be an increase in the seasonal and permanent population. This larger population will place an increase in the demand on recreational opportunities and facilities across the Forest.

Conclusion

Under all of the alternatives, a variety of opportunities would continue to be provided through a combination of motorized, non-motorized, dispersed, and developed outdoor recreation. The resulting setting and facilities would continue to be consistent with the Roaded Natural classification.

Scenery Management
Resource-Specific Information and Existing Condition

Forest Plan Direction

For all management areas, the Forest Plan (2006) lists the following guideline (page II-15):

XII. Visual Management
   A. All management activities should meet or exceed the Scenic Integrity Objectives established for the Forests through Scenery Management System outlined in "Agriculture Handbook 701, Landscape Aesthetics - A Handbook for Scenery Management."

The following information relates to the processes of consideration that are outlined in the handbook and how they apply to the Sheep Dip Project Area.

Landscape Character Elements

Landscape character is a combination of physical, biological, and cultural attributes that give a geographic area its visual and cultural image, and often, unique character. Landscape character represents different attributes of landform, vegetation, surface water features, and cultural features that exist throughout the area of interest.

Landform: The Forest uses an ecological classification system to describe the landforms that are within it. On a landscape scale, the most appropriate descriptor is the LTA. The most evident LTA within the Project Area is LTA 3 or sandy morainal hills. These consist of moderately developed well-drained sands on slopes from 0 to 40% (NRCS Soil Web Survey 2013) and make up approximately 85% of the Project Area.

Vegetation: The ecological classification system links the dominant vegetative types to the prevalent landtypes. Based on this, the dominant predicted vegetative types throughout the Project Area would include long-rotation conifers and hardwoods, with areas that are non-forested. In addition, other minor vegetative types based on the other LTAs present would include short-rotation conifers, aspen, and oaks. Table 3-3 is illustrative of the existing vegetation within the Project Area.

Currently, the vegetative classes and the amount present are consistent with the dominant LTAs present within the Project Area.

Water Features: Water serves as an important landscape character element. Within the Project Area, water features include Johnson Creek and the Pine National Wild and Scenic River (Pine River). Of these, the Pine River has the greatest influence on the scenic integrity within the Project Area. There are approximately 570 acres of Wild and Scenic River (MA 8.1) within the

Project Area, located between Dobson and Peterson Bridges. Related to the LTAs and vegetative characteristics of this stretch of river, the Pine National Scenic River Environmental Assessment and Management Plan (River Plan) (1995) describes it as follows:

> "Morainal hills blend with clay hills and plains (LTA 6) between Elm Flats and Peterson Bridge. Soils in the riverbed and adjacent corridor are generally sandy, but contain several clay lenses characteristic of soils within LTA 6. Northern hardwood forests still predominate, with aspen dominating the top of terraces and occupying a larger niche in the overall forest composition. Bigtooth aspen, black oak, and northern white cedar also increase on the first terrace of the river. The highest densities of northern white cedar occur between Dobson and Peterson Bridge. Shrubby species on the riverbanks are mainly willows, dogwoods, high bush cranberry, and alder." (page III-2)

The Outstanding Remarkable Values for which the Pine River was designated include both recreation and scenic values. The latter is described in the River Plan as follows:

> "Scenery is one of the most outstanding attributes of the Pine River. The designated portion of the river contains a unique riparian landform for the Lower Michigan region with its deeply incised river channel and high, exposed sand banks. Diverse vegetation also contributes to the river corridor's high scenic quality. Tree species vary from cedar-hemlock, ash, elm, sugar and red maple and basswood in the lowlands, to upland sites with stands of mixed oak, pine, aspen. Understory vegetation such as wild grape, thorn apple, tag alder, and willow provide cover for wildlife and protection of river banks. There are also small openings scattered throughout the corridor that provide visual diversity among the hardwood and pine forested borders. The vegetation along the Pine offers an interesting variety of form, texture, and color with the change of seasons." (page I-4)

The vegetative and scenic descriptions presented in the River Plan are still accurate and consistent with what exists within the river corridor portion of the Project Area today.

Cultural Features: Starting in the 1800s, the cutting of native forests, the establishment of agriculture, and the alteration of natural drainage patterns have affected the vegetative patterns throughout the Project Area. Red and white pine planting, fire suppression, and the harvest of forests became commonplace after the establishment of the Manistee National Forest in the 1930s; private and public land ownership became intermingled. The management of NFS lands focused on maintaining high amounts of forest cover, while private land remained more open. Other elements, such as utility rights-of-way, gas and oil wells, and roads became part of the landscape character.

Classification of Landscape Character

Landscape character descriptions are a way to measure landscape characteristics based on human perception of the intrinsic beauty of landform, water characteristics, vegetative patterns, and cultural land-use.

Distinctive: Landscapes associated with a combination of water features and high visibility and little to no evidence of other development.

Typical: Landscapes associated with a combination of topographical features, vegetative variances, and minor evidence of other development.

Indistinctive: Landscapes with little topographical or vegetative variance and evidence of other developments are common.

The landscape character description is also used as a reference for the scenic integrity of all lands. Scenic integrity indicates the degree of intactness and wholeness of the landscape character. Conversely, scenic integrity is a measure of the degree of visible disruption of the landscape character. A landscape with very minimal visual disruption is considered to have high scenic integrity. Those landscapes having increasingly discordant relationships among scenic attributes are viewed as having diminished scenic integrity. Scenic integrity is expressed in terms of very high, high, moderate, low, very low, and unacceptably low.

- Very High: Landscapes are unaltered with no deviation from the landscape character; landscape character is fully expressed.
- High: Landscape appears unaltered, with deviations subtle and not evident; landscape character is largely expressed.
- Moderate: Landscape appears slightly altered, with deviations beginning to dominate; landscape character is moderately expressed.
- Low: Landscape appears moderately altered, and deviations may be strongly dominant; low expression of landscape character.
- Very Low: Landscape appears heavily altered, and deviations may be strongly dominant; very low expression of landscape character.
- Unacceptably Low: Landscape is extremely altered, with deviations extremely dominant; landscape character is unrecognizable.

Based on the landscape character description, a numerical scenic class-rating is assigned to all lands. These ratings, 1-7, indicate the relative scenic importance, or value, of discrete landscape areas.

- Scenic Classes 1 and 2: High Public Value
- Scenic Classes 3 to 5: Moderate Public Value
- Scenic Classes 6 and 7: Low Public Value

Based on the above criteria, Table 3-34 summarizes the existing conditions of the scenic quality for the MAs within the Sheep Dip Project Area.

Conclusion

While the NFS lands within the Project Area contain some components of the landtype, vegetation, water features, and cultural features for a higher level of scenic integrity, the evidence of past management activities, major and minor developments, and fragmentation reduce the overall rating to one of low to moderate.

Area of Analysis

For this analysis, the scenic integrity of the Project Area is considered as the result of the interrelationship of the landscape character elements as viewed from existing travel ways and use areas, using typical on-the ground observer positions. For the direct and indirect effects, this would be limited to the NFS lands within the Project Area, as the Forest Service only has the jurisdiction to alter or manage for these elements on these lands. For the cumulative effects, consideration will be given to all lands (private and NFS), as they all contribute to the viewshed of the Project Area.

Existing Scenic Quality within the Sheep Dip Project Area
Table 3-34

Element	Management Area	Description	Rationale
Land Area (approximate)	2.1 and 8.3	11,148 acres	NFS lands in these MAs within the Project Area boundary.
	8.1	570 acres	Surveyed corridor boundary within Project Area.
Classification of Landscape Character	2.1 and 8.3	Typical	NFS lands have varying topography and vegetative types and other developments are noticeable.
	8.1	Distinctive	Corridor offers a combination of water, high visibility, and little evidence of development.
Scenic Class	2.1 and 8.3	3	The high level of recreational use (motorized and non-motorized) indicates that the public places a moderate value on the scenic importance.
	8.1	1	The amount and type of use on the Pine River indicates a high level of value from the public.
Scenic Integrity	2.1 and 8.3	Low to moderate.	Evidence of past forest management activities, major and minor roads, power lines, and private developments are intermingled with NFS lands.
	8.1	Moderate	Evidence of past management activities (i.e. rollways, harvest/ plantings, erosion controls, and roads) and private developments are evident within the corridor.

The Direct and Indirect Effects of Implementing Alternative 1

Under Alternative 1, the scenic integrity of NFS lands within the Project Area would change slowly, affected only by natural events. Within MAs 2.1 and 8.3, the landscape character would remain typical as there would be little noticeable change to the topography or vegetation. Any change would occur through natural processes over time or through periodic and infrequent events. The scenic class would remain at a level 3 (of moderate public value), as it would continue to be similar to other general forest areas. Scenic integrity would continue to be considered low to moderate as past forest activities would remain visible. The pattern of spatial and temporal disturbances from past tree planting, aspen clearcuts, upland opening maintenance, road developments, and power line corridors would generally provide a landscape of low to moderate interest. Scenic classes of lower interest would predominate where dense, unthinned plantations and even-aged oak and aspen forests are abundant, and would be interspersed with areas of higher scenic class value where non-forest areas or larger-diameter trees occur. Foreground landscape views would remain fragmented, and opportunities to view desired scenic elements would be infrequent. A low expression level of scenic characteristics, such as intermixed forests of oaks, white pine, and hardwoods, would be common across the landscape and the potential for distinctive characteristics would decline as trees begin to encroach into the existing non-forested areas. This would be especially noticeable along the M-55 corridor and the designated motorized trail systems within the Project Area.

The Direct and Indirect Effects of Implementing Alternatives 2, 3, and 4

Of the four elements considered in scenery management (landform, vegetation, water features, and cultural features), the vegetation would be the one most directly affected by the Action Alternatives. Timber harvesting activities would create variations within and adjacent to the stands proposed for these activities. These variations would be most evident under Alternative 2, which offers the maximum acres of timber harvesting (1,168 acres) and includes the shelterwood (314 acres) and overstory removal (119 acres) harvests of conifer plantations. In the short-term, the shelterwood treatment would visually provide a more open landscape of greater scenic contrast. As the understory in these areas naturally fills in, there would be another visual shift to a multi-layered forest of varying species composition. This would also occur under Alternative 3, though to a lesser extent. Under Alternative 4, no conifer shelterwood or overstory removal harvests would occur and these areas would visually remain as they are now, conifer plantations with varying levels of understory development.

In addition, all of the Action Alternatives would provide similar levels of aspen clearcutting and opening maintenance/creation. In clearcut areas, there would be an immediate and highly discernible visual impact, as these areas would visually shift from mature forest to open areas with reserve trees. This would be most evident in the southwest portion of the Project Area. Opening maintenance and creation activities would occur throughout the Project Area. The level of visual impact that these activities would have would be dependent on the existing condition and level of woody encroachment within the individual opening. In the areas where trees and shrubs have become well-established, the maintenance/creation activities would be more evident. Again, these effects would be more pronounced along the major travel corridors within the Project Area (i.e. M-55, county and forest roads, and motorized trail systems).

In summary, under the Action Alternatives, the NFS lands within the Project Area that is within MAs 2.1 and 8.3 would remain typical. The proposed vegetative treatments would increase diversity, especially in areas of monoculture plantings. Clearcut and opening

maintenance/creation areas would provide noticeable contrast to areas of mature forest. These activities would not shift the scenic class within this MA and would be consistent with a scenic integrity of a low to moderate level. This would be due to a combination of the visible effects of management activities (i.e. timber harvesting and temporary road construction), the continued presence of other major and minor roads, adjacent private developments, and other utilities (i.e. power lines). The proposed activities would serve to increase the interest of the scenic class, as areas are thinned, non-forested areas become defined, larger-diameter trees occur, and the field-of-view for the forest visitor increases.

In MA 8.1, under all alternatives, the landscape character would continue to be distinctive through the presence of the Pine River, the high visibility that is afforded due to the high bluffs, and the limits of active forest management activities within the designated corridor. Scenic changes within the corridor would be related to natural processes, the dominant force being that of the river. The scenic class would remain at a level 1 (of high public value), as the scenic characteristics represented by the corridor become less represented in other areas. The scenic integrity would remain moderate, as the evidence of past management activities (i.e. rollways, harvest/plantings, erosion controls, and roads) and private developments would remain evident within the corridor.

The Cumulative Effects of Implementing Alternatives 2, 3, and 4

In the past, in portions of this Project Area, the management of NFS lands has included an emphasis in maintaining visual quality. Specifically, the M-55 Scenic Corridor (1984) was identified and specific management objectives were established to guide the management activities adjacent to the state highway that bisects the Project Area. While this has since been superseded by the guidance provided in *Agriculture Handbook 701, Landscape Aesthetics* through the Forest Plan, the characteristics that identified this area as a scenic corridor then, remain intact: a combination of attributes related to the landtype, vegetation, water, and cultural features.

Land ownership patterns throughout the Project Area are unique for the Manistee National Forest; in that, most of the Project Area consists of contiguous blocks of NFS lands. As a result, the past and present management activities on these lands can have a greater influence on the scenic integrity. As the majority of the Project Area is in MA 2.1 (Roaded Natural-9,023 acres) or 8.3 (Experimental Forest-2,025 acres) those traveling through and utilizing the Forest for recreation are accustomed to the visuals associated with active forest management (i.e. timber harvests, road construction, etc.). These activities (on both NFS and private lands) are likely to continue to be evident throughout the Project Area in the future.

Individual visual interpretations throughout the Project Area have been and will continue to be influenced by how people are utilizing the resources. In this area, the highest level of visual interpretation comes through people traveling through the Project Area on M-55 (~7 miles). In addition, visitors also utilize the area for motorized recreation (snowmobile trails, motorcycle trail, and driving for pleasure). Non-motorized use includes such activities as canoeing, kayaking (Pine River), and downhill and cross-country skiing (resort). For all of these recreational activities, the amount of time individuals spend within any one particular area is limited by the nature of the activity and users are required to focus their attention on what is directly in front of them. These recreational trends are expected to remain consistent in the reasonably foreseeable future.

Conclusion

Under all of the alternatives considered in this project, the Project Area would continue to contain some components of the landtype, vegetation, water features, and cultural features for a higher level of scenic integrity. The combination of past management activities, major and minor developments, and fragmentation would continue to be consistent with a low to moderate rating.

Transportation

Existing Condition & Resource-Specific Information

The analysis area for direct and indirect effects for transportation includes all NFS lands within the Project Area which encompasses compartments 11, 12, 13, 14, 15, 81, 83, 86, 87, and 88 of the Cadillac-Manistee Ranger District in Henderson and South Branch Townships, Wexford County, MI.

The analysis area for cumulative effects for transportation includes Forest Service compartments directly adjacent to the Project Area and includes compartments 5, 6, 7 10, 16, 17, 18, 19, 29, 80, 82, 84, 85, 89, 94, 98, and 99. This area would include all roads found directly in the Project Area and also those roads that would be utilized for management activities including vehicle activity associated with timber sales and other management activities.

There are approximately 66 miles of roads open in the Project Area according to the HMNF's GIS database. This amounts to approximately 3.2 miles per square mile (i.e. 21 sq. mi. / 66 road miles). There are approximately 51 miles of roads open in the Project Area when considering just Forest Service lands according the HMNF's GIS database. This amounts to approximately 2.8 miles per square mile (i.e. 18 sq. mi. / 51 road miles). When we look at the CEA, there are approximately 150 miles of roads open in the Project Area according to the HMNF's GIS database. This amounts to approximately 2.5 miles per square mile (i.e. 60 sq. mi. / 150 road miles).

Standards and guidelines found in the forest-wide management area direction for transportation system management can be found in the Forest Plan (page II-39-40). The first guideline stated under this section states that there is a need to "Identify Forest Service existing roads and determine those needed for administration and public use. Roads not needed will be obliterated." There is another guideline stated in this section that "Collector and local roads will be designed and constructed to transport forest products, to accommodate planned motorized recreation use, and to accommodate administrative traffic." According to Forest Plan standards there needs to be "Complete obliteration of temporary roads within one year after the need for them has ceased."

The Forest plan also has a guideline for the maximum average of miles of road per square mile by management area for all road classes. There are no management standards or guidelines for the transportation system in MAs 8.1 and 8.3. The road density goal for MA 2.1 is between 0 and 3 miles of all roads per square mile.

Forest Plan standard and guidelines specifically for MA 2.1 the Forest Plan states in the *Goals and Objectives* section that the area should provide a roaded natural recreation experience. Furthermore, the Forest Plan also states in the DFC that the area will provide roads and trails appropriate for motorized and non-motorized uses and that road closures are evident.

Due to the institution of the Travel Management Rule for the HMNF, the transportation system was analyzed in detail. The Forest Service Engineering staff drove, mapped and catalogued, and made recommendations for every Forest Service road within the Project Area. Roads that are wholly or partially within or adjacent to NFS lands, and that are determined to be needed for long-term motor vehicle access, including state roads, county roads, privately owned roads, NFS roads, and other roads authorized by the Forest Service are identified on the Forest's Motor Vehicle Use Map (MVUM). As a result of this roads analysis, there are a wide variety of activities prescribed for the transportation system of the Project Area (Table 3-35). The majority of forest roads now found in the Project Area are required to complete the harvesting activities as well as provide important access roads and control lines for firefighting forces. The roads that are scheduled to be obliterated are those that the roads analysis found to be unneeded, serve a purpose already filled by another road, or are causing resource damage.

Road management effects both forest management and public use of an area, and influences resource damage and protection. Road construction or reconstruction is designed to provide long-term access into an area at the minimum level necessary to meet resource and protection objectives. Design standards, seasonal restrictions, and road closures are all opportunities to influence the use of an area.

The Direct and Indirect Effects of Implementing Alternative 1

There would be no changes made to the roads in the Project Area. All NFS roads that are currently open would remain open. All NFS roads that are currently closed would remain closed. The open roads would continue to be minimally maintained. The NFS roads would be subject to closure at any time in accordance with the Forest Plan and the Travel Management Rule.

Proposed Road Activity by Length and Cost for All Action Alternatives
Table 3-35

Road Activity	Alternative 2		Alternative 3		Alternative 4	
	Length	Cost	Length	Cost	Length	Cost
Construction – Level 2[1]	0.3	$11,200	0.3	$11,200	0.3	$11,200
Reconstruction – Level 1[2]	0.8	$14,600	0.8	$14,600	0.8	$14,600
Reconstruction – Level 2	7.5	$109,300	7.5	$109,300	7.5	$109,300
Closure – Level 2	0.7	$525	1.2	$900	0	0
Redesignation – Level 1 to Level 2	0.5	NA	0.5	NA	0.5	NA
Redesignation – Level 2 to Level 1	1.1	NA	1.1	NA	0	NA
Totals	**10.9**	**$135,625**	**11.4**	**$136,000**	**9.1**	**$135,100**

[1]*Level 2 roads are open to the public.*
[2]*Level 1 roads are for Forest Service use only.*

The direct effects of taking no action would be that the public would continue to be able to utilize the current roads throughout the Project Area. People that use the Project Area for recreation or access to homes would experience no displacement or loss of access. As population trends increase around the Project Area, and use increases within the Project Area, the roads would receive heavier use. This use may lead to more erosion and resource damage on the minimally maintained NFS roads. Additional roads within the Project Area would likely be created, due to the increase in use.

The Cumulative Effects of Implementing Alternative 1

Historically, the transportation system throughout the Project Area was used mainly for logging and transporting local people and agricultural commodities. Scattered throughout the Project Area are old railroad grades. These old railroad grades were used primarily for extracting timber from the area. As the land was cleared and converted to agricultural land, some of the railroad grades were converted into the current road system. Since that time, the land has converted back to forested land. The Forest Service has used some of the existing roads and built needed roads in the area for modern day logging operations. Some of these roads have remained open after harvesting and others have been closed.

The Direct and Indirect Effects of Implementing Alternative 2

Approximately 0.3 miles of permanent roads would be constructed either to access harvest units that currently have inadequate access, or to correct existing roads that have issues relating to the ownership of the present rights-of-way (Table 3-35). All of these newly constructed roads would be open to the public (Level 2). In addition, approximately 0.5 miles of roads currently open only to Forest Service administrative use (Level 1) would be designated as Level 2 roads, and, therefore, open to the public for use. This would result in an increase of approximately 0.8 miles of additional roads open for public use. This increase in newly constructed or redesignated roads open to the public would be offset by the closure of approximately 0.7 miles of Level 2 and the redesignation of approximately 1.1 miles of from Level 2 to Level 1 roads. This would result in a net loss of approximately 1 mile of road currently open to public use.

Some roads may need to be reconstructed to access the harvest units or improve the quality of the road system. Minor adjustments in road clearing limits or realignment of the existing roads may be necessary to accommodate harvesting equipment. Road reconstruction activities would impose short-term visual impacts because of the cleared vegetation, exposed mineral soils, and the presence of heavy equipment. There is approximately 8.3 miles of road requiring some type of reconstruction. Of these roads that are already in existence, approximately 7.5 miles are part of the MVUM that has been prepared for the HMNF and are open for public use. The remaining approximately 0.8 miles of road reconstruction are on roads to be used for Forest Service administrative use only.

Negative visual impacts would decline as these areas become revegetated. Sites used as landings would be rehabilitated after the harvest operations are completed to promote revegetation of native species and reduce compaction and erosion potential. Driving surfaces of roads needed for timber sales would be improved or maintained in current conditions during sale activity.
The direct effects of Alternative 2 would be that the public would largely have the have the same access to the Project Area. Subtracting the approximately 1 mile of the road system accessible for public use, the average amount of roads per square mile would go from approximately 2.8 mile per square mile to 2.7 miles per square mile. The existing road system in the Project Area

would be improved with existing roads reconstructed to a higher standard and roads that need realigning or repositioning are reconstructed. This would be accomplished by removing roads that are unnecessary or have rights-of-way issues. The road system would still allow users to adequately access the area for recreation and would allow local traffic to pass through the area on an improved road system, while still resulting in a net reduction of road miles.

Indirectly, Alternative 2 would result in a net decrease in road density as duplicate roads, and roads that have rights-of-way issues, are removed.

The Direct and Indirect Effects of Implementing Alternative 3

The direct and indirect effects of Alternative 3 are very similar to those described for Alternative 2. In response to additional internal discussions an additional approximately 0.5 miles of a forest road, that was already being partially closed, would be added. This would increase the closure of Level 2 roads from approximately 0.7 miles to 1.2 miles (Table 3-35). If added to the roads that are being redesignated to Level 1, the net loss of roads accessible by the public would be approximately 2.3 miles. Subtracting the approximately 1.5 miles of the road system accessible for public use, the average amount of roads per square mile would go from approximately 2.8 mile per square mile to 2.7 miles per square mile.

The amounts of road reconstruction would remain the same as for Alternative 2, and the effects would be similar.

Indirectly, Alternative 3 would result in a net decrease in road density as duplicate roads, and roads that have rights-of-way issues, are removed.

The Direct and Indirect Effects of Implementing Alternative 4

The direct and indirect effects of Alternative 4 are very similar to those described for Alternative 2 and 3 for road construction, reconstruction of both types of roads, and the redesignation of Level 1 roads to Level 2 roads. The approximate mileages of these three types of activities are the same as for Alternatives 2 and 3 (Table 3-35). In response to some of the comments received during scoping which requested that no roads currently open for public use be closed

Approximately 0.3 miles of permanent roads would be constructed either to access harvest units that currently have inadequate access, or to correct existing roads that have issues relating to the ownership of the present rights-of-way (Table 3-35). All of these newly constructed roads would be open to the public (Level 2). In addition, approximately 0.5 miles of roads currently open only to Forest Service administrative use (Level 1) would be designated as Level 2 roads, and, therefore, open to the public for use. This would result in an increase of approximately 0.8 miles of additional roads open for public use. Under Alternative 4, there would be no road closures and no redesignation of Level 2 roads to Level 1 roads, and therefore, no loss of publicly accessible roads would occur. The roads that are not being closed would continue to cause resource damage or to duplicate access to areas of the forest.

The amounts of road reconstruction would remain the same as for Alternative 2, and the effects would be similar.

Indirectly, Alternative 4 would not result in a net decrease in road density as duplicate roads, and roads that have rights-of-way issues, would remain unchanged.

The Cumulative Effects of Implementing Alternative 2, 3, and 4

In the past, roads have been created by the Forest Service, in and around the Project Area, for the purpose of extracting timber. Many of these roads have been left open for public use. There are also roads that have been created by the public for recreation.

Roads that do not appear on the MVUM and are discovered in the Project Area in the future may be closed and rehabilitated to reduce the erosion potential and vehicle use of these roads. Land pressures on non-forest land would likely increase as population trends increase. This would likely cause more fragmentation and private roads on properties adjacent to the Project Area.

Civil Rights and Environmental Justice

Resource-Specific Information & Existing Condition

The analysis area for civil rights and environmental justice encompasses Wexford County where all of the activities will take place.

Forest Service activities must be conducted in a discrimination-free atmosphere. Contract work that may be generated from this project would include specific clauses offering civil rights protection. The Forest Service would enforce these policies.

Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic groups should bear disproportionately high and adverse human health or environmental effects resulting from Federal agency programs, policies, and activities. Environmental justice is also the identification of projects that are located near minority and low-income communities that have an adverse environmental impact. The purpose of the evaluation is to determine if a disproportional number of projects that have adverse environmental effects are located near minority and low-income communities.

Based on figures obtained from the *2005-2009 American Community Survey 5-Year Estimates* (US Census 2010), the percent of minority populations for Wexford County is less than the State of Michigan as a whole (3.7% versus 20.3%) (Table 3-36). The percent of low-income population for Wexford County is greater than the State of Michigan (16.4% versus 14.5%) (Table 3-36). This information indicates that Wexford County does not qualify as an environmental justice community.

Demographics of Wexford County and the State of Michigan
Table 3-36

Locality	Percentage of Minority Population (%)	Percentage of Low-income Population (%)
Wexford County	3.7	16.4
State of Michigan	20.3	14.5

The Direct and Indirect Effects of Alternatives 1, 2, 3, and 4

The Action Alternatives are not expected to disproportionately impact human populations. There are no human health or safety factors associated with the Action Alternatives that would disproportionately affect low-income or minority populations in or around the Project Area.

No activities are expected to affect the civil rights of any landowners, or other individuals, near the Project Area. Any contracts would be issued in accordance with USDA regulations. There would be no discrimination based on race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, and marital or family status. The laws, rules, and regulations governing nondiscrimination conduct in government employment would be adhered to.

Irreversible and Irretrievable Commitment of Resources

Resource-Specific Information & Existing Condition

Irreversible commitments are decisions affecting non-renewable resources such as heritage resource sites. Such commitments are considered irreversible, because the commitment would deteriorate the resource to the point that renewal can occur only over a long period of time or at great expense. Commitments are also irreversible if the resource has been destroyed or removed.

Irretrievable commitments of natural resources are commitments that result in the loss of productivity or use of resources due to management decisions made in the Action Alternatives. These are opportunities foregone for the period of time that the resource is unavailable. Foregoing future timber harvest opportunities in the area converted from commercial forest land into a permanent upland opening represents an irretrievable commitment of resources because a decision to not grow trees can be changed by either natural or artificial regeneration in the future.

The Direct and Indirect Effects of Alternatives 1, 2, 3, and 4

Loss of soil due to erosion would be an irreversible commitment of resources. However, due to incorporation of BMPs, Forest Plan standards and guidelines, and mitigation measures specified in this document, it is not anticipated that there would be any measurable soil loss under the Alternatives 2, 3, and 4.

Loss of heritage resource sites resulting from accidental damage or vandalism would be an irreversible commitment of resources. The mitigation measures specified in this document provide reasonable assurances there would be no irreversible loss of heritage resources.

There is no other irreversible commitment of resources associated with Action Alternatives.

There would be no irretrievable damage to resource productivity under the Action Alternatives. Short-term extraction of timber products from NFS lands would occur; however, these sites would remain forested. Reasonable assurances of reforestation are in place and would provide for long-term sustained yield.

CHAPTER 4
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