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Macedonia

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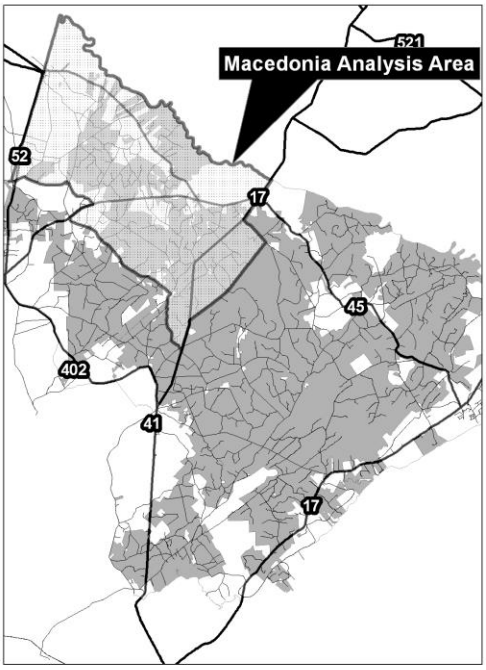
Chapter 1 - Purpose of and Need for Action

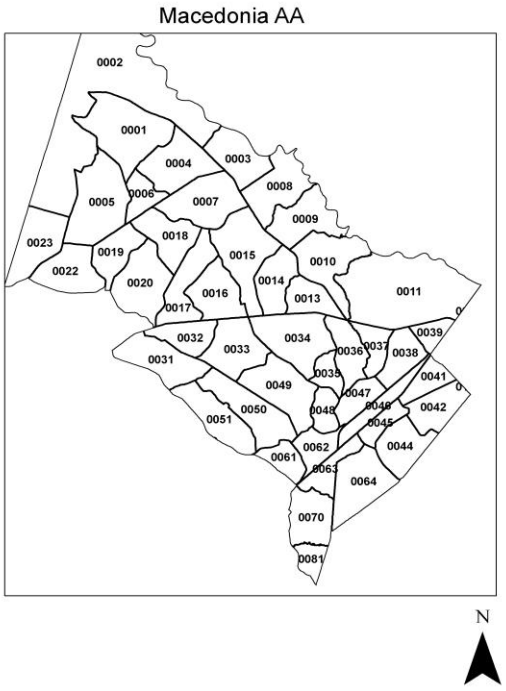
1.1 Introduction

The Francis Marion National Forest is proposing silvicultural treatments consisting of first commercial (pulpwood) thinning, intermediate (pulpwood/sawtimber) thinning, longleaf restoration, thinning to promote mixed pine/hardwoods, and loblolly seedtree cuts on approximately 8,121[1] acres in the Macedonia analysis area. These treatments are proposed primarily in loblolly and longleaf pine stands.

The Macedonia analysis area is located in the northern portion of the forest bounded by the Santee River, Bethera road (state road 48), Bonneau, St. Stephens and FS 158. This analysis contains 45 management compartments located in Berkeley County, South Carolina. The Macedonia analysis area consists of 92,648 acres of private property and national forest system lands. The Forest Service lands within the analysis area consist of 50,157 acres.

The maps below show the location of the Macedonia Analysis Area and the compartments included in the AA.





Because of the complexities of the urban interface in this analysis area, prescribed fire has been carried out on a very limited basis. As a result, the majority of the analysis area is dominated by dense loblolly pine stands with heavy mid-stories as a result of infrequent fire. However, Compartments 17, 18, 44, 45, 47 and 64 have been burned at least three times in the last decade. The pine stands in these compartments are more open with grass/herbaceous/shrub communities

[1] Due to a calculation error, this acreage is 20 acres greater than the acreage shown in the purpose and need document mailed out during the scoping period.

as a result of the frequent burning. Scattered among these open pine forests, are densely stocked loblolly pine stands that were established after Hurricane Hugo.

The environmental assessment (EA) would document the potential environmental impacts that may occur as result of the Proposed Action. The EA would be prepared in compliance with the National Environmental Policy Act (NEPA) of 1969 (42 United States Code (USC) 4321 et seq.), which requires an environmental analysis for Federal actions having the potential to impact the quality of the human environment; the Council on Environmental Quality (CEQ) Regulations (40 Code of Federal Regulations (CFR) 1500 through 1508) for implementing NEPA; USDA's NEPA Policies and Procedures (7 CFR Part 1b); Forest Service Manual (FSM) 1950; and Forest Service Handbook (FSH) 1909.15.

1.2 Background

The Francis Marion National Forest is located in southeastern South Carolina, in Berkeley and Charleston counties. These counties are a part of what is commonly referred to as the "Lowcountry", which is a term to describe the state's low lying counties along the Atlantic Coastal Plain. Elevations range from 0 to 80 feet above sea level.

This region is characterized by sub xeric sandy ridges, poorly drained flatwoods, swamps, savannas/seeps, upland depressions, ephemeral drains and isolated wetlands.

The forest types include loblolly pine, longleaf pine, mixed loblolly-longleaf pine, pond pine, hardwood (sweetgum, maple, hickory, and bald cypress etc.) and mixed pine hardwood forest types.

In 1989 a category 4 hurricane named Hugo struck the South Carolina Coast in Charleston County causing significant changes to the forested ecosystems on the Francis Marion. These changes included a broad structural transformation of thousands of acres of older pine stands into young pine seedling stands that naturally became established after the storm. As a result there are currently over 20,000 acres of dense, 20+ year old loblolly pine stands Forest wide. Since the storm, successful efforts have been made and continue to be made to thin these dense stands.

Another significant impact from the storm was the decimation of the Forest's endangered Red Cockaded Woodpecker (RCW) population. Hurricane Hugo destroyed 87% of the cavity trees, 63% of the bird population and 59% of the foraging habitat.

Prior to Hugo, the RCW population exceeded 475 clusters[1] and was expanding. As of 2010, the population has exceeded the recovery goal of 350 potential breeding groups as described in the 2003 Recovery Plan.

A third significant impact of the '89 Storm has been its effect on the Forest's prescribed burn program. Prescribed fire plays a critical role in restoring and sustaining the fire dependent plant

[1] an aggregate of cavity trees previously and currently used by a defined group of woodpeckers

and animal communities of the Forest. As a result of the large "heavy" fuels[1] created by Hugo, prescribed burning continues to pose significant threats to public safety.

Some of the Macedonia analysis area has been burned using mitigation measures[2] that safeguard the public. However, a large portion of the Analysis Area is located where prescribed fire poses an unreasonable risk due to the concentration of human development and vehicular traffic. As a result, the frequency of prescribed burning in these areas has been inadequate to restore and sustain native fire ecosystems.

1.3 Management Direction

The proposed action would help to accomplish the goals, objectives, and desired conditions consistent with the *1996 Revised Land and Resource Management Plan, Francis Marion National Forest* (Forest Plan).

The Macedonia analysis area is located in the following Management Areas described in the Forest Plan:

Management Area	Management Goals
8	Unique characteristics.
26	To restore and maintain the longleaf pine/fire ecosystem.
27	Mixed pine hardwood.
28	To achieve Forest-wide goals with no single emphasis.
29	To link wilderness areas with similar ecotypes to minimize fragmentation.

Treatments would improve overall forest health by reducing stand densities, increasing structural and age class diversity across the landscape, restoring the longleaf pine ecosystem, improving habitat for fire-dependent species and promoting mixed pine hardwoods forest types where appropriate.

The proposed action would also help accomplish objectives that are consistent with the *Recovery Plan for the Red-cockaded Woodpecker (Picoides borealis) Second Revision* (Recovery Plan), by improving existing foraging habitat and providing for future foraging and nesting habitat.

[1] "Heavy" fuels are dead and downed logs and large branch wood that were felled by Hugo and subsequent minor hurricanes. These fuels take decades to decompose. They would catch fire and continue to smolder well after the prescribed burn is completed, producing residual smoke that poses risks to visibility on roadways and the health of nearby residents who suffer respiratory ailments.

[2] Mitigation measures include traffic control on stretches of highways impacted by smoke, public notification and adherence to the South Carolina Smoke Management Guidelines.

1.4 Proposed Action

The proposed action is composed of three silvicultural prescriptions, one wildlife and one herbicide treatment:

Prescription #1 would thin young, dense pine stands on **4,277 acres** using commercial or biomass treatments with conventional logging equipment. These stands have never been thinned since their establishment.

Prescription #2 would thin older pine stands **1,283 acres** using commercial timber sales. Most of these stands have been thinned once since their establishment.

Prescription #3 would restore longleaf pine on sites currently dominated by loblolly pine on **801 acres** using commercial timber sales followed by site preparation and hand planting. Site preparation would be by prescribed fire, mastication and/or herbicide treatment.

Prescription #4 would promote mixed pine hardwood stands on **488 acres** by commercially thinning loblolly pine in stands containing many desirable oak and hickory trees in the canopy and sub-canopy.

Prescription #5 would use the seedtree method on **1,272 acres** to commercially harvest and regenerate loblolly pine.

Wildlife Snag Creation would be for cavity nesting birds such as blue birds, red headed woodpeckers, and brown headed nuthatches on a maximum of 2084 acres. The created snags would also reduce the incidence of kleptoparasitism[1] on the RCW.

1.5 Purpose and Need

The purpose and need for this project is to:

1. Reduce hazardous fuel loadings in dense pine stands.

   Approximately 10% to 20% of the pine stands in the analysis area are densely stocked, less than 30 years old and have not been burned within the last decade. There is a need for thinning in order to reduce vertical fuel continuity ("ladder fuels"), thereby reducing the risk of catastrophic wild fire and allowing the safe reintroduction of prescribed burning.

[1] This is the theft by one species of resources procured by another species to the detriment of the species being parasitized. Generally this term is applied to the theft of food, but has recently been expanded to include the theft of other resources such as nesting cavities created by the RCW.

2. Increase the health and vigor of the stands by reducing tree densities.

   The dense pine stands mentioned above pose a high risk of southern pine beetle infestation and damage from disease due to poor growth and vigor. There is a need to reduce stocking levels in these stands in order to reduce the above risks and promote forest health.

3. Enhance RCW foraging and nesting habitat.

   The Macedonia analysis area has a large population of red-cockaded woodpecker which is listed by the United States Fish and Wildlife service as endangered. Approximately 27,000 acres (54%) of the analysis area is dominated by loblolly, longleaf and pine/hardwood stands. Less than half (46%) of this pine acreage contains trees large enough (greater than 10 inches in diameter at breast height) to provide adequate RCW foraging and nesting habitat. The rest of the acreage (54%) is in dense pine stands where most of the stems are less than 10 inches in diameter and therefore are not currently providing foraging habitat.

   There is a need to thin younger stands to improve the growth and vigor of the remaining pine trees so they reach foraging size sooner.

   There is a need to thin older pine stands to create more open canopy and midstory conditions that are conducive to RCW feeding and nesting behavior.

   There is also a need to convert young loblolly stands to longleaf pine. Longleaf provides higher quality foraging and nesting habitat in the future and is much less vulnerable to mortality from fire, southern pine beetle infestation, tree diseases and hurricanes.

4. Improve conditions for fire dependent plant and animal communities.

   The majority of the land in the analysis area has seen very little prescribed fire to restore and maintain fire dependent communities. This is due largely to a heavy urban interface and traffic routes within the analysis area. However, there are opportunities to expand the core burn area into a portion of the Macedonia AA where burning on a 2-3 year cycle can be accomplished with reasonable mitigation costs. In order to enhance the effectiveness of the burning in promoting fire dependent plant and animal communities, there is a need to thin densely stocked pine stands of all ages to reduce canopy densities and allow greater solar radiation to penetrate to the ground layer.

5. Restore longleaf pine on a portion of stands now dominated by loblolly pine where prescribed fire can be consistently applied and soil types are suitable.

   It is estimated that 50 to 75% of the original longleaf component in the analysis area has been converted to loblolly pine due to past land use practices in the early twentieth century and catastrophic events such as Hurricane Hugo. There is a need to restore the

original longleaf forests that are now dominated by loblolly pine in order to ensure long term ecological health by reestablishing this important keystone species.

6. Create early successional habitat and structural diversity by establishing younger age classes in the pine forest type.

   Due to the lack of early seral stage habitat (currently less than 5%) there is a need to create this habitat by removing a substantial portion of the canopy of the dominant stand. Early seral stages of grass-forb-shrub habitat would benefit species such as the yellow-breasted chat, eastern bluebird, eastern kingsnake, and white-eyed vireo.

7. Enhance the mixed pine/hardwood forest type in stands where RCW habitat is not emphasized, prescribed burning is limited and where there is a substantial hardmast component in the midstory.

   The mixed pine/hardwood forest type would be one of many habitats that would complement the RCW/fire habitat. The proposed mixed pine/hardwood stands would contain an abundance of mast producing trees which would benefit wildlife species such as deer and turkey.

1.6 Scoping

The scoping period for this project began on January 20th and ended February 28, 2013. A letter describing the proposed action, the purpose and need and requesting public input was sent to individuals and agencies included on a District mailing list. Comments received from scoping were considered and used to refine the proposed action.

1.7 Decision to be Made

The environmental assessment (EA) discloses environmental effects of the proposed action and the no action alternative. The responsible official, the District Ranger, would make a decision based on a review of the EA. The District Ranger must decide:

1. Whether to proceed with the proposed action or the “No Action” alternative.

2. Whether the decision that is selected would have a significant impact on the quality of the human environment or not. If a determination is made that the impact is not significant, then a “Finding of No Significant Impact” (FONSI) would be prepared. Significant impacts on the quality of the human environment would require the preparation of an Environmental Impact Statement [NEPA, 1501.4 (c) and (e).]

The decision would be documented in a Decision Notice (FSH, 1909.15, 43.2) signed by the District Ranger.

1.8 Issues

Comments received in response to scoping were reviewed by the interdisciplinary team (IDT) and are categorized below as key and non-key issues. Key issues were used to develop another action alternative, develop design criteria, and focus effects analysis in Chapter 3. Public comments are contained in the project record.

Key Issues

1. Issue: Tree densities left after thinning are too high to promote improved conditions for fire dependent plant and animal communities.

   Response: Thinning densities were carefully considered so as to provide for improved stand health and growth while providing for adequate growing stock. Traditional forestry thinning guidelines were used in stands (Prescription #1 and Prescription #2) where frequent prescribed burning is difficult. In these stands, heavier thinning would result in more open pine canopies that would lead to over-developed mid-stories and potential loss of pine habitat in the future.

   Lower thinning densities, however, were prescribed in those stands (Prescription #2, Treatment Class #3) where burning can be applied frequently enough to hold mid-story development in check and maintain the pine forest type. Additional information is provided in Chapter 3 Vegetation section of this EA.

2. Issue: Live oak left in substantial numbers would adversely affect the pine lands by "precluding the desirable ground cover, and the fauna that depend on it."

   Response: Oaks and hickories that are in the upper canopy are prescribed to be left in prescriptions #1, 2, 4 and 5. Live oak is specifically mentioned in Prescription #1, Treatment Class #2. Oaks and hickories, including live oak, are widely scattered within the treatment units of prescriptions 1, 2, and 5. Leaving these species as prescribed, would not alter the character of the pinelands. Also, live oak is rather rare in this analysis area, and therefore would not substantially impact the ground cover except, perhaps, in very isolated and scattered spots.

   The intent of prescription 4 is to develop stands of mixed pine and hardwoods in order to meet the goals and objectives of management #27 in the Forest Plan. Again, live oaks are rare in these stands. Additional information is provided in Chapter 3 Vegetation section of this EA.

3. Issue: There is opposition to the use of herbicides in prescription #3 because of potential adverse impacts to the environment.

   Response: Another action alternative was developed to address this issue. Alternative 3 would not include herbicide use.

4. Issue: The list of species considered when developing the alternatives should be expanded beyond game species and the RCW.

   Response: The red cockaded woodpecker is a federally endangered species that happens to be an important keystone species of the pine/fire ecosystem. The health of the RCW population is an indicator of ecosystem health. Game animals, such as squirrel, deer and wild turkeys also provide an indication of forest health, although not necessarily the health of the pine/fire ecosystem. Impacts of the alternatives on threatened, sensitive and endangered plant and animal species native to the Francis Marion was evaluated in the biological assessment. In addition, chapter 3 of the EA addresses the effects of the alternatives on management indicator species, migratory birds and aquatic communities.

Chapter 2 - Alternatives

This section discusses alternatives to meet the purpose and need discussed in Chapter 1. Three alternatives would be analyzed, including the No Action alternative.

2.1 Alternative 1: No Action

Under the No Action alternative, no vegetative treatment would occur with this decision. The use of prescribed fire in the Macedonia analysis area for habitat maintenance and restoration of threatened and endangered species may be utilized under the *Prescribed Fire on the Francis Marion National Forest Environmental Assessment (2006)* and Decision Notice. In addition, ongoing management activities in this management area include recreation management, road maintenance and previous vegetation management decisions. These may occur within or adjacent to stand boundaries from previous decisions that are not linked to this environmental assessment.

2.2 Alternative 2: Proposed Action

The proposed action (Table 2.2-1) is as follows:

PRESCRIPTION #1: FIRST COMMERCIAL THINNING - 4,277 acres.

This prescription would be divided into two treatment classes.

Treatment Class 1:

Loblolly pine trees in these stands would be thinned commercially for pulpwood for the first time since their establishment. Current pine densities range from 90 to 160 square feet per acre (250-350 trees per acre) and the desired leave target basal area averages from 55-65 square feet per acre after the thinning[1]. This would equate to around 100 to 120 trees per acre.
Pine trees that would be cut would generally range in size from 4.6 to 10 inches DBH[2].
The priority for trees to be left after thinning in this treatment class would be:

A) Longleaf pine exhibiting good health, form and crowns equal to at least one third of total tree height.
B) Larger sized loblolly stems free from disease and defect.
C) Desirable hardwood trees, especially mast producers such as oaks and hickories in the upper canopy.

[1] Basal area is a unit of measure that foresters use to describe the density of trees within a stand. It is defined as the total horizontal cross-sectional area of all the tree stems per acre, measured at breast height (4.5 feet above ground level). For the purposes of this project forests are stands of trees with 60 square feet of basal area per acre or greater. Woodlands have timbered stands between 40 and 60 square feet of basal area per acre. Savannas have a very sparse tree canopy less than 40 square feet per acre). Thinning or stocking control reduces the number of tree stems in order to keep trees/stands healthy and thrifty.

[2] DBH – Diameter at Breast Height

Smaller pine and hardwood trees less than 4.6 inches DBH may also be harvested. This material is referred to as "biomass" and may be chipped and used to generate electric power and other energy products.

Treatment Class 2:

These three stands are predominantly longleaf pine with scattered loblolly trees occurring throughout. In this treatment class, loblolly pine would be removed and longleaf would be thinned commercially for pulpwood. Current basal areas range from 100 to 140 square feet per acre and the desired leave target basal area for longleaf would average from 55-65 square feet per acre after the thinning.

The priority for trees to be left after thinning in treatment class 2 would be:

A) Larger sized longleaf pine exhibiting good health, form and crowns equal to at least one third of total tree height.
B) Desirable hardwood trees, especially mast producers such as live oak, post oak and hickory that are in the mid to upper canopy.

Smaller pine and hardwood trees less than 4.6 inches DBH may also be harvested. This material is referred to as "biomass" and may be chipped and used to generate electric power and other energy products.

PRESCRIPTION #2: INTERMEDIATE THINNING – 1,283 acres.

Stands proposed for intermediate thinning typically range in age from 30-60 years old and consist of pine that is generally larger in diameter than the first commercial thinnings mentioned above. The material to be cut is generally large enough to be sold as pulpwood, chip-n-saw or small saw timber, though this would not be used as a determining factor as to the need for treatment.

Trees to be removed in this category generally range in size from 5.0 to 15.0 inches DBH. Currently these stands are carrying basal area densities from 80 to 160 square feet per acre.

This prescription would be divided into three treatment classes based on the amount of basal area that would be left after treatment.

Treatment Class 1:

Stands would be thinned down to a target basal area of 65 – 75 sq. ft. per acre. These stands are dominated by loblolly pine and heavy hardwood mid-stories and are in areas where prescribed fire occurs on a very limited basis.

The priority for trees to be left after thinning in this treatment class would be:

A) Longleaf pine exhibiting good health, form and crowns equal to at least one third of total tree height.
B) Larger sized loblolly stems exhibiting good health, form and crowns equal to at least one third of total tree height.
C) Desirable hardwood trees, especially mast producers such as oaks and hickories in the upper canopy.

Smaller pine and hardwood trees less than 4.6 inches DBH may also be harvested. This material is referred to as "biomass" and may be chipped and used to generate electric power and other energy products.

Treatment Class 2:

Stands would be thinned down to a target basal area of 55-65 sq. ft. per acre.

The slightly lower leave basal areas would help create more open stand conditions. These stands occur in areas where prescribed fire consistently occurs at two to three year intervals.

The priority for trees to be left after intermediate thinning in treatment class 2 would be:

A) Longleaf pine exhibiting good health, form and crowns equal to at least one third of total tree height.
B) Larger sized loblolly stems free from disease and defect.
C) Desirable hardwood trees, especially mast producers such as oaks and hickories in the upper canopy.

Smaller pine and hardwood trees less than 4.6 inches DBH may also be harvested. This material is referred to as "biomass" and may be chipped and used to generate electric power and other energy products.

Treatment Class 3:

In order to create favorable foraging habitat for the RCW, these stands would be thinned down to a target basal area of 45-55 sq. ft. per acre.

Stand 25 of compartment 63 is a mixed longleaf, loblolly stand which is burned on consistent two to three year return interval. The lower target basal area would favor longleaf cohort development in the understory.

Stand 3 and 13 of compartment 15, stand 6 of compartment 38, and stand 12 of compartment 63 are in areas where prescribed fire has been much less consistent in the past and therefore have heavy mid-stories. These mid-stories would be removed either as biomass during the commercial thinning or by mastication using heavy equipment to grind up small pine and hardwood midstory trees left after logging. If mastication is used, this shredded material would be scattered over the treatment area and not piled. In order to minimize soil disturbance,

mastication would avoid wet soil conditions and use machines with a compaction rating of 6 lbs. per square inch or less.

The priority for trees to be left after intermediate thinning in treatment class 3 would be:

A) Longleaf pine exhibiting good health, form and crowns equal to at least one third of total tree height.
B) Larger sized loblolly stems free from disease and defect.
C) Desirable hardwood trees, especially mast producers such as oaks and hickories in the upper canopy.

Smaller pine and hardwood trees less than 4.6 inches DBH may also be harvested. This material is referred to as "biomass" and may be chipped and used to generate electric power and other energy products.

PRESCRIPTION #3: LONGLEAF RESTORATION - 801 acres.

Longleaf pine restoration would take place in stands dominated by loblolly pine. This proposed prescription would be divided into five treatment classes in which the method of site preparation depends on the condition of the stand and burn history.

Treatment Class 1:

These stands are in areas where prescribed fire has occurred at least three times in the last decade and mid-story development is fairly limited. Prescribed fire would be used for both site preparation prior to planting and release after seedlings have become established.

1. Commercial Harvest -
   - All loblolly trees 4.6 inches DBH and greater would be harvested, leaving 6-10 of the largest pines available per acre. These residual trees would provide structural diversity in the stand and can serve as RCW foraging and nesting habitat, especially as the new longleaf seedling stand grows to maturity.
   - Leave longleaf pine exhibiting good health, form and crowns equal to at least one third of total tree height. Available longleaf trees equal to or greater than 10 inches DBH may count towards the 6 to 10 trees per acre left after harvest. These trees may serve as current and future cavity trees for the RCW, as well as a longleaf seed source to augment the planted longleaf seedlings.
2. Site Preparation -
   - Site preparation would be accomplished by prescribed burning in the spring or early summer.
3. Hand Planting -
   - In the late summer or early fall following site preparation burning, longleaf seedlings would be planted on a ten by ten foot spacing (435 seedlings per acre).
   - The planted stand would be protected from prescribed (Rx) burning, using a constructed fire line if the surrounding compartment is to be burned during the first growing season after planting. Rx burning would be resumed in the stand along with

the rest of the compartment after the seedlings have become established, usually two years after planting.

Treatment Class 2:

These stands have heavy midstory and woody understory development due to the infrequency of prescribed burning in the last two decades.

1. Commercial Harvest / Mid-Story Removal -
   - All loblolly trees 4.6 inches DBH and greater would be harvested, leaving 6-10 of the largest pines available per acre. These residual trees would provide structural diversity in the stand and can serve as RCW foraging and nesting habitat, especially as the new longleaf seedling stand grows to maturity.
   - Leave longleaf pine exhibiting good health, form and crowns equal to at least one third of total tree height. Available longleaf trees equal to or greater than 10 inches DBH may count towards the 6 to 10 trees per acre left after harvest. These trees may serve as current and future cavity trees for the RCW, as well as a longleaf seed source to augment the planted longleaf seedlings.
   - Mid-story vegetation would be removed either commercially as biomass or by mastication. Heavy equipment would grind up small pine and hardwood midstory/understory trees and shrubs left after logging. If mastication is used, this shredded material would be scattered over the treatment area and not piled. In order to minimize soil disturbance, mastication would avoid wet soils and use machines with a compaction rating of 6 lbs. per square inch or less.
2. Hand Planting -
   - In the late summer or early fall, following midstory removal, longleaf seedlings would be planted on a ten by ten foot spacing (435 seedlings per acre).
   - The planted stand would be protected from Rx burning using the same guidelines as described in treatment class 1.
3. Herbicide Release –
   - Longleaf seedlings would be released from woody competition one to two years after planting. The method of release would use dormant (leaf off) season basal bark (manual using back-pack sprayers) application of herbicide.
   - The herbicide used would be Triclopyr (Garlon 4 or equivalent) which would be applied directly to the stem of targeted woody species. The following species would be targeted for treatment: sweet gum, water oak, turkey oak, black jack oak, blue jack oak, red maple, wax myrtle, gallberry, fetter bush, sweet pepper bush, and sumac.
   - Herbicide mixture would contain the following:
     - 16% to 18% Triclopyr (Garlon 4 or equivalent).
     - 84% to 82% vegetable oil and adjuvant diluent.
   - Herbicide treatment would be monitored for effectiveness the following growing season after application. If treatment has achieved less than 60% kill of targeted species, retreatment would be conducted the following winter.

Treatment Class 3: This stand is dominated by a mixture of longleaf/loblolly pine in the canopy with enough longleaf to provide a seed source for natural regeneration.

1. Commercial Harvest -
   - All loblolly pine would be commercially harvested.
   - Longleaf pine would be retained. However, wherever thick patches occur, longleaf would be thinned down to 55 to 65 sq. ft. per acre.
2. Site Preparation -
   - Canopy gaps resulting from the loblolly removal and successive prescribed burns would promote open stand conditions, grass/herb dominated understory and the establishment of longleaf seedling cohorts in the understory.

Treatment Class 4:

This stand is dominated by a mixture of longleaf/loblolly pine in the canopy. However, unlike treatment class 3, there would not be enough longleaf canopy trees to provide sufficient seed for future longleaf seedling cohort development.

1. Commercial Harvest -
   - All loblolly pine would be commercially harvested.
   - Retain longleaf pine.
   - Wherever thick patches occur, longleaf would be thinned down to 55 to 65 square feet per acre, leaving trees exhibiting good health and form.
   - Mid-stories would be removed either commercially as biomass or by mastication. Heavy equipment would grind up small pine and hardwood midstory/understory trees and shrubs left after logging. If mastication is used, this shredded material would be scattered over the treatment area and not piled. In order to minimize soil disturbance, mastication would be done using machines with a compaction rating of 6 lbs. per square inch or less.
2. Hand Planting -
   - In the late summer or early fall following site preparation burning, Longleaf seedlings would be planted on a ten by ten foot spacing (435 seedlings per acre) wherever canopy gaps of 0.5 acre in size or greater occur within the stand.
   - The planted stand would be protected from Rx burning using the same guidelines as described in treatment class 1.
3. Herbicide Release –
   - Longleaf seedlings would be released from woody competition one to two years after planting. The method of release would use dormant (leaf off) season basal bark (manual using back-pack sprayers) application of herbicide.
   - The herbicide used would be Triclopyr (Garlon 4 or equivalent) which would be applied directly to the stem of targeted woody species. The following species would be targeted for treatment: sweet gum, water oak, turkey oak, black jack oak, blue jack oak, red maple, wax myrtle, gallberry, fetter bush, sweet pepper bush, and sumac.
   - Herbicide mixture would contain the following:
     - 16% to 18% Triclopyr (Garlon 4 or equivalent).
     - 84% to 82% vegetable oil and adjuvant diluent.

- Herbicide treatment would be monitored for effectiveness the following growing season after application. If treatment has achieved less than 60% kill of targeted species, retreatment would be conducted the following winter.

Treatment Class 5:

This stand is dominated by loblolly pine poletimber. However, the majority of loblolly pine trees were killed in the Wedboo fire in the summer of 2011.

1. Site Preparation –
   - Midstory and understory hardwoods and shrubs would be removed by mastication.
2. Hand Planting -
   - In the late summer or early fall following site preparation burning, longleaf seedlings would be planted on a ten by ten foot spacing (435 seedlings per acre).
   - The planted stand would be protected from Rx burning using the same guidelines as described in treatment class 1.
3. Herbicide Release –
   - Longleaf seedlings would be released from woody competition one to two years after planting. The method of release would use dormant (leaf off) season basal bark (manual using back-pack sprayers) application of herbicide.
   - The herbicide used would be Triclopyr (Garlon 4 or equivalent) which would be applied directly to the stem of targeted woody species. The following species would be targeted for treatment: sweet gum, water oak, turkey oak, black jack oak, blue jack oak, red maple, wax myrtle, gallberry, fetter bush, sweet pepper bush, and sumac.
   - Herbicide mixture would contain the following:
     - 16% to 18% Triclopyr (Garlon 4 or equivalent).
     - 84% to 82% vegetable oil and adjuvant diluent.
   - Herbicide treatment would be monitored for effectiveness the following growing season after application. If treatment has achieved less than 60% kill of targeted species, retreatment would be conducted the following winter.

Prescription #4: THIN TO PROMOTE MIXED PINE HARDWOODS – 488 acres.

These stands are dominated by loblolly pine and have heavy mid-story development due to infrequent occurrence of prescribed fire. The mid-story contains many desirable oak and hickory trees in the canopy and sub-canopy. This prescription would remove a substantial portion of the loblolly pine by thinning to a basal area of 40 to 50 square feet per acre providing ample canopy space to desirable oaks and hickories. Loblolly pine trees overtopping or adjacent to these desirable hardwoods would have a high priority for removal.

Prescription #5: LOBLOLLY SEEDTREE CUT – 1,272 acres.

These stands are dominated by loblolly pine and have heavy mid-story development due to infrequent occurrence of prescribed fire.

Loblolly trees 4.6 inches DBH and greater would be harvested, leaving 10-20 sq. ft. / acre leaving the largest, best formed loblolly pine for structural diversity and to act as seed trees.

Mid-story vegetation would be removed either commercially as biomass or by mastication. Heavy equipment would be used to grind up small pine and hardwood midstory trees left after logging. If mastication is used, this shredded material would be scattered over the treatment area and not piled. In order to minimize soil disturbance, mastication would be done using machines with a compaction rating of 6 lbs. per square inch or less.

Desirable mast hardwoods, such as oaks and hickories, larger than 6 inches in diameter, would not be removed.

Stands would be allowed to seed back to loblolly pine.

Wildlife Snag Creation

Snag creation can play an important role in offsetting the impact of kleptoparasitism on the RCW and provides habitat for numerous species of fauna. Snags are a source of insects and other invertebrates that serve as food for various wildlife species. They also provide perches and cavities for many bird species, cover for small mammals and herpetofauna, and are future sources of downed woody debris. Various studies have shown that increases in the availability of snags on forest lands can lead to an increase in the species richness, diversity, and abundance of cavity nesting birds.

Intermediate thinning and longleaf pine conversion stands would be the primary areas selected for snag creation, but other treatment areas may be selected as well, especially if they are in close proximity to RCW clusters.

Once logging activities are completed, the “hack and squirt” method may be used to create snags for wildlife within each treatment area. The "hack and squirt" method would involve cutting into the cambium of selected trees with an axe or other sharp object and then applying an undiluted or 50% solution of Garlon 3A or equivalent (active ingredient triclopyr) in water to the cut surface.

Approximately one to two trees per acre would be selected for snag creation, and consist of tree species such as but not limited to sweetgum, red maple and loblolly pine.

Connected Actions

Connected actions associated with this project include:

1) Construction of fire lines around prepared and sold timber sale units to protect them from fire when the surrounding compartment is being prescribed burned.
2) Construction of fire lines to protect first year planted longleaf pine seedlings from fire when the surrounding compartment is being prescribed burned. Planted longleaf pine areas would be burned on a two to three year rotation after they have become established, usually by the second year after planting.

3) Construction of skid trails, landings and temporary roads for the removal and loading or chipping of trees on site. Temporary roads (4.48 miles) and ramps would be needed to access some landings.
4) Approximately 53.95 miles of system road reconstruction and maintenance would be needed. Reconstruction work would consist of, but not be limited to: laying gravel on road surfaces, replacing culverts, ditch cleaning, removing brush and trees along road rights-of-way, installing or replacing gates, and correcting road safety hazards. Maintenance would consist of spot gravel, road grading, cleaning culverts, light brushing and mowing. The intent is to have a maintainable forest road system within the project area. Some road improvement activities are necessary to bring roads up to a maintainable standard especially on newly acquired lands.
5) Log decks and primary skid trails would be disked and planted in native vegetation and/or desirable non-native annual crop species dependent upon costs and resources available.

Connected Actions	Estimated (miles/quantity)
Firelines - (to protect timber sales and newly planted longleaf stands)	Up to 10 miles per year for 3 years
Temporary roads needed for logging	11 temporary roads for a total of 4.48 mile
System road reconstruction	53.95 miles
Culvert replacement	25 culverts

Temporary roads would be needed in the following stands:

Compartment	Stand	Length (miles)	Prescription
3	19	.15	1st Thinning
15	3	.50	Intermediate Thin
17	5	.22	Longleaf Restoration
17	20, 26	.48	Loblolly Seedtree
19	12	.61	1st Thinning
20	11	.65	Intermediate Thin
45	9,10	.65	Intermediate Thin
49	8	.25	Loblolly Seedtree
50	9	.32	1st thinning
62	37	.55	1st Thinning
70	16	.10	Loblolly Seedtree
	TOTAL MILES	**4.48**	

Maps showing the locations of the proposed temporary roads are located in Appendix A. A Travel Analysis Process Report has been completed following procedures found in Forest Service Handbook (FSH) 7709. The final report is located in the project file.

Table 2.2-1 Proposed Action by Compartment, Stand, Acres and Treatment Class.

Prescription #1: FIRST COMMERCIAL THINNING.

Treatment Class #1: Thin pine down to 55-65 sq. ft. / acre. Biomass material, pine and hardwood trees less than 4.6 inches in DBH, may also be removed during the commercial thinning. Leave any longleaf trees wherever they may occur.

Treatment Class #2: Remove all loblolly and thin longleaf down to 55-65 sq. ft.

Compt.	Stand	Dominant Species	Dominant Size Class	Birth Year	Acres	Treatment Class
0002	007	Loblolly	Poletimber[1]	1987	64	**1**
0002	016	Loblolly	Poletimber	1989	53	**1**
0003	019	Loblolly	Poletimber	1988	21	**1**
0006	006	Loblolly	Poletimber	1988	109	**1**
0007	003	Loblolly	Poletimber	1978	58	**1**
0007	015	Loblolly	Poletimber	1986	12	**1**
0008	011	Loblolly	Poletimber	1989	51	**1**
0010	007	Loblolly	Poletimber	1989	65	**1**
0010	017	Loblolly	Poletimber	1987	322	**1**
0014	009	Loblolly	Poletimber	1986	47	**1**
0014	019	Loblolly	Poletimber	1989	46	**1**
0015	020	Loblolly	Poletimber	1983	12	**1**
0016	003	Loblolly	Poletimber	1986	23	**1**
0016	021	Loblolly	Poletimber	1989	11	**1**
0017	001	Loblolly	Poletimber	1989	10	**1**
0017	008	Longleaf	Poletimber	1985	43	**2**
0017	014	Loblolly	Poletimber	1985	15	**1**
0017	023	Loblolly	Poletimber	1989	6	**1**
0018	013	Loblolly	Poletimber	1987	60	**1**
0019	012	Loblolly	Poletimber	1986	60	**1**
0022	005	Loblolly	Poletimber	1987	93	**1**
0022	006	Loblolly	Poletimber	1987	40	**1**
0031	2, 17	Loblolly	Poletimber	1988	80	**1**
0031	003	Loblolly	Poletimber	1984	87	**1**
0032	001	Loblolly	Poletimber	1984	16	**1**
0033	002	Loblolly	Poletimber	1989	71	**1**
0033	003, 16	Loblolly	Poletimber	1988	258	**1**
0033	012, 10	Loblolly	Poletimber	1989	91	**1**
0034	001	Loblolly	Poletimber	1989	54	**1**
0034	002	Loblolly	Poletimber	1985	38	**1**

[1] Poletimber = 4.6” to 10” DBH

Prescription #1: FIRST COMMERCIAL THINNING (Continued)

Treatment Class #1: Thin pine down to 55-65 sq. ft. / acre. Biomass material, pine and hardwood trees less than 4.6 inches in DBH, may also be removed during the commercial thinning. Leave any longleaf trees wherever they may occur.

Treatment Class #2: Remove all loblolly and thin longleaf down to 55-65 sq. ft.

Compt.	Stand	Dominant Species	Dominant Size Class	Birth Year	Acres	Treatment Class
0034	004	Loblolly	Poletimber	1985	31	**1**
0034	005	Loblolly	Poletimber	1988	41	**1**
0034	006	Loblolly	Poletimber	1989	32	**1**
0034	010	Loblolly	Poletimber	1987	72	**1**
0034	012	Loblolly	Poletimber	1988	30	**1**
0034	014	Loblolly	PT/LgPT[1]	1984	80	**1**
0034	016	Loblolly	Poletimber	1983	79	**1**
0034	019	Loblolly	Poletimber	1988	51	**1**
0035	3,6,7	Loblolly	Poletimber	1989	57	**1**
0036	006	Lob/Long	Poletimber	1990	76	**1**
0036	007	Loblolly	Poletimber	1981	18	**1**
0036	012	Loblolly	Poletimber	1987	17	**1**
0036	013	Lob/Long	PT/LgPT	1990	32	**1**
0036	014	Loblolly	Poletimber	1989	68	**1**
0036	018	Loblolly	Poletimber	1990	41	**1**
0037	002	Loblolly	Poletimber	1985	40	**1**
0037	010	Loblolly	Poletimber	1989	16	**1**
0038	002	Loblolly	Poletimber	1989	13	**1**
0038	007	Loblolly	Poletimber	1988	52	**1**
0038	011	Loblolly	Poletimber	1990	59	**1**
0041	012	Loblolly	Poletimber	1989	52	**1**
0042	016	Loblolly	Poletimber	1989	33	**1**
0048	017	Loblolly	Poletimber	1988	41	**1**
0049	002	Loblolly	Poletimber	1989	155	**1**
0049	004	Loblolly	Poletimber	1989	47	**1**
0049	011	Loblolly	Poletimber	1988	32	**1**
0049	013,014	Loblolly	Poletimber	1980	173	**1**
0049	019	Loblolly	Poletimber	1990	29	**1**
0050	005	Loblolly	Poletimber	1984	17	**1**
0050	009	Loblolly	Poletimber	2001	40	**1**
0050	014	Loblolly	Poletimber	1988	62	**1**
0050	015	Loblolly	Poletimber	1986	42	**1**

[1] PT/LgPT = 4.6” to 12.9” DBH

Prescription #1: FIRST COMMERCIAL THINNING (Continued)

Treatment Class #1: Thin pine down to 55-65 sq. ft. / acre. Biomass material, pine and hardwood trees less than 4.6 inches in DBH, may also be removed during the commercial thinning. Leave any longleaf trees wherever they may occur.

Treatment Class #2: Remove all loblolly and thin longleaf down to 55-65 sq. ft.

Compt.	Stand	Dominant Species	Dominant Size Class	Birth Year	Acres	Treatment Class
0050	016	Loblolly	Poletimber	1989	4	**1**
0051	004	Loblolly	Poletimber	1990	20	**1**
0051	005	Loblolly	Poletimber	1989	34	**1**
0051	020	Loblolly	Poletimber	1989	76	**1**
0051	021	Loblolly	Poletimber	1993	47	**1**
0051	023	Loblolly	Poletimber	1989	39	**1**
0062	016,017	Loblolly	Poletimber	1982	29	**1**
0062	023	Longleaf	Poletimber	1975	7	**2**
0062	024	Loblolly	PT/LgPT	1964	29	**1**
0062	034	Lob/Long	Poletimber	1986	11	**1**
0062	037	Loblolly	Poletimber	1975	44	**1**
0063	013	Longleaf	Poletimber	1987	12	**2**
0064	015	Loblolly	Poletimber	1987	69	**1**
0064	023	Loblolly	Poletimber	1986	11	**1**
0070	001	Loblolly	Poletimber	1989	145	**1**
0070	008	Loblolly	PT/LgPT	1982	25	**1**
0070	009	Loblolly	Poletimber	1986	103	**1**
0070	010	Loblolly	Poletimber	1988	28	**1**
				Total	**4,277**	

Prescription #2: INTERMEDIATE THINNING

Treatment Class #1: Thin pine down to 65-75 sq. ft. / acre. Biomass material (pine and hardwood trees less than 4.6 inches in DBH) may also be removed during the commercial thinning. Leave any longleaf trees wherever they occur.

Treatment Class #2: Thin pine to 55-65 sq. ft. per acre. Leave any Longleaf trees wherever they occur.

Treatment Class #3: Thin pine to 45-55 sq. ft. per acre to manage foraging habitat for RCW Cluster. Favor scattered longleaf. Midstory would be removed either by commercial harvest or as biomass or by non-commercial mastication.

Compt.	Stand	Dominant Species	Dominant Size Class	Age	Acres	Treatment Class
0001	010	Loblolly	Sawtimber[1]	1969	69	**1**
0003	018	Loblolly	Sawtimber	1977	69	**1**
0003	026	Loblolly	Sawtimber	1981	34	**1**
0004	001	Loblolly	Lg PT[2]/ST[3]	1970	143	**1**
0015	003	Loblolly	LgPT/ST	1974	225	**3**
0015	013	Loblolly	Sawtimber	1975	56	**3**
0015	019	Loblolly	Lg PT	1976	50	**1**
0015	023	Loblolly	Sawtimber	1979	36	**1**
0016	009	Loblolly	Lg PT	1975	71	**3**
0017	016	Loblolly	PT/ST	1976	96	**2**
0020	011,012	Loblolly	Lg PT/ST	1978	114	**1**
0022	003	Loblolly	Sawtimber	1973	23	**1**
0037	012	Loblolly	Sawtimber	1948	30	**1**
0038	006	Loblolly	Lg PT/ST	1972	72	**3**
0038	008	Loblolly	LgPT/ST	1972	62	**1**
0045	010,009	Loblolly	Sawtimber	1970	45	**2**
0063	012	Lob/Long	PT/LgPT	1981	24	**3**
0063	025	Lob/Long	LgPT/ST	1973	51	**3**
0070	025	Loblolly	Sawtimber	1983	13	**1**
				Total	**1,283**	

[1] 13”DBH or larger
[2] Lg PT = Large Poletimber (10”-12.9” DBH)
[3] ST = Sawtimber (13” DBH or larger)

Prescription #3: LONGLEAF RESTORATION

Treatment Class #1: Remove loblolly, leaving 6-10 of the largest trees/acre. Retain any longleaf. Site preparation by prescribed burning. Hand plant longleaf seedlings.

Treatment Class #2: Remove loblolly, leaving 6-10 of the largest trees/acre. Retain any longleaf. Site preparation by mastication and prescribed burning. Hand plant longleaf seedlings. Hand release longleaf seedlings using herbicide.

Treatment Class #3: Remove loblolly and retain all longleaf.

Treatment Class #4: Remove loblolly and retain longleaf. Site preparation by mastication and prescribed burning. Hand plant longleaf seedlings. Hand release longleaf seedlings using herbicide.

Treatment Class #5: Majority of loblolly poletimber was killed in the Wedboo fire. Site preparation by mastication and prescribed burning. Hand plant longleaf seedlings. Hand release longleaf seedlings using herbicide.

Compt.	Stand	Dominant Species	Dominant Size Class	Age Year	Acres	Treatment Class
0004	024	Lob/Long	Poletimber	1988	126	**3**
0015	009	Loblolly	Poletimber	2011	27	**5**
0015	010	Loblolly	Poletimber	1986	35	**2**
0015	017	Loblolly	Poletimber	1988	70	**2**
0016	004	Loblolly	Poletimber	1991	33	**2**
0016	017	Loblolly	Poletimber	1989	51	**2**
0017	005	Loblolly	Poletimber	1985	59	**2**
0018	019	Lob/Long	Poletimber	1985	56	**4**
0036	019	Loblolly	LgPT/ST	1988	37	**2**
0036	022	Loblolly	LgPT/ST	1967	40	**2**
0044	001	Loblolly	LgPT/ST	1973	69	**1**
0045	014	Loblolly	Poletimber	1985	26	**1**
0045	016	Loblolly	PT/LgPT	1966	11	**1**
0046	020	Loblolly	LgPT/ST	1963	23	**1**
0047	001	Loblolly	LgPT/ST	1976	32	**1**
0062	007	Loblolly	PT/LgPT	1965	39	**2**
0063	007	Loblolly	LgPT/ST	1973	32	**1**
0064	003	Loblolly	LgPT/ST	1973	35	**1**
				Total	**801**	

Prescription #4: THIN TO PROMOTE MIXED PINE/HARDWOOD.

Treatment Class #1: Thin pine down to 40-50 sq. ft. / acre, releasing favorable hardwoods where possible.

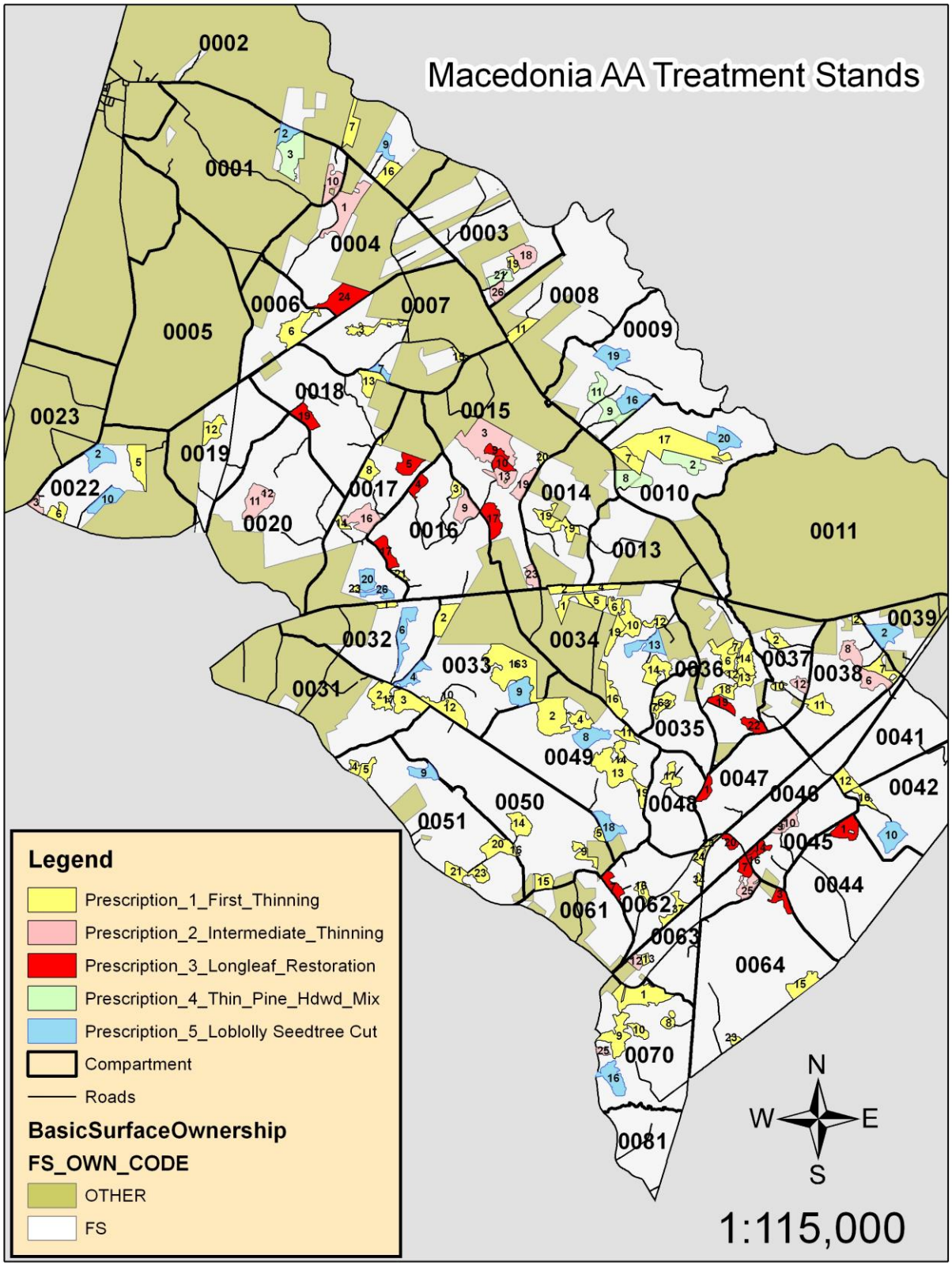
Compt.	Stand	Dominant Species	Dominant Size Class	Age	Acres	Treatment Class
0001	003	Loblolly	Sawtimber	1974	129	**1**[1]
0003	021	Loblolly	Poletimber	1988	40	**1**
0009	009	Loblolly	Poletimber	1989	80	**1**
0009	011	Loblolly	Poletimber	1983	58	**1**[2]
0010	002	Loblolly	PT/ST	1987	92	**1**
0010	008	Loblolly	Sawtimber	1946	89	**1**
				Total	**488**	

[1] Patches of Shortleaf, favor Shortleaf where possible.
[2] Large portion of stand contains class II heritage sites.

Prescription #5: LOBLOLLY SEEDTREE CUT.

Treatment Class #1: Cut down to 10-20 sq. ft. / acre leaving the largest, best formed loblolly pine. Site preparation would be by mastication to remove midstory hardwoods.

Compt.	Stand	Dominant Species	Dominant Size Class	Age	Acres	Treatment Class
0001	2	Loblolly	Sawtimber	1964	38	**1**
0002	9	Loblolly	Sawtimber	1967	38	**1**
0007	7	Loblolly	Sawtimber	1967	21	**1**
0009	16	Loblolly	Sawtimber	1984	80	**1**
0009	19	Loblolly	Sawtimber	1939	80	**1**
0010	20	Loblolly	Poletimber	1987	79	**1**
0017	20	Loblolly	Poletimber	1972	48	**1**
0017	26	Loblolly	Poletimber	1972	33	**1**
0022	2	Loblolly	Sawtimber	1973	78	**1**
0022	10	Loblolly	Sawtimber	1981	65	**1**
0032	6	Loblolly	Poletimber	1989	79	**1**
0033	4	Loblolly	Sawtimber	1957	45	**1**
0033	9	Loblolly	Sawtimber	1956	80	**1**
0034	13	Loblolly	Sawtimber	1940	79	**1**
0039	2	Loblolly	Sawtimber	1971	79	**1**
0042	10	Loblolly	Poletimber	1985	80	**1**
0049	8	Loblolly	Sawtimber	1970	79	**1**
0049	18	Loblolly	Sawtimber	1971	69	**1**
0051	9	Loblolly	Sawtimber	1967	45	**1**
0070	16	Loblolly	Poletimber	1987	77	**1**
				Total	**1,272**	


Macedonia AA Treatment Stands
Legend
Prescription_1_First_Thinning
Prescription_2_Intermediate_Thinning
Prescription_3_Longleaf_Restoration
Prescription_4_Thin_Pine_Hdwd_Mix
Prescription_5_Loblolly Seedtree Cut
Compartment
Roads
BasicSurfaceOwnership
FS_OWN_CODE
OTHER
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W
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1:115,000

2.3 Alternative 3

This alternative addresses issue 3 in section 1.8.

It is identical to Alternative 2 except the planted longleaf seedlings would not be released using herbicide and instead would be released by manual labor using brush saws.

2.4 Alternatives Considered but Not Developed

Thinning as used in this EA is synonymous with stocking control. The intent is to reduce the number of tree stems in a forested stand based on site quality and capability to achieve the stated purpose and need. Three other action alternatives were considered but not developed.

- An alternative to use noncommercial treatments consisting of mechanical (chippers) and manual methods (chainsaws) was considered but not developed. Some stands are very dense and the material left on the ground would pose a fire hazard if not treated. In addition, these types of treatments are very expensive to implement resulting in a lower number of acres that could be treated. A large portion of the project area would remain untreated and the purpose and need could not be met with this alternative.

- An alternative to only prescribe burn was considered but not developed because stands are very dense and fire would not reduce stand densities over enough of the area. Fire would treat just a portion of the fuels and would not create enough gaps in the canopy to establish desired habitat conditions. The purpose and need could not be met with this alternative.

- An alternative was considered to not build any temporary roads. However, this alternative was not developed because temporary roads are needed to access the stands in need of treatment. Not treating these stands would result in a majority of them being over stocked and at risk for insect and disease attack. Past experience shows that temporary roads on the coastal plain have minimal long term resource effects if Forest Plan standards and guidelines are followed including adherence to *South Carolina's Best Management Practices for Forestry* and *Soil and Conservation Practices Guide for R8*.

2.5 Design Criteria

Forest wide standards, guidelines, goals, and objectives are found in the *Revised Land and Resource Management Plan for the Francis Marion National Forest* (1995), *South Carolina's Best Management Practices for Forestry* (BMP's) (SCFC, 2003) and *Soil and Conservation Practices Guide for R8*. Additional management requirements and mitigation measures can be found in the *Final Environmental Impact Statement, Vegetation Management in the Coastal Plain/Piedmont*.

Activities and effects would be monitored to ensure compliance with the Monitoring Plan (Forest Plan, Appendix B).

The following design criteria would apply to Alternatives 2 and 3:

Cultural Resources

1. Identified national register or eligible properties would be marked and avoided during site disturbing activities associated with logging, temporary road construction, road reconstruction, fireline construction and reconstruction. If cultural resources are discovered during implementation, work would stop and the site would be evaluated for National Register eligibility.

Red Cockaded Woodpecker

2. Mechanical activities would not be conducted within 200 feet of an RCW cluster during the RCW breeding season (April 1st – July 31st) in order to reduce the potential impact of disturbance on nesting activities.

3. Mechanical activities within RCW clusters would only take place between one hour after sunrise and one hour before sunset year round.

4. No new firelines would be installed within 200 feet of RCW cavity trees except where needed to construct firelines adjacent to private property lines.

5. No heavy equipment would pass through active RCW clusters on the way to harvest areas for treatment with the **exception** of the following:

    - Clusters that occur along existing roads and which cannot be avoided using alternate routes.
    - Logging equipment conducting habitat improvement activities within an RCW cluster.

6. Any temporary haul road that passes through an RCW cluster would limit heavy equipment operations between one hour before sunset and one hour after sunrise.

7. Log decks would not be placed within clusters.

8. Logging equipment would not be permitted to stop within clusters, unless habitat improvement activities are occurring within the cluster.

9. Thinning may take place within 50 feet of RCW cavity trees if it can be done without soil rutting or damaging the cavity trees. Logging activities would be immediately suspended at the first sign of rutting within this 50 foot zone.

Other Threatened, Endangered and Sensitive Species

Firelines, temporary road construction, skid trails and log landings would not be placed at known site locations of threatened, endangered and sensitive species. Also see Design Criteria #31 below.

Fisheries and Streamside Zone Management

10. New culverts and culvert replacements would allow for aquatic organism passage where deemed appropriate.

11. Perennial and intermittent streams would be identified on sale area maps and protective measures would be specified in the timber sale contract.

12. To minimize disturbance, woody debris (limbs and logs) may be used on skid trails when they cross intermittent streams. The un-embedded woody material on the surface would be removed after skidding is completed. Woody material embedded or "worked in" to the soil would not be removed and soil would not be put into the stream. Normal stream flow pattern, channel form and stability would be maintained.

Soils Management and Isolated Wetlands

13. Logging would not take place under the following soil conditions:

    - There is evidence of surface ponding of water.
    - The water table is within 18 inches of the surface (12 inches on plastic soils).
    - Soil moisture exceeds plastic limit (plastic limit is exceeded if soil can be rolled to pencil size without breaking or crumbling).

14. Skid Trails and timber harvesting would not occur within isolated wetlands.

15. On wet soil types, and mapped remnant savanna habitats, locate skid trails, log landings and log ramps according to the following criteria and only as designated by a forest officer:

    - Locate log landings on elevated terrain. Use existing log decks where possible.
    - Limit concentrated skid trails and log landings to no more than 10% of the area.
    - Construct log ramps on the best drained sites.

16. Skid trails would not be installed immediately adjacent to isolated wetlands and skid trails would be located parallel to wetland edges instead of perpendicular to them unless approved by the district wildlife biologist.

17. When harvesting timber adjacent to isolated wetlands, trees would be felled away from and not into the wetlands.

Firelines

18. Temporary firelines would be used in the short term as needed to exclude some units from burning in order to protect newly established regeneration or to avoid fire impact to recently prepared sale units.

19. Dozer firelines would be bladed as opposed to being constructed with a fire plow in order to prevent rutting and channeling of water.

20. Dozer firelines would not be used within riparian areas except where they must tie into stream channels or other water bodies to contain the burn. Where dozer lines tie into stream channels or other water bodies, soil disturbance would be kept to a minimum by avoiding blading or altering surface or subsurface soils as much as possible. Crossing flowing streams or water bodies with dozers or other heavy equipment would be avoided.

Visual Quality

21. Slash on logging decks would be treated (for example: removed, chipped or scattered) to within an average of two feet of the ground within 200 feet of SC Hwy 17A, SC Hwy 45, Bethera, Greentown, Hoodtown, and Wrenn roads and Jericho horse trail.

22. When possible, log landings, roads and bladed skid trails would be located out of view from major travel routes (public roads and highways) and minimize exposure of bare mineral soil.

23. Flowering and other visually attractive desirable hardwood trees would be left in seed-tree units where possible.

Snags

24. Existing snags would be left standing for wildlife if they do not pose a safety hazard or interfer with project work.

Herbicide Use

25. Herbicide mix water must come from a public water supply and would be carried to the site by the contractor or workers.

26. Trucks containing herbicide or tank mixed herbicide would not be allowed to park within 200 feet of a stream or pond. Herbicide mixing, loading or cleaning areas would not be located within 200 feet of open water.

27. Streams would be protected from herbicide translocation by avoiding herbicide application within a minimum of 40 feet of streams and isolated wetlands.

28. Notice signs would be posted where public access is likely and would include the application date, herbicide applied and safe reentry date.

29. In three stands (compartment 15, stand 17; compartment 16, stand 17; and, compartment 36, stand 22), Carolina tuff grass, crested fringed orchid, Curtis' dropseed, and incised groovebur would be located and a buffer would be flagged around them so they can be avoided before the herbicide application.

Non-Native Invasive Species (plants)

30. All mechanical equipment used in association with this project would be subject to equipment cleaning provisions in order to prevent the introduction and spread of non-native invasive species (NNIS) into the project area. NNIS occurring in stands proposed for treatment (see Table 3.2.1A-2) would be evaluated for treatment prior to and after logging operations.

Protection of Threatened and Endangered Plants

31. The following measures would be taken to protect sites containing threatened, endangered and sensitive plants:

- Compartment 15 Stand 17 (See map B-1 in Appendix B): Several stems of ***Carolina fluffgrass*** (*Tridens caroliniana*) found in a small group just outside the northern boundary of the stand. Have district wildlife fish rare plant (WFRP) personnel flag site to avoid all logging activities and avoid herbicide treatment.
- Compartment 15 Stand 19 (See map B-1 in Appendix B): One plant of ***Carolina fluffgrass*** (*Tridens caroliniana*) found in a small opening within the stand. Have district wildlife fish rare plant (WFRP) personnel flag site to avoid all logging activities.
- Compartment 16 Stand 17 (See map B-2 in Appendix B): Have district WFRP personnel flag out the two sites containing the ***Crested Fringed Orchid*** (*Pteroglossapsis ecristata*) in order to avoid logging activities and avoid herbicide release treatment.
- Compartment 17 Stand 26 (See map B-3 in Appendix B): Have district WFRP personnel flag out the depression wetland containing ***Boykin's lobelia*** (*Lobelia boykinii*) in order to avoid all logging activities.
- Compartment 36 Stand 22 (See map B-4 in Appendix B): Have district WFRP personnel flag out the areas containing ***Curtis' dropseed*** (*Sporobulus curtissii*), ***Carolina fluffgrass*** (*Tridens caroliniana*) and ***Incised groovebur*** (*Agrimonia incise*) in order to avoid log decks or skid trails during logging as well as avoid herbicide release treatment.
- Compartment 37 Stand 12 (See map B-5 in Appendix B): Have district WFRP personnel flag out the area containing ***Curtis' dropseed*** (*Sporobulus curtissii*) in order to avoid log decks or skid trails during logging.
- Compartment 46 Stand 20 (See map B-6 in Appendix B): Have district WFRP personnel flag ***Pineland plantain*** (*Plantago sparsiflora*) along Hwy 41 to avoid all logging activities.
- Compartment 47 Stand 1 (See map B-7 in Appendix B): Have district WFRP personnel flag out the three areas containing ***Curtis' dropseed*** (*Sporobulus curtissii*) in order to avoid log decks or skid trails during logging.

- Compartment 62 Stand 23 (See map B-8 in Appendix B): One plant of ***Pineland plantain*** (*Plantago sparsiflora*) found in the ROW along road FS 118. Have district WFRP personnel flag site to avoid all logging activities.

Recreation

32. To minimize the impacts to the Jericho Horse/Palmetto trail the following measures would be taken for compartment 70, stands 1, 9, 16 and compartment 64, stand 23.

    a. Skidding timber across the above trail would be minimized. Any skidding necessary would be perpendicular to the trail.
    b. Skidder trails that cross the trail would be signed as "Closed to Traffic" to prevent recreational trail users from using the skidder trails.
    c. The trail would not be used for skidding timber or temporary haul roads except where the trail is located on an existing woods road. After the sale, this section of trail would be cleaned, smoothed and bladed to facilitate use by recreational trail users. Logging use of existing trails would be coordinated with district recreation staff prior to use.
    d. Signs warning the public would be placed on all trail access points where logging activities are occurring. The trail would be closed when appropriate.

2.6 Monitoring

1. The stands listed in prescription #3 (longleaf restoration) would be surveyed on the first year after planting longleaf to determine survival and replanting needs. These stands would also be monitored during the second and fifth year after planting to determine if additional release treatments would be necessary.

2. The stands listed in prescription #5 (loblolly seedtree cut) would be surveyed 3-5 years to determine stocking levels of loblolly regeneration.

3. The stands listed in prescription #3 (longleaf restoration) and treatment classes 2, 4 & 5 would be monitored the following growing season after herbicide application. If herbicide treatment has achieved less than 60% kill of targeted species, retreatment would be conducted the following winter.

4. All stands and associated roads would be monitored for cogongrass within three years after treatment.

2.7 Comparison of Alternatives

Table 2.7-1 Comparison of Alternatives

Description	No Action	Alt. 2 & 3
Prescription #1 – First Commercial Thinning Thin young, dense pine stands using conventional logging equipment via commercial timber sales or biomass treatments.	0	4,277 acres
Prescription #2 – Intermediate Thinning Thin older pine stands using commercial timber sales.	0	1,283 acres
Prescription #3 – Longleaf Restoration Restore longleaf pine on sites currently dominated by loblolly pine.	0	801 acres
Prescription #4 – Thin to Promote Mixed Pine hardwoods.	0	488 acres
Prescription #5 – Loblolly Seedtree Cut	0	1,272 acres
Wildlife Snag Creation Create one to two snags per acre for cavity nesting birds and to reduce the incidence of kleptoparasitism on the RCW.	0	Up to 2,084 acres

Table 2.7-1 Comparison of Alternatives (Continued)

Connected Actions	No Action	Alt. 2 & 3
Firelines - (to protect timber sales and newly planted longleaf stands)	0	Up to 10 miles/year for 3 years
Temporary Roads Needed for Logging	0	4.48 miles
System Road Reconstruction/Maintenance	0	53.95 miles
Culvert Replacement	0	25 Culverts

Chapter 3 – Affected Environment and Environmental Consequences

This section summarizes the physical, biological, social, and economic environments of the project area and the potential changes due to implementation of the alternatives. This chapter provides an analytical basis for the comparison of alternatives in the previous chapter.

3.1 Physical Environment

CFR 1508.8 "Effects" include:

(a) Direct effect, which are caused by the action and occur at the same time and place.
(b) Indirect effects, which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable.
(c) Cumulative effects (also called cumulative impacts), which are effects on the environment which result from the incremental impacts of the action when added to other past, present, and reasonably foreseeable future actions.

The physical environment is divided into Soils, Water and Riparian, Air Quality, and Climate Change and Carbon Storage.

3.1.1 Soils

Introduction

The purpose and need for this project is described in Chapter 1, Section 1.5 with seven (7) specific needs identified. The treatments proposed to achieve the purpose and need involve the implementation of five (5) silvicultural prescriptions, one wildlife treatment and one herbicide treatment. Ground-based vegetation treatments, i.e. timber harvest, would be the primary method used, creating the potential for impacts to the soils of the project area. Treatments would also create opportunities to restore, enhance and protect forest ecosystem components in the project area.

While natural disturbance agents such as wildfires, insects and diseases have the potential to impact soil productivity, the treatments of this project also have the potential to affect soil productivity. The purpose of this Soils section is to evaluate and disclose the potential effects of each alternative on soil productivity and to document compliance with the regulatory direction and applicable laws. The primary concerns with regards to the proposed actions are the impacts of soil compaction, erosion, and loss of organic matter.

This section identifies the applicable laws and regulations that provide direction for the protection of the soil resource, explains the analysis methods and scale used to determine the potential effects of each alternative, identifies features designed to minimize detrimental soil disturbance, describes the existing condition of soils in the Macedonia analysis area, discloses environmental consequences of each alternative, and discusses the project design features and monitoring requirements.

Regulatory Framework

Laws and regulations provide direction for the management and protection of individual resources. Forest Service manuals and handbooks, Forest plans, and state Best Management Practices (BMPs) identify the methods and guidelines that individual actions must follow to comply with the laws and regulations. The applicable regulatory framework that provides direction for the protection of soil productivity comes from the following:

- Forest Service Manual - Section 2500 (WO Amendment 2500-90-2)
- Multiple-Use Sustained-Yield Act of 1960
- National Forest Management Act of 1976
- Forest Service - Region 8 Soil Quality Standards, FSH 2509.18-2003-1
- Land and Resource Management Plan, Francis Marion National Forest, 1995
- South Carolina's Best Management Practices for Forestry (BMPs), 1994
- Forest Service - Region 8 Soil and Water Conservation Practices (SWCPs) Handbook, 2003

Methodology for Analysis

Scope of the Analysis

The geographic boundary used to assess direct effects to soils is the activity areas or locations where treatments such as tree removal, temporary road construction, site preparation, and road maintenance are proposed (refer to applicable maps of Proposed Action). The analysis area for soils encompasses all land within an individual treatment or activity area. In general, soils outside the boundaries of the activity areas are not expected to be directly, indirectly, or cumulatively affected by this proposal. This boundary was chosen because it can be used to determine effects to soil quality from the proposed actions. For instance, the direct effects from a log landing would be the acreage used for the landing because it is the acreage of soil directly impacted by the activity.

The following activities or disturbances could potentially affect soil quality and productivity:

- Operations to fell commercial value trees – felling machines during harvest operations
- Operations to move felled trees to landing areas - skidders
- Operations to process and load logs in loading areas, and associated equipment movements
- Construction, maintenance, and closure of log landings, skid roads and temporary roads
- Site preparation for reforestation – mechanical equipment for mastication treatment
- Reconstruction and/or maintenance of permanent Forest Service system roads
- Construction of fire control lines around treatment areas using bulldozers

These activities have the potential to cause detrimental disturbance to the soil, impacting soil quality and/or productivity through compaction, rutting, erosion, displacement, and loss of organic matter and ground cover.

Forest Service Region 8 Soil Management Handbook defines Soil Quality as: *the ability of a specific kind of soil to function within its surroundings, support plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation*. (USDA-FS-R8-2509.18, 2003)

Soil quality is also defined as the capacity of a soil to function within an ecosystem to sustain biological productivity, maintain environmental quality, and promote plant and animal health (Doran and others 1996). The most productive part of the soil occurs near the surface at the contact between the forest litter and the mineral soil. This is also the part of the soil that is easiest to disturb during management activities. Therefore, the analysis of activities was limited to this most productive portion of the soil. Evaluation of deeper soil layers and underlying parent material was used only to determine how they influence the productivity of upper soil layers.

The Region 8 Soil Quality Standards (R8 Supplement 2509.18-2003-1) were designed to be applied at the project level of activities. For harvest operations, the activity areas are identified as the stands to be treated and any associated temporary roads and log landings. For these activities, the intent of this analysis was not to assess the existing site conditions and effects to the soil productivity across the entire "project area". Rather, the scope of this analysis was narrowed to assess the existing site conditions and effects to soil productivity within the immediate vicinity of the proposed management activities.

The soil quality standards are not applicable to intensively developed sites, e.g. permanent system roads or developed recreation sites. These sites are considered as essential infrastructure, not part of the productive land base and are managed for other purposes. They are not intended to prohibit other resource management practices such as, installing water bars or preparing sites for planting, as long as such practices are consistent with long-term sustainability of the soil resource. Permanent roads do have the potential to affect soil-hydrologic function.

Concerning the temporal boundaries, the temporal scale is dependent on the specific issue being addressed with no one scale being appropriate in all issues. The analysis may need to evaluate the effects of proposed management over all seasons for several days, years, decades, or perhaps centuries. Generally, detrimental effects on soils are not permanent and depend primarily on soil texture, parent material, aspect, and moisture. For this project, field assessments detected soil disturbance up to 40 years in the past and the effects of the proposed management activities can be estimated to about 5-10 years into the future.

The temporal boundary used to assess effects would vary depending on the activity. Short-term effects from: (1) increases in soil moisture from harvesting may last a year or two until new vegetative growth occurs; or (2) disturbance or mixing of the soil organic horizon may disrupt decomposition processes for a few weeks or months. Long-term effects of five to over 50 plus years may result if the highly productive upper layer of soil is compacted or removed. For example, soil displacement or soil compaction could result from skid trail development and use. This may remove the organic matter and available nutrients in the upper layer of the skid trails and affect water infiltration. This effect may persist from the time use of the skid trails begins until three to five years following the completion of timber harvest activities, and soils are ripped

and re-vegetated; or, if compacted soils on the skid trails are not ripped after use, impacts to soil productivity on the skid trails may persist for 40 to 70 years.

Field visits by Forest Service personnel, Geographic Information System data, records of past activities, and information from the soil surveys for the Francis Marion National Forest were used to evaluate the impacts of proposed activities. The description of anticipated impacts to the soil resource was based on the sensitivity of the soils in the project area and the amount of soil proposed activities are likely to disturb. Forest Service Handbook FSH 2509.18 Soil Management Handbook R8 Supplement 2 soil quality standard 4.a states "At least 85 percent of an activity area is left in a condition of acceptable potential soil productivity following land management activities (USDA-FS-R8-2509.18, 2003). To see if this threshold would be exceeded by proposed Macedonia Project activities, acres of soil impacted by soil disturbing activities (skid trails, log landings, and temporary road construction) were estimated using the best available information, and compared to the total acres of the activity areas (harvest units and road corridors).

Affected Environment

The Macedonia Project identifies treatment units in the Proposed Action on a total of 8,121 acres, primarily consisting of thinnings and longleaf pine restoration treatments generally ranging in age from 35 to 65 years old. The project area is located within the boundaries of the Francis Marion National Forest, Berkeley County, South Carolina. Proposed treatments would occur on forest lands that vary in elevation, aspect, slope, soils, disturbance history, and resilience to disturbance.

Ecologically this project area is situated in the Atlantic Coastal Flatlands Section (232C), identified in the Forest Service National Hierarchical Framework of Ecological Units (Cleland et. al. 1993). Section 232C is a sub-unit level of the Outer Coastal Plain Mixed Forest Province (232), marked by high humidity (especially in summer) and the absence of cold winters.

<u>Atlantic Coastal Flatlands</u> (232C): predominant landform is a flat, weakly dissected alluvial plain formed by deposition of continental sediments onto submerged, shallow continental shelf, later exposed by sea level subsidence. Elevation ranges from 0 to 80 feet, average annual precipitation about 46 inches and a growing season of 185 to 220 days. Soils have a thermic temperature regime, deep, medium textured and adequate to excessive water supplies for use by vegetation. This Section has a moderate density of small to medium size perennial streams and a low density of associated rivers, most with moderate volume of water at very low velocity. Fire has probably been the principal historic disturbance, with climatic influences of frequent hurricanes. (USDA Forest Service, 1994)

The project area is located in one soil survey area, Berkeley County, published cooperatively by the USDA Natural Resources Conservation Service and the USDA Forest Service (NRCS, 1980). The mapping data for National Forest lands is available in a Forest GIS data-base and the NRCS Web Soil Survey website.

Soil scientists of the Francis Marion National Forest have developed a grouping for the soil series mapped on the Forest to facilitate the understanding of soil characteristics on use and management. The groupings, displayed in Table 3.1.1-1, are based primarily on the interpretations for use and management of the soils, with particular emphasis on the characteristic of soil wetness, and its influence on the potential for compaction or rutting from equipment use. The soil groups are briefly described below the Table.

Wetlands commonly occur in many soil types that are found within the analysis area. It is possible approximately half of the soils on federal lands, in the analysis area, may be considered hydric. Hydric soils[1] are often associated with wet flats, bays, swamps and wetlands. The water table typically is close to the surface and soils having restricted drainage are common throughout the area (NRCS, 2010).

Table 3.1.1-1. Forest Soil Groups on the Francis Marion National Forest

Group Number	Forest Soil Groups on the Francis Marion National Forest (similar interpretations)
1	Bonneau, Cainhoy, Hockley, Lakeland, Norfolk, & Wagram
2	Chipley, Echaw
3	Caroline, Craven, & Faceville
4	Charleston, Duplin & Goldsboro
5	Lenoir & Wahee
6	Leon, Ocilla, Scranton, & Seewee
7	Bethera, Chastain, Lynchburg, Rains, Tawcaw & Wadmalaw
8	Bayboro, Byars, Meggett, Pamlico, Pantego, Rutlege, Santee, Stono & Yonges

Soil wetness increases from Group 1 to Group 8.

Soil Group 1

Soil Series in Project Area include Bonneau, Cainhoy, and Norfolk

These soils are somewhat excessively well-drained to well-drained. Soil texture ranges from fine loamy to loamy and consist of sandy clay loams in the subsurface generally starting around 17 - 27 inches. They are located on broad ridges and generally have good infiltration and moderate permeability. Logging activities can be allowed on these soils throughout the year except immediately following heavy rainfall. After heavy rain events compaction and slight rutting is possible. The window of opportunity for logging these areas is about 8 to 10 months out the year. Seasonal or wet soil restrictions may be needed during unusually wet periods.

[1] A hydric soil is defined as a soil that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part. Redoximorphic features are observed by visual inspection, including soil color. Features also include redox concentrations (accumulations of iron and manganese oxides producing rust-colored masses), redox depletions (grey masses where iron and manganese have been stripped), oxidized rhizospheres (rust colored areas surrounding roots where oxygen leaving the roots has oxidized iron in the soil), and reduced matrices (low chroma soils resulting from the presence of reduced iron). Soil Scientists have used redoximorphic features in conjunction with color and texture to classify hydric soils by their geographic location.

Soil Group 2

Soil Series in the Project Area include Chipley and Echaw

This group is composed of two soils, Chipley series and Echaw series, which occur in a complex pattern on broad upland areas adjacent to low wet areas. Chipley soils are very deep, somewhat poorly drained, very rapid or rapidly permeable soils, while Echaw soils are deep and moderately well drained. Both soils are sandy. The range in soil characteristics such as wetness variance and depth to the water table makes it difficult to develop design criteria for logging. However, these areas generally have long dry periods during most years so impacts from logging would be minimal. Slight rutting following a heavy rainfall can occur. The window of opportunity for logging these areas is about 8 months out of the year. Seasonal or wet soil restrictions may be needed during unusually wet periods.

Soil Group 3

Soil Series in the Project Area include Caroline, Craven and Faceville

These soils are well drained to primarily moderately well drained. Soil textures range from sandy to silty loams with high levels of clay in the subsurface, starting generally at 8 to 9 inches. Compaction and rutting is normally not a problem except for logging when the soil surface is too wet. Permeability is moderately slow to slow in the clayey subsurface. This clay layer restricts water movement therefore, restricting logging practices following rainfall or wet periods. The soil surface can be moist but not wet before logging. The window of opportunity for logging these areas is 6-8 months out of the year. Seasonal or wet soil restrictions may be needed during unusually wet periods.

Soil Group 4

Soil Series in the Project Area include Craven and Goldsboro

These soils are moderately well drained and are subject to rutting following heavy rainfall periods. The Goldsboro soils typically consist of loamy sand on the soil surface and a sandy clay loam in the subsurface. The subsurface of this soil has an accumulation of clay from 12-40 inches deep. In general permeability is moderate in this soil group. Logging activities can be allowed most of the year except during heavy rainfall periods and probably several days following rainfall. Compaction can occur in these soils when drying out following rainfall periods. Extensive rutting should not be allowed as this can affect rooting depths, surface and subsurface hydrology. The window of opportunity for logging these soils is 6-8 months out of the year. Seasonal or wet soil restrictions may be needed during heavy rainfall and wet periods.

Soil Group 5

Soil Series in the Project Area include Lenoir and Wahee

These soils are somewhat poorly drained and have slow permeability due to very high levels of clay. The clay layers in these soils occur close to the surface primarily starting at approximately 8 inches to 11 inches. Therefore, ponding is likely to occur after a heavy rainfall event. The water can stay on the soil surface for days. It is difficult for roots to penetrate through the sub-surface layer due to thickness of the clay near the surface layer. Though soils in this series may emulate hydric soils generally, none these soils are truly hydric. It may be difficult to convert these soils from loblolly to longleaf, except in prolonged droughts and after numerous burning cycles. Some inclusions of longleaf are present within these mapping units. Rutting, displacement and compaction are all concerns when these soils are in wet conditions. The window of opportunity for logging these soils is 4-6 months out of the year. Seasonal or wet soil restrictions would need to be in effect during most of the year, especially during rainfall or wet periods. Low PSI equipment would extend the time it can be logged. It is best to log during dry periods to prevent damage to soil productivity and to the residual stand.

Soil Group 6

Soil Series in the Project Area include Leon, Ocilla, Seagate and Wahee
These soils have textures that range from sandy to sandy loam and are found mostly on poorly drained to somewhat poorly drained sites. These soils stay wet for long periods following heavy rainfalls. Permeability ranges from moderately slow to rapid. Leon series is considered to be “all hydric”. The Leon soils have an organic cement layer beneath the surface that has the tendency to restrict water movement through the soil resulting in keeping the soil surface wetter than the other soils listed in this category. This phenomenon also reduces water permeability in these two soils. This soil group has a high potential for rutting because they are wet and sandy throughout most of the soil profile. It is critical that the soil surface is dry enough to minimize rutting and soil displacement. The normal window of opportunity for logging these sites is 4-6 months out of the year, because of the seasonally high water table (SHWT) which is at 6” to 2’ 1-6 months out the year for most of these soils. Seasonal or wet soil restrictions would need to be in effect much of the year. Under unfavorable logging conditions, a soil scientist may need to do site evaluations prior to logging or monitoring during logging. During all other times the timber sale administrator would do site evaluations to ensure soil quality standards are not compromised. Low PSI equipment would extend the time it can be logged. It is best to log during dry periods to prevent damage to soil productivity and to the residual stand. The water table should be greater than 12 inches below the soil surface before logging.

Soil Group 7

Soil Series in the Project Area include Bethera, Lynchburg, and Rains

These hydric soils are primarily poorly drained and associated with clay in the subsurface. Permeability ranges from slow to moderate. They can stay saturated for extended periods and may be seasonally flooded depending on the site and amount of rainfall. The window of opportunity for logging these sites is approximately 2-4 months out of the year. These soils are easy to compact and can affect soil productivity. Compaction can affect root development and can cause ponding on the soil surface. Rutting is also an issue when these soils are moist to wet. Rutting affects the normal water surface flow and soil productivity. Root penetration is reduced

and surface water movement is restricted when these soils are compacted and rutted. It is important to monitor these sites more frequently during harvesting activities than the soil groups listed above. Under unfavorable logging conditions, a soil scientist may need to do site evaluations prior to logging or monitoring during logging. During all other times the timber sale administrator would do site evaluations to ensure soil quality standards are not compromised. Low PSI equipment would extend the time it can be logged. It is best to log during dry periods to prevent damage to soil productivity and to the residual stand. The water table should be greater than 12 inches below the soil surface before logging.

Soil Group 8

Soil Series in the Project Area include Bayboro, Meggett, Pamlico, Pantego, Pickney, Santee and Yonges.

These soils are very poorly drained and have deep organic soil surface layers. Most of these soils are considered hydric. Some of the soils are sandy throughout the profile and others contain high levels of clay. Approximately 12” of organic materials may have accumulated on the surface due to flooding and saturation for extended periods of time. Ponding is frequent on these soils, and they dry slowly. Some of the areas have small inclusions located higher within the soils mapping unit. These inclusions, if large enough, may be logged earlier than other stands as they dry out or during periods of drought. Rutting tends to be a severe problem with these soils, so ponding is often more evident after logging. The window of opportunity for logging these areas generally is less than 2 months in a good (i.e., dry) year. Low PSI equipment would extend the time it can be logged. It is best to log during dry periods to prevent damage to soil productivity and to the residual stand. Under unfavorable logging conditions, a soil scientist may need to do site evaluations prior to logging or monitoring during logging. During all other times the timber sale administrator would do site evaluations to ensure soil quality standards are not compromised prior to and during logging.

During soil survey mapping, soil scientists traverse the landscape to inventory and classify soils into soil mapping units. Key soil properties evaluated during surveys include slope gradient, soil depth to bedrock, soil texture, soil drainage, landform position of occurrence, and other physical properties that could influence soil productivity and management. Landform features that may limit use and management are also noted; e.g. depressions, ditches, bays, and swamps. These characteristics are typically evaluated in the field setting, recorded on data sheets or imagery and compiled into the soil survey base map coverage.

Identification of stream associated landforms, e.g. floodplains and riparian corridors, is an important element of managing the forest landscape. These areas typically have different vegetation communities, ecological processes and soil characteristics that reflect their structure and components. Two soil series are mapped along nearly level, low-lying flats and in drainage-ways in the project area; Chastain and Meggett. These soil series typically occur on broad and narrow, low-lying drainage-ways and depressions with well-defined drainage patterns. Meggett soils are poorly drained with a loam texture surface and gray clay subsoil, mottled with shades of brown, yellow and red, characteristic of poor drainage and hydric conditions. Actions on these

soils could potentially be regulated by Section 404 regulations of the federal Clean Water Act, depending on the activity.

Table 3.1.1-2, Listing of Treatment Acres by Soil Series, displays the Proposed Action treatment acreages by the soil series name, Francis Marion soils group, and the proposed treatments by acres proposed on the different soil series in the project area.
The Bethera, Lenoir and Wahee soil series are the soils with percentages of occurrences of 15% or greater on proposed action stands. These three series occur on an estimated 54% of the stands proposed for treatment, primarily in the stands proposed for first thinning.

Table 3.1.1-2. Listing of Treatment Acres by Soil Series in the Macedonia Project Area

Soil Series Name	FM Soil Group	First Thinning	Intermediate Thinning	Seedtree Cut	Longleaf Restoration	P-H Mix	Soil Acres Total	% of Project Area
Bayboro	8	99.78	1.23	62.92	6.07	0	170	2.0
Bethera	7	1135.23	144.66	347.55	126.61	52.65	1,807	22.0
BonneauA	1	88.40	16.52	39.29	69.43	64.78	278	3.4
BonneauB	1	18.23	2.81	0	47.41	28.39	97	1.1
BorrowPits	n/a	0	0	5.87	0	0	6	>1
Cainhoy	1	14	37.95	36.19	79.66	13.13	181	2.2
CarolineA	3	24.36	0	0.28	0	0	25	>1
CarolineB	3	89.19	104.09	5.53	23.73	0	223	2.7
Chastain	7	0.72	0	1.81	0	0	3	>1
Chipley-Echaw	2	151.13	64.82	26.24	83.83	0	326	4.0
CravenA	4	68.18	0	58.05	9.79	8.44	144	1.7
CravenB	4	64.29	86.12	43.74	0	0	194	2.4
DuplinA	4	124.46	38.26	91.24	23.81	38.8	317	3.9
DuplinB	4	140.01	37.99	1.58	0	55.55	235	2.9
Goldsboro	4	127.76	1.02	61.79	53.96	21.32	266	3.3
Lenoir	5	649.56	330.15	127.28	57.53	158.70	1,323	16.2
Leon	6	16.43	0	0	17.78	0	34	>1
Lynchburg	7	330.94	86.26	13.23	20.56	10.28	461	5.7
MeggettA	8	185.44	65.69	34.67	3.68	9.58	299	3.7
MeggettB	8	0.94	0	0	0	0	1	>1
NorfolkA	1	16.39	6.44	6.80	0	2.36	32	>1
NorfolkB	1	0.19	0.54	0	5.81	0	7	>1
Ocilla	6	12.19	0	0	2.19	2.33	17	>1
Pamlico	8	10.67	0.03	0	0.31	0	11	>1
Pantego	8	129.02	4.31	32.52	12.72	0	179	2.2
Pickney	8	4.23	21.31	0.06	27.34	0	53	>1
Rains	7	58.61	35.63	7.11	10.0	18.0	129	1.6
Santee	8	10.30	2.88	5.44	0	0	19	>1
Seagate	6	0	2.19	0	0	0	2	>1
Wahee	6	708.96	193.12	265.78	120.34	2.90	1291	16
Total Acres		4,280	1,284	1,275	803	487	8,128	

Explanation of Soil Series Names – soil types listed as A or B were mapped on at least two slope classes within the Project Area. Slope class A represents 0 to 2 percent slopes and class B represents 2 to 6 percent slopes. The slope groups are listed separately to provide identification of soil types that may have different interpretations and management during the proposed action.

The "FM Soil Group" denotes the Francis Marion Soil Grouping identified for the soil series. The soil acres listed in each column are derived from a GIS mapping of the proposed action treatment areas coverage combined with the current Francis Marion soil survey coverage; acres are approximate.

Existing Site Conditions

The Macedonia Analysis Area, in Berkeley County, SC, was heavily impacted by the Category 4 hurricane known as "Hugo" that struck the South Carolina coast in Charleston County in 1989 moving inland across the Francis Marion National Forest and associated areas. The storm caused significant changes to the Forest's ecosystems, particularly to the mature longleaf and loblolly pine stands that provided habitat for a large population of Red Cockaded woodpeckers, resulting in an almost complete loss of cavity trees, and the bird population at that time. The storm created fuel loads described as "heavy" due to the size of the trees and logs destroyed. Most of these fuels are slow to decompose, and the use of prescribed fire has been minimal over much of the Project Area. The result of this reduced level of prescribed burning and lack of wildfire in the area on soil productivity has generally been to maintain or enhance soil productivity. Salvage logging of the Hugo damage was implemented following the storm, resulting in the stands proposed for first time thinning in the Macedonia Project. Growth of pines, hardwoods and associated vegetation in these stands indicates soil productivity has likely recovered from any past disturbance prior to Hugo. The "heavy" fuel (large diameter) provides added organic matter to the soils, and coarse woody debris available to build nutrient levels. The soils in the stands identified in the proposed action have been managed for sustainable conditions during Forest Service ownership, and remain productive as a result of this direction. One stand, Compartment 39/2, has a "legacy" drainage ditch that extends across most of the stand, estimated at 8 feet deep, 10 to 15 feet wide and carried water approximately 2 feet deep in mid-July, 2013. Although the history is not officially documented, District personnel estimate the ditch was constructed between 1963 and 1968 to improve drainage through the stand. Proposed timber management operations in the stand, to implement a loblolly seed tree system, would likely require a temporary crossing of the ditch to meet BMPs. Future plans for the ditch, after the timber sale, have not been evaluated or proposed.

Environmental Consequences Common to Action Alternatives

Soil Disturbance, Compaction, Productivity and Erosion: Risk of soil disturbance and site degradation exists whenever ground-based equipment is used in forest operations. The severity and areal extent of this disturbance can be managed (Miller 2004). Soil disturbance refers to a change in the natural state of a soil caused by an artificially imposed force (Arnup, 1998). Region 8 Soil Quality direction defines soil disturbance as: ***any activity that alters the existing physical, chemical and/or biological properties of the soil.***

Four basic steps can be analyzed to determine whether a proposed activity would cause adverse impacts to soil productivity:

- Determine what is detrimental disturbance caused by the activity
- Match equipment and best management practices to the site

- Minimize detrimental disturbance
- Ameliorate or rehabilitate detrimental disturbance where needed

In the application of silvicultural or timber management practices, detrimental soil disturbance is commonly recognized in the form of compaction, erosion, or rutting resulting from the use of ground-based harvesting equipment (Howes, 2006). Soils can be adversely impacted by activities such as building temporary roads and log landings, operating heavy equipment, skidding logs and piling slash. The amount of detrimental disturbance that occurs depends on soil moisture, slope steepness, complexity of topography, and rock content of the soil, depth of slash, season of harvest, skidding design, and type of equipment used, sale administration and the skill of equipment operators. Combinations of these factors affect the magnitude and extent of disturbance.

Disturbance of soils from timber harvest management practices would result in some form of physical, chemical and biological changes within the sites disturbed. Direct effects to the soils are changes/loss of soil organic matter content, soil erosion, soil compaction, and nutrient leaching and/or displacement. Indirect effects are accelerated weathering, loss of soil as sediment, alteration of organic matter formation, and alteration of soil permeability/water infiltration.

Skidding felled trees along skid trails to a log landing, and the log landing/loading operations typically cause most of the soil disturbance within a harvest unit. This disturbance is typically compaction, mixing of soil layers, and rutting during wet periods. Surface erosion within a harvest unit is typically limited because of the quantity of woody material left on the ground surface, which disperses and breaks up overland water flows. Thinning operations leave more residual material than regeneration harvest methods, primarily due to a lower number of trees removed, and the continuing contribution of tree tops, limbs, needles and other material to the forest floor. Proper and timely installation of drainage controls or rehabilitation on areas of soil disturbance have been demonstrated as best management practices (BMPs) that can reduce accelerated erosion. These practices are implemented through Forest Service timber sale contract provisions that specify operational procedures and practices to address ground disturbance and soil protection.

Soil Compaction: Soil compaction in forest management operations is primarily associated with equipment use. Compaction increases soil bulk density and decreases porosity as a result of the application of forces such as weight and vibration caused by the operation of heavy equipment common to forest operations. Compaction can detrimentally impact both soil productivity and watershed conditions by causing increased overland flow during storm events and reduced plant growth due to a combination of factors including reduced amounts of water entering the soil and its reduced availability to plant growth, a restricted root zone, and reduced soil aeration. It is generally acknowledged that all soils are susceptible to soil compaction or soil porosity, particularly when wet.

Soil compaction is dependent on soil texture, organic matter, and soil moisture (McKee et al. 1985). Soil compaction causes increased soil density (weight per unit volume) or bulk density. This effect can hamper root penetration and growth, reduces soil aeration, and inhibits soil water

movement. The lower the bulk density range, the greater the impacts to tree growth from soil compaction. Sandy textured soils have a higher range bulk density compared to clay textured soils. Presence of organic matter and tree limbs and leaves can reduce soil compaction by providing support to equipment. Soil moisture content has a pronounced effect on soil compaction as it influences soil porosity. Identifying compaction susceptible soils by surface texture, maintaining surface organic matter, and operating equipment under low soil moisture conditions (BMPs) would reduce the effects of soil compaction within the general forest and on skid trails used for thinning and restoration operations. Temporary roads and log landing areas would be compacted to higher levels due to multiple traffic use and passes. Harvest technique can also reduce or increase the potential for soil compaction. Use of standard logging equipment (skidders) can compact the soils with as few as three passes over the same ground. Specialized equipment that reduces or disperses equipment weight, such as low-pressure tires, can assist with limiting soil compaction effects.

Soil compaction during equipment operations is most visible as soil rutting, or the creation of depressions from the vehicle tires, generally during periods of soil saturation or wetness and/or high water table. Formation of ruts occurs when soil strength declines and is not adequate to hold up the weight of the vehicle load. The impact pushes the soil down, and then outwards, destroying natural soil structure, and disturbing the normal flow of water through the soil profile. The photo below illustrates soil rutting caused by skidding during periods of saturated soils. Visible ruts in the photo are 8 to 10 inches deep, 12 to 14 inches wide, and the rut is approximately 200 feet long.

Timber harvest site – skid trail rutting by operations during winter wet period, clayey soils.
Photo Credit – USDA Forest Service

NRCS Web Soil Survey provides soil interpretation for soil mapping units to provide an indicator of potential impacts of various activities and treatments. The majority of soils mapping units within the Macedonia Project areas are rated moderate for soil rutting hazard, primarily on the low strength properties. The loam and clay soil textures would readily form ruts when soil moisture content is at or above field capacity – or saturation. This rating is based on standard NRCS/USFS soil rating criteria established in the National Forestry Manual (NRCS, 1998) and National Soil Survey Handbook (NRCS, 1996). Soil properties rated for compaction include soil

texture, depth to water table, and percent rock fragments greater than 75mm in size. This condition would occur after several days of rain, soils have not dried out and heavy equipment operates over the soils.

Compaction and rutting can be minimized by locating access routes on well drained terrain, operating equipment during optimum soil conditions (dry) to minimize the occurrence of rutting (BMPs), and by addressing soil rutting conditions when identified during operation periods and implementing timely mitigation measures. Design criteria proposed for Alternative 2 to minimize compaction would be followed in accordance with the Forest Plan and BMPs. Soils in the remaining 83 percent of the project area have a moderate compaction rating (rutting likely to occur), with a small amount of soils with a slight rating (subject to little or no rutting). Soil data identifying compaction hazard are included in the project file information for soils.

Use of special equipment (e.g. low psi) and/or operating under seasonally dry soil conditions, usually March through November, would aid in minimizing soil compaction caused by operations of conventional ground-based harvesting equipment within stands (BMPs). Harvest operations on stands rated as severe need to be conducted under dry conditions that usually occur late summer and early fall. Soil compaction can be expected on temporary roads, skid trails and log landings. Application of mitigating measures, ripping and re-vegetation would assist in reducing the effects of soil compaction over a three to five year period. Full recovery can take as long as 20 years.

Soil Erosion: Soil erosion is recognized as potentially the most serious form of soil damage. Soil may be permanently lost and soil particles leaving this site may result in sediment in nearby streams which would impact water quality and possibly compromise aquatic habitats. Ground disturbing management practices influence erosion principally because they remove vegetative ground cover and often concentrate and channel runoff water. Research has shown that transportation system and associated impact areas of log decks and primary skid trails are the most common causes of accelerated erosion that occurs in forested watersheds (Gucinski et al., 2000). In addition, erosion rates would tend to remain greater on these areas for several years following their use due to altered soil structure and loss of infiltration.

A soil’s susceptibility to erosion varies by soil type and position on the landscape. A slight or moderate erosion hazard indicates that standard erosion control measures such as installing water bars plus seeding and fertilizing roads or skid trails, and not exposing more than 20 to 30 percent of mineral soil in treatment areas, are sufficient to prevent excessive erosion. The stands in the Macedonia project generally have gentle slopes, less than 6% gradient, thus erosion hazard is less of a concern if BMPs are applied, and vegetation cover is maintained to minimize soil exposure resulting in erosion. Due to the relatively flat slopes in the Atlantic flatwoods and lower coastal plain, the amount of soil loss and erosion with sediment to streams is the lowest of any physiographic area.

Soils within the proposed treatment areas have ratings of slight to moderate for harvest equipment operability, based on NRCS Web Soil Survey ratings. This rating is based on slope, plasticity index, content of sand, depth to a water table. The slight to moderate rating indicates erosion could occur when soils lack ground cover to slow the velocity and concentration of

overland water flow. Requiring Best Management Practices including erosion control measures, proper location of access routes, re-vegetation of bare areas and drainage controls would be recommended for ground disturbing activities to minimize the impact and maintain soil productivity and water quality.

Silvicultural practices such as harvesting trees are known to potentially affect the soil resource primarily through nutrient removal. Harvest in the proposed action alternative would involve removal of the mature saw timber trees, site preparation using roller drum chopping and a removal of residual seed trees three to five years later. Proposed thinning harvest activities would harvest the stem only with tree branches and needles remaining scattered on site. Nutrient removal or restoration where harvesting the stem only, reduces nutrient removal by 50-60% (Pritchett and Fisher, 1979). Nutrient loss from stem removal is believed replaced by soil weathering and natural inputs (Grier et al., 1989, Jorgensen et al, 1971, Wells, 1971, and Pritchett and Fisher, 1979).

Proposed harvest units are expected to meet the regional soil quality guideline of not exceeding 15 percent disturbance because portions of existing trails and roads would be utilized, reducing the need for new ground disturbance. This is feasible and would be required by the timber sale contract. In addition utilization of existing roadbeds and skid trails would allow for rehabilitation of those areas to be implemented under the timber sale contract.

Temporary roads constructed for access to proposed treatment stands and associated skid trails for thinning and restoration treatments are known to affect the soil resource primarily through nutrient removal, soil compaction and soil erosion. Nutrient loss is greatest on temporary roads since the organic layer and surface soil is removed in the process of construction and/or maintenance. Skid trails under a thinning operation usually do not remove organic or soil surface layers leaving nutrients in place. Primary skid trails (those with multiple passes) can be expected to remove organic layers and create soil exposure as high as 50 percent. Secondary skid trails, those with surface soils intact, can be expected to have loss of organic surface and soil exposure as high as 25 percent.

Prescribed Fire and Firelines

Impacts to soils are covered under the *Prescribed Burning on the Francis Marion Environmental Assessment, 2006.*

Prescribed fire is proposed in Prescription #3, longleaf restoration. Burning is proposed for site preparation (early spring or summer) in Treatment Class 1 on 228 acres. Stands in Treatment Class 2 (364 acres), Treatment Class 4 (56 acres) and Treatment Class 5 (27 acres) would be protected, after planting, from prescribed burning in adjacent stands that make up a burning block.

Up to 10 miles per year for three years of new construction dozer line may be required for the Macedonia project. Firelines have similar effects as those associated with skid trails and temporary roads, exposing mineral soil, but effects can be mitigated when designed with

drainage features to remove concentrated flow. Water flow would be dispersed into the forest buffer prior to reaching streams or other sensitive resources.

Pre-burn site planning allows time to locate and mitigate fireline construction to minimize impacts. Firelines are also installed on upland terrain features to the extent possible, away from streams. If firelines show repeated, unauthorized motor vehicle use, then a barricade may be installed to prevent use, until reused again.

Herbicide Application

Snags in any harvest area would generally be retained. Where snags do not exist or are low in number, they would be created by injecting non-mast hardwoods or pines with Garlon 3A or equivalent (active ingredient–Triclopyr) using the "hack and squirt" method. This method is targeted and precise, applying small amounts of herbicide. Injector cuts would be made around the circumference of treated trees. The herbicide is injected directly into the tree and would not be expected to move into the soil.

Longleaf seedlings in stands proposed for longleaf restoration would be released from woody competition one to two years after planting using dormant (leaf off) season basal bark application of herbicide. The herbicide to be used is Triclopyr (Garlon 4 or equivalent) applied directly to the stem of targeted woody species. This application is described in more detail in the proposed action in Chapter 2. Triclopyr is a selective systemic herbicide used to control woody plants, and has a soil half-life of 30 days.

Triclopyr is potentially mobile in soils since it is generally not bound to soil particles, but in general there is minimal movement through soil. Cut surface treatments are precise allowing little chance of misapplications. Applications are not in proximity of riparian areas or streams.

Direct and Indirect Effects of Alternative 1

Alternative 1, No Action, would have minimal effects on soils as no new ground disturbing activities would be initiated in the Project Area. Existing rates of natural erosion and sedimentation would likely continue, and alterations to soil productivity would be insignificant. Lack of disturbance in the dense pine stands, from prescribed fire or wildfire, would result in continued decline of understory vegetation. Vegetation litter and duff would continue to accumulate, benefiting soil productivity, nutrient levels and moisture retention. Fuel accumulation would continue, and potential wildfires could be more severe in their impacts to the area. Most wildfires would be contained and not be severe or frequent enough across the landscape to damage soil productivity. Emergency suppression activities, primarily construction of firelines where needed, have the potential to result in impacts to soils, streams and wetlands.

Cumulative Effects of Alternative 1

Alternative 1 would not implement any new activities that would directly or indirectly disturb soils. Soil erosion may occur as a result of existing conditions or activities; however cumulative effects would be minimal. Activities, on National Forest lands, that are reasonably foreseeable

would be implemented under the standards for protecting soils listed in the Revised Land and Resource Management Plan for the Francis Marion National Forest; therefore, cumulative effects from these actions are minimal.

Activities on adjacent or intermingled private lands in the analysis area may include timber removal, agriculture, prescribed burning, road construction and maintenance, and residential developments. These activities would be specific to private lands, and no cumulative effects would be expected to the soils on National Forest lands.

Direct Effects of Alternative 2

Proposed harvest treatments in the project area would have short- and long-term direct effects on forest soils, due to soil disturbance. Impacts, however, can be minimized and mitigated. Detrimental effects of concern for the Macedonia project include:

- Compaction and soil rutting
- Erosion and displacement

Past effects from logging are detectable up to 40 or more years. The effect of proposed activities should be relatively short compared to techniques used in the past. If all natural elements and processes remain intact, one can expect soil impacts to be nearly undetectable within 20 to 40 years.

Alternative 2 proposes to conduct silvicultural treatments on approximately 8,121 acres within the project area, treating 152 individual stands. Five silvicultural prescriptions are proposed, implementing first-time thinning, intermediate thinning, seedtree harvest, and removal of overstory to restore longleaf pine. Operations described under this proposed action include:

1) Mechanical felling of selected commercial value loblolly pine trees. Felling machines would move between trees to access trees to be cut and removed.
2) Skidding to gather felled trees and bring to a central landing area for processing and loading onto trucks. Skidders move around the stand to collect cut trees, and move the collected trees on designated skid trails and/or roads to the landing area. Skidders make repeat trips over skid trails to various parts of the stand.
3) Skidders and loaders operate in the central landing area to process felled trees for loading onto trucks that access the landing area over temporary or permanent roads.
4) Skid trails and roads, log landings and temporary truck access roads are opened (existing routes) or constructed to provide equipment access to remove harvested materials. The same routes are rehabilitated, as needed, to provide drainage, aeration to ameliorate compaction, and addition of appropriate ground cover with vegetation and/or mulch to restore soil protection and function after harvest operations cease.
5) Site preparation for reforestation using mastication mechanical equipment
6) Construction of prescribed fire control lines around reforestation stands

Ground and soil disturbances in these operations would occur inside the boundaries of the harvest units, with concentrated disturbance on primary skid trails, log landing and loading areas,

temporary haul routes for truck traffic to the landing, and on Forest Service system roads. Fire control lines, constructed around areas planted to longleaf pine seedlings, also have the potential to create detrimental disturbance.

Pre-planning and design analysis for the Proposed Action stands has identified stand boundaries, access routes, including new temporary roads, stream crossings, fire control lines for later prescribed burning, and areas of sensitive soils or site conditions that may require specific design criteria to reduce adverse effects during operation periods. Access routes exist in most of the stands from prior entries for timber harvest operations. These routes would be used in the Proposed Action projects if location and condition meet Forest Plan standards and BMPs. Table 3.1.1-3 displays the categories of ground disturbance related to operations to implement the Proposed Action.

Table 3.1.1-3 Acres of Ground Disturbance related to Alternative 2 – Proposed Action

Activity	Number of sites or Miles	Assumptions	Acres of soil Impacted
Log Landings	152 stands, 1 landing per 50 acres	1/3 to ½ acre per landing	81
Temporary Roads	4.48 or 23,564 feet	20 foot wide roadbed and shoulders – 2.4 acres per mile	11
Skid Trails	Average 10% of treatment area	Skid trails not bladed, trees removed from corridor	810
Fire Control Lines	Up to 10 miles/year for 3 years	Fire line width – 12 feet; 1.7 acres per mile	43
Site Preparation – Mastication	37 stands proposed for treatment	Stands to be treated would be identified after harvest	2218
Total Acres			3163

Pre-planning has identified the need for new construction of 11 temporary roads to access stands and log landings. A total of 4.48 miles (23,564 feet) of temporary roads has been identified, resulting in ground disturbance of approximately 11.0 acres disturbed using a 20 foot wide road prism (road bed and sides). Log landings are needed for any timber harvest sale unit, typically one per unit. These landings are typically from 1/3 to ½ acre in size. Skidding from the cut trees to the log landings is generally within 1/4 to ½ mile distance. Skid trails are not bladed, minimizing the disturbance to the soil surface. Trees are removed within the corridor traversed by skidders, maintaining litter and slash on the ground to provide cover to the soil. Experience has shown that the percentage of harvest areas involved in skid trails to be around 10%. The 810 acres of soil impacted by skid trails would be primarily overland travel by the skidders, with minimal to no blading or excavation of soils. The remaining 135 acres (1-2% of the total project area) disturbed for log landings, temporary roads, and fire control lines would require some amount of soil disturbance through removal of vegetation cover, excavation of soil, and construction of drainage to facilitate logging operations. At the end of operations, these areas of disturbed soils would be rehabilitated by shaping disturbed soils to provide natural drainage, and restoring ground cover with vegetation or mulch to protect the soils from erosion.
The estimated total area of ground disturbance for skid trails, temporary roads, log landings for the Macedonia project, 945 acres, is to identify the area that could potentially receive detrimental disturbance within the project area. Operations within the stands to remove commercial trees would require skidding to bring the trees into the log landings for processing and loading for truck transport. Skidding operations generally make 2 to 3 passes along skid trails; however they

are generally not excavated to open the route. These trails typically have woody debris left on the ground surface to provide cover and minimize erosion caused by overland flow (BMP).

Site Preparation in Silvicultural Prescriptions 2, 3 and 5 – Mastication

Use of a mechanical site preparation method known as mastication is proposed in 37 stands over 2,218 acres in prescriptions 2, 3 and 5. Mastication, a mechanical site preparation method, is generally used as an alternative to prescribed fire to reduce the competition from non-commercial stems in the understory and midstory before regeneration activities. Mastication involves reducing the size of forest vegetation and downed material by chewing, grinding, shredding, chunking or chopping material. The treatment and end result are achieved by using a machine mounted cutting attachment to move across the stand after commercial harvest is completed, cutting the stems leaving a "carpet" of mulch on the ground. The mastication treatment leaves a relatively dense, compact layer of woody material. Mechanical mastication is a relatively new tool for treating shrub and small tree fuels, and is being used to reduce fire hazard in areas where application of prescribed fire is impractical due to proximity to urban interface areas. By chopping these ladder fuels into small chunks, standing live and dead fuels are converted to more compact, dead, surface fuels, which are usually left on the forest floor to protect the soil from erosion and to retain nutrients. (Knapp, 2008)

Mastication equipment varies in configuration, basically requiring the use of a cutting head moving across the ground on a skidder, dozer, excavator or tractor. The size of the mover varies with the size of the cutting head. The impacts to the soil and site related to the mastication treatment are primarily the potential for soil compaction or rutting if operated on wet soil conditions, and possible gouging of the soil if the cutting head is not maintained at an optimum height above the surface. Some stands would be prescribed burned after mastication to reduce the cover of woody debris. Research has shown that mastication has minimal effects on soil properties (Waldrop, 2010). A study was conducted in stands impacted by southern pine beetle kill were treated by mastication and burning. Soil fertility was largely unaffected, but soil structure was temporarily impacted by the treatment, but no permanent impacts noted.

Mastication site preparation machine used to grind or chop standing trees and shrubs
Photo Credit: USDA Forest Service

Design Criteria have been developed for Alternative 2 that would mitigate detrimental effects to soil in the treatment stands. Design criteria are described in Section 2.4 of Chapter 2, Soil Management and Isolated Wetlands. Two common elements in these Design Criteria are the control of concentrated water that can contribute to erosion, and protection of existing areas such as gullies or streams that can be damaged by equipment or erosion. These criteria would be used in Timber Sale contract provisions to mitigate impacts during operations.
Implementation monitoring of forestry best management practices (BMPs) is an ongoing activity conducted in South Carolina under the direction of the South Carolina Forestry Commission, along with the USDA Forest Service as a cooperator. Surveys across the state on various practices and ownerships have documented compliance with the BMP direction and the resulting impacts to soil and water resources. Compliance rates of 94.0% were noted for harvesting systems (Sabin, 2012).

Indirect Effects of Alternative 2

Many indirect effects are possible when soil conditions are compromised. Compaction can decrease water infiltration rates, leading to increased overland flow and associated erosion and sediment delivery to streams. Compaction decreases gas exchange (oxygen), which in turn degrades sub-surface biological activity and above ground forest vitality. Rutting and displacement cause the same indirect effects as compaction and also channel water in an inappropriate fashion, increasing erosion potential.

Timber harvest operations remove biomass and site organic matter and thus affect nutrient cycling. Generally, nutrient losses are proportional to the volume of biomass removed from a site. Nutrients are lost during harvesting by removing the stored nutrients in trees, and additional nutrients are lost if the litter layer and woody debris are removed, more common in whole tree harvesting systems. Amounts of nutrient loss from a site would vary with forest types and site conditions (Grier et al, 1989). The amount of nutrients present in the trees would also vary with stand age and development of the humus layer (Grier et al., 1989).

Indirect effects of soil nutrient loss include reduced growth and yield and increased susceptibility to pathogens, such as root disease and insect infestation. Precipitation and weathering of rocks would continue to make additional nutrients available on site. Annual needle, leaf, and twig fall, forbs and shrub mortality would continue to recycle nutrients as well.

A majority of the proposed thinnings and restoration activities would harvest stem only, leaving tree branches and needles remaining onsite, with the exception of small tree/biomass thinning which remove the whole tree from the site. Nutrient removal from intermediate thinning or restoration harvests (where harvesting the stem only) is significantly less than that of whole tree harvesting. In the study performed by (Mann et. al, 1988) when whole tree harvesting was compared to traditional sawtimber/pulpwood thinning it found that whole tree thinning resulted in a disproportionately greater nutrient removal because of the high nutrient concentrations in twigs and branches of trees. In addition, Johnson and Curtis (2001) found that, on average, forest harvesting in North America had little or no effect on soil carbon (C) and nitrogen (N). Concentrations of C and N may have a slight decrease within the first year of harvesting but is not substantial or prolonged (Knoepp and Swank 1997). Nutrient loss in all cases is eventually replaced by soil weathering and natural inputs (Pritchett and Fisher, 1979). Although nutrients are replaced, cutting alters the processes that regulate nutrient cycling, which frequently accelerates nutrient leaching and loss in dissolved form. However, the soils on the forest have sufficient levels of nutrients including nitrogen, phosphorus and potassium to maintain soil productivity and vegetation often responds with rapid growth after thinning.

To summarize, by maintaining organic matter and ground cover on at least 85 percent of the site, nutrient cycling and availability should not be altered. The design criteria and Best Management Practices are prescribed to achieve this desired outcome. Localized losses may occur at log landings or along some temporary roads.

Direct and Indirect Effects of Alternative 3 – Modification of Alternative 2

This alternative would have the same effects from ground-disturbing activities on soils as Alternative 2. The proposed release of planted longleaf seedlings would be implemented in Prescription #3, treatment classes 2, 4 and 5 using manual labor with brush saws, instead of herbicide stem application.

Cumulative Effects of Alternatives 2 and 3

Effects from previous impacts, expected new impacts from harvesting operations or fuel treatments, and foreseeable future events combine to influence long-term soil productivity. The effects to long-term soil productivity as a consequence of the actions being proposed in the Proposed Action Alternative relates to the cumulative effects from erosion, compaction, and displacement as noted above.

Effects of Timber Harvesting

By practicing a “light hand on the land” policy during all soil disturbance activities, by adhering to design criteria common to all action alternatives and following Forest Plan direction, long-

term soil productivity would be maintained. In addition, fuel loadings throughout most of the analysis area would be reduced from timber harvesting and prescribed fire and the construction of temporary roads would improve overall access for fire suppression needs. These actions would reduce the probability of a future accumulation of fuels and wildfire hazard, which could impair long-term productivity.

Effects of Log Landing and Temporary Road Construction and Closure

Pre-planning in the Macedonia project area has identified the need for temporary roads to access ten stands to be thinned, totaling 4.48 miles in length, or about 11 acres. Most of these roads have existing routes and templates, requiring minimal ground disturbance to prepare them for use. This condition would minimize the amount of soil disturbance and maintain vegetation cover along the routes to buffer disturbance and resulting erosion. When harvest activities are complete, these routes would be closed to vehicle use and rehabilitated to restore drainage and ground cover. Log landings, an estimated one half acre landing per 30 acres of harvest area, would also be closed and rehabilitated to restore drainage and ground cover, resulting in a return to desired soil productivity levels within 3 to 5 years.

Effects of Road Maintenance on System Roads

All Forest Service system roads built in the past have a lasting effect on soil productivity due to compaction and displacement. There are approximately 70 roads or segments of roads identified for use in the project area, totaling 53.95 miles. Most of the road segments are 0.5 miles or less in length. Their maintenance for recreation, fire control, and vegetation management requires ongoing use, which results in compaction and displacement throughout the project area. Most of the system roads proposed for use in the project stands need standard maintenance work, e.g. blading of the roadbed, clean ditches and culverts, add gravel when needed. These activities may increase short-term erosion and sediment movement from road surface runoff initially but should be minimal, especially on road segments that occur at upper slope landscape positions, low in road surface gradient, or at adequate buffer distances from stream channels. Road maintenance includes culvert installation, blading of road surfaces, and brushing along cut or fill slopes, and typically improves drainage and decreases erosion from water channeling down the road surface in the long run.

In summary, the proposed action alternative combined with all past, present, and reasonably foreseeable management activities would affect soil productivity in the project area. Foreseeable activities include timber harvest, National Forest system road management and maintenance, Forest recreation maintenance and management, and fire management. The combined effects of most future activities would cumulatively improve soil productivity, primarily by reducing impacts from roads, and improving forest health of the residual stands.

At the scale of the project area, the contribution of cumulative impacts by the Macedonia Project would not be significant on soil productivity or the soil resource. Forest Service activities would meet standards for maintaining soil productivity through proper implementation of management requirements and the prescribed design criteria.

3.1.2 Water (Including Riparian Areas and Wetlands)

Affected Environment

Area/Weather

The Francis Marion National Forest (FMNF) normally receives about 45-50 inches of rainfall each year. Summer average rainfall rates are typically higher than the rest of the state. The higher rainfall averages in June through September along the coast are partly due to the proximity to ocean moisture, hurricane and tropical storm events that tend to be more frequent and severe along the Atlantic and Gulf coasts. Periods of intense summer precipitation combined with poorly drained soils can create periods of saturation and ponding on some sites. Dormant season periods with high rainfall can create ponding and saturation, and under those circumstances, the hydric and poorly drained soils remain flooded, ponded or saturated for extended periods. Below average rainfall or periods of drought can reduce water in streams and wetlands.

Information from Devendra Amatya, Research Hydrologist on the Santee Experimental Forest (SRS), summarized the local information as follows. The average runoff coefficient is approximately 25% of the average precipitation. The runoff coefficient would be higher in the dormant season and lower in the growing season. In the growing season, when temperatures are warmer, evaporation is higher, and trees and other vegetation are actively utilizing water in transpiration, lower runoff may be experienced during rainfall events. For the nearly 100% forested 200 ha watershed at Santee (WS 80), the average yield was about 10 inches based on historic data (1969-81) prior to Hugo in 1989. This is about a 20% runoff coefficient. The 5-year (1990-94) post-Hugo estimate yielded larger average yield of 12.7 inches or coefficient of 26% as there was a moderate to large amount of vegetation loss. However, the latest 3-year (2003-05) data has a wide variation of outflows, but the average R/O coefficient decline to 24.5% as the regenerated vegetation is apparently using more water and water yield values must be declining toward original conditions.

Riverine features on the forest commonly have been bounded by ocean deposits and have substantial control of surface drainage. Rainfall-runoff sequences, tropical storms, floods, and tidal actions have developed the drainage network, which also includes extensive riparian areas and wetlands that range from defined to poorly defined hydrologic characteristics. In some instances, the drainage pattern has been modified by man. A series of sandy barriers and beaches deposited through geologic time capture and contain flow, defining the boundaries of poorly defined braided channels or channels with broad floodplains. The surface hydrology has tendencies to parallel the coast form, but there are locations where a break in the beach-barrier allows flow to descend to the next controlling surface feature. Well defined depressional wetland features such as Carolina bays found in the area. Other wetlands are of various sizes and shapes that have connections to the past geologic history. Some have been changed by natural and man-induced surface hydrology adjustments. Various sizes of sand dominate the channel materials. Bottomland hardwood and other wetland species normally provide stability and structural integrity to channel systems. Disturbance regimes of intense wildfire and severe hurricanes have had some influence, but changes by man have probably produced the most marked changes.

Physical features of the FMNF that are also typical of Macedonia project area include the relative flat topography in the coastal plain and flatwoods, localized maritime interface with tidal influence and a landscape that is hydrologically influenced by wetlands within a complex and often poorly defined drainage system. The complex wetland types and characteristics are a critical part of the hydrology with habitats that need to be maintained, and in some instances restored. One effect that has been measured at the wilderness boundary in Wambaw Creek Wilderness as a result of reduced flow in the Santee River is the increased brackish water interface from tidal waters as they extend landward, especially during the highest tides. Hydrologic modifications are part of this areas complex history to this area including Lakes Marion and Moultrie, the Cooper River diversion, Santee River rediversion, roads, historic rice fields, drainage ditches, canals, dikes and railroad trams.

Management activities have varying potential to induce hydrologic modification if not correctly designed, implemented and maintained. Hydrologic modification has potential to locally influence soil and water quality and quantity of surface or groundwater. Localized severe rutting can modify hydrology so limits in activities may be associated with timber harvest and firelines to prevent excessive rutting impacts.

To a great degree, the surficial aquifer is unconfined, but localized layers of clay can provide some localized confining features. The northern extent of the Floridan aquifer borders the Santee River and is a confined aquifer that underlies much of the National Forest, which thickens in depth seaward from north to south, extending into Georgia and Florida. Although a number of geologic formations comprise the Floridan aquifer system, they are all carbonate rocks, with most from the Eocene age, but locally as young as the Meocene to as old as the Paleocene age. The transmissivity of the Upper Floridan aquifer is generally less than 10,000 feet per day. In some places, the clayey rocks of the upper confining unit have eroded away, and large solution openings, some of which cause sinkholes, have developed where the confining unit is thin or absent. The lower Floridan aquifer is confined by over 200 feet of low permeability rocks. Implementing South Carolina Best Management Practices for Forestry (BMPs) and adherence to the Revised Land and Resource Management Plan, Francis Marion National Forest (Forest Plan) helps to insure that soil rutting, compaction and disturbance are held to a minimum.

This assessment did not evaluate, but does not preclude measures to improve soils, water quality, channel stability, aquatic habitat and other desired results identified as goals and objectives in the forest plan. These items were not evaluated at this time, but would be considered as opportunities for funding emerge with KV, stewardship or appropriated dollars.

Watershed

The project area (PRA) is in the Middle Atlantic Coastal Plan Ecoregion in the hydrologic boundaries of the Santee and Cooper River Basins, HUC 03050112 and HUC 03050201; with smaller basins of Rediversion Canal-Santee River; Wedboo Creek; Savanna Creek; Wittee Lake-Santee River; Dutart Creek-Santee River; Walker Swamp; Cane Pond Branch; Wadboo Creek; Nicholson Creek. Of these nine watersheds, about 45 percent of the 226,850 acres is managed by the Forest Service with the majority of private land being forested (Table 3.1.1-3). There is one stand (10 acres) that overlaps into the Penn Branch- Santee River watershed not included in the

analysis. This watershed is excluded from analysis due to negligible size of treatment. Impacts would be the same as adjoining areas included in analysis.
Elevations range from ~0 to 80 feet above mean sea level. Many small perennial, intermittent and ephemeral streams exist throughout the PRA. All the streams within the PRA are tributaries to the Santee River or the Cooper River. All streams within the PRA watersheds are classified "freshwaters" (FW). Most of these freshwaters are suitable for primary and secondary recreation, as source of drinking water, fishing, survival and propagation of a balanced indigenous community as well as industrial and agricultural uses.

Riparian Areas

Wetlands, riparian areas and water habitats tend to dominate land classification of most of the sixth level drainages. Bottomland hardwood wetlands often dominate the federal lands with emergent herbaceous wetlands and open water habitats common on the other lands. Various types of wetlands exist. Wetlands have obvious features such as:

- Moderate to well defined channels or depositional features containing relatively permanent standing to flowing water, with adjacent margins dominated by bottomland hardwoods, hydrophytes, and water loving plants,
- Poorly defined, low gradient channels with variations in flooding frequency,
- Features are based on sedimentation and erosion pattern of water, wind and tidal action linked to specific geological time periods,
- Elliptical Carolina bays,
- Riverine wetlands make connections to surface waters, and
- Other types of isolated and depressional wetlands influenced by rain, groundwater, flooding and/or tidal action.

Ephemeral wetlands of various types add to the biological diversity in the project area. Because of their size, isolation and hydrology, they support a very different assemblage of species than that found in larger, more established wetlands. Some of these are connected to rare or endangered species. The short-lived nature of ephemeral wetlands makes them unsuitable for those species which require permanent water or saturated conditions. For some species of anurans and amphibians, which require habitats for only a portion of their life history, ephemeral wetlands are ideal because they are able to exploit their seasonally conditions, without predation or competition from organisms that require more persistent saturation or water. Pondberry is an example of an endangered species whose habitats rely on these areas.

None of the proposed activities are located in karst topography with sinkhole features and no impacts from projects or connected actions are expected.

Seeps are locally found along river and channel terrace slope breaks or fault zones that may intercept groundwater sufficiently to provide ephemeral to permanent saturation, with a limited amount of surface flow. Some of these provide habitat for bryophytes, crayfish, and various types of hydrophytic plants. Localized fens are seeps with shallow groundwater connections, are low in nutrients and may support pitcher plant, sundews or other communities of plants that have some means to generate their own energy through insect capture. Some of these areas are small

and potentially sensitive to activities. Although these areas are not known to exist within this proposal, they would be avoided by management practices if found. Forest Plan standards and guidelines in combination with following BMPs would protect these areas.

Water Quality

Table 3.1.2-1. Land Use/Land Cover in the Macedonia Project Watersheds								
Watershed	Land Cover Type/Land Cover Usage							
	Cropland	Forested	Grassland	Barren	Urban	Herbaceous Wetland	Water	Proposed action*
Rediversion Canal-Santee River	7.21	61.77	21.43	0.06	1.78	2.19	2.06	1.25
Wedboo Creek	2.48	81.93	11.29	0.00	0.08	1.51	0.06	11.12
Savanna Creek	1.02	90.27	4.84	0.00	0.05	1.55	0.02	12.77
Wittee Lake-Santee River	3.93	87.09	4.51	0.09	0.00	0.94	1.91	0.77
Dutart Creek-Santee River	0.29	84.60	3.91	0.72	0.30	3.51	4.62	0.31
Walker Swamp	5.13	74.43	14.29	0.02	0.78	1.62	0.11	2.31
Cane Pond Branch	0.29	90.96	6.23	0.00	0.04	0.17	0.04	11.63
Wadboo Creek	0.61	88.44	5.74	0.01	0.39	2.17	0.29	2.41
Nicholson Creek	0.01	96.25	0.92	0.00	0.01	1.36	0.02	2.17

Source: SCDNR, 2001. *Thinning is part of the overall Forested area, this calculation is Thinning acres/Total watershed acres as a percentage.

As shown in Table 3.1.1-3 the dominant land use/land cover of the area including national forest and private land in these watersheds is forested, followed by grassland. Forested land is characterized by a mix of deciduous and evergreen trees, including forested wetlands. Barren land is characterized by a non-vegetated condition of land, both natural (rock, non-vegetated flats) and human induced (clearcut forest) (SCDHEC, 2003).

Federal and State laws regulate the quality of surface waters in South Carolina, including the Federal Clean Water Act (CWA) South Carolina Pollution Control Act (48-1-10, et seq., S.C. Code of Laws, 1976). South Carolina water quality standards provide for the protection and maintenance of the existing and classified uses of the waters of the State. Waters in South Carolina are classified for a variety of designated uses, which include: aquatic life, recreation, drinking water and agriculture. A watershed quality assessment of the Santee River Basin was prepared in 2005 by the South Carolina Department of Health and Environmental Control (SCDHEC) and presents a general assessment of the water quality conditions and water pollution control programs in South Carolina. There are six water quality monitoring sites within the PRA. Two sites were located within the Rediversion Canal-Santee River fully supports aquatic life and recreation. One was located within the Dutart Creek-Santee River fully supports aquatic life and recreation. Two sites were located within the Walker Swamp both fully support aquatic life, however the upper site does not support recreation and the lower site partially supports due to fecal coliform. One site was located within the Wadboo Creek fully support aquatic life;

however the site partially supports recreation due to fecal coliform but is improving. Protecting water resources, forestry BMP's are in most instances effective at controlling nonpoint source pollution and protecting aquatic biology when being used appropriately and adequately. The South Carolina Best Management Practices for Forestry was used to determine the minimum riparian widths or streamside management zone (SMZ) (see Table 3.1.2-2). The SMZ is divided into two parts: the primary and the secondary. The primary SMZ is 40 feet wide on each side of the stream. The width of the secondary SMZ depends on the average percent slope perpendicular to the stream. These are the minimum distances that would be considered to buffer practices along streams and other water bodies.

Table 3.1.2-2. Minimum Riparian Widths for Perennial and Intermittent Streams (may also be used for other water bodies such as Lakes, Ponds, and Wetlands)

Percent Slope Perpendicular to Stream	Zones		
	Primary Zone	Secondary Zone	Total width applied to each side of stream
Less than 5%	40	0	40
5% to 20%	40	40	80
21% to 40%	40	80	120

Roads

Roads managed by private landowners or entities, Forest Service, state, county and other federal agencies are the most prominent feature on the landscape. On private land, roads are mostly native surface and are designed for periodic to permanent use in such activities as logging, farming, ranching, recreation and access to home sites. State, county and U.S. roads are mostly paved, whereas roads managed by the Forest Service are mostly graveled with some native and paved surfaces depending on the distance from streams and maintenance level designation. Roads can affect water quality and aquatic habitats by causing chronic soil erosion, resulting in sedimentation into streams.
The vegetation management activities proposed for the PRA can have a variety of effects on water resources. Most of the effects are temporary to short term. These effects are generally described below.

Direct and Indirect Effects of Alternative 1

Impacts on water resources under alternative 1 would be limited to the effects of periodic prescribed burning under already existing project decisions, routine road maintenance, invasive species control, southern pine beetle control efforts, management activities on private lands and climate change. Some road maintenance issues that would be repaired or improved with the action alternatives would not be fixed. No other impacts are anticipated under this alternative.

Cumulative Effects of Alternative 1

Existing levels of erosion-based sediment were approximated from land use activities and delivered to small streams (methods summarized by Hansen et. al, 1994, Roehl, 1962). Estimates of erosion and sediment from these practices have been made by using the land use estimates and

average erosion coefficients for these practices (Hansen et. al., 1994). The summary of erosion and sediment calculations are in the process records automated in GIS by Geoff Holden, Forest GIS Coordinator. Over 86% of the sediment was linked to private sources. These types of erosion include channel, gully and other forms of erosion that are difficult to predict. Normal geological and legacy erosion and sedimentation would continue related to current conditions. Using analysis of erosion and sedimentation (located in the project record) current mean sediment concentrations were estimated at 12.88 ppm. Most of the identified erosion and sediment effect estimates in the subwatersheds listed deal with land use and management related to forestland, barren areas, roads, and pasture/grassland, especially on private lands.
No substantial impacts to riparian areas, perennial, intermittent or ephemeral streams would occur under this alternative since BMPs apply to private land forestry practices as well. Soil loss and sediment yields would be associated with existing roads and ongoing land management activities. Other pollutants to streams or water bodies may occur associated with activities in the subwatersheds including oil or petroleum based leaks along motorized areas including roads, parking lots; herbicide and pesticide uses associated with undesired plants, insects, disease; litter and garbage dumping or recycling; pets and farm animals; septic tanks, waste treatment facilities, etc. On private land, sediment and water quality (including fecal) impacts are primarily associated with communities, roads and timber harvesting.

Direct and Indirect Effects of Alternative 2

Timber Harvest and Connected Actions

The potential for water resource impacts is primarily temporary in duration and minor to moderate on site, with elevated sediment concentrations for two to three years within the PRA sub-watersheds. See Table 3.1.2-3 for a comparison of watershed size to treatment area. With the concentration of the proposed treatments, increase in sediment would primarily be within the Santee River.

Ursic (1986) concluded from data across the south that timber harvesting did not significantly increase sediment levels within any of the South's physiological regions. He observed that any increase in sediment normalized the first year after treatment operations were completed. The development and use of skid trails would likely increase stream sediment during use and for a short term after. Proper implantation of BMPs would help mitigate soil loss from skid trails.
The first thinning (Prescription #1) and intermediate thinning (Prescription #2) as proposed would reduce tree density which would result in increased growth of crowns and understory vegetation. Crown growth and closure would occur in about five to seven years for moderately stocked stands (residual basal area of 55-65 square feet). The recovery period to canopy closure would be somewhat faster for thinned stands with a higher residual basal area. Individual stands are expected to quickly return to pre-harvest water yields since adjacent hardwood stands and hardwood inclusion areas within harvest units would not be thinned. Water yield increases within thinned units are expected to be short term as the residual trees grow larger crowns and roots take advantage of the available water and nutrients.

Table 3.1.2-3. Approximate Watershed and First Thin Acres in the Lower Macedonia Project Watersheds

Watershed	Watershed acres	Proposed Action Acres	Percent
Rediversion Canal-Santee River	23,584	295	1.2
Wedboo Creek	15,492	1,722	11.1
Savanna Creek	17,238	2,201	12.8
Wittee Lake-Santee River	29,754	230	0.8
Dutart Creek-Santee River	29,199	91	0.3
Walker Swamp	37,182	860	2.3
Cane Pond Branch	10,749	1,250	11.6
Wadboo Creek	34,413	829	2.4
Nicholson Creek	29,240	636	2.2
Total	226,850	8,114	3.6

*Slight rounding differences

The longleaf pine restoration areas (identified as Prescription #3, 801 acres) would have somewhat longer water yield increases. Maintaining large overstory trees would help reduce some of the initial water increases as compared with other types of regeneration cuts. Harvested units would first be dominated by grasses and shrubs which would begin to use up some of the available water on the site. Planting longleaf pine would have little initial impact on water yield in the short term. However, as the trees grow and occupy more of the site their uptake of water would increase and normal water yields would return faster than if they were not planted.
In prescription #2, treatment 3 and in Prescription #3, mastication (grinding up of understory woody vegetation and dead woody material) would remove additional understory vegetation slightly reducing transpiration in the short term. However, this would help growth and survival of planted longleaf pine seedlings. They would occupy the site faster than if the treatment was not done.

Herbicide release (prescription 3, treatment classes 2, 4 and 5) of longleaf seedlings one to two years following planting using dormant season basal treatment of understory hardwoods would reduce a large portion of the understory. The potential for surface or ground water contamination from an application of triclopyr is very slight with manual use of back-pack sprayers. There would be no aerial or broadcast applications of herbicide. Rainfall can cause stem wash off after application, removing herbicide residue from plant surfaces and transporting them into the soil. Volatilization occurs while herbicides are still exposed to sunlight and air and involves chemical movement in the vapor form through the air.

Plant uptake, removes and absorbs herbicide from foliage and bark surfaces or from the soil and temporarily or permanently depending on the herbicide, removes them from transport. Leaching moves herbicides through litter, soil and out of the plant rooting zone. Surface runoff rapidly transports residues off site either in solution or adsorbed to sediment. Subsurface flow of water removes herbicides in solution from the treatment site in slower ground flow. Processes that

break down herbicide chemical structures include photodecomposition, microbial and plant metabolism, thermal degradation and hydrolysis. These processes along with those that transport herbicides, determine the degree to which herbicides persists in the environment.

Triclopyr is a selective systemic herbicide used to control woody and herbaceous broadleaf plants. There are two basic formulations of triclopyr (triethyamine salt and butoxyethyl ester).Offsite movement through surface or subsurface runoff is a possibility with triclopyr acid as it is relatively persistent and has only moderate rates of adsorption to soil particles. The salt formulation is water-soluble and with sunlight it may degrade in several hours. The ester is not water-soluble and can take longer to degrade. The ester binds to organic particles in the water column and precipitates to the sediment layer. Bound ester molecules degrade through hydrolysis or photolysis to triclopyr acid which moves back into the water column and continues to degrade.

The hack and squirt method would have a lower potential for contamination since the herbicide is applied directly to the cambium of the treated vegetation via a squirt or spray bottle. The herbicide is then readily taken up by the plant. Herbicide applications would be performed to meet BMP standards and design criteria. The dispersed nature of herbicide application in combination with the low frequency and low application rates would present a low risk of pollution to groundwater. The half-life of triclopyr in water ranges from 1 to 10 days depending on water conditions.

Streams would be protected from herbicide translocation by limiting herbicide application distances to streams, riparian and aquatic zones. Riparian corridors would reduce the amount of offsite movement of triclopyr in stormflow. Stream side management zones would absorb any limited movement without noticeable effect on land or aquatic vegetation. Placement of an untreated SMZ parallel to the channel greatly reduces the potential for direct contamination of water resources and these no treatment zones absorbs any movement without noticeable effect on aquatic vegetation.

The thinning to promote mixed hardwoods (Prescription #4) would have similar affects as prescriptions 1 & 2 but would have somewhat longer water yield increases. Loblolly Seedtree cut (Prescription #5) would have similar affects as prescriptions 1 & 2 but would have somewhat longer water yield increases. Water yields would increase following harvesting gradually returning to normal levels after a period of 5-10 years. Site preparation burns and creation of wildlife snags are not expected to have a measurable impact on overall water yield since minimal additional vegetation removal is expected.

Increases in water yield from 1 to 2 inches above the 10.5 inch average annual water yield experienced on the Santee Experimental Forest could be seen for short time periods until vegetation recovers and stands close. Water yield increases would return to normal once the areas are fully reoccupied by trees and root systems have spread fully into the viable rooting zone. The time period for these adjustments is typically 5-15 years for water yield increases, but in the coastal plain, the duration might be less on fast growing upland sites.

Skid trails, firelines and temporary roads decrease water infiltration and can increase surface water flow. If connected to streams or ditch lines and left uncontrolled, the added flow and

erosion can result in sedimentation to streams. Rutting and compaction on skid trails, landings, dozer constructed firelines, temporary roads and maintenance on permanent roads may alter or interfere with normal surface water connections to streams. Minimizing or avoiding adverse impacts on streams includes identifying sensitive soils and the conditions that produce adverse effects. Soils have been grouped as to sensitivity (refer to soils section in this EA relative to groupings 6, 7, and 8) to ponding, compaction and rutting. In addition, these effects tend to be minimal due to the relatively flat terrain and high degree of organic matter soil cover. Sedimentation effects would be minimized with implementation of the design criteria that minimize excessive rutting and compaction from heavy equipment. BMP use would help ensure compliance with the Clean Water Act. Log landings and major skid trails may be disked and planted to native and/or desirable non-native vegetation which would also help to stabilize soil and reduce erosion potential.

Some new fireline would be built to exclude areas from burning for the short term either to protect sold harvest units or to protect recently planted longleaf pine seedlings. Periodic prescribed fire would be reintroduced once these seedlings are established. Firelines have many of the same effects as skid roads and design criteria to limit their effects are similar. Firelines expose mineral soil, but have limited effects when designed with drainage features such as rolling dips or other structures to remove concentrated flow and disperse it into the forest buffer prior to reaching streams or other sensitive resources. Fireline smoothing may also be applied in situations where soil compaction and/or a soil berm prevents normal drainage patterns or retains surface water. The surface irregularities or conditions are repaired by practices such as pulling the soil berm back into the fireline and smoothing. Soil ripping or disking may be used to break up compaction or to prepare seedbed for revegetation. Unlike wildfire, prescribed fire activities have ample time to locate and mitigate fireline construction to avoid impacts. As a result, many of the prescribed firelines are installed on upland areas in the best terrain available and are closed after use.

Road Reconstruction and Maintenance

System road reconstruction (53.95 miles) and temporary road construction (4.48 miles) would produce a sediment source through grading and ditching. Roads can adversely affect water quality through removal of vegetation and litter cover. Soil compaction, exposure to raindrops and ground disturbance create impervious surfaces that increase potential for runoff of sediment into steams. Road surfaces also increase the risk potential for chemical contamination from petroleum product leaks and spills. The existing road system may affect the hydrology of the area resulting in changes in water yields and stream morphology.

System road reconstruction (including replacing a number of culverts) and maintenance would benefit nearby water resources by minimizing soil movement and by ensuring that drainage culverts function properly. Road banks would be protected and maintain with adequate amounts of vegetative cover. Surface drainage structures in the form of dips or water-bars would be used as needed to divert and limit concentrated flow, erosion and sediment sources. Road maintenance improves or restores water flow from the road surface and ditch line and directs the water into vegetated areas where appropriate so erosion is reduced and sediment is trapped before it reaches streams.

New temporary roads are planned in thirteen stands. Also, existing logging ramps (roads typically less than 100 feet long that tie in with county roads) would be reused where possible to reduce impacts. Temporary roads, log landings and other concentrated disturbances would be closed with adequate erosion and surface drainage controls to reduce impacts to streams and other resources. Roads with soil berms or excessive fill materials may need additional maintenance if they impact natural surface drainage patterns. Temporary roads are closed after harvest and impacts decrease in intensity as the road surface and cut-fill slopes stabilize, and roads revegetate following completion of activities (Fulton and West, 2002; Gucinski et al., 2002).

Spot gravelling and restoring aggregate on the road surface during reconstruction work would protect wet areas on haul roads and prevent excessive rutting. Culvert installation, fill slope and road maintenance would likely add some temporary increases in sediment and turbidity to the streams. Added effects occur when stream crossing structures need replacement, are removed and soils are stabilized. Adverse water quality impacts from temporary road construction are typically short-term impacts that rapidly dissipate once activities are completed.
Total sediment yields for the proposed actions were estimated from Soil Loss and Sediment Yield Rates for Land Management Planning for the Francis Marion National Forest (adjusted from Hansen et al, 1994). Estimates of the erosion and sediment levels from activities in Alternative 2 also include the same background data from alternative 1 (No Action). Calculated sediment yield for alternative 2 was 263 tons of sediment over a ten year period above the "No Action" level. Analysis details are included in the project file. The erosion rates are based on Dissmeyer and Stump (1978) average soil loss rates for the lower Coastal Plain (flatwoods) with slopes averaging 1 percent. Sediment delivery ratio or the amount of erosion reaching a stream was estimated at 10 percent.

The concentrations of sediment in the water for the analysis area would increase from 12.88 in alternative 1 to 12.96 ppm in alternative 2. The average concentrations of sediment within the USFS lands increased from 1.68 to 1.76 ppm. The concentrations are low over the ten years, but some short term impacts to streams may occur during storm events associated with harvest units. Based on these estimates, the potential increase in sediment yields to the analysis area and subwatersheds would be negligible overall, but still could have some minor temporary effects on streams within activity areas during severe events. Impacts would diminish rapidly downstream in larger, mid-order streams that are dominated by forests and wetlands.

Cumulative Effects of Alternative 2

Other past, present and foreseeable future activities within the project area watersheds mentioned in Alternative 1 that also have a potential to interact cumulatively to affect water resources include herbicide release, SPB suppression and control activities, invasive exotic plant control, system, county, state and special use road maintenance, temporary road construction and maintenance, timber sale activities, prescribed burning, various types of land uses associated with forestry, agriculture, rural and urban development.

Timber harvest would also be conducted as part of SPB suppression, and control. SPB control efforts occurring before the timber sale could result in the harvest of trees that would ordinarily

be harvested during the PRA timber sale. SPB control efforts occurring after the timber sale could result in openings created in overstocked stands where intermediate and first thinning are proposed. Temporary road construction to access SPB outbreaks and routine road maintenance would result in more soil disturbance and the potential for increased erosion and sediment yields.

Prescribed burning following re-vegetation by understory species would increase potential runoff and higher water yields. A low intensity burn would minimize this. Generally, during low intensity surface burns, woody vegetation recovers quickly along with warm season grasses. Prescribed burning would not be conducted in the regeneration areas in the short term.

Some past and current projects within the affected project area watersheds involve the use of herbicides for selective release and non-native invasive plant control. Herbicide would be applied by on-the-ground, foliar and cut surface application methods. These methods would reduce the potential for drift or accidental contamination of non-target areas. Herbicides used would degrade in the environment after application, leaving a limited window for cumulative adverse effects from other herbicide use projects.

Soil loss is the amount of soil movement off site. Only a small portion is typically transported into streams for each of the activities. The length of time for site recovery was adjusted from normal timber sale activities that typically have a greater duration (Dissmeyer and Stump, 1978). The recovery time should be less than indicated because BMPs and Forest Plan standards would be followed. The erosive effect of water is reduced by quickly re-establishing vegetation on highly impacted areas such as skid trails and log landings.

The composite sediment concentration for the nine sub-watersheds increased 0.08 ppm 12.88 to 12.96 ppm, over the decade from implementing the proposed actions. At the sub-watershed scale, this change is negligible. The concentrations indicated are those associated with small perennial streams, and do not take into account the reduction in sediment delivery from about 34% to 13-17% expected as drainage size increases from 3rd to 4th order drainages (typically hundreds of acres in size) to sub-watershed scale (sixth level HUCs or 6th-7th order drainages that are 10,000 acres or more in size). Detailed information on the analysis is contained in the project record.
The summary of the cumulative sediment effects with the proposed action included an additional 263 tons from activities and roads over a 10-year period within the analysis area and coupled with the current 5,511 tons on the 101,391 acres of National Forest, and the 36,829 tons on the 125,458 acres of private lands within the PRA for a total of 42,616 tons of sediment within the analysis boundary (226,850 acres). The values based on many assumptions were not rounded in the development of this analysis, but they are not indicative of precision or accuracy. Some small variances in acreages reported were due to differences in the GAP and GIS analyses. The results are estimates for use in comparing the alternatives.

Activities on Private Lands

The majority of the PRA watersheds, including interspersed private lands, consist of closed canopy evergreen forest/woodland. Timber harvest activities on private lands are expected to contribute to both short-term and long-term adverse impacts to water resources in the PRA

watersheds and would interact cumulatively with the proposed vegetation management activities. Overall, these adverse impacts are not expected to be substantial since the majority of the watershed is forested, providing protective buffers along streams and wetlands. The implementation of BMP is relatively well accepted as a standard practice on private land and aids in the protection of water quality. Loggers are often trained in BMP implementation. The potential for timber harvesting under Alternative 2 to cumulatively contribute to adverse impacts on water resources would be minimal over the short-term.

Direct, Indirect and Cumulative Effects of Alternative 3

Proposed activities under Alternative 3 include the same actions as Alternative 2 except the planted longleaf seedlings would not be released using herbicide but instead would be released by manual labor using brush saws.

The effects described for alternative 3 apply to this alternative as well except that there would be no effects from herbicide. There would be no effects to water resources from the manual use of brush saws under this alternative.

3.1.3 Air

Affected Environment

Air pollutants of most concern to natural resources on the Francis Marion National Forest include ozone, particulate matter, sulfur dioxide, nitrogen oxides and mercury.

Ozone is a pollutant formed by emissions of nitrogen oxides and volatile organic compounds in the presence of sunlight. Nitrogen oxides (NOx) are released when any fuel is combusted at very high temperatures; major sources of NOx include automobiles, power plants and industrial boilers. Volatile organic compounds (VOCs) are emitted from both manmade and natural sources, including chemical manufacturing, gasoline-powered vehicles, trees and vegetation. Research has shown that in the southern US there is an overabundance of naturally-occurring VOCs, and thus ozone formation is "NOx-limited”. This means that the concentration of ambient ozone is primarily dependent on the amount of nitrogen oxide emitted into the air. When ozone is formed, it causes human health concerns as well as negative impacts to vegetation. Specifically, elevated ozone concentrations can reduce the health and vigor of sensitive vegetation and reduce plant growth. The US Environmental Protection Agency (EPA), as directed by Congress, has set a national ambient air quality standard (NAAQS) of 0.075 parts per million (ppm) to protect both human health and the environment. At this time, all areas of the Francis Marion National Forest are meeting NAAQS for ozone [Fiscal Year 2011 Monitoring and Evaluation Annual Report, Francis Marion National Forest (2011 Monitoring Report)].

Particulate matter is a mixture of extremely small particles made up of soil, dust, organic chemicals, metals, and sulfate and nitrate acids. The size of the particles is directly linked to health effects, with smaller particles causing the worst impacts to human health. Additionally, particulate matter is the main cause of visibility impairment. These tiny particles absorb and reflect light which diminishes scenery views. Regional haze usually covers large geographical

areas, and many local and regional sources of pollution contribute to the degraded visibility conditions. EPA has set NAAQS for ultra-small (less than 2.5 microns in diameter) particulate matter on both a short-term (24-hour) and annual basis to protect human health and visibility. The 24-hour fine particulate matter (PM2.5) NAAQS to protect both humans and the environment is currently set at 35µg/m3, while the annual PM2.5 NAAQS for human health is 12µg/m3. At this time, all areas of the Francis Marion National Forest are meeting NAAQS for fine particulate matter. (2011 Monitoring Report)

Sulfur and nitrogen deposition can cause stream acidification and leaching of important soil nutrients needed for healthy terrestrial and aquatic biota. Nitrogen deposition can also cause eutrophication or nutrient enrichment that negatively impacts water quality, aquatic biota, and may increase invasive plant growth. Sulfur comes primarily from the combustion of coal at electrical generating units. Nitrogen compounds are derived from both the combustion of fuel at very high temperatures (such as in power plants, industrial boilers, and automobiles) as well as from various agricultural processes. Although EPA has considered setting a multi-pollutant NAAQS to address deposition-related affects, they have decided there currently is not enough scientific information to set one standard that would adequately protect the diverse ecosystems across the country. This proposal does not have the potential to affect sulfur or nitrogen deposition and would not be evaluated further.

Mercury is another important environmental contaminant that reaches the forest primarily through atmospheric deposition. The primary source of anthropogenic (manmade) mercury is the combustion of coal. Mercury is fairly stable and accumulates in the environment until conditions are right for dispersal. This can occur by wildland fires ejecting the mercury back into the atmosphere, or when associated with wetlands it can be converted via sulfate reduction to its most toxic form, methyl mercury (MeHg). The MeHg is ingested by aquatic organisms and bioaccumulates as it makes its way through the food web, and can affect humans when too many fish are consumed in one week. Unhealthy levels of MeHg have led to fish consumption advisories in almost every state. Methyl mercury has also been found in numerous species of wildlife. EPA regulates the amount of mercury that is emitted into the air from many different sources, including power plants, municipal waste combustors and medical waste incinerators. Frequent low intensity fires may actually help in the sequestration of mercury by leaching mercury deep into the soil where it would be less available for runoff into streams given the flat topography of the project area (Waldrop 2009). This proposal does not have the potential to affect mercury release into the atmosphere given the frequency of burning in the area and the flat terrain and therefore, would not be evaluated further.

Air pollution can come from local sources – such as activities within the National Forests – or may be transported from distant sources that are hundreds of miles upwind by weather patterns. The only Class I area is Cape Romain National Wildlife Refuge (NWR), located just to the east of the Francis Marion National Forest. There is one nonattainment area partially located within the air shed, the Charlotte-Rock Hill Nonattainment Area for ozone. There are no other nonattainment or maintenance areas within the air shed.

The National Emissions Inventory (NEI) (http://www.epa.gov/ttn/chief/eiinformation.html) was used to assess the historic trends of air pollution emissions near the Francis Marion National

Forest. Local, state and tribal air regulatory agencies are required by the EPA to periodically inventory the amount of emissions within their respective jurisdictions. These inventories form the basis for air pollution trends analysis, air quality modeling efforts and regulatory impact assessments. At this time, the NEI website has inventory data for the years 2002, 2005 and 2008 available for download.

The table below shows the total emissions within the air shed for each of these pollutants for 2002, 2005 and 2008.

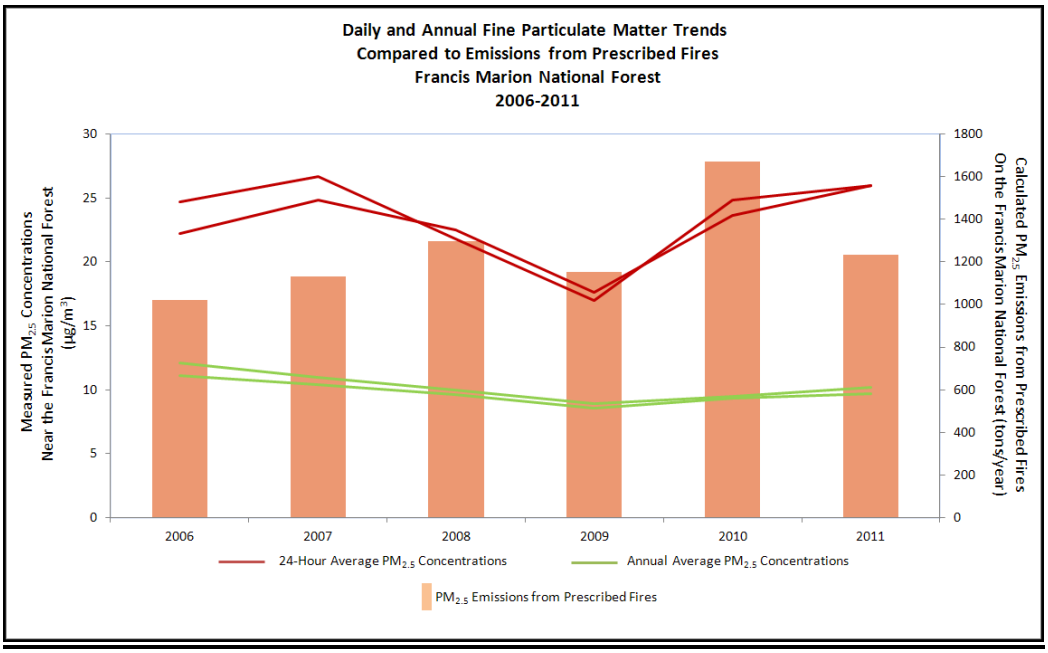
Table 3.1.3-1. Emission of Sulfur Dioxide, Nitrogen Oxides and Particulate Matter within the Air Shed for the Years 2002, 2005, and 2008

Pollutant	Emissions (tons/year)			Percent (%) Change in Emissions (2002-2008)
	2002	2005	2008	
Sulfur Dioxide (SO_2)	382,580	380,422	260,698	-31.8%
Nitrogen Oxides (NO_x)	425,217	386,348	350,047	-17.7%
Particulate Matter < 10 µm in diameter (PM_{10})	347,000	352,730	329,259	-5.1%
Particulate Matter < 2.5 µm in diameter ($PM_{2.5}$)	103,769	112,506	114,651	+10.5%

Emission reductions over the past decade have been achieved as a result of new regulations, voluntary measures taken by industry, and the development of public-private partnerships. It is expected that air quality would continue to improve as recently adopted regulations are fully implemented, and as a result, it is anticipated that emissions of air pollution released within the air shed of the Francis Marion National Forest would continue to decline.

In addition to monitoring, the potential impacts that regional air pollution has on the natural resources within the Francis Marion National Forest, the Forest also conducts activities, particularly prescribed fire, that contribute to air pollution. With the increasing prescribed fire program, it is important to assess whether there is any indication that local and regional PM2.5 levels are mirroring that trend. The following figure shows the daily and annual fine particulate matter concentrations near the Forest from 2006 through 2011 as compared to emissions from prescribed fire conducted on the Forest during that same time period. As shown, PM2.5 concentrations do not appear to be correlated with PM2.5 emissions from prescribed fires.

Figure 3.1.3-1. Fine Particulate Matter Trends on the Francis Marion National Forest



Direct and Indirect Effects of Alternative 1

No changes in the air quality would occur since no activities would be conducted under this alternative that has the potential to generate emissions or smoke. Existing air quality conditions and patterns would continue.

At this time, all areas of the Francis Marion National Forest are meeting the NAAQS for ozone and for fine particulate matter.

Cumulative Effects of Alternative 1

A forest-wide prescribed burn environmental assessment (EA) has been prepared and includes the effects of periodic prescribed burning in the area. Air quality monitoring would continue on the Francis Marion, and smoke management would continue to be evaluated for all prescribed burning activities.

At this time, all areas of the Francis Marion National Forest are meeting the NAAQS for ozone and for fine particulate matter considering past, present and reasonably foreseeable future actions on private and national forest system lands. Air quality monitoring would continue to measure ambient ozone concentrations at sites located in Charleston and Berkeley counties and for fine particulate matter at sites operated by the South Carolina Department of Health and Environmental Control as well as a monitoring site at Cape Romain NWR operated by EPA under the Interagency Monitoring of Protected Visual Environments (IMPROVE) program.

Direct and Indirect Effects of the Action Alternatives

Minor amounts of dust and emissions from heavy equipment and trucks would occur during logging operations and activities associated with road reconstruction and maintenance and reseeding/revegetation activities. The amount of dust generated would depend upon local soil and road conditions and would be limited to high vehicle traffic and activities. Emissions in the area would be of short duration occurring during the time of equipment operations. Site preparation consisting of mastication would occur on a limited number of acres to reduce understory woody material and to prepare a seed bed for planted seedlings and natural regeneration.

Under alternative 2, site preparation would be done using herbicides and no additional effects to air quality are expected. Under alternative 3, herbicides would not be used but would rely on manual methods to release seedlings. Prescribed burning would result in the same amount of emissions under either alternative. A limited number of acres would be burned annually over a five year period, adding miniscule amounts of emissions. These emissions would be noticeable at the stand level but would not be discernible at the compartment or forest scale in terms of the air shed. The effects from each action alternative would be nearly the same.
All areas of the Francis Marion National Forest would continue to meet NAAQS for ozone and for fine particulate matter with the implementation of the action alternatives.

Cumulative Effects of the Action Alternatives

Periodic prescribed burning takes place annually on the Francis Marion National Forest and has ranged from 32 to 39 thousand acres per year from 2007 to 2011 based on the annual monitoring reports prepared for the Francis Marion National Forest. The potential additional areas to be added to the prescribed fire program for the forest total about 5 to 10 thousand acres. The additional acres of burning would not measurably affect air quality in the air shed.

Prescribed fires typically produce lower per-acre emissions than wildland fires. Because prescribed fire generally produces fewer per-acre emissions than wildland fire, it is possible to burn more acres with prescribed fire than would normally occur with wildland fire and still maintain the same total emissions within the air shed. Prescribed burning could increase up to about 50,000 acre per year and still meet air quality standards. A forest-wide prescribed burn environmental assessment and a decision notice were signed for prescribed burning and included the effects of increased prescribed burning on the forest. Additional detailed discussion and analysis of the potential impacts from prescribed fire on air quality are found in the Guide to Prescribed Fire in the Southern Forests (U.S. Department of Agriculture 1989b) and Vegetation Management of the Coastal Plain/Piedmont Environmental Impact Statement (refer to pages IV-106 through IV-113).

In addition, there are numerous biomass thinning and first thinning operations currently active on the Forest, under existing environmental documents. These thinnings would reduce fuel levels and “ladder fuels,” decreasing the potential for crown fires that could contribute to air pollution. Some of the thinned areas would be added to the prescribed burn program and would reduce the

size and frequency of wildland fires in the long term, thus reducing smoke and particulates in the air.

Impacts to air quality from existing timber harvest and road maintenance operations could potentially occur as a result of the sustained use of heavy machinery that generate emissions in a localized area. Negligible to minor, temporary increases in carbon monoxide (CO), nitrogen oxides (NOx), and hydrocarbons would occur as a result of proposed on-site operations. In addition to tail pipe emissions from heavy equipment, increased vehicle traffic along paved, unpaved (dirt), and gravel roads, as well as the temporary disturbance of the ground surface during timber harvest activities, could potentially cause increases in fugitive dust. These impacts would be temporary and limited to periods of high vehicle traffic and activity.

Past, present and reasonably foreseeable projects (including the action alternatives proposed) on federal and private lands would continue to meet NAAQS for ozone and for fine particulate matter. Air quality standards are being met based on Forest Plan monitoring.
Air quality would continue to be monitored on the Forest following current protocols, and reporting would be done on a yearly basis. This would provide information on impacts and trends in air quality from management activities and the need for adjustments in the burning program on the District and Forest.

3.1.4 Climate Change and Carbon Storage

Affected Environment

The affected environment is considered at both the project and global scale. Global climate change may affect the natural resources on the Francis Marion Ranger District and interfere with management objectives in the project area. The vegetation management activities proposed may affect carbon storage ability and influence global climate change.
The US Global Changes Research Program published a 2009 report (USGCRP 2009) on climate changes on different regions in the US. Predictions for the Southeast include: air temperature increases; sea level rise; changes in the timing, location and quantity of precipitation; and increased frequency of extreme weather events such as hurricanes, heat waves, droughts and floods. These predicted changes would affect renewable resources, aquatic and terrestrial ecosystems and agriculture, with implications for human health.

The Template for Assessing Climate Change Impacts and Management Options (TACCIMO) was used to determine likely changes to climate in the project area. TACCIMO report (September 2013) summarizes the resulting climate change impacts predicted to take place for the Southern Region of the US. Climate change, especially climate change variability (droughts and floods), may alter hydrologic characteristics of watersheds with implications for wildlife, forest productivity and human use. This climate change variability may manifest itself in long-term and seasonal patterns in temperature that influence ecosystem health and function. These impacts result from both long-term warming and from shorter term fluctuations in seasonal temperature that may interrupt or alter temperature dependent ecosystem processes. Impacts to resources are documented in TACCIMO Literature Report (September 2013) and are incorporated by reference in this EA.

The Francis Marion National Forest is in the process of completing a forest-wide assessment of resource conditions and trends in preparation for revising the Forest Plan in 2014 and 2015. The assessment includes information relative to forest carbon. Information in that report indicates that the Francis Marion is a carbon sink (more carbon is being absorbed through forest growth than is being released into the atmosphere). Information in that report is incorporated by reference in this EA.

Direct, Indirect and Cumulative Effects of Alternative 1

In the short term, alternative 1 would result in no change to the current trend for carbon storage or release in the project area. However, not taking action to improve ecological health would likely result in substantially lower carbon stocks and substantially increased carbon emissions in the future as the result of forest decline, severe wildfires and losses from storms, insects and disease.

Studies on longleaf pine (Pederson, Varner and Palik 2008) indicate that drought exacerbates mortality because increased evaporative demand reduces vigor, which predisposes trees to insect and disease. The same results would be expected for loblolly pine and hardwood species in the project area. Potential increases in wildfire activity would also add to this mortality.
Loblolly pine predominates in the analysis area on soil types once dominated by mixtures of hardwoods and longleaf pine. Declines in agriculture and grazing, coupled with planting of loblolly pine on private lands have led to dense mature stands in and around the analysis area. Natural disturbance events such as the massive forest blow down from Hurricane Hugo also triggered loblolly pine to regenerate across portions of the analysis area. Dense, un-thinned/unmanaged stands of pine would be subject to increasing moisture stress especially under prolonged drought conditions. There could be increased risk of Southern pine beetle mortality in overstocked stands.

Past and present projects including periodic prescribed burning, pre-commercial and commercial thinning (pulpwood and intermediate) have reduced hazardous fuels, improved growing conditions and increased habitat diversity. This has reduced pine mortality and favored carbon storage both for the short and long term. Understory grasses, forbs and shrubs have increased as a result of increase moisture and light conditions. However, a large portion of the Macedonia project area has not been treated and remains at high risk for potential forest health problems in the future.

Potential gains and losses of carbon would be subject to changes in land-use, such as the conversion of forests to agricultural lands. Increased urbanization is occurring on private lands around the forest. However, national forest system lands provide for the long term management of forest areas, which offsets changes in land management and ownership patterns on private lands on the coastal plain. Large shifts in land use are not expected to occur on private lands in the analysis area and continued management of national forest system lands that include thinnings, restoration of longleaf pine habitat and prescribed burning would result in forest stands that are better able to cope with climate variability.

Direct, Indirect and Cumulative Effects of the Action Alternatives

Silvicultural treatments in the project area are aimed at thinning overstocked immature, slow growing loblolly and longleaf pine stands. Thinning would increase the amount of available water and other nutrients necessary to sustain growth and help stands withstand stress from climate changes. Opening the forest canopy would result in increased growth rates/vigor and a proliferation of understory plant development. This would also be beneficial to a variety of native plants and animals that are dependent on this type of habitat for their growth and survival.

Thinnings that favor retention of desirable hardwoods and longleaf pine coupled with prescribed fire would favor less loblolly pine. Longleaf would be better adapted to the drier sites and stocking control would keep these stands healthy. Restoring longleaf pine on a portion of stands now occupied by loblolly pine would increase habitat diversity and result in new stand compositions that are better able to withstand extreme weather events along with dryer conditions. The potential for insect and disease damage would be reduced because uniform stand conditions would be broken up by treatments. The project would increase the amount of early successional habitat adding to structural and habitat diversity. These management actions would provide stand and forest conditions that are more resistant to dryer and hotter conditions.

The rate at which trees take up or sequester carbon is directly related to growth. The total amount of carbon in a tree depends on its' size or total amount of biomass. Third growth forests like these contain less total carbon, but continue to take up and store carbon. The Forest Plan assessment indicates that this is the case for the Francis Marion National Forest.

Management activities such as prescribed fire, thinning and regeneration harvests that maintain a variety of forest ages may increase the overall ability of the forest to sequester carbon. Prescribed burning improves the resilience of forests to climate-induced disturbances such as a catastrophic wildfire which help sustain the current strength of the carbon sequestration ability of forests.

The action alternative would initially release carbon, leave fewer trees to store carbon, but would also create and maintain a herbaceous layer with a capacity for carbon storage and which may be more resistant to long-term climate change. At a global or national scale, the short-term reduction in carbon stocks and sequestration rates of the proposed project are imperceptibly small as are the potential long-term benefits. Therefore, the project would not significantly add to global climate change.

Past and present projects including periodic prescribed burning, pre-commercial and commercial thinning (pulpwood and intermediate) have reduced hazardous fuels, improved growing conditions, and increased habitat diversity that includes the development of understory grasses, forbs and shrubs. This has reduced pine mortality and favored carbon storage both for the short and long term.

Potential gains and losses of carbon would be subject to changes in land-use, such as the conversion of forests to agricultural lands. Increased urbanization is occurring on private lands around the forest. However, national forest system lands provide for the long term management of forest areas, which offsets changes in land management and ownership patterns on private

lands on the coastal plain. Large shifts in land use are not expected to occur on private lands in the analysis area and management of national forest system lands would result in forest stands that are better able to cope with climate variability.

3.2 Biological Environment

The biological environment is divided into four sections:

- Vegetation and Non-Native Invasive Plants
- Proposed, Endangered, Threatened and Sensitive (PETS) Species
- Management Indicator Species (MIS)
- Aquatic Communities

Effects of the proposed action to PETS are described in detail in a biological evaluation included in the appendix.

3.2.1 Vegetation

Affected Environment

The Macedonia analysis area comprises a total of 92,648 acres. Of this total, 50,157 acres are Forest Service lands. The remaining is private property dispersed in small and large ownership blocks throughout the analysis area.

There are numerous vegetative communities in the Macedonia project area. These communities occur on a variety of soil types and landforms from poorly drained flatwoods to well-drained sandy ridges. The pine forests comprise approximately 58% of the national forest land in the project area and are dominated by early to mid seral stage pine forests as a result of hurricane Hugo in the fall of 1989. Pine stands that have not been commercially thinned in the last decade have dense canopies with little or no gaps between the dominant and co-dominant trees.

Below is the percentage make-up of the pine forests in the project area.

Table 3.2.1-1. Percentage of Pine Forests in the Project Area

Pine Type	Percentage
Loblolly Dominated Stands	**82%**
Mixed Loblolly Hardwoods	**9%**
Longleaf Dominated Stands	**1%**
Mixed Longleaf /Loblolly Stands	**8%**
TOTAL	**100%**

Older pine forests (older than 35 years of age) comprise 30% of the pine forests in the analysis area. These stands are characterized by dense canopies and heavy mid-story and understories due

to the lack of consistent burning on short rotations. In most stands there is little recruitment of a younger age class needed to replace the older trees in the future as they die out.

The project area also contains numerous dense and overstocked stands of loblolly pine pulpwood stands less than 35 years of age (70% of the pine forests in the project area). These stands exhibit decreased vigor and very little understory plant diversity. The overcrowded condition presents an increased susceptibility to insect infestations such as southern pine beetle outbreaks.

Portions of the analysis area (Compartments 17, 18, 44, 45, 47 and 64) have been burned at least three times in the last decade. These pine forests contain relatively open mid-stories of hardwood such as oak/hickory, black gum and sweetgum. Understories are dominated by grasses, herbs, and sedges. Shrubs also dominate in the understory but have been kept low due to frequent prescribed fire.

Bottomland and swamp hardwoods such as swamp gum, red maple, pond cypress, swamp chestnut oak and water oak are interwoven within these pine forests as seasonally flooded ponds, depressions, drains and bay heads.

The species composition and diversity are dependent on several interacting factors such as fire frequency/intensity, overstory/midstory canopy density, soils/hydrology and past management practices.

Bottomland and swamp hardwood forests and isolated wetlands and pocosins comprise 43% of the project area. Bottomland hardwoods usually contain species such as swamp chestnut oak, swamp gum, cherrybark oak, sweetgum, loblolly pine, red maple, willow oak, water oak and laurel oak. The swamp hardwood forests are typically dominated by bald cypress and water tupelo. The pocossins and isolated wetlands are dominated by ericaceous shrubs, pond pine, water tupelo and the bay species (red, sweet and loblolly bay).

Most of the swamp and bottomland hardwood forests are in the mid to late seral stages of succession.

Special communities such as Carolina bays, sink holes, wet savannas, calcareous communities are also scattered throughout the project area. Some have been mapped and catalogued as unique natural areas. The majority has not been designated as such and are scattered throughout the pine forests.

Direct, Indirect Effects and Cumulative Effects of Alternative 1

Under this alternative there would be no thinning, longleaf restoration or loblolly seedtree cuts in any of the pine forests in the project area. Management of these forests would be limited to an established prescribed burn program that maintains a highly variable burn cycle in the project area.

Under this alternative, there would be no opportunity to improve the growth and vigor of overstocked stands of young loblolly pine (15-30 year age class). As these stands age, there

would be an increased susceptibility to southern pine beetle infestations. Suppression of southern pine beetle activity would continue on federal lands in the area in reaction to outbreaks. An environmental assessment is in place on the Forest to do cut-and-leave and cut-and-remove treatments to reduce spread and to salvage merchantable trees in the event of an outbreak. Outbreaks are expected in the future as younger stands continue to be overstocked and slow-growing. In the long term, there would be increasing risk to insect and disease activity as overall forest health declines.

Under this alternative, older pine stands with closed canopies would not be thinned, which would continue to inhibit the development and diversity of sun loving grasses, forbs and mast producing shrubs such low bush blue berry, huckleberry, runner oak and dwarf chinquapin. Closed canopies would also inhibit crown development of longleaf pine seed trees necessary for the establishment of longleaf regeneration in the understory to replace older trees as they die. Opportunities for opening crown canopies would be limited to natural disturbances such as wind falls, fire mortality and lightning strikes.

Other opportunities lost under this alternative are:

- The conversion of some loblolly stands to longleaf using regeneration harvest followed by planting longleaf seedlings.

- The development and maintenance of RCW foraging habitat which requires open canopied pine forests with larger diameter trees (greater than 10” DBH).

- The development of early seral stage habitat using regeneration harvests to provide vegetative and structural diversity.

- Development of mixed pine hardwood stands in those areas of the analysis area that are not managed for longleaf or the RCW.

Direct and Indirect Effects of Alternatives 2

Pine stands after thinning and biomass treatments (prescriptions 1, 2 and 4) would have the following benefits:

- Decreasing competition for sunlight and soil resources would allow the retained trees to grow more vigorously, reducing their susceptibility to southern pine beetle attack.

- Increasing growth rates and vigor of younger trees would allow them to grow into the larger diameter size classes to ensure the development of future RCW foraging habitat.

- Allowing the crown development of potential longleaf seed trees, wherever they may occur. Seed tree development would facilitate the natural establishment of longleaf seedlings in the understory necessary for future stand replacement, either through natural disturbance or intentional management.

- Enhancing the positive effects of the ongoing prescribed burn program by allowing more sunlight to penetrate through the canopy to the ground. The increase in light penetration would stimulate the establishment, growth and diversity of the grass/herb/shrub community in the understory.

- Allowing the crown development of midstory oaks and hickories that would be left during the thinning operations. Improved crown development would result in greater mast production and thus food source for a variety of wildlife.

- Removing loblolly pines that crowd or suppress longleaf trees. This would push tree species composition in the canopy towards longleaf dominance in the long term.

In the stands targeted for pulpwood and biomass thinnings (prescription 1), trees that are sawtimber-sized pine and hardwoods would be cut and removed only as needed to facilitate logging operations. They would typically be cut if they are a safety hazard for logging operations or cannot be maneuvered around by equipment on skid trails, landings, access ramps to landings and temporary and system roads. They may be removed to improve road maintenance (mowing or brushing) or if they are a safety hazard. This prescription aims to retain the larger trees where possible for the development of RCW foraging habitat. Cutting and removing a small portion of sawtimber was analyzed for the project relative to RCW and the effects are considered minor.

In stands targeted for intermediate and biomass thinnings (prescription 2), sawtimber-sized pine trees may be cut to promote the growth of neighboring trees that are better formed, more vigorous and to release longleaf seedtrees and regeneration cohorts. This prescription aims to retaining larger, more vigorous trees where possible for the development of RCW foraging habitat. Cutting and removing a portion of sawtimber was analyzed for the project relative to RCW and the effects are considered minor.

The stands designated for longleaf restoration (prescription 3) would convert approximately 3% of the loblolly dominated forests in the project area to longleaf pine. Approximately 55% of these loblolly stands are less than 30 years of age.

The removal of a significant portion of the pine canopy in stands targeted for longleaf restoration in prescription 3, treatment classes 1 and 3, in combination with consistent prescribed burning, would allow development of a seral community dominated by grass/forbs/shrubs. This community would benefit species and species associations that require prairie or sparse canopy conditions, such as bob white quail, prairie warbler, yellow breasted chat, small mammal species and associated raptors.

The stands that would be treated in prescription 3, treatment classes 2, 4 and 5, have a well-established hardwood component in the understory due to the alteration and suppression of the natural fire regime for more than a century. Decades of invasion and dominance by loblolly pine and understory hardwoods, such as sweetgum and oaks, have displaced the native pyrogenic grassland community and associated longleaf pine to the point where restoration would be very difficult using prescribed fire by itself due to the difficulty of killing the hardwood rootstock.

Herbicide release (prescription 3, treatment classes 2, 4 and 5) of longleaf seedlings one to two years following planting using dormant season basal treatment of understory hardwoods would eliminate a significant portion of the understory hardwood rootstock, thus "turning back the clock" of succession caused by fire suppression. Herbicide release, followed by recurring burning, would reduce shading to the understory and longleaf pine seedlings, thus placing succession back on a trajectory toward restoration of the pyrogenic system.

Herbicide application during the dormant season instead of the growing season would reduce the risk of eliminating non-target species belonging to the grass/forb community.

Establishment and growth of longleaf pine seedlings in prescription 3 would create a future growing stock for RCW foraging and cavity nesting habitat and convert loblolly dominated pine stands to longleaf pine.

Stands that would be treated in Prescription 4 are dominated by loblolly pine with heavy mid-stories containing a substantial number of mast producing hardwoods such as oaks and hickories. These stands are located in portions of the analysis area that are very difficult to prescribe burn due to their proximity to the urban interface. These stands are also outside of the ½ mile foraging circle of any red cockaded woodpecker cluster. Prescription 4 would open the pine canopy to allow a significant increase of sunlight to the mid-story, giving the hardwoods an opportunity to grow into the dominant canopy layer and, in the case of mast producers, encourage acorn and nut production for the benefit of a number of wildlife species.

Prescription 5 would significantly reduce the number of loblolly pine trees to create very open canopy conditions. Removal of the mid-story and understory by logging and mastication would create open conditions beneath the residual pines for several years (1 to 5) until regrowth occurs and loblolly pine seedlings become established by natural seeding. Grasses and forbs would significantly occupy the site during this period until displaced by hardwood coppice and loblolly seedlings. Loblolly pine would eventually dominate the canopy of the new stand in the long term (10-15 years) while the residual loblolly seed trees would die out through attrition.

Effects of Design Criteria

Mitigation measures can be found in the Francis Marion Revised Land and Resource Management Plan (1995), the Forest Fire Management Plan (available at http://www.fs.fed.us/r8/fms/forest/fire), and South Carolina Best Management Practices for Forestry (1995, reprint 2003). Additional mitigation measures can be found in the Final Environmental Impact Statement, Vegetation Management in the Coastal Plain/Piedmont, Chapter II.

Designated skid trails and landings would reduce the impacts to vegetation. Using woody debris to cross small intermittent channels would limit impacts to these areas and prevent deep ruts and disturbance to vegetation. Known sites containing threatened and endangered plants would be avoided to prevent impacts to these plant species. Small savanna communities may experience disturbance during logging but the conditions after thinning of the pine canopy and prescribed burning would enhance these communities.

Application of non-soil active herbicide to release longleaf planting would occur during the dormant season to avoid impacts to non-target grasses and forbs not in active growth.

Measures would be used to protect known RCW trees to avoid damage during logging operations. Fireline construction and reconstruction would avoid impacts to known threatened and endangered plants. Existing firelines would be reused to avoid additional vegetation disturbance in areas. Fireline construction would avoid trenching. Mounded soil material would be smooth and put back into the fireline. This would promote native plant re-establishment and prevent the channeling of water. Perennial and intermittent streams and hardwood inclusions would be avoided during logging operations to reduce damage to trees and other vegetation.

Cumulative Effects of Alternative 2

Past federal actions in the project area consist of:

1. First thinning of dense loblolly stands less than 30 years of age that became established in the aftermath of hurricane Hugo.

2. An established prescribed burn program that treats the Macedonia project area on an intermittent basis.

3. Midstory mastication in RCW clusters to restore critical habitat.

Private land actions include road improvements, housing development expansion, especially in the WUI. In addition, timber management occurs on private land as well.

Management on national forest system lands would promote habitat diversity by thinning, regeneration harvests and burning. These forest management activities would offset some of the adverse impacts to vegetation and fire-dependent habitats occurring with urban expansion.

Vegetation management on the National Forest when combined with timber management on private lands would provide barriers to insect and disease spread and would reduce fuel hazards. Fuel treatments across the landscape do not have to be continuous to have dramatic effects on reducing fire intensity and spread. It is assumed that there would be a positive accumulation of reduced fire risk and spread from vegetative treatments on private and public lands, especially when combined with recurring prescribed burning on portions of the analysis area.

Timber management on private land would provide transitory habitat for some fire-dependent/early successional communities, even though private land objectives are different than that of the Francis Marion. However, when combined with development and maintenance of habitat specifically targeting threatened, endangered, sensitive and management indicator species there is an accumulation of positive short term and long term benefits.

Special communities such as Carolina bays, sink holes, and calcareous communities would generally be unaffected by the activities in this proposal. Landscape-level prescribed fire and the

botanical areas occurring in this proposal, are less likely to be managed for on adjacent private land and therefore the cumulative effects are likely to be beneficial.

Direct, Indirect Effects and Cumulative Effects of Alternative 3

Alternative 3 is identical to Alternative 2 except planted longleaf seedlings would not be released using herbicide and instead would be released by manual labor using brush saws.

Manual release of longleaf seedlings from competing vegetation would provide temporary release benefits to the planted seedlings. However, because the root stocks of the vegetation that is cut would not be killed, vigorous sprouting would results in a dense coppice of woody vegetation that would compete with the longleaf seedlings, adversely affecting their growth and survival. This would increase the probability for the need of multiple plantings. Dense woody growth would persist even if prescribed fire were used on a biennial return interval, preventing the conversion to a grass, forb dominated plant community.
Under this alternative, there would be a high probability the objectives of longleaf conversion would be compromised and the understory dominated by woody vegetation for prescription 3, treatment classes 2, 4 and 5.

3.2.1A Non-Native Invasive Plants (NNIS)

Affected Environment

Non-native invasive plant species occurring in stands proposed for treatment, were noted in 3 plant survey contracts (Glitzenstein, 2011; Gaddy, 2011; and Glitzenstein, 2013) contracted by the U.S. Forest Service for this project area. NNIS plants were documented in 48 stands proposed for treatment, see table # __ for stands with NNIS and documented NNIS species. NNIS species documented include Japanese Climbing Fern (*Lygodium japonicum*), Japanese Honeysuckle (*Lonicera japonica*), Sericea Lespedeza (*Lespedeza cuneata*), Bahia grass (*Paspalum notatum*), Bermuda grass (*Cynodon dactylon*), Brazilian vervain (*Verbena brailiensis*), Chinese privet (*Ligustrum sinense*), Chinese Wisteria (*Wisteria sinensis*), Colombian waxweed (*Cupea carthagenensis*), Formosa firethorn (*Pyracantha koidzumii*), Japanese stiltgrass (Microstegium vimineum), Silktree (Albizia julibrissin), Vasey's grass (*Paspalum urvillei*), Bigpod sesbania (*Sesbania herbacea*), and Chamber-bitter (*Phyllanthus urinaria*).

Table 3.2.1A-1. List of NNIS Documented in Surveyed Stands in the Macedonia Analysis Area

Common Name	Scientific Name	4 Digit Code
Japanese Climbing Fern (*Lygodium japonicum*)	*Lygodium japonicum*	LYJA
Japanese Honeysuckle (*Lonicera japonica*)	*Lonicera japonica*	LOJA
Sericea Lespedeza (*Lespedeza cuneata*)	*Lespedeza cuneata*	LECU
Bahia grass (*Paspalum notatum*)	*Paspalum notatum*	PANO
Bermuda grass (*Cynodon dactylon*)	*Cynodon dactylon*	CYDA
Brazilian vervain (*Verbena brailiensis*)	*Verbena brailiensis*	VEBR
Chinese privet (*Ligustrum sinense*)	*Ligustrum sinense*	LISI
Chinese Wisteria (*Wisteria sinensis*)	*Wisteria sinensis*	WISI
Colombian waxweed (*Cupea carthagenensis*)	*Cupea carthagenensis*	CUCA
Formosa firethorn (*Pyracantha koidzumi*i)	*Pyracantha koidzumii*	PYKO
Japanese stiltgrass (*Microstegium vimineum*)	*Microstegium vimineum*	MIVI
Silktree (*Albizia julibrissin*)	*Albizia julibrissin*	ALJU
Vasey's grass (*Paspalum urvillei*)	*Paspalum urvillei*	PAUR
Bigpod sesbania (*Sesbania herbacea*)	*Sesbania herbacea*	SEHE
Chamber-bitter (*Phyllanthus urinaria*)	*Phyllanthus urinaria*	PHUR
Coffeeweed (*Senna obtusifolia)*	*Senna obtusifolia*	SEOB
Common Korean-clover (*Kummerowia striata*)	*Kummerowia striata*	KUST
Small Carpgrass (*Arthraxon hispidus*)	*Arthraxon hispidus*	ARHI
Tropical Mexican-clover (*Richardia brasiliensis*)	*Richardia brasiliensis*	RIBR
Chinaberry (Melia azedarach)	*Melia azedarach*	MEAZ

Table 3.2.1A-2. List of Stands Proposed for Treatment with NNIS

COMPT	STAND	Prescription	NON-NATIVE INVASIVE SPECIES IN ANALYSIS AREA																				
			LYJA	LOJA	LECU	PANO	CYDA	PHUR	VEBR	LISI	WISI	CUCA	PYKO	MIVI	ALJU	PAUR	SEHE	PHUR	SEOB	KUST	ARHI	RIBR	MEAZ
1	2	5		X						X													
1	3	4	X	X							X			X	X								
2	7	1	X	X																			
2	9	5		X	X					X													
2	16	1		X	X			X															
3	18	2		X							X	X		X									
3	19	1		X							X	X		X									
3	21	4		X							X	X		X									
3	26	2		X							X	X		X									
6	6	1			X				X		X	X									X		
7	3	1		X						X	X												
7	7	5		X																			
7	15	1			X										X								
8	11	1			X									X	X								
9	11	4			X						X			X							X		
9	16	5	X	X	X									X									
9	19	5	X																				
10	2	4	X	X																			
10	7	1		X	X			X	X		X			X		X	X	X			X		
10	8	4			X																		
10	17	1	X	X	X		X							X		X				X	X	X	
10	20	5	X	X	X																		X
14	9	1	X	X	X																		
14	19	1		X																			
15	10	3	X																				
15	13	2	X	X							X												
15	17	3	X			X																	
15	19	2		X											X	X		X	X			X	
15	20	1		X				X							X	X			X			X	
15	23	2		X	X			X						X						X			
16	3	1		X	X	X						X			X						X		
16	4	3	X																				
16	17	3		X	X																		
16	21	1						X															
20	11,12	2	X																				
22	2	5		X							X												
22	5	1			X	X																	
22	10	5	X	X	X								X		X								
33	03,16	1								X													
33	12,10	1			X							X				X				X	X		
34	10	1													X								
34	13	5								X													
36	18	1	X							X					X								
36	19	3	X		X																		
38	7	1	X							X					X								
46	20	3	X							X													
64	3	3	X											X									

Japanese climbing fern, a native of Asia, was introduced into Florida as an ornamental plant in the 1930's and poses a particular threat to native fire-maintained ecosystems. Japanese climbing fern often forms dense tangled mats of vegetation, shading and killing understory vegetation and creating fuel ladders, which can intensify fire and carry them into tree crowns. The spores, by which this plant spreads, can move rapidly undetected, by wind or on contaminated equipment or plant material. Japanese climbing fern appears to becoming more common on the Forest, with over 3100 occurrences documented on the Forest.

Sericea lespedeza, Bahia grass, Bermuda grass and Common Korean Clover were included in seed mixes historically and may be found to limited extent along roads, in wildlife openings and on log decks. Although not abundant in the Francis Marion National Forest, these species can be promoted by fire and on some sites, can spread displacing native vegetation and altering species diversity, wildlife suitability, and management plans (Evans et.al, 2006). Tannins and other allopathic chemicals are produced from lespedeza roots which can further inhibit growth of native plant species.

Chinaberry, Japanese honeysuckle, Chinese wisteria and Chinese privet are well known for their abundance in the southeast, and on the forest are often found in association with old home sites, where they can form dense infestations outcompeting native vegetation. Both Chinese wisteria and Chinese privet are commonly used as ornamental shrubs and for hedgerows on private lands, but can invade a variety of habitats, spreading quickly once established. Due to their evergreen tendencies, both Japanese climbing fern and Chinese privet compete successfully, particularly in disturbed areas and in areas maintained with frequent prescribed fire.

The remaining species documented are generally not common on the Forest and in some cases the sites documented are the only known sites. Some of these species, particularly bigpod sesbania and coffeeweed, are annuals and ground disturbing activities can cause them to sprout from residual seed banks. In many cases these species can remain dormant after the ground disturbance has healed but may reappear in the future if ground disturbing activities occur.

Direct and Indirect Effects of Alternative 1

Additional ground-disturbing activities would not take place with this alternative, nor activities which increase availability of light for rapidly growing opportunistic non-native invasive plant species. Alternative 1 is expected to have no direct or indirect effects on the spread of non-native invasive plants, and no impacts to habitats since no additional activities would occur. Non-native invasive plants are expected to increase in the area over time, particularly in the absence of prescribed fire.

Cumulative Effects of Alternative 1

No cumulative effects of Alternative 1 on the introduction and spread of non-native invasive plants are anticipated, as no direct or indirect effects are anticipated. Ongoing projects associated with other decisions, including first thinning, prescribed burning, mastication of select areas for the RCW, and non-native invasive plant detection and control would continue to take place, but there would be no additional cumulative effects of the no action alternative associated with this project. Non-native invasive plants are expected to increase in the area over time, particularly in the absence of prescribed fire.

Direct and Indirect Effects of Alternative 2

Harvest activities, tree planting, and road construction can each improve conditions for the spread of non-native invasive plant species, by increasing light to the forest floor, creating bare soil providing a micro-site for establishment, and by introducing equipment from other areas on site, which can bring in invasive plant species propagules increasing the chances of establishment (Evans et.al. 2006). Project design criteria, such as equipment cleaning provisions, and the treatment of non-native invasive plants prior to and after harvest, are designed to minimize the direct and indirect effects of activities proposed in Alternative 2, on the introduction and spread of non-native invasive plant species. Only non-invasive perennial, annual, or native plants would be planted in areas associated with this proposal, including log decks, so no invasive plants would be intentionally introduced. Direct effects to habitats are not anticipated, since all non-native invasive plants have been identified which occur within the

project areas, and at minimum, efforts would be made to treat all known locations for Japanese climbing fern.

Indirectly, project activities would provide micro-sites for non-native invasive plants once soil has been disturbed, but these sites are likely to revegetate rapidly with native vegetation from the surrounding areas, which would prevent the establishment of invasive species. Equipment cleaning provisions would be strictly enforced when moving on site and between sites identified with Japanese climbing fern populations. No non-native invasive plants would be intentionally introduced. All regeneration and thinning sites would be periodically monitored to ensure no new infestations are developing within areas where soil-disturbing activities are taking place. Given that the design criteria are followed, indirect effects of the project are likely to be minimal.

Cumulative Effects of Alternative 2

Non-native invasive plants continue to increase throughout the state and few incentives exist for private land owners to control these species once established. Many invasive plants colonize roadside habitats, and would continue to spread if left uncontrolled. Statewide, opportunities exist for private and state landowners to cost share with federal agencies to control invasive plants, and through Wyden amendment authorities, forests can treat adjacent lands when invasive plant populations pose a threat. Since the project is likely to have insignificant direct and indirect effects of invasive plant species to habitats, above and beyond what would occur without treatments, the cumulative project effects are likely to be minimal. If non-native invasive plants continue to spread along roadsides, independent of this project, opportunities to partner in control would exist both within and outside the scope of this project.

Direct and Indirect Effects of Alternative 3

Since Alternative 3 is identical to Alternative 2 except that lower target basal areas are proposed, mastication in select stands is proposed to prepare areas for planting, and the use of herbicide is dropped, the direct and indirect effects on the spread of non-native invasive plants is not expected to differ from Alternative 2. Minimal direct and indirect effects are anticipated given design criteria are followed.

Cumulative Effects of Alternative 3

Non-native invasive plants would continue to spread largely unabated on private lands in Alternative 3, similar to Alternative 2, but since direct and indirect effects are expected to be minimized by following design criteria, so also would the cumulative effects of Alternative 3 on the introduction and spread of non-native invasive plants.

3.2.2 Proposed, Endangered, Threatened, Sensitive Species (PETS)

Affected Environment

See project Biological Evaluation (BE, Appendix B), environmental baseline for species evaluated. This BE provides a description of existing conditions for proposed, endangered, threatened, and sensitive (PETS) species addressed, as well as a complete list of threatened, endangered and sensitive species. Based on survey results and State heritage records, the red-cockaded woodpecker (RCW), Bachman's sparrow, Carolina fluffgrass, Crested fringed orchid, Boykin's lobelia, pineland dropseed, incised groovebur and pineland plantain are the only PETS species known to occur within or immediately adjacent to the proposed treatment areas. The only other PETS species known to occur within the analysis area are the Bald eagle (documented from one site on private property near Santee River) and pondberry (documented in stand 15 of compartment 62). American chaffseed, Southeastern myotis, wood stork, Bachman's warbler, short-nose sturgeon, West Indian manatee, Canby's dropwort, frosted flatwoods salamander, Carolina gopher frog, migrant loggerhead shrike, Atlantic sturgeon, savannah milkweed, Carolina spleenwort, awned meadowbeauty, many-flowered grass pink, cypress-knee sedge, Loomis' yellow loosestrife, loose watermilfoil, climbing heath, yellow fringeless orchid, shortbristle beaksedge, coastal beaksedge, and carolina dropseed were eliminated from further analysis due to their low likelihood of occurrence based on lack of known occurrences and/or suitable habitat.

There are 52 RCW clusters with foraging partition stands located within the Macedonia Analysis area. Of these, there are 24 inactive and 16 active RCW clusters whose .5 mile foraging partitions overlap treatment areas. All 16 are potential breeding groups (2 or more birds) based on annual monitoring conducted since 2007.

Forest sensitive plant species have been documented to occur within nine of the proposed treatment areas. Pineland plantain has been documented along the road shoulders/ditch of Forest Service road 118, Strawberry Road adjacent to stand 23 in compartment 62 and along the SC Hwy 41 right of way adjacent to stand 20 in compartment 46. Curtis' dropseed has been documented within three of the proposed treatment areas (stand 22, compartment 36; stand 12, compartment 37; and stand 01, compartment 47). Carolina fluffgrass has also been documented from three of the proposed treatment areas (stands 17 and 19 of compartment 15, and stand 22 of compartment 36). For the remaining three PETS plant species, Crested fringed orchid has been documented from in stand17 of compartment 16, Boykin's lobelia has been documented from one site in stand 26 of compartment 17 and incised groovebur has been documented from one site in stand 22 of compartment 36.

Unique habitats documented from within the analysis area include several sites of mature-pine-hardwood forests which were likely never open longleaf dominated woodlands; a very xeric *Carya pallida* dominated sandhill in and adjacent to stand 03 in compartment 01; a *Lyonia lucida* dominated pocossins which includes an intact transition to a *Sporobulus curtissii* dominated savanna in stand 01 of compartment 47; a diverse dry ridge in stand 01 of compartment 47 dominated by a Pinus taeda overstory with an understory and ground layer dominated by species expected in a longleaf system; a mature shortleaf pine ridge with upper slope hardwoods and

understory plants indicative of an upper slope oak-hickory forest in stand 17 of compartment 15; a mature longleaf pine habitat interspersed with mature dry site hardwoods in stand 17 of compartment 15 and a hardwood dominated slope forest transitional to bottomland, grass dominants in stand 09 of compartment 16.

Direct, Indirect, and Cumulative Effects of Alternative 1

Under this alternative, management actions of this proposal would not be implemented. Directly, PETS species would not be affected because no management actions are proposed. Indirectly, habitat for species associated with an open fire maintained landscape with open canopies would not be improved. Indirect effects to PETS plants would be insignificant, as long as prescribed burning continues to take place as it has historically. However, foraging habitat for the RCW would not be improved with this alternative. The no action alternative would not enhance age class diversity or provide for longleaf restoration in areas currently dominated by loblolly pine. Prescribed burning, as proposed in other decisions, would not have the cumulative or synergistic benefits that it would when combined with small and large tree thinnings included in the action alternatives. Under no action, species associated with bottomland hardwoods or hardwood ecotones, including Rafinesque's big-eared bat, and Southeastern myotis, would be unaffected. Cumulative effects to PETS and their habitats are also likely to be insignificant. Through time, prescribed burning in the area would maintain the present openings within which species associated with wetland ecotones and savannas, and sub-xeric woodlands and savannas, can survive. Past federal actions in the project area include first thinning, an established prescribed burn program, the mastication of foraging habitats and cluster sites for the endangered red-cockaded woodpecker, and non-native invasive plant control. These programs would continue to occur under the no action alternative.

Direct and Indirect Effects of Alternative 2

There would be no direct effects for PETS species not known to occur within or adjacent to stands proposed for management, including no direct effects to Bald eagle, pondberry, American chaffseed, Southeastern myotis, wood stork, Bachman's warbler, short-nose sturgeon, West Indian manatee, Canby's dropwort, frosted flatwoods salamander, Carolina gopher frog, migrant loggerhead shrike, Atlantic sturgeon, savannah milkweed, Carolina spleenwort, awned meadowbeauty, many-flowered grass pink, cypress-knee sedge, Loomis' yellow loosestrife, loose watermilfoil, climbing heath, yellow fringeless orchid, shortbristle beaksedge, coastal beaksedge, and pineland dropseed. Potential direct and indirect effects to PETS species would be minimized and/or eliminated by design criteria. Such criteria include minimizing fire line construction, temporary road construction and placement of log landings at known site locations of PETS species. Mechanical activities would not be conducted within 200 feet of red-cockaded woodpecker clusters from April 1 through July 31.

Carolina fluffgrass, Crested fringed orchid, Boykin's lobelia, Curtis'dropseed, incised groovebur and pineland plantain are known to occur within or adjacent to stands proposed for management. Direct effects of logging equipment to Carolina fluffgrass, Crested fringed orchid, Boykin's lobelia, Curtis'dropseed, incised groovebur and pineland plantain would be insignificant or eliminated by design criteria (see design criteria # 29, page 31, for site specific locations and

mitigation during implementation). No direct effects to the PETS plant populations are anticipated, though there is a small chance that individual plants could be crushed or uprooted and project activities are not expected to affect viability of these populations.

Table 3.2.2-1.Site Specific Locations of PETS Plants and Design Criteria

COMPT	STD	Common Name	Proposed Treatment	Design Criteria
15	17	Carolina fluffgrass	Longleaf Restoration	Do not locate any decks or primary skid trails on plant site. Logging activity would only commence after clearance by FS District WFRP personnel.
15	19	Carolina fluffgrass	Intermediate Treatment	One plant found in small opening within stand. Flag out site and avoid during logging.
16	17	Crested Fringed Orchid	Longleaf Restoration	Do not locate any decks or primary skid trails on plant site. Avoid herbicide release treatment.
17	26	Boykin's lobelia	Loblolly Seedtree Cut	Avoid depression during implementation in areas where plant is found. Collect KV funds to daylight depression.
36	22	Curtis' dropseed	Longleaf Restoration	Do not locate any decks or primary skid trails on plant site. Logging activity would only commence after clearance by FS District WFRP personnel. Avoid herbicide release treatment.
36	22	Carolina fluffgrass	Longleaf Restoration	Do not locate any decks or primary skid trails on plant site. Logging activity would only commence after clearance by FS District WFRP personnel. Avoid herbicide release treatment.
36	22	Incised groovebur	Longleaf Restoration	Do not locate any decks or primary skid trails on plant site. Logging activity would only commence after clearance by FS District WFRP personnel. Avoid herbicide release treatment.
37	12	Curtis' dropseed	Intermediate treatment	Do not locate any decks or primary skid trails within the TESP polygon. Logging activity would only commence after clearance of FS District WFRP
46	20	Pineland plantain	Longleaf Restoration	Have district WFRP personnel flag out the site along Hwy. 41 to avoid logging activities
47	1	Curtis' dropseed	Longleaf Restoration	Do not locate any decks or primary skid trails within the TESP polygon. Logging activity would only commence after clearance of FS District WFRP
62	23	Pineland plantain	First Commercial Thinning	1 plant found in road ROW along Strawberry Road. Flag out and avoid during logging

In general, direct effects considered included those which could result in the disruption of nesting activities due to entry of mechanical equipment during nesting season, crushing or uprooting of individuals, and direct mortality from herbicide application. Herbicide proposed for use in wildlife snag creation and the herbicide release treatments are not expected to impact PETS species as long as all herbicide label and forest plan standards are followed, and herbicide is carefully and selectively applied.

Snag creation can play an important role in offsetting the impact of kleptoparasitism on the RCW and provides habitat for numerous species of fauna. Snags are a source of insects and other invertebrates that serve as food for various wildlife species. They also provide perches and cavities for many bird species, cover for small mammals and herpetofauna, and are future

sources of downed woody debris. Various studies have shown that increases in the availability of snags on forest lands can lead to an increase in the species richness, diversity, and abundance of cavity nesting birds.

The herbicide treatments would be carefully selected and would not occur in areas known to harbor PETS plants. Indirect effects that were considered included those with the potential to alter hydrology, decrease the number of foraging-sized pine trees available for RCW nesting and foraging, increase prevalence of nonnative invasive plants, and to create undesirable habitat conditions for fire dependent species such as the RCW and Bachman's sparrow. Implementation of mitigation measures would minimize direct and indirect effects of alternative 2 to all known PETS species within treatment areas.

Indirectly and directly, the proposed action is expected to benefit PETS species with known habitat or occurrences in the analysis area in the long-term. In the short term, the proposed action does have the potential to indirectly affect the RCW by the taking of potential foraging and nesting-sized pine trees. However, this reduction is not expected to adversely affect the RCW, nor is it expected to inhibit the establishment of new clusters through natural attrition (i.e., pioneering or budding). The benefits of improving RCW foraging and nesting habitat across thousands of acres is expected to offset any potential short-term impacts of removing foraging and nesting-sized pine trees. This is especially true when potential foraging and nesting-sized pines are removed in stands that currently offer poor quality foraging and nesting habitat. The residual pine basal areas proposed in alternative 2 are expected to sustain open-canopied conditions for an extended period of time, which is expected to be beneficial to PETS species analyzed. Traditionally, past thinning projects on the FMNF have promoted leaving residual basal areas in the range of 55-65 sq. ft. /acre. Leaving a residual basal area of 50-60 sq. ft. /acre in prescription 2 treatment class 1 may lead to closed-canopied conditions sooner than would be expected than treatment class 2. If closed-canopied conditions do develop sooner in this treatment, beneficial PETS species effects may be short lived.

PETS plant species associated with wet pine and pond cypress savannas or depressions and ecotones in association with pond cypress and/or swamp tupelo ponds, seeps, and pocosins (Crested fringed orchid, Boykin's lobelia, Curtis'dropseed, and pineland plantain)

Rare plant species associated with wet pine and pond cypress savannas or depressions all occur as remnants within a landscape maintained open by frequent prescribed fire. On the scale at which these plant populations occur, canopy opening through thinning would increase sunlight available on the forest floor, and could stimulate fine fuels and the continuous herbaceous plant cover needed to carry a fire. When combined with landscape-level prescribed fire, which is addressed through other project plans or decisions, these activities are likely to benefit the TES species and their habitats in the longer-term.

Species associated with wetlands and wetland ecotones are sensitive to alterations in hydrology, which could occur as a result of implementing this project. Forest Plan standard and contract specifications are designed to prevent or minimize rutting of soils and the entry by equipment in wetlands and on sensitive or potentially wet or poorly drained soils. Within unique communities identified in plant surveys, logging would not take place until the soil surface has dried enough

that there is no evidence of surface ponding of water. Impacts to identified wet savanna habitats would be minimized by careful location of skid trails and landings, and by the blading rather than plowing of firelines. Existing log decks would be used, where possible, to minimize impacts to savanna vegetation. Firelines proposed around longleaf regeneration areas, would alter vegetative cover, but vegetation is likely to recover rapidly given the soil profile is not permanently altered.

PETS plant species associated with sub-xeric longleaf pine and loblolly pine woodlands (Incised groovebur, Carolina fluffgrass).

Rare species associated with upland longleaf pine and loblolly pine woodlands all occur within a landscape co-dominated by fire maintained herbaceous understories. At a landscape-scale, and when combined with frequent prescribed fire, this project could benefit habitat for all species associated with upland longleaf pine and loblolly pine woodlands, by opening up the canopy, restoring native longleaf, and promoting fuels necessary for carrying a desirable prescribed burn. Following thinning or regeneration activities, stands may be initially dominated by early successional, weedy species. Fireline construction, log deck placement (although existing log decks would be used when possible), and road maintenance activities, all have the potential to negatively alter perennial habitat on a small scale. In conjunction with prescribed fire, habitat quality is expected to improve for perennial PETS species associated with longleaf ecosystems.

Given the small size of rare plant populations in the area and design criteria identified, only small scale indirect effects to habitat are anticipated.

Cumulative Effects of Alternative 2

Ongoing projects or plans on the Forest include landscape level prescribed fire (up to 250,000 in the next five years), nonnative invasive plant control (potentially on 3,000 +/acres), ongoing recreational activities, and numerous small and large tree thinnings. Ongoing activities on private land include but are not limited to urban development and timber harvesting. The FMNF represents the largest contiguous landscape in South Carolina where landscape level fire and PETS management is occurring on such a grand scale. In general, the proposed action is expected to cumulatively benefit all PETS species addressed in the BE. Species either not likely to be found in the area, or primarily associated with bottomland hardwoods or hardwood ecotones (i.e. Rafinesque's big-eared bat, and Southeastern myotis), are unlikely to be affected.

The status of all PETS species on the Forest is further summarized in the Annual Monitoring Reports available at: http://www.fs.fed.us/r8/fms/fmarion/resources/planning. High tree densities and closed-canopied conditions currently exist in almost all of the treatment areas. These conditions reduce the amount of light reaching the forest floor and limit floral and faunal diversity. Thinning these stands would open up the forest canopy allowing for increased sunlight penetration. Ultimately, floral and faunal diversity is expected to increase following the proposed treatments. This is especially true when the treatments are followed by prescribed burning activities. Most of the rare plants on the FMNF positively respond to the increased light availability that results from canopy openings and frequent prescribed fire. When considered in conjunction with the ongoing prescribed fire program on the forest, this proposal is likely to have

cumulative beneficial effects to habitats for sensitive plants addressed. Cumulative effects to the T&E plants pondberry and American chaffseed are likely to be insignificant, since both species are limited in distribution within the analysis area.

At least seven populations for pineland plantain are known from the Forest, and at least four of these are quite extensive, consisting of hundreds of plants (Hwy.41, Whilden Road, Dog Swamp Road, Compartment 82). The Hwy. 41 population is within this analysis area, and one (in part) occurs adjacent to one of the stands proposed for management. This particular population is part of a larger, more extensive population which occurs along the road rights-of-way of SC Hwy. 41 between Bethera Road (S-48) and Tiger Corner road (FDR 157) containing hundreds of plants. Since ongoing forest activities are potentially impacting only a very small section of this right-of-way, there are anticipated to be no cumulative effects to this species.

Direct and Indirect Effects of Alternative 3

The same factors and considerations used in determining effects of the proposed action apply to alternative 3. Alternative 3 is identical to Alternative 2 except the planted longleaf seedlings would not be released using herbicide and instead would be released by manual labor using brush saws.

Alternative 3 is expected to be just as beneficial to PETS species as alternative 2. In the short term, this alternative does have the potential to indirectly affect the RCW by the taking of potential foraging and nesting-sized pine trees. However, this reduction is not expected to adversely affect the RCW, nor is it expected to inhibit the establishment of new clusters through natural attrition (i.e., pioneering or budding). The benefits of improving RCW foraging and nesting habitat across thousands of acres is expected to offset any potential short-term impacts of removing foraging and nesting-sized pine trees. This is especially true when potential foraging and nesting-sized pines are removed in stands that currently offer poor quality foraging and nesting habitat.

A foraging analysis was completed for all clusters whose .5 mile foraging partitions overlap or encompass proposed treatment areas (See foraging analysis table in the biological assessment). None of the foraging for the 40 clusters located within 0.5 mile of proposed treatment areas is expected to fall below the managed stability standard following the proposed treatments.

Foraging habitat was assessed based on the recovery standard described in the Recovery Plan for the Red Cockaded Woodpecker (Picoides borealis) Second Revision, hereinafter referred to as The Recovery Plan.

Cumulative Effects of Alternative 3

The proposed treatments in alternative 3 are expected to cumulatively benefit most all PETS species addressed in this proposal. Only insignificant cumulative effects, if any, are anticipated for PETS plants under this alternative. Species either not likely to be found in the area, or associated with bottomland hardwoods, such as Bachman's warbler, Rafinesque's big-eared bat, and Southeastern myotis, are likely to be unaffected.

3.2.3 Management Indicator Species

Affected Environment

A wide variety of wildlife species are found throughout the Francis Marion National Forest. The forest represents one of the largest and most biodiverse forested landscapes in South Carolina. In order to complete the analysis of potential impacts to wildlife regarding issues and concerns from the Proposed Action and the alternatives, Management Indicator Species (MIS) are used to represent the diversity of habitats. Long-term changes in the populations of these species serve as a barometer of the overall health of ecosystems. Population information for wildlife species is usually collected at the forest level rather than at stand level inventories. These estimates are related to the habitats occurring in the area. Eight MIS were identified as potentially occurring in the project area and vicinity thereof (Table 3-1).All of these MIS have been documented within the analysis area. Detailed discussions of these species can be found in the Management Indicator Species Population and Habitat Trends, Francis Marion and Sumter National Forests (USDA 2001), which is available upon request.

Table 3.2.3-1. Management Indicator Species Selected

MIS Species	Habitat Altered or Created	Direct/Indirect Effects	General Comments
Painted bunting *(Passerina ciris)*	No	No/No	Associated with maritime shrub-scrub and grassy habitats mixed in a woodland setting; most often found in largely forested areas with substantial edge and grassy forest openings and stands exhibiting structural diversity and large amounts of fleshy fruit; one of the most locally occurring, steepest declining, high priority species within the southeastern U.S.; migratory.
American swallow-tailed kite *(Elanoides forficatus)*	Yes	No/Yes	A tree top nester in predominantly forested landscapes typically with open canopy characteristics; most common in floodplain forests and other large tracts of forested Wetlands/mixed pine habitats of the outer coastal plain; State listed as endangered; migratory.
Red-cockaded woodpecker *(Picoides borealis)*	Yes	No/Yes	A bird of the open pine woodlands and savannas of the coastal plain and sandhills; uses park-like mature pine woodlands and savannas with little mid-story and few broad-leaved hardwoods for nesting; federally listed as endangered; non-migratory.
Yellow-throated vireo *(Vireo flavifrons)*	Yes	Possible/Yes	A bird of open deciduous forests; most common in edge habitats of mature deciduous and mixed deciduous forests; migratory
Northern parula *(Parula americana)*	Yes	No/Yes	A bird of the upper canopy in primarily deciduous forests with well-developed mid story and understory layers; migratory.

MIS Species	Habitat Altered or Created	Direct/Indirect Effects	General Comments
Prairie warbler *(Dendroica discolor)*	Yes	Possible /Yes	Frequents brushy old fields and open pine stands; population is common but declining; frequently host to cowbird parasitism; vulnerable to habitat loss that occurs with canopy closure of forests; neotropical migrant.
Awned meadow beauty *(Rhexia aristosa)*	No	No/ No	A species of the pond margins and moist soils of the savannas of the coastal plains; more common in habitats with few woody species that are frequently burned.
Pine woods tree frog *(Hyla femoralis)*	Yes	No/Yes	Most common near bogs or swampy areas in pine flatwoods and savannas in the coastal plain; also found in hardwood forests and swamps.
Sweet pitcher plant *(Sarracenia rubra)*	No	No/No	A carnivorous perennial plant of the bogs and moist soil margins of pocosins, bays and cypress – tupelo ponds of the coastal plain.
Northern bobwhite quail *(Colinus virginianus)*	Yes	Possible/Yes	Favors fields, grasslands, brushy habitats and open woodland; significantly declining over most of its range due to habitat loss and changes in farming practices; non-migratory.
Eastern wild turkey *(Meleagris gallopavo)*	Yes	Possible/Yes	Most common in predominantly forested landscapes with open understories and frequent openings, either grasslands or agricultural; favors oak and oak – pine woodlands with adequate water supplies; nonmigratory

Direct and Indirect Effects of Alternative 1

There would be no direct effects to any of the MIS under this alternative since management activities would not occur. Creation of habitat for species that require early successional/open habitat conditions, such as the prairie warbler, would be a random occurrence under this alternative. Any incidental habitat created via natural events would be of marginal quality and limited distribution. Habitat for eastern wild turkey would remain unchanged, as this species would continue to rely on existing open areas and hard mast sources in the area. Loblolly pine would continue to dominate the treatment areas identified for longleaf restoration. Brood habitat for eastern wild turkey and northern bobwhite quail would not be created. Any improvements to brood rearing habitat would be incidental to random events such as insect or disease outbreaks, severe weather, or catastrophic wildfire.

Habitat for species of seasonally flooded isolated wetlands and savannas (awned meadow beauty, pine woods tree frog and sweet pitcher plant) would remain unchanged.

Habitat for the American swallow-tailed kite and RCW would essentially remain unchanged.

Cumulative Effects of Alternative 1

Typical ongoing activities in the analysis area include wildlife habitat improvement and maintenance, timber harvesting, prescribed burning, and trail construction/maintenance. Habitats for early-successional and open pine woodland/savanna MIS species are typically being maintained by prescribed burning on select portions of the Francis Marion, and are generally experiencing declining trends forestwide. This alternative would not contribute towards enhancement or maintenance of habitat for species such as the RCW, prairie warbler and northern bobwhite quail.

Forestwide trends for MIS that have been summarized in Management Indicator Species Population and Habitat Trends – Francis Marion & Sumter National Forest (2001), Annual Monitoring Reports (2002-2012), North American Amphibian Monitoring Protocol monitoring results (2007-2013) and Fauth (2003), suggest that populations for pine woods tree frog, awned meadow beauty, and sweet pitcher plant are stable on the Forest. Generally, localized declines in populations for awned meadow beauty and sweet pitcher plant have been observed on the FMNF where frequent prescribed fire is lacking.
Habitat for species of the forest canopy (i.e., American swallow-tailed kite) and the eastern wild turkey would essentially remain unchanged in the Macedonia Project Area under this alternative.

Direct and Indirect Effects of Alternative 2

Direct temporary effects include immediate consequences of cutting, removal, burning, installation and maintenance of fire lines, and road construction activities, which could result in the crushing or harming of individuals within treatment areas. Indirect effects include the consequences of management activities that result in the modifications of habitat and ecological conditions that affect food, water, cover and other life requirements for a species.
No direct effects to the avian MIS are expected because these species would temporarily leave treatment areas once disturbances begin. However, it is possible that if these species are nesting during logging operations, individual nests and nestlings could be lost due to timber harvesting activities. These effects are considered minor due to the fact that only a portion of the area would be logged at any one time. In addition, timber harvesting would have to occur at the exact time when species are most vulnerable and also occur over successive years in order to have substantial impacts. This is unlikely given past harvesting practices and adherence to best practices such as the RCW management guidelines described in the Recovery Plan.

In general, habitat diversity within the Macedonia Analysis Area would increase under this alternative. Thinned stands would result in habitat that is preferred by Eastern wild turkey, RCW, and northern bobwhite quail, especially as these stands mature and are kept somewhat open by frequent prescribed burning. Species such as the Northern Parula and yellow-throated vireo should benefit from the enhancement of mixed pine/hardwood communities in compartments 1, 3, 9 and 10. There are at least three historic swallow-tailed kite nesting sites within the Macedonia Analysis Area (i.e., two in compartment 44 and one in compartment 50). All of the proposed treatments should improve foraging habitat for the swallow-tailed kite. Within longleaf pine restoration areas, habitat for prairie warbler, Northern bobwhite quail and other early successional species would be created and enhanced. Due to the fact that timber harvesting

treatments proposed in Prescriptions 3-5 would essentially consist of seedtree and shelterwood harvests, these stands would provide overstory structure for RCW foraging, potential future RCW cavity trees, and could serve as nesting/perch trees for the swallow-tailed kite and other avian species. Restoration of longleaf pine on the FMNF is a long-term investment for the RCW population, as well as for all species associated with the longleaf pine ecosystem.

Habitat for early successional and fire dependent species would be shorter lived within treatment areas being left with higher residual basal areas. All of the residual basal areas that would be left in Prescription 1 (Treatment Class 1-4) and Prescription 2 (Treatment Class 1-3) are generally higher than would be recommended purely from and ecological or biological perspective. In the short term, the proposed action does have the potential to indirectly affect the RCW by the taking of potential foraging and nesting-sized pine trees. However, this reduction is not expected to adversely affect the RCW, nor is it expected to inhibit the establishment of new clusters through natural attrition (i.e., pioneering or budding). The benefits of improving RCW foraging and nesting habitat across thousands of acres in the Macedonia Analysis Area is expected to offset any potential short-term impacts of removing foraging and nesting-sized pine trees. This is especially true when potential foraging and nesting-sized pines are removed in stands that currently offer poor quality foraging and nesting habitat. The residual pine basal areas proposed in alternative 2 are expected to sustain open-canopied conditions for an extended period of time, which is expected to be beneficial to PETS species analyzed. However, this statement does not hold true for the high basal areas proposed in Prescription 1 (Treatment Class 1-4) and Prescription 2 (Treatment Class 1-3). The beneficial effects produced with the aforementioned prescriptions and treatments would be short lived, as these stands would likely result in closed-canopy conditions within 3-5 years after thinning occurs. Thinning the aforementioned prescriptions and treatments to much lower residual basal areas (e.g., 50-60 sq. ft. per acre instead of 55-65 sq. ft. per acre) would delay canopy closure and offer beneficial effects for a longer period of time.

Implementation of design criteria would minimize direct and indirect effects of alternative 2 to all MIS species within treatment areas. Indirectly and directly, the proposed action is expected to benefit MIS species with known habitat or occurrences in the analysis area in the long-term.

Herbicide proposed for use in wildlife snag creation and longleaf release is not expected to negatively impact MIS species as long as all label and forest plan standards are followed, and herbicide is carefully and selectively applied. The method of herbicide release for longleaf would use dormant (leaf off) season basal bark application of herbicide. This type of treatment should limit exposure to sensitive species such as *Hyla femoralis.* In addition, the basal bark application is such a target specific method of application, the direct and indirect contact with sensitive species is highly unlikely. The herbicide used for longleaf release would be Triclopyr (Garlon 4 or equivalent) which would be applied directly to the stem of targeted woody species. As described in Prescription 3 Treatment Class 5, the following species would be targeted for treatment during herbicide release: sweet gum, water oak, turkey oak, black jack oak, blue jack oak, red maple, wax myrtle, gallberry, fetter bush, sweet pepper bush, and sumac. The herbicide mixture used for herbicide release would contain the following: 16% to 18% Triclopyr (Garlon 4 or equivalent) with 84% to 82% vegetable oil and adjuvant diluent. If available, only herbicides and surfactants approved for aquatic application would be used for snag creation.

Cumulative Effects of Alternative 2

This effects analysis tiers to the Forest-wide MIS document dated August, 2001 which provides context for species and their habitats across the Francis Marion.

This alternative would create and maintain habitat for species that benefit from a diversity of habitats and have substantial acreage in more open forested conditions. Habitat conditions such as this rapidly disappeared on the FMNF after Hurricane Hugo, and continue to be in short supply across the forest. In addition to activities planned in this alternative, other projects are being implemented and/or planned on the Francis Marion. Those projects include thinning treatments on thousands of acres over the next five years, prescribed burning 30-40,000 acres/year, refurbishing dozer fire lines, non-native invasive species control treatments, mastication of midstory within RCW partitions, and trail construction/reconstruction and maintenance.

With the exception of the northern portion of the analysis area, private lands in the area are predominantly forested. Private lands become more widespread north of Hwy 17A, and this portion of the analysis area contains a significant amount of private agriculture. Private lands are managed primarily for purposes other than maintaining/enhancing biodiversity, and may or may not be consistently managed to provide quality habitat conditions.

Species associated with fire adapted plant communities and habitat conditions that persist over time would realize the greatest benefit from this alternative. Habitat for RCW, prairie warbler, and northern bobwhite quail would be created, enhanced, and maintained within the Macedonia Analysis Area.

In general, the proposed action is expected to cumulatively benefit all MIS species that have been identified. High tree densities and closed-canopied conditions currently exist in almost all of the treatment areas. These conditions reduce the amount of light reaching the forest floor and limit floral and faunal diversity. Thinning these stands would open up the forest canopy allowing for increased sunlight penetration. Ultimately, floral and faunal diversity is expected to increase following the proposed treatments. This is especially true when natural ecological conditions/communities are restored (e.g., longleaf pine), and the treatments are followed by prescribed burning activities.

Direct and Indirect Effects of Alternative 3

The same factors and considerations used in determining effects of the proposed action apply to alternative 3. Alternative 3 is identical to Alternative 2 except that the planted longleaf seedlings would not be released using herbicide, and instead, would be released by manual labor using brush saws.

Indirectly, foregoing the herbicide treatment would have insignificant effects on MIS species and their habitats as long as all other treatments are conducted consistent with design criteria.

As mentioned in Alternative 2 analysis, higher residual basal areas proposed in Prescription 1 (Treatment Class 1-4) and Prescription 2 (Treatment Class 1-3) may lead to the development of closed-canopied conditions sooner than if these treatments were to leave residual basal areas lower than 55-65 sq. ft./acre. If canopy closure occurs within 3-5 years as is anticipated, beneficial effects to species such as the RCW, prairie warbler and northern bobwhite quail may be shorter lived than those resulting from a treatment such as that proposed in Prescription 2 Treatment Class 4. Alternative 3 is expected to benefit MIS in the Macedonia Analysis Area in the long-term. Alternative 3 is expected to be just as beneficial to MIS species as alternative 2.

In the short term, the proposed action does have the potential to indirectly affect the RCW by the taking of potential foraging and nesting-sized pine trees. However, this reduction is not expected to adversely affect the RCW, nor is it expected to inhibit the establishment of new clusters through natural attrition (i.e., pioneering or budding). The benefits of improving RCW foraging and nesting habitat across thousands of acres is expected to offset any potential short-term impacts of removing foraging and nesting-sized pine trees in this project. This is especially true when potential foraging and nesting-sized pines are removed in stands that currently offer poor quality foraging and nesting habitat.

Cumulative Effects of Alternative 3

Past, present and future actions that are approved on national forest system lands include prescribed burning and timber harvesting. These ongoing actions along with this alternative cumulatively would benefit Eastern wild turkey, RCW, and northern bobwhite quail. Species such as the Northern Parula and yellow-throated vireo would benefit from treatments across the forest that enhance or created mixed pine/hardwood communities. All of the proposed treatments and treatments in other timber sales should improve foraging habitat for the swallow-tailed kite. Active projects that restore longleaf pine areas would improve habitat for prairie warbler, Northern bobwhite quail and other early successional species. Past and proposed harvest that establishes seed trees and shelterwoods would provide overstory structure for RCW foraging, potential future RCW cavity trees, and could serve as nesting/perch trees for the swallow-tailed kite and other avian species. Agriculture, timber harvesting and prescribed burning on private lands also creates transitory early successional habitat that would benefit some wildlife and plant species. Early successional habitat is usually not the primary objective in private land management. Other actions on federal lands include NNIS treatments, wildlife opening maintenance and road maintenance. Cumulatively there would be beneficial impacts to MIS species with this alternative.

3.2.4 Migratory Birds

The Forest Service is recognized as a national and international conservation leader, and plays a pivotal role in the conservation of migratory bird populations and their habitats. Within the National Forest System, conservation of migratory birds focuses on providing a diversity of habitat conditions at multiple spatial scales, while ensuring that bird conservation is addressed when planning for various land management activities.

The Macedonia Analysis Area falls within Bird Conservation Region (BCR) 27 – Southeastern Coastal Plain. Several sources were reviewed to identify priority migratory birds that are likely to be found in and around this project (e.g., Partners in Flight (PIF) published list of priority species and habitats for BCR 27, USFWS published list of Birds of Conservation Concern 2008, the South Carolina Breeding Bird Atlas, and "Status and Distribution of South Carolina Birds" written by Post and Gauthreaux). The results of this review produced the following table of bird species of priority management concern. Species indicated in Table 3.2.4-1 were selected for analysis based on documented or known occurrences within or adjacent to treatment areas. Some species were also selected based on known occurrences within the Macedonia Analysis Area, and the likelihood of high quality habitat being affected or created. Effects to the swallow-tailed kite, prairie warbler and Bachman's sparrow have already been addressed in the MIS section of this EA and/or the attached biological assessment. As such, they are not thoroughly discussed in this section.

Table 3.2.4-1. Priority Migratory Birds for the Francis Marion National Forest

Species	Habitat Altered or Created	Habitat	Direct Effect Y/N	Indirect Effect Y/N
Swallow-tailed kite	Yes	Mature hardwood, forested wetlands, pine/hardwood mix	N	N
American kestrel	Yes	Open, mature pine	Y	Y
Brown-headed nuthatch	Yes	Open, mature pine	Y	Y
Wood thrush	Yes	Mature hardwood, pine/hardwood mix	Y	Y
Black-throated green warbler (Wayne's ssp.)	No	Mature hardwood, forested wetlands	N	N
Prairie warbler	Yes	Scrub-shrub, early succession, or maritime forest	Y	Y
Swainson's warbler	Yes	Dense understory in mature hardwood, forested wetlands, pine/hardwood mix	Y	Y
Painted bunting	No	Scrub-shrub, early succession, or maritime forest	N	N
Bachman's sparrow	Yes	Open pine, grassland scrub/shrub	Y	Y
Migrant loggerhead shrike	Possible	Open pine, grassland scrub/shrub	N	N
Hooded warbler	Yes	Bottomland and upland hardwood forests	Y	Y
Northern parula	Yes	Bottomland and upland hardwood forests	Y	Y
Worm-eating warbler	Yes	Mature Mixed mesophytic, cove hardwoods, hemlock/white pine	Y	Y

Over 250 different species of birds have been documented on the FMNF. Due to its significance to resident and migratory birds, the Francis Marion National Forest has been designated as an Important Bird Area by both the National Audubon Society and the American Bird Conservancy. Important Bird Areas are defined as sites that have been documented to support significant populations of particular species or a significant diversity of species. The FMNF provides essential stopover habitat for autumn and spring migrating birds, as well as critical breeding habitat. Three species known to occur on the Francis Marion and listed on the National Audubon's red list include the Red-cockaded Woodpecker (RCW), Swainson's Warbler *(Limnothlypis swainsonii) and* Bachman's Sparrow *(Aimophila aestivalis).* Approximately 12 species of migratory birds listed on the National Audubon's yellow list have been documented on the forest. Due to the diversity of habitats found within the analysis area, species with high conservation priority such as the Black-throated Green Warbler (*Dendroica virens*), Swainson's Warbler (*Limnothlypis swainsonii*), Prothonotary Warbler (*Protonotaria citrea*), Worm-eating Warbler (*Helmitheros vermivora*), Brown-headed Nuthatch (*Sitta pusilla*), RCW, Chuck-will's Widow (*Caprimulgus carolinensis*), Yellow-throated Warbler (*Dendroica dominica*), and Northern Parula (*Parula Americana*) are likely to occur there. Isolated wetlands and other palustrine wetlands within the analysis area are used by multiple other priority species, including: Little Blue Heron, American Woodcock and Swallow-tailed Kite (*Elanoides forficatus*) for foraging, roosting and nesting.

Other than those listed in Table 3-2, all other migratory bird species that occur in BCR 27 were excluded from analysis because: 1) they were not identified as birds of continental importance in the PIF North American Landbird Conservation Plan; 2) they were not identified as birds of conservation concern in the USFWS Birds of Conservation Concern BCR 27; 3) the project area occurs outside of their known breeding, wintering, or migratory range; and/or 4) suitable habitat is not expected within the project area (currently or in the near future).
In general, the proposed treatments in the Macedonia Analysis Area are expected to increase habitat diversity and restore desired forest conditions within treatment areas. Proposed treatments should ultimately create and/or improve habitat quality for migratory birds, as well as other vertebrate species which require specific habitat conditions (e.g., fire maintained ecosystems and mixed pine hardwood forests). The Forest Service, along with multiple partners, has been monitoring bird populations on the Francis Marion National Forest for since the early 1990's. This monitoring has typically been conducted annually in order to assess avian presence/absence, relative abundance and frequency of occurrence by habitat condition. There are approximately 17 bird monitoring points within the Macedonia Analysis Area, and several occur within or immediately adjacent to treatment areas. Avian species relative abundance for the 17 bird monitoring points can be found in Attachment 2. Temporal trends for priority migratory bird

species listed in Table 3.2.4-1 are reported in Attachment 1. Of all the species listed in Table 3-1, the worm-eating warbler is the only species which is primarily confined to the Macedonia Analysis Area on the Francis Marion National Forest. The worm-eating warbler breeds in hardwood forests throughout the Southeast, except in areas of the Lower Coastal Plain (La Sorte et al. 2007 & Hanners and Patton 1998). It winters in Central America and the eastern Caribbean. This species nests in areas of moderate to steep slopes and patches of dense understory shrubs within large tracts of deciduous and mixed forest. In the Coastal Plain, breeding populations occur in bottomland hardwoods, with an understory of dense evergreen shrubs. As reported by La Sorte et al. 2007, management designed to benefit the worm-eating warbler is focused primarily on retaining large forested blocks with dense shrub understories.

The Francis Marion National Forest has done very little to meet Forest Objective 11 as described in the *Revised Land and Resource Management Plan Francis Marion National Forest*. Objective 11 states: "Increase the acres managed as mixed pine/hardwood forest types to 14,800 acres in the long term." Although only 488 acres are proposed for treatment, Prescription 4 of the Macedonia Environmental Assessment is the FMNF's first large effort to try to meet Forest Objective 11 since 1996. The creation and/or enhancement of mixed pine/hardwood forest in the Macedonia Analysis Area should prove beneficial for priority migratory species that are dependent upon this type of habitat (i.e., swallow-tailed kite, wood thrush, hooded warbler, Swainson's warbler, northern parula, and worm-eating warbler).

According to USFS Breeding Bird Survey data from 1992-2007, several priority migratory bird species have experienced range-wide population declines in the South Atlantic Coastal Plain (La Sorte et al. 2007). Table 3.2.4-2 lists the population trends for priority migratory bird species that were identified for the Macedonia Environmental Assessment. Some priority species are apparently declining on the Francis Marion and Sumter National Forests, while some species appear to be experiencing population increases. Unfortunately, data for some species is lacking across the Francis Marion and Sumter National Forests (e.g., painted bunting and black-throated green warbler).

Table 3.2.4-2. Population Trends for Priority Migratory Birds Associated with the Macedonia EA, Francis Marion National Forest; Berkeley County, South Carolina

	Percent Annual Change in # of Observations	
Species	**Region 8 South Atlantic Coastal Plain 1997-2004[1]**	**Francis Marion & Sumter National Forests 1992-2004[1]**
AMERICAN KESTREL	-8.5	NA - No data
BACHMAN`S SPARROW	-6.6	-6.3
BLACK-THROATED GREEN WARBLER	NA - No data available	NA - No data available
BROWN-HEADED NUTHATCH	1.7	5.4
HOODED WARBLER	23.0	-0.6
MIGRANT LOGGERHEAD SHRIKE	NA - No data available	NA - No data available
NORTHERN PARULA	6.8	-4.1
PAINTED BUNTING	NA - No data available	NA - No data available
PRAIRIE WARBLER	6.4	-8.1
SWAINSON`S WARBLER	16.9	8.2

Species	Percent Annual Change in # of Observations	
	Region 8 South Atlantic Coastal Plain 1997-2004[1]	Francis Marion & Sumter National Forests 1992-2004[1]
SWALLOW-TAILED KITE	NA - No data available	NA - No data available
WOOD THRUSH	1.3	-9.9
WORM-EATING WARBLER	19.2	7.7

[1] From La Sorte et al. (2007)

Direct and Indirect Effects of Alternative 1

Under the No Action alternative, current management actions would continue to guide management of the project area. No activities presented in this proposal would be implemented to accomplish the purpose and need.

The natural resources and ecological processes within the project area would continue at the existing level of human influence. The characteristics of the forest environment would be affected primarily by natural disturbances such as insects, disease, and weather events. Custodial management of recreation areas, roads, prescribed burning and other projects already approved under prior decisions would continue under this alternative.

Direct Effects

Direct effects are effects to the species known or assumed to occur in the proposed project area. They occur at the same time and place as the project activity. Priority migratory bird species listed in Table 3-1 would continue to use what little habitat is available for them in the project area under the No Action alternative. Landscape scale habitat creation/restoration would not occur under this alternative. The no action alternative would not provide any benefits to priority migratory bird species that were identified.

Indirect Effects

Indirect effects include the consequences of management activities that result in the modifications of habitat and ecological conditions that affect food, water, shelter, and other life requirements for a species. Habitat conditions for priority migratory bird species would not be affected under the No Action alternative. Natural processes and the minimal amount of forest management within the project area would create a minimal amount of preferred habitat. Due to the closed canopy conditions found within most of the unnatural loblolly pine stands identified, little if any habitat would be restored or enhanced. It is conceivable that the no-action alternative would lead to indirect negative avian effects, especially for those species listed in Table 3.2.4-2. It is important to note that the majority of the treatment areas are dominated by offsite loblolly pine. Currently, these treatment areas provide marginal habitat for avifauna. In fact, some treatment areas such as Compartment

Cumulative Effects of Alternative 1

Cumulative effects are effects to the species and their habitats over time, and consider past,

present, and future actions. There are other projects being planned and implemented on the FMNF that would continue under the No Action alternative. Projects include a minor amount of timber harvesting, prescribed burning for hazard fuel reduction and wildlife habitat improvement, road maintenance, and recreation trail construction/maintenance. Ongoing activities have the potential to benefit various species listed in Table 3-1, but not on the scale that the proposed project seeks to accomplish. With the No Action alternative, no additional activities would take place, so there would be no additional cumulative effects within the project area or across the FMNF.

Direct and Indirect Effects of Alternative 2

In general, the proposed treatments are expected to benefit all avian species identified in Table 3.2.4-2. While there is always the potential to injure or lose individuals when management activities are designed to create or improve habitat, direct effects on populations of any migratory bird species from the proposed actions would likely be imperceptible. As previously mentioned, the FMNF has been monitoring bird populations on the forest for decades. This annual monitoring is conducted to assess avian presence/absence and frequency of occurrence by habitat conditions. As long as monitoring efforts continue, the FMNF would be able assess avian trends on the forest after the treatments are completed. Proposed treatments could temporarily disturb and, to some degree, displace migratory birds that are present at the time. It is possible that individual nests and nestlings of avian species could be lost due to these activities. However, this potential effect may be temporal for the following reasons: vegetation management activities may or may not occur while nests are active, harvesting activities are of short duration in any given location if active nests are present, and many avian species raise multiple broods or are known to re-nest if disturbed during the nesting season. Consequently, no measurable decline in reproductive success of migratory birds is expected to result from any of the proposed activities for Alternative 2. Impacts to adult birds are not expected, as adults would likely disperse from the area of disturbance and readily re-nest (either in adjacent suitable habitat or within the treatment area after treatments are completed). In terms of habitat, all proposed treatments should result in preferred habitat conditions, especially if maintained with frequent fire. The creation of snags, especially when created within relatively young pine stands, would be extremely beneficial to species such as the brown-headed nuthatch, and other cavity nesting birds.

Treatments proposed under alternative 2 are expected to improve habitat for species that are dependent upon open fire maintained pine ecosystems, as well as mixed pine hardwood forest. Thinning increases forest health and tree vigor and permits more sunlight to reach the forest floor, allowing the ground cover to flourish. Combining thinning with burning also stimulates native ground cover, which further enhances foraging and nesting habitat. Controlling non-native invasive species promotes species diversity within the plant community as well. The result of more area in suitable habitat, better food sources, better nesting sites, and reduced distances to next similar habitat on the landscape translates into higher likelihood of nesting success, higher reproductive rates, and better condition of individuals when they begin their migration. When combined with timber harvesting and prescribed burning, wildlife snag creation would greatly enhance habitat for cavity nesters such as the brown-headed nuthatch. Snags created would also serve as perches and foraging sites for numerous migratory birds, and even non-avian species

such as the pinewoods treefrog. Unfortunately, higher residual basal areas proposed in Prescription 1 (Treatment Class 1-4) and Prescription 2 (Treatment Class 1-3) may lead to the development of closed-canopied conditions sooner than if these treatments were to leave residual basal areas lower than 55-65 sq. ft./acre. If canopy closure occurs within 3-5 years as is anticipated, beneficial effects for species such as the brown-headed nuthatch, prairie warbler and Bachman's sparrow may be shorter lived than those resulting from a treatment such as that proposed in Prescription 2 Treatment Class 4 (i.e., residual basal area = 45-55 sq. ft./acre).

Cumulative Effects Alternative 2

This alternative would create and maintain habitat for avian species that benefit from a diversity of habitats and have substantial acreage in more open forested conditions. These conditions rapidly disappeared on the FMNF after Hurricane Hugo, and continue to be in short supply across the forest. In addition to activities planned in this alternative, other projects are being implemented and/or planned on the Francis Marion. Those projects include thinning treatments on thousands of acres over the next five years, prescribed burning 30-40,000 acres/year, refurbishing dozer fire lines, non-native invasive species control treatments, mastication of midstory within RCW partitions, and trail construction/reconstruction and maintenance.

With the exception of the northern portion of the analysis area, private lands in the area are predominantly forested. Private lands become more widespread north of Hwy 17A, and this portion of the analysis area contains a significant amount of private agriculture. Private lands are managed primarily for purposes other than maintaining/enhancing biodiversity, and may or may not be consistently managed to provide quality habitat conditions.

Species associated with fire adapted plant communities and habitat conditions that persist over time would realize the greatest benefit from this alternative. Habitat for RCW, prairie warbler, and northern bobwhite quail would be created, enhanced, and maintained within the Macedonia Analysis Area.

In general, the proposed action is expected to cumulatively benefit all priority migratory bird species that have been identified in Table 3-1. High tree densities and closed-canopied conditions currently exist in almost all of the treatment areas. These conditions reduce the amount of light reaching the forest floor and limit floral and faunal diversity. Thinning these stands would open up the forest canopy allowing for increased sunlight penetration. Ultimately, floral and faunal diversity is expected to increase following the proposed treatments. This is especially true when the treatments are followed by prescribed burning activities. Avian use of the treatment areas is expected to increase following treatment, especially when maintained via prescribed burning.

Direct and Indirect Effects of Alternative 3

The same factors and considerations used in determining effects of the proposed action apply to alternative 3. Alternative 3 is identical to Alternative 2, except that the planted longleaf seedlings would not be released using herbicide, and instead, would be released by manual labor using brush saws. No measurable direct effects to migratory birds in Table 3-1 are anticipated from the mastication treatment. In fact, the mastication treatments may actually enhance nesting and

foraging habitat for species such as the Bachman's sparrow. Indirectly, foregoing the herbicide release of longleaf seedlings are expected to have insignificant effects on selected migratory birds and their habitats

High residual basal areas proposed in Prescription 1 (Treatment Class 1-4) and Prescription 2 (Treatment Class 1-3) may lead to the development of closed-canopied conditions sooner than would be expected under a treatment like Prescription 2 Treatment Class 4 (i.e., residual basal area = 45-55 sq. ft./acre). If this happens, beneficial effects to species such as the brown-headed nuthatch, prairie warbler and Bachman's sparrow may only last 3-5 years. Directly and indirectly, alternative 3 is expected to benefit selected priority migratory birds species, especially those that are dependent upon open fire maintained pine woodlands and mixed pine hardwood forest. Alternative 3 is expected to be just as beneficial to selected priority migratory bird species as alternative 2.

Cumulative Effects of Alternative 3

The proposed treatments in alternative 3 are expected to cumulatively benefit most all avian species addressed in this proposal. Species either not likely to be found in the area, are unlikely to be affected.

3.2.5 Aquatic Communities

Affected Environment

The Macedonia project area is located across several Forest watersheds. Forest watersheds contain warm water aquatic communities that include fish and macroinvertebrates. The warm water aquatic community serves as a management indicator that is monitored to indicate the effects of management on riparian resources. Fish, crayfish, aquatic insects and mollusks are all components of the community. Fish species sampled by the USFS are listed in the following table.

Table 3.2.5-1. Species captured by backpack electrofishing (1993-2010)

Species		Occurrence	# Watersheds	# Streams
Amblyopsidae				
Chologaster cornuta	swampfish	x	1	1
Amiidae				
Amia calva	bowfin	x	4	5
Anguillidae				
Anguilla rostrata	american eel	x	5	5
Aphredoderidae				
Aphredoderus sayanus	pirate perch	x	6	13
Atherinidae				
Labidesthes sicculus	brook silverside	x	1	1
Catostomidae				
Erimyzon oblongus	creek chubsucker	x	4	6
Minytrema melanops	spotted sucker	x	2	2

Species		Occurrence	# Watersheds	# Streams
Centrarchidae				
Acantharchus pomotis	mud sunfish	x	5	13
Centrarchus macropterus	flier	x	7	11
Enneacanthus gloriosus	bluespotted sunfish	x	2	2
Enneacanthus obesus	banded sunfish	x	2	2
Lepomis auritus	redbreast sunfish	x	3	3
Lepomis gibbosus	pumpkinseed	x	2	2
Lepomis gulosus	warmouth	x	3	6
Lepomis macrochirus	bluegill	x	4	6
Lepomis marginatus	dollar sunfish	x	4	7
Lepomis punctatus	spotted sunfish	x	6	9
Micropterus salmoides	largemouth bass	x	5	6
Clupeidae				
Dorosoma cepedianum	gizzard shad	x	1	1
Cyprinidae				
Hybognathus regius	Eastern silvery minnow	x	1	1
Luxilus cornutus	common shiner	x	5	6
Notemigonus crysoleucas	golden shiner	x	4	5
Notropis chalybaeus	ironcolor shiner	x	3	4
Notropis cummingsae	dusky shiner	x	3	3
Notropis petersoni	coastal shiner	x	6	9
Esocidae				
Esox americanus	redfin pickerel	x	7	15
Esox niger	chain pickerel	x	2	4
Elassomatidae				
Elassoma zonatum	banded pygmy sunfish	x	3	5
Fundulidae				
Fundulus lineolatus	lined topminnow	x	1	1
Ictaluridae				
Ameiurus natalis	yellow bullhead	x	3	5
Ameiurus nebulosus	brown bullhead	x	2	3
Noturus gyrinus	tadpole madtom	x	2	2
Percidae				
Etheostoma fusiforme	Swamp darter	x	1	1
Poeciliidae				
Gambusia holbrooki	Eastern mosquitofish	x	4	7
Heterandria formosa	least killifish	x	1	1
Umbra pygmaea	Eastern mudminnow	x	4	6

The American eel and ironcolor shiner are ranked as G4 and the mud sunfish as G4G5 by NatureServe (2013). This ranking indicates that the species is uncommon, but not rare and that there is some cause for long term concern due to declines or other factors. All other fish species sampled in the watershed are ranked as G5 which indicates that the species is common, widespread and abundant. The conservation status of the ironcolor shiner was designated as

vulnerable by the American Fisheries Society (Warren, et. al. 2000). The vulnerable designation indicates that a species may become endangered or threatened by relatively minor disturbances to its habitat or that it deserves careful monitoring of its distribution and abundance. All other fish species sampled above were designated as currently stable by the American Fisheries Society (AFS). This indicates that a species is currently stable and its distribution is widespread and stable or that a species may have declined in portions of its range but is not in need of immediate conservation management actions.

The SC Comprehensive Wildlife Conservation Strategy (Kohlsaat et. al. 2005) includes the South Carolina Department of Natural Resources Priority Species List. These species warrant conservation concern to maintain diversity in South Carolina waters. The species are ranked in priority as moderate, high and highest. The American eel is ranked as highest priority and the mud sunfish are rated as moderate priority.

In addition, there are several other species known to occur in larger streams and rivers. These include federally listed species such as the shortnose and Atlantic sturgeons.

Macroinvertebrate population conditions are unknown. No aquatic insects have been collected. Crayfish and mussels were collected during monitoring in 2011.

Table 3.2.5-2. Crayfish species collected in the Project Area (Eversole and Jones 2011)

Scientific Name	Common Name	Conservation Status			
		NatureServe	State	AFS	State priority
Cambaridae					
Fallicambarus fodiens	Digger crayfish	G5		CS	
Procambarus acutus	White river crawfish	G5	S5	CS	
Procambarus ancylus	Edisto Crayfish	G4G5	S4S5	CS	
Procambarus enoplosternum	Black mottled crayfish	G4G5		CS	Moderate
Procambarus troglodytes	Eastern red swamp crayfish	G5	S4S5	CS	

Crayfish collected during fish community surveys are listed in Table 3.2.5-2 and identified in Eversole and Jones (2011). American Fisheries Society status ranks (Taylor et al 2007) include CS (currently stable), V (vulnerable), T (threatened), E (endangered) and E* (endangered, possibly extinct). The SC Comprehensive Wildlife Conservation Strategy ranks the black mottled crayfish at moderate priority. *Procambarus clarkii* is an introduced species and (Eversole and Jones) report that a detailed distribution survey is warranted in South Carolina for this non-native species.

Table 3.2.5-3. Mollusk species collected in the Project area (Catena Group 2011).

Scientific Name	Common Name	Conservation Status			
		NatureServe	State	AFS	State Priority
Mussels					
Elliptio angustata	Carolina lance	G4	S3	SC	Moderate
Elliptio cistellaeformis	Box Spike	G4			
Elliptio complanata	Eastern elliptio	G5	S5	CS	Moderate
Elliptio congaraea	Carolina slabshell	G3	S3	SC	Moderate
Elliptio fisheriana	Northern lance	G4		SC	High
Elliptio icterina	Variable spike	G5	S4	CS	Moderate
Elliptio roanokensis	Roanoke slabshell	G3	S2	SC	High
Lampsilis splendida	Rayed pink fatmucket	G3	S2	SC	High
Ligumia nasuta	Eastern pondmussel	G4	S2	SC	High
Pyganodon cataracta	Eastern floater	G5		CS	
Uniomerus carolinianus	Florida Pondhorn	G4	S3	CS	
Utterbckia imbecillis	Paper pondshell	G5		CS	
Villosa modioliformis	Eastern rainbow	G5		CS	
Clams and Snails					
Amnicola sp.	an Amnicola				
Campeloma limum	File campeloma	G5			
Corbicula fluminea	Asiatic clam	G5			
Physa pomilia	Glossy physa	G5			
Physa sp.	a Physid				
Planorbella trivolvis	Marsh ram'shorn	G5			
Pseudosuccinea sp.	a Lymnaea				
Rangia cuneata	Atlantic rangia				
Sphaeriidae	a Sphaeriid clam				
Viviparus georgianus	Banded Mystery snail	G5			
Viviparus intertextus	Round Mystery snail	G4			

Mussel species collected are listed in Table 3.25-3. The majority of mollusk species are unranked by the SC Natural Heritage Program. AFS conservation status is from Williams et. al. 1992. CS denotes a species or subspecies whose distribution and abundance may be stable, or it may have declined in portions of its range but is not in need of immediate conservation actions. SC denotes a species that may become endangered or threatened by relatively minor disturbances to its habitat, and deserves careful monitoring of its abundance and distribution. The SC Comprehensive Wildlife Conservation Strategy ranks the Carolina lance, Eastern elliptio, Carolina slabshell and Variable spike as moderate priority. The Northern lance, Roanoke slabshell, rayed pink fatmucket and Eastern pondmussel are rank at high priority.

Forest coastal streams are characterized by pool and glide habitat types with sandy substrates. Habitat diversity is mostly provided by tree roots and aquatic vegetation. During recent surveys, it has been observed that large woody debris is lacking in the coastal stream systems. Hansbarger and Dean (1994) stated that fish inventory was difficult due to the abundance of downed trees and wood in the streams after Hurricane Hugo.

Direct and Indirect Effects of Alternative 1

There would be no direct or indirect impacts to aquatic communities under this alternative. The aquatic community would remain in its present state and any current population trends would continue.

Cumulative Effects of Alternative 1

There would be no cumulative impacts to aquatic communities from the no action alternative.

Direct and Indirect Effects of Alternative 2

Alternative 2 proposes five different prescriptions of action: first thinning on 4,277 acres including immature loblolly and longleaf pine poletimber plantations age, intermediate thinning on 1,283 acres including immature loblolly and longleaf pine of sawtimber plantations age, longleaf restoration on 801 acres including immature loblolly/longleaf pine of poletimber and sawtimber plantations age, thin to promote mixed pine hardwoods on 488 acres including immature loblolly/longleaf pine of poletimber and sawtimber plantations age, and loblolly seedtree cut on 1,272 acres including loblolly pine of sawtimber plantations age. In addition a treatment on up to 2,084 acres to create one to two snags per acre for cavity nesting birds and to reduce the incidence of kleptoparasitism on the RCW. Stands proposed to be treated are predominately in upland areas. Connected actions include prescribed fire, road reconstruction and maintenance, skid road construction, log landing construction, and erosion control.

Timber Harvest and Connected Actions

There is no management proposed within riparian corridors. However, off-site movement of disturbed soils and herbicides may occur during inclement weather periods. Soil and vegetation disturbance occurring near streams from tree removal, log landings, road reconstruction and maintenance and skid roads/trails could result in the addition of sediments to project area streams. Sedimentation can cause direct mortality to macroinvertebrate and fish life stages through burial and suffocation of eggs and larvae. Turbidity can cause gill damage which interferes with respiration, abrasion, changes in feeding behavior, and macroinvertebrate drift resulting in a shift in community dynamics. Indirectly, sediment can fill in and destroy habitat niches within a stream impacting reproductive success, refugia and food sources. Sediment deposition can result in a reduction of fish and macroinvertebrate density and biomass in a stream. There would be no skid road/trail construction or crossings associated with riparian corridors. There is 4.48 miles of temporary road construction proposed for this project. There would be no log landing or loading locations within any riparian areas. Skid roads and log landings would be revegetated immediately following harvest activities in individual units.

Prescribed burning is proposed periodically throughout the project area. Bladed fire line construction would not occur adjacent to or across riparian corridors and ephemeral stream zones to the streams, where possible. Where very dense vegetation occurs and hand lines cannot be constructed, dozer lines can be constructed but would not cross stream channels and should approach the stream from either side of the channel without pushing soil into streams or disturbing the stream bank. Dozer lines constructed to streams should not be normal operation. Equipment and dozers moving across stream channels destroy stream bank and channel integrity

leading to habitat degradation. This activity could also cause direct mortality to aquatic species, particularly mollusks and less mobile species, if they are present at the equipment crossing site. Fire lines would remain on the landscape and be used repeatedly over the years, possibly resulting in cumulative effects. Dozer lines would not be used within riparian areas except where they tie into stream channels or other water bodies. In most cases, hand tools would be used to construct fire lines through riparian corridors and ephemeral channels to the streams. Erosion control methods would be implemented at the time of construction and again during fire line rehabilitation. Fire lines would be blocked to limit access to general use.

Prescribed burning should not be intense enough to destroy trees in the riparian areas since the objective is to keep this area forested. This would ensure large wood and leaf litter recruitment to the stream system and temperature stability. Prescribed burning increases the potential for nutrients to be carried to the stream channel. Long term nutrient input has the potential of enriching stream waters and altering aquatic community composition and decreasing species diversity.

Roads

System road reconstruction (53.95 miles) and temporary road construction (4.48 miles) would produce a sediment source through grading and ditching. There would be no temporary road construction or crossings associated with riparian corridors or ephemeral streams. Log landings and temporary roads would be revegetated at the time each harvest area is closed to reduce soil erosion and off-site soil movement .These activities would be accomplished in a manner that would prevent sediment runoff into area waters. Erosion control devices would be installed during road maintenance activities where needed to deter soil runoff from streams. Road ditch lines would not be routed toward stream crossings, but instead into vegetative buffers. Drainage from existing roadside ditches would be directed away from streams prior to filling or excavation activities.

Stream channel excavation for culvert installation would result in direct mortality to aquatic life in the immediate vicinity. Culvert placement and removal also result in sediment loading and turbidity, as well as destroying the stream bank and channel integrity. Where culverts are installed, there would be a loss of stream habitat quantity and quality for the length of the structure. In addition, culverts can interfere with the natural flow of streams and the movement of substrate, woody debris and aquatic species throughout the stream system. The use of wet concrete in culvert placement can alter stream water pH which results in aquatic species mortality. Mitigation measures would be implemented to minimize impacts from road activities.

Erosion control would be placed between the road and all waters prior to soil disturbance to prevent sediment loading. Excavated soils would not be placed next to the stream bank, but offslope from the stream. Erosion control measures such as matting, silt fences, diversions and temporary rock sediment dams would be installed to trap sediment in areas where runoff water is leaving the project site. Erosion control devices would be maintained in working order throughout project activities and until plant growth is established and stable enough to control runoff and erosion. Riparian areas and stream crossings would be seeded and mulched as soil disturbance occurs.

Forest Standards and Guidelines (Revised Land and Resource Management Plan, 1996) and South Carolina Best Management Practices for Forestry would be applied to all activities associated with this project. As a minimum, riparian areas would extend 100 feet either side of perennial streams and other perennial water bodies. Plant and soil characteristics would be used to determine the extent of riparian ecosystems (FW-70). Resource management activities may be implemented if riparian conditions are maintained or improved and large woody debris recruitment into aquatic habitats is not compromised. Any activity that occurs would maintain an unbroken canopy for 30 feet either side of perennial streams and other perennial water bodies (FW-115). Tree harvest that occurs in the 40 to 70 foot zone on perennial streams and water bodies and 40 feet on either side of intermittent streams must maintain a residual basal area of 50 percent. South Carolina Best Management Practices for Forestry apply to ephemeral streams on the Forest. Water flow and soil integrity should be protected in these streams. Use of mechanical equipment would be restricted to protect the riparian and water resources and should not occur in riparian areas except at designated stream crossings (FW-115).

Herbicide Use

There is no herbicide use proposed within riparian corridors or ephemeral stream zones. However, off-site movement of disturbed soils and herbicides may occur during inclement weather periods. Herbicide (Triclopyr – triclopyr ester with vegetable oil and adjuvant diluent) use in longleaf restoration (prescription #5 treatments 2, 4 and 5) and snag creation (triclopyr amine on 2,084 of the harvested acres).

Triclopyr – There are two formulations of triclopyr; a triethamine salt and a butoxyethyl ester. In soils, both degrade to the parent compound, triclopyr acid. The average half-life of triclopyr acid in soil is 30 days. Offsite movement through surface or subsurface runoff is possible, as it is relatively persistent and has only moderate rates of soil particle absorption. In water, the salt formulation is soluble and may degrade in several hours with adequate sunlight. The ester form is not water soluble and can take significantly longer to degrade in water. It can bind with organic material in the water column and be transported and deposited as sediments. Triclopyr acid and the salt formulation are slightly toxic to fish and aquatic invertebrates. The LC50 for rainbow trout of the acid and the salt formulation is 117 mg/l and 552 mg/l respectively. For bluegill, the LC50 is 148 mg/l and 891 mg/l respectively. The ester formulation is highly toxic to fish and aquatic invertebrates with an LC50 of 0.74 mg/l for rainbow trout and 0.87 mg/l for bluegill sunfish. The Ester formulation is readily absorbed through fish tissues and rapidly converted to triclopyr acid. The acid can be accumulated to a toxic level when fish are exposed to sufficient concentrations or for sufficient durations. There is a significant chance of acute lethal effects to fish exposed to low levels residues for more than six hours and delayed lethal effects have been seen in fish exposed to high concentrations for a short duration. If applied properly, triclopyr would not be found in concentrations adequate to kill aquatic organisms. However, some water bodies remain at risk of lethal contamination levels, especially those that are shallow and have slow velocity where dissipation is slow and those that are heavily shaded where photodegradation is reduced (Tu et al 2001).

Adjuvants – An adjuvant is any compound (including surfactants) that is added to a herbicide formulation or tank mix to facilitate the mixing, application, or effectiveness of that herbicide.

There is little information on the effects of adjuvants to aquatic systems. Some adjuvants have the potential to be mobile and pollute surface or groundwater sources. The use of adjuvants near water may have adverse effects in some aquatic species (Tu et al 2001). It is recommended to use an adjuvant with the active ingredient of d-limonene, a byproduct of the citrus industry, for the herbicide applications. The formulated product is practically nontoxic to freshwater fish and slightly toxic to freshwater invertebrates on an acute basis (EPA 1994).

Herbicide release (prescription 3, treatment classes 2, 4 and 5) of longleaf seedlings one to two years following planting using dormant season basal treatment of understory hardwoods would reduce a significant portion of the understory. The potential for surface or ground water contamination from an application of triclopyr is very slight and no aerial or broadcast applications of herbicide are being proposed. Rainfall can cause stem wash off after application, removing herbicide residue from plant surfaces and transporting them into the soil. Volatilization occurs while herbicides are still exposed to sunlight and air and involves chemical movement in the vapor form through the air.

Plant uptake removes and absorbs herbicide from foliage and bark surfaces or from the soil and temporarily or permanently depending on the herbicide, removes them from transport. Leaching moves herbicides through litter, soil and out of the plant rooting zone. Surface runoff rapidly transports residues off site either in solution or adsorbed to sediment. Subsurface flow of water removes herbicides in solution from the treatment site in slower ground flow. Processes that break down herbicide chemical structures include photodecomposition, microbial and plant metabolism, thermal degradation and hydrolysis. These processes along with those that transport herbicides, determine the degree to which herbicides persists in the environment.

The hack and squirt method would have a lower potential for contamination since the herbicide is applied directly to the cambium of the treated vegetation via a squirt or spray bottle. The herbicide is then readily taken up by the plant. Herbicide applications would be performed to meet BMP standards and design criteria. The dispersed nature of herbicide application in combination with the low frequency and low application rates would present a low risk of pollution to groundwater. The half-life of triclopyr in water ranges from 1 to 10 days depending on water conditions.

Streams would be protected from herbicide translocation by limiting herbicide application distances to streams, riparian and aquatic zones. Riparian corridors would reduce the amount of offsite movement of triclopyr in stormflow.

Forest Standards and Guidelines would be applied to herbicide activities associated with this project. No herbicide is applied within 30 horizontal feet of lakes, streams, wetlands or springs unless it is a selective treatment for non-native invasive species (FW-100). Soil active herbicides with a half-life longer than three months is not broadcast on erodible soils or aquifer recharge zones (FW-114) Application equipment, empty herbicide containers, clothes worn during treatment and skin are not cleaned in open water or wells. Mixing and cleaning water must come from a public water supply and be transported to the site (FW-98). Herbicides and application methods are chosen to minimize risk to human and wildlife health and the environment (FW-39) and are applied at the lowest rate effective in meeting project objectives (FW-40). Prescribed

burning would not occur within 30 days of herbicide application (FW-42). Herbicide mixing, loading or cleaning areas are not located within 200 feet of open water (FW-27).

Herbicide contamination to aquatic systems may result from drift, rainfall runoff, or residue leaching through the soil into groundwater. Implementation of herbicide labeling information that addresses application before and during rainfall events and windy conditions would minimize contamination. Weather conditions would be monitored and herbicide applications scheduled so that drift is minimized or eliminated. In addition, herbicides would not be applied previous to or during periods of rain due to the offsite movement of herbicides through surface or subsurface water runoff and the movement of herbicides with soil particles. Loss of vegetation occurring near streams from herbicide application could result erosion and the addition of sediments to streams.

Design Criteria

The degree of impact on the aquatic community depends on the extent and duration of riparian disturbance and the time period it takes for site rehabilitation. Revegetation of disturbed soils and installation of erosion control methods should be implemented to minimize these impacts. Forest Standards and Guidelines associated with riparian areas and streams and the following mitigation measures would be implemented to minimize impacts from proposed activities:

- Grading and ditching would be accomplished in a manner that would prevent sediment runoff into area waters. Erosion control devices such as diversions and temporary rock sediment dams would be installed prior to road reconstruction and maintenance activities where needed to deter soil runoff from streams. Erosion control devices would be maintained in working order throughout project activities and until plant growth is established and stable enough to control runoff and erosion. Road ditch lines would not be routed toward stream crossings, but instead into vegetative buffers. Drainage from existing roadside ditches would be directed away from streams prior to filling or excavation activities. Drainage from existing roadside ditches would be directed away from streams prior to filling or excavation activities. These measures also apply to long term use of any temporary roads that are used as wildlife strips.

- Erosion control methods would be installed at stream crossings prior to culvert replacement and soil disturbance to prevent sediment loading. These should be maintained in working order throughout project activities and until plant growth is established and stable enough to control runoff and erosion. Stream banks would be seeded and mulched the same day of disturbance as an immediate site rehabilitation measure to improve water quality conditions for aquatic life.

- Stream crossing designs should incorporate culverts which are fish passable. When possible, open bottom arch culverts equal in size to the bank full width of the stream should be installed. Culverts should be installed to mimic natural stream functions to allow the transport of wood and sediment and sized to prevent erosion and head cutting. Beaver levelers should be designed to allow passage of aquatic organisms. Stream excavation would be restricted to the immediate vicinity of the culvert installation. No wet concrete would come in contact with stream water when installing stream crossings.

- Equipment used to transport herbicide would not be allowed to park within 200 feet of water resources.

Determination of Effect

There are no federally listed or forest sensitive aquatic species within the project area. This project may have direct impacts on individuals of the aquatic community through culvert replacement, but is not likely to impact community diversity. This project may have indirect impacts on the aquatic habitat from sediment input through road maintenance and reconstruction but is not likely to impact aquatic community diversity. The implementation of Forest Plan standards associated with riparian areas and streams and SC Best Management Practices would minimize impacts to the aquatic community.

Cumulative Effects of Alternative 2

Other projects across the Forest include timber activities, prescribed burning, road reconstruction, non-native invasive species treatment and various recreational activities. Each of these projects has been or would be analyzed for impacts to aquatic resources and mitigation measures implemented where needed.

Forest wide prescribed burning is covered under the "Prescribed Fire on the Francis Marion National Forest Environmental Assessment (2006)". Treatment of non-native invasive species is covered under the "Non-Native Plant Control on the Francis Marion National Forest (2004)". In addition to Forest activities, private land development occurs across the landscape within the Forest boundary.

There are no federally listed or proposed aquatic species within the project area. Direct and indirect impacts to the aquatic community would be minimum and short term and are not likely to impact community diversity. There should be no cumulative impacts to the aquatic community from Macedonia Analysis Area project activities with the implementation of Forest Plan standards associated with riparian areas and streams and SC Best Management Practices.

Direct, Indirect Effects and Cumulative Effects of Alternative 3

Proposed activities under Alternative 3 include the same actions as Alternative 2 except the planted longleaf seedlings would not be released using herbicide but instead would be released by manual labor using brush saws.

The effects described for alternative 3 apply to this alternative as well except that there would be no effects from herbicide. There would be no effects to aquatic resources from the manual use of brush saws under this alternative.

3.3 Social Environment

3.3.1 Cultural Resources

Affected Environment

Approximately 12,000 years ago American Indians first occupied the area of South Carolina that is now part of the Francis Marion National Forest. Historic period tribal groups known to have lived the area include the Etiwan, Sampa, Santee, Sewee, and Wando. Archeological and historical research has been used to reconstruct and interpret Native American prehistory and the advance of Euro-American settlement in the Lowcountry of South Carolina beginning in the late seventeenth century. Land acquisition for a national forest in South Carolina began in 1934 and the Francis Marion National Forest was created by presidential proclamation in 1936.

More than 2,400 heritage resource sites are recorded on the Francis Marion National Forest. Prehistoric period sites include campsites, villages, hunting areas, and stone tool quarrying areas. Historic period sites include plantations, small farms, mill sites, dams, cemeteries, churches, Revolutionary War battlefields, Civil War period camps and cannon emplacements, tar kilns, bridges, three Civilian Conservation Corp camps and a World War II POW camp, CCC recreational improvements, and two forest fire lookout towers. Numerous old Indian trails, railroad beds, and abandoned roadbeds can be found on the forest.

These remnants of past cultures remind us of the centuries-old relationship between people and the land. These heritage resources hold clues to past ecosystems, add richness and depth to our landscapes provide links to living traditions, and may lead the forest visitor into an unforgettable encounter with history.

Prehistoric and historic heritage resources are nonrenewable and the purpose of the heritage management is to protect significant heritage resources, to share their values with the forest visitor, and to contribute relevant information and perspectives to forest management.

Cultural resources include historic properties as defined in the National Historic Preservation Act (NHPA), cultural items as defined in the Native American Graves Protection and Repatriation Act (NAGPRA), archaeological resources as defined in the Archaeological Resources Protection Act (ARPA), sacred sites as defined in Executive Order 13007, *Protection and Accommodation of Access to "Indian Sacred Sites,"* to which access is provided under the American Indian Religious Freedom Act (AIRFA), and collections. As defined by the NHPA, a historic property or historic resource is any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places (NRHP), including any artifacts, records, and remains that are related to and allocated in such properties. The term also includes properties of traditional religious and cultural importance (traditional cultural properties), which are eligible for inclusion in the NRHP as a result of their association with the cultural practices or beliefs of an Indian tribe or Native Hawaiian organization. Archaeological resources include any material of human life or activities that is at least 100 years old, and that is of archaeological interest.

Section 106 of the NHPA (PL 89-655) provides the framework for Federal review and consideration of cultural resources during Federal project planning and execution. The Advisory Council on Historic Preservation (ACHP) has promulgated the implementing regulations for the Section 106 process (36 CFR Part 800). The Secretary of the Interior maintains the NRHP and sets forth significance criteria (36 CFR Part 60) for inclusion in the register. Cultural resources may be considered "historic properties" for the purpose of consideration during the review of a Federal undertaking if they meet NRHP criteria. The implementing regulations at 36 CFR 800.16(v) define an undertaking as "a project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a Federal agency, including those carried out by or on behalf of a Federal agency; those carried out with Federal financial assistance; those requiring a Federal permit, license or approval; and those subject to state or local regulation administered pursuant to a delegation or approval by a Federal agency." Historic properties are those that are formally placed on the NRHP by the Secretary of the Interior, and those that meet the criteria and are determined eligible for inclusion.

A Memorandum of Understanding (MOU) between the Advisory Council on Historic Preservation, The South Carolina Department of Archives and History and the Francis Marion and Sumter National Forests was executed November 14, 2000. The MOU was developed to comply with the terms of the Programmatic Agreement concerning the management of historic properties on national forest lands in the Southern Region, which was executed on November 19, 1992 and to satisfy the National Forest's responsibilities under Section 106 of the National Historic Preservation Act (NHPA). The MOU establishes Categorical Exclusions for routine and recurrent activities that are unlikely to affect heritage properties, including prescribed burns and new fireline construction.
The Forest Service conducted four separate inventories for cultural resource within the proposed Macedonia Analysis Area between October 2010 and December 201. The results of the surveys are included in four separate reports prepared by cultural resource consultants under contract to the Forest Service. The Forest Service, in consultation with the South Carolina State Historic Preservation Office (SHPO), determined the National Register of Historic Places eligibility of the cultural resources recorded during the inventory and determined the effect of the proposed land management activities on any cultural resources on or National Register of Historic Places as part of Section 106 consultation process.

The Forest Service located or relocated 169 archaeological sites within the Macedonia Analysis Area. No historic structures or buildings were recorded and there are no known traditional cultural properties within the project area. Of the 169 archaeological sites one site is listed in the National Register of Historic Places, 33 were determined eligible for listing in the National Register of Historic Places, 116 were determined not eligible for listing in the National Register, and 19 sites remain unevaluated.

Contexts in which impacts to cultural resources may occur

All of the alternatives propose treatments that result in restoring ecosystem health. These treatments would also lead to the restoration of natural processes and landscapes which in turn has the potential to restore the historic setting and cultural landscapes of the forests. Cultural resources, depending on their nature and composition, are subject to different types of impacts.

There are a number of types of land management activities that vary in magnitude (acres or miles), but nonetheless have the greatest potential to affect heritage resources. Direct affects to heritage resources include management activities that involve ground disturbance or modifications have the greatest potential for direct affects to heritage resources. These activities would include, but are not limited to any soil disturbance such as the use of heavy equipment in harvesting, grading, plowing, disking, and excavating. Soil compaction or rutting by heavy equipment would also have a direct affect. Also, any activity that alters a site's immediate or proximal setting, for example, introduction of intrusive visual or auditory components, would have a direct effect.

Indirect affects to heritage resources may include looting or vandalism due to increased access, and site degradation or silting of a historic property resulting from an off-site project or construction of roads or trails.

Timber harvesting is a source of potential direct affects to the heritage resources. Timber harvesting may directly affect heritage resources when soil is significantly disturbed by heavy machinery and vehicles, when trees are felled on historic ruins or cemeteries, when logs are skidded across sites, or indirectly when erosion is caused by removal or disruption of vegetation cover or increased surface soil exposure. In general terms, even-aged harvesting may affect cultural resources located on the ground surface or at relatively shallow depths. An uneven-aged harvest or single tree selection would similarly disturb the heritage resources located on the surface and in the upper soil matrix, but disturbed areas would be dispersed within the harvest area. With either management practice the skid trails, log loading areas, and other areas where vehicle use is concentrated would receive the greatest disturbance and thus provide the most significant direct affects to heritage properties. Indirect effects could include deterioration of sites and artifacts due to increased site vandalism from increased access and surface exposure of heritage sites.

The potential maximum direct, indirect, and cumulative affects to heritage resources located on the Francis Marion National Forest can be assessed according to the maximum extent (acres) within which ground-disturbing activities can potentially occur for each alternative.

Legally mandated inventories for heritage resources would be conducted prior to timber harvest and subsequent site preparation under all alternatives. On the Francis Marion National Forest site preparation following timber harvest, or vegetation management performed apart from timber harvest, is usually performed with the aid of heavy equipment. Site preparation activities, therefore, can result in significant direct, indirect, or cumulative affects to archaeological sites.

New road construction may directly affect heritage resources, given variables specific to each portion of construction. Disturbance within a construction corridor may remove soil containing cultural deposits, depending on the local situation. In cases where fill is added, archaeological sites may be buried deeper. This may protect the site from compaction or rutting, while at the same time essentially precluding additional scientific study using conventional archaeological techniques. Maintenance or reconstruction of existing roads presents less potential for direct affects to intact archeological sites because the majority of damage to an archaeological site probably occurred during the original construction. Access to heritage resources provided by

roads, however, may result in indirect affects to significant properties by facilitating increased visitation and possibility of vandalism. Also, artifact exposure during construction could promote site vandalism.

The potential effects of road construction to heritage resources would be determined by the amount of acreage for timber management activities proposed for each alternative. Accordingly, it can be projected that those alternatives that provide for the greatest number of activities over the largest area would have the greatest potential to affect heritage resources.

All of the alternatives propose similar increases in the construction and maintenance of trails and facilities. Therefore, all of the alternatives have a potential to directly affect heritage resources during construction and maintenance and indirectly through the increase in forest users.

Direct and Indirect Effects of Alternative 1

This alternative would have no effect on heritage resources.

Direct and Indirect Effects of Alternative 2 and 3

These alternatives would have no adverse effects on recorded National Register eligible and unevaluated archaeological sites as effects would be avoided by excluding most land management activities from occurring on or within the sites. Log landings, decks, log piles and temporary roads would be constructed outside of these sites. However, some harvesting activities may be allowed to occur within these sites under certain conditions as agreed to during the Section 106 consultation with the SC SHPO. Forest Service timber sale administrator or harvest inspector would monitor activities around the identified archaeological sites to ensure their protection during harvesting and other connected actions.

The Forest Service, in consultation with the SC SHPO, has determined that the proposed actions would have no significant impacts on any cultural resources eligible for listing in National Register of Historic Places or not yet evaluated for listing.

Cumulative Effects of Alternative 2 and 3

All of the proposed land management activities vary in magnitude and intensity, but nonetheless have the potential to affect heritage resources. Cumulatively, the repeated implementation of activities including timber management, road construction, or construction of log loading areas could, over time, result in the degradation of heritage resources and a reduction in the number of intact heritage resources.

The degree of cumulative affects to heritage resources from all management activities could be greatly reduced through the implementation cultural resource protection measures and mitigation measures prior to the initiation of these management activities. Processes and actions not associated with land management activities, such as erosion, natural weathering, wildfire or other natural process, could affect heritage resources too. Cumulative effects from illegal activities, primarily vandalism, may occur on certain sites unless actions are taken to prevent or discourage

such activities through vigorous law enforcement and a program of public awareness concerning the nature of heritage resources on public lands.

The Forest Service determined that the proposed harvesting and other connected actions would have no cumulative direct or indirect adverse effects to unevaluated or National Register eligible cultural resources.

3.3.2 Scenery and Recreation

Affected Environment

Scenery

The project area is located on the coastal plain of South Carolina and is comprised of a mixed ownership of residential, light agriculture/commercial, and national forest system lands. Highways 17, 17-A, 45, and 41 are the major roads in the project area with local secondary roads providing access for residents and visitors. The majority of the project area is not visible from the major highways but rather requires driving secondary roads under the jurisdiction of the State, County and Forest Service.

Scenery is primarily a pine dominated forested environment interspersed with Carolina bays, tupelo gum/cypress swamps and hardwood bottomlands. Small openings are scattered across this rural landscape. The area is generally flat and sight distances are often obscured by vegetation. Past timber harvest and areas periodically prescribed burned, like long leaf pine stands, provide views into the forest. There are no vistas or overlooks and private lands often provide breaks in vegetative patterns.

Visual quality objectives (VQOs) guide the degree of change in natural landscapes. The VQOs of the Francis Marion National Forest are established in the *Revised Land and Resource Management Plan Sumter National Forest* (Forest Plan), S-8. The VQO classes in the project area are:

- Retention - natural appearing – human activities are not evident to the casual forest visitor.
- Partial Retention (PR) - slightly altered – human activity may be evident, but must remain subordinate to the characteristic landscape.
- Modification - moderately altered – human activity may dominate the characteristic landscape, but must at the same time, follow naturally established form, line, color and texture. It should appear as a natural occurrence when viewed in foreground or middle ground.

A majority of the compartments in the analysis area are classified as modification. Partial retention areas occur along major roads and trails and include Highways 17A, 41, 45, 48, 52, 158, 170 and 171 and the Palmetto Trail and the Jericho Horse Trail. Large blocks of partial retention are adjacent to the Santee River in the northeast portion of the project area. Other major

partial retention areas occur south of Highway 17A and another area occurs to the northwest side of road 158 adjacent to Hellhole Bay Wilderness.

The management actions in each alternative would be analyzed to determine the effects on scenery.

Recreation

A variety of recreational activities take place in the project area and include hiking, sightseeing, boating and kayaking, fishing, hunting, camping, biking, bird watching, photography, horseback riding and target shooting. Recreational facilities within the area of analysis include a boat launch site on the Cooper River, Boggy Head Rifle Range, and the Jericho Horse Trail and the Palmetto Trail. A trailhead associated with the Jericho Horse Trail is located on Highway 41.

The Recreation Opportunity Spectrum (ROS) is a system for classifying and managing recreation opportunities based on physical setting, social setting and managerial setting. The combination of the three criteria results in six different ROS classes which are described below. The end product of recreation management is a diverse range of opportunities from which people can derive various experiences.

Table 3.3.2-1. Recreational Opportunity Spectrum Class Descriptions

ROS	Class Descriptions
Primitive	Opportunity for isolation from man-made sights, sounds, and management controls in an unmodified natural environment. Only facilities essential for resource protection are available. A high degree of challenge and risk are present. Visitors use outdoor skills and have minimal contact with other users or groups. Motorized use is prohibited.
Semi-primitive non-motorized	Some opportunity for isolation from man-made sights, sounds, and management controls in a predominantly unmodified environment. Opportunity to have a high degree of interaction with the natural environment, to have moderate challenge and risk and to use outdoor skills. Concentration of visitors is low, but evidence of users is often present. On-site managerial controls are subtle. Facilities are provided for resource protection and the safety of users. Motorized use is prohibited.
Semi-primitive motorized	Some opportunity for isolation from man-made sights, sounds, and management controls in a predominantly unmodified environment. Opportunity to have a high degree of interaction with the natural environment, to have moderate challenge and risk and to use outdoor skills. Concentration of visitors is low, but evidence of other area users is present. On-site managerial controls are subtle. Facilities are provided for resource protection and the safety of users. Motorized use is permitted.
Roaded Natural	Mostly equal opportunities to affiliate with other groups or be isolated from sights and sounds of man. The landscape is generally natural with modifications moderately evident. Concentration of users is low to moderate, but facilities for group activities may be present. Challenge and risk opportunities are generally not important in this class. Opportunities for both motorized and non-motorized activities are present. Construction standards and facility design incorporate conventional motorized uses.
Roaded Modified	Similar to the Roaded Natural setting, except this area has been heavily modified (roads or recreation facilities). This class still offers opportunity to have a high degree of interaction with the natural environment and to have moderate challenge and risk and to use outdoor skills.
Rural	Area is characterized by a substantially modified natural environment. Opportunities to affiliate with others are prevalent. The convenience of recreation sites and opportunities are more important than a natural landscape or setting. Sights and sounds of man are readily evident, and the concentration of users is often moderate to high. Developed sites, roads, and trails are designed for moderate to high uses.

The project area is classified as *road natural*, *rural* and *semi-primitive motorized*. The *rural* classification occurs within a one mile wide corridor along the major travel routes in the area (Highways 17A, 41, 45, 48, 52, 158, 170 and 171). The *semi-primitive motorized* classification surrounds the Hellhole Bay Wilderness and is within Management Area 29. The remainder of the project area is classed as *roaded natural*.

The effects of the alternatives on these classifications would be evaluated in the alternatives.

Direct, Indirect and Cumulative Effects of Alternative 1

Scenery

No immediate impacts on scenery are anticipated under alternative 1. The VQO for all unharvested compartments and stands would meet the *retention* definition.

Indirectly, the visual character of unharvested stands would go through changes. Many areas would have less diversity. There would be less ability to view into the forest as stands become denser and less visually appealing to some people. Over the long term, trees would eventually die and fall down or be highly susceptible to southern pine beetle activity. Fuel buildup over time could result in wildfires which could drastically change the composition of the forest.

Past, present and reasonably foreseeable projects in the area include fire line reconstruction/maintenance, prescribed burning, already approved timber harvest treatments, precommercial thinning, wildlife opening maintenance and maintenance of utility rights-of-way. These activities would add some visual diversity in the area by providing a variety of forest views. The cumulative effect on scenic quality and diversity would be maintained in the short term but less diverse views would develop in the long term.

Recreation

No immediate impacts on recreation are expected under this alternative. In the long term, as stands become denser and or mortality occurs from insects and disease or from wildfires, hunting, bird watching and sightseeing activities may be adversely impacted. These activities rely on more open stand conditions that attract disturbance game species such as white-tailed deer and various kinds of non-game wildlife.

The cumulative effect on recreational activities would not be impacted in the short term but could lead to decreased hunting opportunities and sightseeing/bird watching for some people in the long term.

The class descriptions for *semi-primitive, roaded natural and rural* would continue to be provided for under this alternative.

Direct and Indirect Effects of Alternative 2 and 3

Both action alternatives would have the same type of harvest activity and connected actions except that alternative 3 would eliminate the use of herbicide in favor of manual treatments instead. The effects on scenery and recreation would be the same for either alternative.

Scenery

Table 3.3.2-2 summarizes VQOs for harvest stands in the action alternatives. Details for individual harvest stands are contained in the project record.

Table 3.3.2-2. Acreage by VQO Classes for Harvest Stands in the Action Alternatives

VQO Classes	Acres
Retention	148
Partial Retention	919
Modification	7,054
Total	**8,121**

Portions or all of four stands are classed as *retention*. Proposed silvicultural prescriptions include first thinning (prescription #1), longleaf restoration (prescription #3) and loblolly pine seedtree regeneration (prescription # 5).

The first thinning prescription would leave stands fully stocked with trees (between 55-65 BA). Utilization standards would eliminate most of the large slash (tops and boles) during logging operations. Any remaining slash would be mechanically broken-up during skidding and would decompose rapidly in the humid environment. Landings are usually small but would be visible adjacent to roads. Browning vegetation and down slash would have a negative impact on the scenic resource in the short term. Thinned stands and understory vegetation would grow rapidly and reduce the contrast with adjacent areas within a few years of harvest. Adverse visual impacts would be minimal and short term given the rapid growth of vegetation typical on the coastal plain. Human activities would not be evident to the casual forest visitor as vegetation recovers within about five years.

The longleaf restoration prescription would remove loblolly pine and retain longleaf pine. Longleaf pine would be planted in gaps created during logging and the area would be prescribed burned after the planted trees are old enough to survive understory burning. Landings are usually small but would be visible adjacent to forest road 161which is located about a mile from highway 41 in an isolated area of the forest. Browning vegetation and down slash would have a negative impact on the scenic resource in the short term. The mix of large and small trees would provide a variety of views within a year or so after logging and would be visually pleasing to some people. Adverse visual conditions would improve rapidly given the structural diversity remaining in the stand after logging is completed. The planting of trees would accelerate the recovery process and other understory vegetation would rapidly grow and reoccupy disturbed sites. Prescribe burning would eliminate any remaining pockets of slash and would also stimulate the growth of a variety of understory grasses, forbs and shrubs. Visual impacts would be minimal and short term given the rapid growth of vegetation typical on the coastal plain. Human activities would be visible after logging is completed but would not be evident to the casual forest visitor as vegetation recovers within about five years.

The seedtree regeneration prescription would result in an open logged appearance. Browning vegetation and down slash would have a negative impact on the scenic resource in the short term. However, this stand is not located directly on a main road and is buffered by a no cut strip of vegetation adjacent to open forest roads 158 and 158-A. Access to the stand is via forest road 6364 which is closed. The residual seedtrees would not be cut and would provide visual diversity as well as wildlife benefits for the long term in the stand. Design criteria would include leaving desirable hardwood trees that add additional form, color and texture to the stand. There would be short term adverse visual impacts but the stand location along with the additional design criteria would reduce these impacts. The placement of the harvest unit would not make it evident to the casual observer

immediately after logging since it is buffered by trees and the road to the stand is closed. Regrowth of trees and other vegetation in the stand would reduce adverse impacts within about five to ten years.

Silvicultural prescriptions associated with stands or portions of stands that are classed as *partial retention* includes first thinning (prescription #1), intermediate thinning (prescription #2), thin to promote mixed pine/hardwood (prescription # 4) and loblolly seedtree regeneration (prescription # 5).

The first thinning prescription would leave stands fully stocked with trees (between 55-65 BA). Utilization standards would eliminate most of the large slash (tops and boles) during logging operations. Browning vegetation and down slash would have a negative impact on the scenic resource in the short term. Any remaining slash would be mechanically broken-up during skidding and would decompose rapidly in the humid environment. Landings are usually small but would be visible adjacent to roads. Thinned stands and understory vegetation would grow rapidly and reduce the contrast with adjacent areas a few years after harvest. Adverse visual impacts would be minimal and short term given the rapid growth of vegetation on the coastal plain. Stands adjacent to open roads would appear slightly altered and human activities though evident would be subordinate to the landscape.

The intermediate thinning prescription would leave stands fully stocked with trees (residual BA would be variable). Utilization standards would eliminate most of the large slash (tops and boles) during logging operations. Browning vegetation and down slash would have a negative impact on the scenic resource in the short term. Any remaining slash would be mechanically broken-up during skidding and would decompose rapidly in the humid environment. Landings are usually small but would be visible adjacent to roads. Visual quality would improve within a few years of harvest because these stands would provide views into the forest and would have a variety of tree sizes. Thinned stands and understory vegetation would grow rapidly and reduce the contrast with adjacent areas within a few years of harvest. Stands adjacent to open roads would appear slightly altered and human activities though evident would be subordinate to the landscape.

The thin to promote mixed pine/hardwood prescription would reduce pine in favor of hardwoods. Browning vegetation and down slash would have a negative impact on the scenic resource in the short term. This prescription would increase the visual diversity in stands especially relative to form, color and texture of the various hardwood species that would remain after harvest. They would be more prominent in the stands. Most of the project area is dominated by pine forest therefore, opportunities to promote hardwoods would add to visual diversity on the landscape. Any remaining slash would be mechanically broken-up during skidding and would decompose rapidly in the humid environment. There may be some breakage of limbs on residual hardwood trees (especially those with large spreading branches such as oaks). Controlled mechanical felling of the pine trees

would limit some of this impact. Landings are usually small but would be visible adjacent to roads. Thinned stands and understory vegetation would grow rapidly and reduce the contrast with adjacent areas within a few years of harvest. Stands adjacent to open roads would appear slightly altered and human activities though evident would be subordinate to the landscape.

The seedtree regeneration prescription would result in an open logged appearance. Browning vegetation and down slash would have a negative impact on the scenic resource in the short term. However, all stands except compartment 22 stand 2 are on dead-end roads where skid trails and log landings would not be visible from main hard surfaced roads. Compartment 22 stand 2 would need a short temporary road (a few hundred feet long) to be constructed to get access to the unit. This road would be closed after treatment activities are completed and would revegetate naturally within a few years and would not be evident. The residual seedtrees in all stands would not be cut and would provide visual diversity as well as wildlife benefits for the long term. Design criteria would include leaving desirable hardwood trees that add additional form, color and texture to stands. There would be short term adverse visual impacts but stand locations along with the additional design criteria would reduce these impacts. The placement of the units, with the exception of compartment 22 stand 2, would not make them evident to the casual observer immediately after logging. Compartment 22 stand 2 would be visible after logging. However, regrowth of trees and other vegetation when combined with the design criteria would reduce adverse impacts within about five to ten years.

Highways 17A, 41, 45 the Jericho Horse Trail and the Palmetto Trail all have a 200 foot wide strip that is classed as *partial retention*. The silvicultural prescriptions associated with these roads and trails include first thinning (prescription #1), intermediate thinning (prescription #2), thin to promote mixed pine/hardwood (prescription # 4) and loblolly seedtree regeneration (prescription # 5). The effects described above under partial retention apply to these linear corridors as well.

In particular, the prescriptions for harvest units that encompass the Jericho Horse Trail and the Palmetto Trail include first thinning and loblolly seedtree regeneration. Design criteria have been included to reduce adverse visual and recreation impacts. They are stated below and are listed in chapter 2 of the environmental assessment.

All remaining stands or portions of stands are classed as *modification*. The proposed silvicultural prescriptions are consistent with this classification and standard logging provision and adherence to Forest Plan standards and guidelines would meet the intent of this classification. Human activities would dominate the landscape but vegetation would quickly recover following the completion of logging activities. The varied prescriptions across the landscape would add to the visual diversity of the forest in the long term.

Recreation

There would be direct effects on recreation areas, trailhead and trails associated with the Palmetto Trail and Jericho Horse Trail from adjacent harvest units as logging takes place. Recreational activities that are likely to be impacted include sightseeing, hunting, camping, hiking, bird watching, photography and horseback riding. Direct effects include the short-term negative impacts to the recreation experience from hearing logging equipment and seeing log decks/landings, and browning vegetation. Some recreationist may choose to go to another area. Logging activities would not impact the entire area all at once but would progress. The impacts in any one area would be short term. Proposed design criteria listed below and in chapter 2 of the EA would reduce adverse effects.

Skid trails can disrupt the flow of recreational traffic by confusing the user as to which trail is to be used and by disturbing the trail tread making it unusable for the hiker, biker or horseback rider. When trails are used as skid trails, the tread is disturbed over a longer section of trail and requires maintenance prior to reusing for recreation. Also, if not warned, recreationists could find use of a trail with logging equipment unsafe. A design criterion is included that would close and sign designated trails during logging activity. This would ensure the safety of the recreating public. The direct impact of closures would be short-term.

Indirect effects include decreased fuel loading in surrounding areas, which decreases the potential for catastrophic wildfire and decreases the chance of facility damage or destruction. Indirect effects also include the understory becoming more open with more views into the forest. There would be an increase in the diversity of plant and animal life especially wildlife that prefers open areas or disturbances. This would provide opportunities for wildlife viewing (bird watching for example) and photography.

There would be some instances where the Jericho Horse Trail and the Palmetto Trail could be used to skid timber for short distances. This would cause negative impacts on the trail experience including less shade as well as less of a “trail” experience and more of a “road” experience. Although using the trail is not an ideal condition, the quickness of the vegetative recovery on the coastal plain in combination with trail rehabilitation work would make the negative impacts short term. Every effort would be made to avoid using the trails during logging operations. Proposed design criteria would reduce the impacts of logging activities on trails.

Direct effects on hunting opportunities include temporarily relocation of game animals because of logging activities. There would be an increase in understory vegetation favorable for wildlife game species such as turkey and deer. Indirectly, the hunting opportunities would improve as the forest becomes more open and increase browse draws in game animals to the newly created disturbances. Also, increased access through the Forest would be less restricted due to the open understory. Road reconstruction and maintenance would improve access to portions of the forest for all recreation users.

Activities unlikely to be impacted by logging and connected activities include boating and kayaking putting in at the Cooper River boat launch, fishing and target shooting at Boggy Head Rifle Range.

Design Criteria

Design criteria are included with the action alternatives to reduce adverse visual and recreational impacts.

Design criteria would reduce impacts from logging operations directly and indirectly on Jericho Horse Trail and Palmetto Trail and recreation users. Skid trails and temporary roads would cross the hiking and horse trails perpendicular and only at spots designated by the Forest Service to reduce visual and recreational user impacts. All logging debris on trails would be cleaned up prior to completion of logging operations and prior to reuse by recreationists. This would reduce impacts to hikers and horseback riders.

Leaving trees that are visually attractive or help define the trails are important to maintaining the visual character of the area and help to avoid making the trail more linear. Placing of signs at the trailhead that inform of logging operations or closures would reduce adverse impacts to the public.

ROS class descriptions for *semi-primitive motorized, roaded natural and rural* would continue to be met with adherence to Forest Plan standards and with the addition of site-specific design criteria.

Cumulative Effects of Alternative 2 and 3

Past, present and reasonably foreseeable projects in the area include fire line reconstruction/maintenance, prescribed burning, already approved timber harvest treatments, precommercial thinning, wildlife opening maintenance and maintenance of utility rights-of-way. Each of these projects has been analyzed for adverse effects to recreation and visual quality.

Scenery

For all areas, regardless of VQO, prescribed burning would maintain open conditions in the understory. Temporary impacts on the visual character of the landscape would occur during and immediately following prescribed burning operations and include blackened soil, dead vegetation, scorched trees and fire lines. The long term visual effects of burning are increased views into the forest and a greater diversity of plants and animals. There would be short term adverse effects but in the long term the diversity of the visual landscape would increase in the area. Open views into stands would be increased and there would be an abundance of understory shrubs, grasses and forbs that would complement views into the forest.

It is anticipated that no long-term adverse cumulative impacts would affect scenic resources from past, present and future projects either on public or private lands. However, temporary and localized effects may occur as individual projects are implemented on the ground. In general, the scenic resources on national forest system lands, combined with the potential for activities on private lands, would VQO designated for these areas in the long term.

Recreation

Cumulative impacts on the recreation opportunities in the long term may occur in the future within the area. As projects are developed, they are individually evaluated for potential effects to the recreation resource. Approved activities would only affect portions of the analysis area at any one time. There would be localized impacts to recreationists and they may be displaced for a short time period to other parts of the forest. Design criteria have been developed to reduce adverse impacts. It is anticipated that no long-term adverse cumulative impacts would affect recreation opportunities, but temporary and localized effects may occur as individual projects are implemented on the ground. In general, the recreation opportunities on national forest system lands, combined with the potential for activities on private lands, would not exceed the recreation opportunity spectrum designation for these areas in the long term.

3.3.3 Economics

Affected Environment

This analysis focuses on economic effects of the proposed action and alternative 3. Costs incurred by the timber purchasers or other parties are not included. The estimates are based on historical data on the Forest.

These estimates are based on appraisals of fair market value for wood products and the expected volume. The intent of treatments is to thin overstocked stands, longleaf restoration, develop mixed pine hardwood stands and create younger age classes in the loblolly forest type.

Costs for future timber management and economic benefits of growing larger more valuable sawtimber trees in a shorter time period have not been estimated but are anticipated.

The alternatives also produce other public benefits such as, but not limited to, wildlife habitat created or maintained, protection or reduced mortality of pine communities and reduced fire hazards because forest fuels would be treated. The economic analysis was done using the “Quick Silver” program. The full analysis is contained in the project file.

Direct and Indirect Effects of Alternative 1

No costs or revenues would be realized under this alternative. Overstocked pine stands would continue to be high risk to pine beetles. Mortality would also occur from competition. Wood products not harvested and lost growth would be revenue foregone under this alternative. There would be minor impacts on local mills and on supplying biomass material for energy.

An indirect effect of the No Action Alternative would be the loss of long-term economic potential of pine stands. Pine stands would stagnate and with mortality from insects and competition, stand gaps would be created that would allow some trees to grow. Stand growth would slow for a time and then pick up again as more and more gaps are created.
Intrinsic values such as wildlife viewing and aesthetic quality were not factored into costs or benefits.

Direct and Indirect Effects of Alternative 2 and 3

Alternatives 2 and 3 were fully analyzed. Cost used in the economic analysis included hauling, road maintenance, temporary and system road construction, biomass fuel treatments, site preparation burning and mastication, planting trees, herbicide and manual release, snag production for wildlife and improvement of habitat for federally listed species. Revenue comes from pulpwood and sawtimber volume that would be sold to timber purchasers.

Benefits and costs for the alternatives 2 and 3 are displayed in table 3.3-1 and detailed costs are contained in the project file. A Roads analysis was completed for this project.

Improvement of fire-dependent ecosystems including that for federally listed species, wildlife viewing, improved safety from reduced hazardous fuel loadings (including that in the wildland urban interface) were not factored into costs or benefits.

Table 3.3.3-1 Economic Comparison of the Alternatives

Results	Alt.1	Alt.2	Alt.3
Present Value of Costs	0	7,555,407	7,599,120
Present Value of Benefits	0	11,862,813	11,862,813
Present Net Value	0	4,307,406	4,263,693
B/C Ratio	0	1.57	1.56

3.3.4 Environmental Justice and the Protection of Children

Affected Environment

Executive Order 12898 is designed to focus the attention of federal agencies on the human health and environmental conditions in minority and low-income communities. Environmental justice analyses are performed to identify potential disproportionately high and adverse impacts to these target populations from proposed federal actions and to identify alternatives that might mitigate these impacts. The region of influence for this action is considered to be located solely within Berkeley County, South Carolina.

Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risks, directs federal agencies to make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children; and ensure that policies, programs, activities and standards address disproportionate risks to children.
Data use for this analysis is from information extracted from *Economic Profile System – Human Dimension Toolkit* [EPS-HDT (September, 2013)].

There are school bus routes in the area that would travel some of the same state and county roads that logging trucks would be using. However there is no identified disproportionate risk to children on these roads as compared to other rural roads in adjacent areas. Most roads provide

access to private lands, residences and communities and are frequently used for a variety of agricultural and other commercial uses.

Table 3.3.4-1 lists the percentage of minorities and persons and families living below the poverty level within Berkeley County as compared to the State of South Carolina as a whole.

The area within and surrounding the project area does not contain a disproportionate number of minority persons or persons/families living below the poverty level when compared to the State of South Carolina. Therefore, additional environmental justice analysis is not required. Similarly, children would not be disproportionately affected by the action alternative. All members of the public would be restricted from work areas to maintain safety. There is a long history of timber management activities in the County and on the forest and local residents are familiar with these management practices. No significant, adverse impacts to children are anticipated.

Table 3.3.4-1 Percentage of Minorities and Persons/Families Living Below the Poverty Level in Berkeley County as Compared to the State of South Carolina

Location	Minority Persons (%)	Persons Below Poverty Level (%)	Families Below Poverty Level (%)
Berkeley County	32.9	13.9	10.6
South Carolina	32.8	17.0	12.7

Direct, Indirect and Cumulative Effects of Alternative 1

This alternative would not adversely affect minority and low-income communities or cause disproportionate environmental health risks or increase safety risks to children.

There would be no measurable cumulative disproportionate impacts to minorities and people/families living below the poverty level from this alternative when added to other past, present and reasonably foreseeable projects on federal and private lands in the analysis area. There would be no adverse impacts to children from this alternative when added to other past, present and reasonably foreseeable projects on federal and private lands in the analysis area.

Direct, Indirect and cumulative Effects of the Action Alternatives

Vegetation management activities within the analysis area would consist of layout and marking of sale units by Forest Service or private contractors. This activity would involve increased Forest Service or private individual vehicle traffic in the analysis area. The secondary traffic related to this project would involve timber purchasers and employees. The final and most substantial increase in traffic would involve logging equipment moving from site to site with log trucks transporting forest products to processing plants.

The area within and surrounding the project area does not contain a disproportionate number of minority persons or persons/families living below the poverty level when compared to the State of South Carolina. Therefore, additional environmental justice analysis is not required.

Children would not be disproportionately affected by the action alternatives. All members of the public would be restricted from work areas to maintain safety. There is a long history of timber management activities on the Francis Marion national Forest and on private lands in Berkeley County. Local residents are familiar with these management practices. No significant, adverse impacts to children are anticipated.

There would be no measurable cumulative disproportionate impacts to minorities and people/families living below the poverty level from this alternative when added to other past, present and reasonably foreseeable projects on federal and private lands in Berkeley County. There would be no adverse impacts to children from this alternative when added to other past, present and reasonably foreseeable projects on federal and private lands in the area.

3.3.5 Human Health and Safety

Affected Environment

The Forest Service Handbook (FSH), Forest Service Manual (FSM), *Final Environmental Impact Statement, Vegetation Management in the Coastal Plain/Piedmont* (VEG EIS) and the *Revised Land and Resource Management Plan, Francis Marion National Forest* (Forest Plan) all provide guidance and establish required measures to protect human health and safety during forest management activities. The Francis Marion National Forest also has a spill response program in place to contain and remove contaminants, such as herbicides.

Direct, Indirect and Cumulative Effects of Alternative 1

This alternative would have no effect on human health and safety beyond current management actions in the area. Under the No Action alternative, no road reconstruction would occur, since none of the proposed vegetation management activities would be implemented.

Past, present and current activities in the area that have the potential to impact human health and safety include prescribed burning, road maintenance and herbicide applications for non-native invasive plants. All of these activities would comply with Forest Plan direction to protect public health and safety and also include project-specific design criteria. Adverse cumulative effects are not expected to human health and safety.

Direct and Indirect Effects of Alternative 2

Timber harvesting activities, temporary road construction, reconstruction and maintenance of system roads would require the use of heavy equipment (such as dozers, skidders, log loaders, bush-hogs, tractors and trucks). The use of heavy equipment and the movement of trees and logs present the highest potential for safety risks during harvest activities. There is a risk of injury to contract workers, Forest Service personnel and recreationists. In accordance with Forest Service

Health and Safety Code Handbook (FSH 6709.11), vegetation management activities require all Forest Service workers to wear safety equipment, including hard hats, eye and ear protection, chaps, and fire retardant clothes. Monitoring of compliance with the Forest safety code would be accomplished through on-site inspections and reviews of accident reports (USDA, 1989b).

For all mechanical treatments in the project area, equipment operators must demonstrate proficiency with the equipment and be licensed to operate it. In addition, a helper must direct the operator where safety is compromised by terrain or limited sight distances (USDA, 1989b).

The private timber sale contractor conducting the harvest would be responsible for adhering to safety specifications during the entire harvest process.

These requirements include the:

- Installation of temporary traffic control devices on roads and trails open to public travel to warn users of hazardous or potentially hazardous conditions;
- Removal of logging slash from all trails open to the public;
- Development of a specific traffic control plan; and
- Installation of road closure devices, such as but not limited to barricades to control entry to the activity site (USDA, 2000a).

Any risks to workers or the public would be minor and temporary.

Herbicide applications have the potential to adversely affect public and worker health and safety. Contractors applying herbicides have the potential to be inadvertently directly exposed to the herbicide as a result of drift or accidental contact during spraying. They can be indirectly exposed by contact with the herbicide residue on plant surfaces. However, due to the use of appropriate control and safety procedures, use of herbicides would not be expected to harm people in the area.

Herbicides would be applied by hand using backpack sprayer equipment. Since the potential for drift is negligible from this equipment, and since no public forest users are expected to be on-site during vegetation management activities, no direct public exposures are expected to occur. Adherence to safety measures would minimize or eliminate adverse human health and safety effects.

In accordance with FSH 7109.11, public exposure to herbicides would be minimized by the clear placement of notice signs at application sites, especially in areas of anticipated visitor use. Monitoring and inspections during and after the project would be used to ensure that proper procedures were followed.

Workers are at greater risk of direct, adverse effects from herbicide use than the public. Workers, including personnel directly involved in the herbicide applications, have the potential to be harmed as a result of an accidental spill of the herbicide during mixing, loading and spraying.

Only herbicides and additives registered by the United States Environmental Protection Agency (USEPA) and approved by the USFS are proposed for use, and only a certified pesticide applicator would train the crew and supervise the application (USDA, 1989b).

Applicators are required to follow regulations established by the Occupational Safety and Health Administration (OSHA). OSHA regulations require that workers personal protective equipment and it must be cleaned. They are required to wear a hard hat with plastic liner, waterproofed boots and gloves and other safety clothing. First aid equipment, including eyewash bottles and wash water separate from drinking water, are required to be on-site during application. Use of protective clothing can substantially reduce worker exposure to herbicides and reduces adverse effects. As stated on page 10 of the VEG EIS, "With all mitigation in force, worker health risks from herbicides would be well below published health and safety standards."
Accidental spills of herbicides or additives may pose a risk to human health and safety. Containers of herbicide would be secured in a part of the vehicle away from people, food, and water to prevent tipping and contamination. Trucks containing herbicide or tank mixed herbicide would not be allowed to park within 200 feet of a stream or pond. Equipment would be required to be inspected daily for leaks and proper function. In the event of an accidental spill, the previously prepared spill plan (FSM 2109.12) would be implemented to contain and clean up the spill and notify the appropriate agencies and individuals (USDA, 1989b). Herbicides would be applied with strict conformance with herbicide label information and instructions.

Road maintenance would improve safety conditions for Forest personnel and users during project activities. While this would have a beneficial effect on human health and safety, this effect would not be significant.

Cumulative Effects of Alternative 2

Past, present, and future actions in and adjacent to the analysis area would be required to comply with established standards, guidelines, and design criteria in the Forest Plan as well. The implementation of other management actions over several years designed to achieve desired conditions in and around the analysis area, would not increase the potential for cumulative, adverse safety impacts. With strict adherence to required safety measures, no significant, cumulative impacts on human health and safety would occur, regardless of the type and amount of activity conducted.

The USFS also conducts prescribed fire within and adjacent to the project area as part of its normal maintenance and general management of the Francis Marion National Forest. Threats to human health and safety during a prescribed fire are smoke inhalation and injury from the fire itself in the event that a controlled burn escapes the area. Various safety measures are in place to protect workers and the public from adverse effects during prescribed fires. A prescribed fire plan is required for each managed burn, which includes a smoke mitigation plan in the event that planned conditions change. Roads and highways are closed if the smoke impairs visibility enough to threaten public safety (USDA, 2000b). The public is notified through signs and closed roads, if necessary, and nearby residents adjacent to the Forest are notified prior to a prescribed burn. In addition, standards and guidelines and mitigation measures provided in the Forest Plan are adhered to during prescribed fires, which minimize or eliminate public human health and

safety concerns resulting from smoke exposure and fire injuries. All burns are conducted by trained staff, supervised by an experienced burn boss, and monitored through review of burn plans, on-site inspections, and post-burn evaluations (USDA, 1989b).

Herbicide use in the area is currently restricted to treating non-native invasive species that pose threats to management objectives on national forest system lands and use on private lands. Adherence to Forest Plan standards and guidelines and design criteria in this EA would avoid adverse cumulative impacts from application of herbicides to human health and safety.

Direct and Indirect Effects of Alternative 3

The effects described for alternative 2 apply with this alternative as well except that herbicide would not be used.

Under Alternative 3, the increase of activity with hand tools and prolonged exposure to forest and weather conditions would slightly increase hazards to forest workers. These risks would be extended over a longer period of time due to increased efforts necessary to control composition and structure of understory vegetation. Manual effects are discussed on pages IV-25-IV-30 in the VEGEIS. The slightly increased adverse effects are not significant.

Cumulative Effects of Alternative 3

Past, present, and future actions in and adjacent to the project area would be required to comply with established standards and guidelines in the Forest Plan. Additional manual treatments when combined with to and mechanical treatments would increase the safety risk to primarily workers during implementation. The implementation of other management actions over several years designed to achieve desired conditions in and around the project area, would not increase the potential for cumulative, adverse safety impacts. With strict adherence to required safety measures, no significant, cumulative impacts on human health and safety would occur, regardless of the type and amount of activity conducted.

Other cumulative effects except those described for herbicide use in alternative 2 apply here as well.

3.4 Monitoring

Activities and effects would be monitored to ensure compliance with Forest Plan standards and guidelines. Forest Service personnel would administer timber sale contracts. This ensures resource protection and adherence to contract clauses including but not limited to heritage resources, riparian areas and streams and other site-specific design criteria.

Tree seedling survival surveys would be conducted three years after planting to determine the need for additional planting in order to achieve project objectives for the stands.

Effectiveness of mitigation measures and a determination that Forest Plan and project objectives are being met would be done periodically on a forest-wide rather than on an individual basis.

However, spot checks of effectiveness of design criteria and compliance with BMPs may occur on this project.

3.5 Irreversible and Irretrievable Commitment of Resources

An irreversible commitment of resources refers to an action that could affect resources that are renewable only after a long period of time (such as soil productivity) or are non-renewable resources (such as cultural resources or mineral extraction). An irretrievable commitment of resources refers to losses of productivity or the use of renewable resources. This represents opportunities foregone for the period of time that the resource cannot be used.

Direct, Indirect and Cumulative Effects of Alternative 1

There would be no irreversible commitment of resources under this alternative. Slow growing stands and tree mortality from competition and Southern pine beetle damage would be an economic loss but the effects would be minor.

Direct, Indirect and Cumulative Effects of the Action Alternatives

There would be no irreversible commitment of resources. Impacts to soil productivity are limited and not substantial, when adhering to Forest Plan standards. The Forest Plan limits surface disturbance associated with soil compaction and displacement. Thinnings and increase habitat and age class diversity would reduce the risk of insect and disease over large areas of the project area. This reduces the potential for catastrophic wildfire and protects vegetation cover which in turn protects soils and maintains long-term productivity. There would be no effect to heritage resources as known historic sites and potential sites eligible for the National Register of Historic Places would be avoided. Evaluations have been completed by archaeologist and consultation and concurrence has been received from the South Carolina State Historic Preservation Office (SHPO).

Thinnings would harvest trees that have economic value and would promote healthy fully stocked stands growing at their optimum potential. There would be no loss in stand productivity with adherence to Forest Plan standards and guidelines.

Past, present and future activities in the area on both federal and private lands have included timber harvesting, grazing, farming and maintenance of homesites. Activities have change little in the past and land uses are expected to remain the same in the future. The productivity of the land is being maintained and significant irreversible commitments of resources are not expected.

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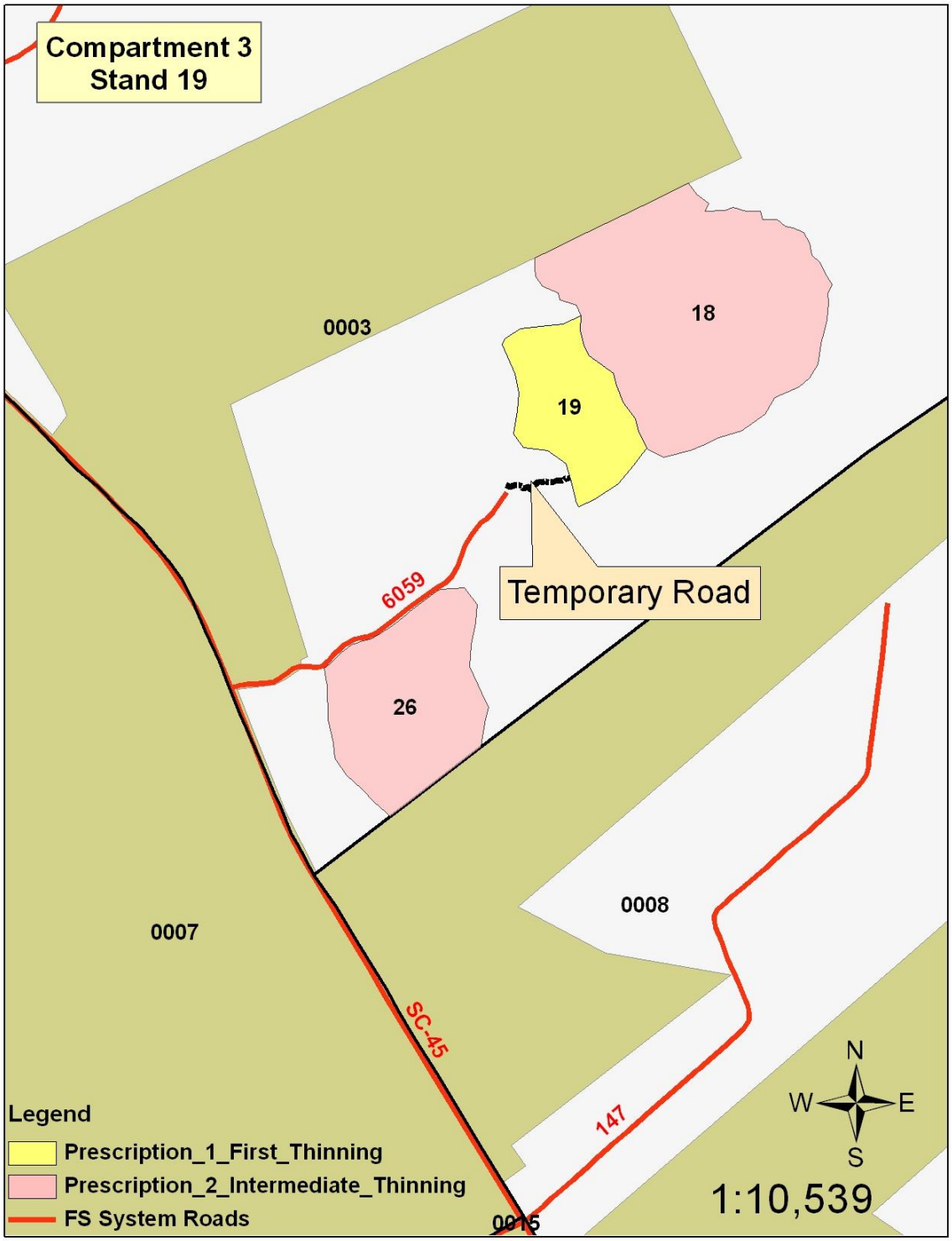
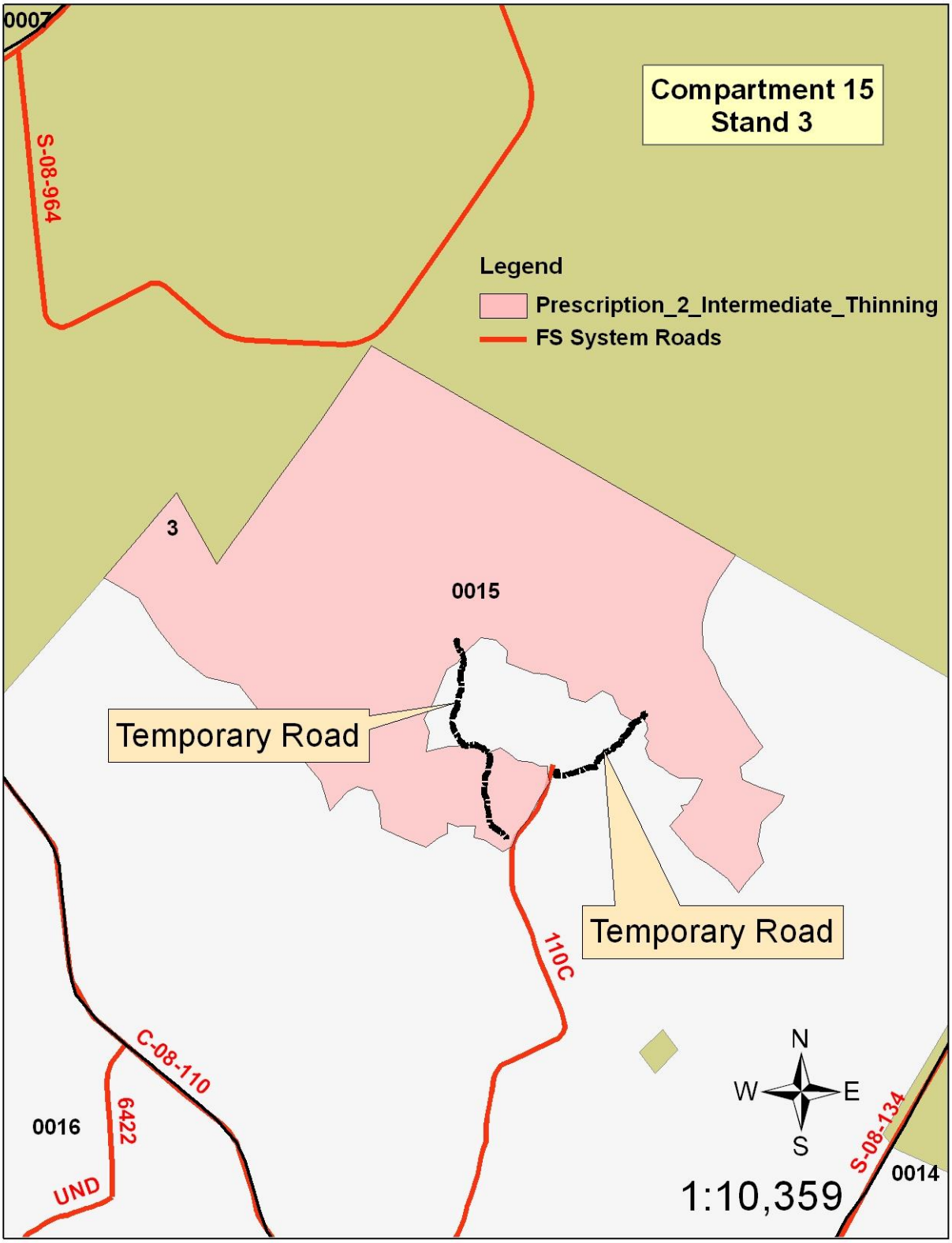
Appendix A – Temporary Roads

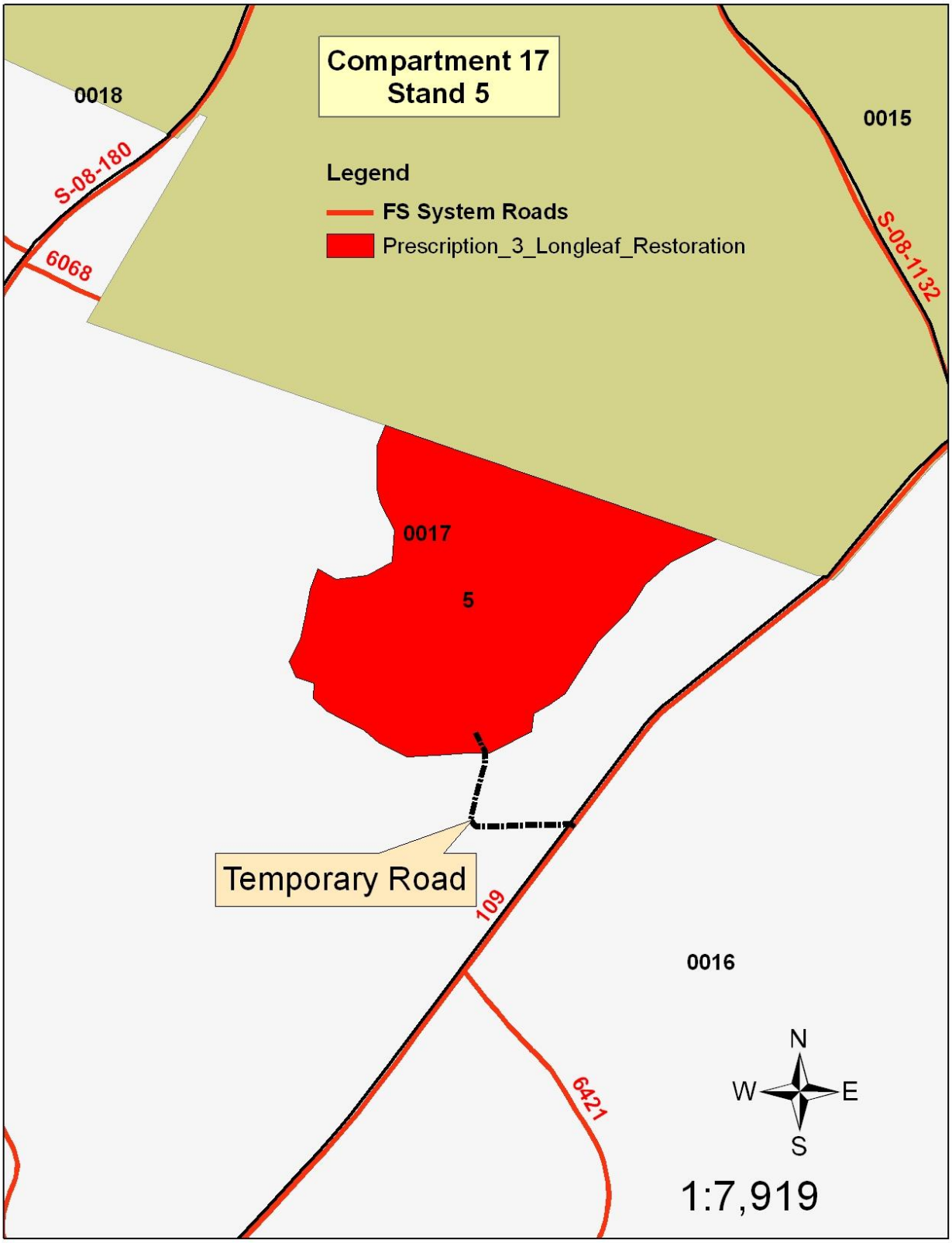
Map A-1



Map A-2


0007
Compartment 15
Stand 3
S-08-964
Legend
Prescription_2_Intermediate_Thinning
FS System Roads
3
0015
Temporary Road
Temporary Road
110C
C-08-110
6422
0016
UND
N
W
E
S
S-08-134
0014
1:10,359

Map A-3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Stand 5
Legend
FS System Roads
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0015
0017
5
0016
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S-08-1132
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6421
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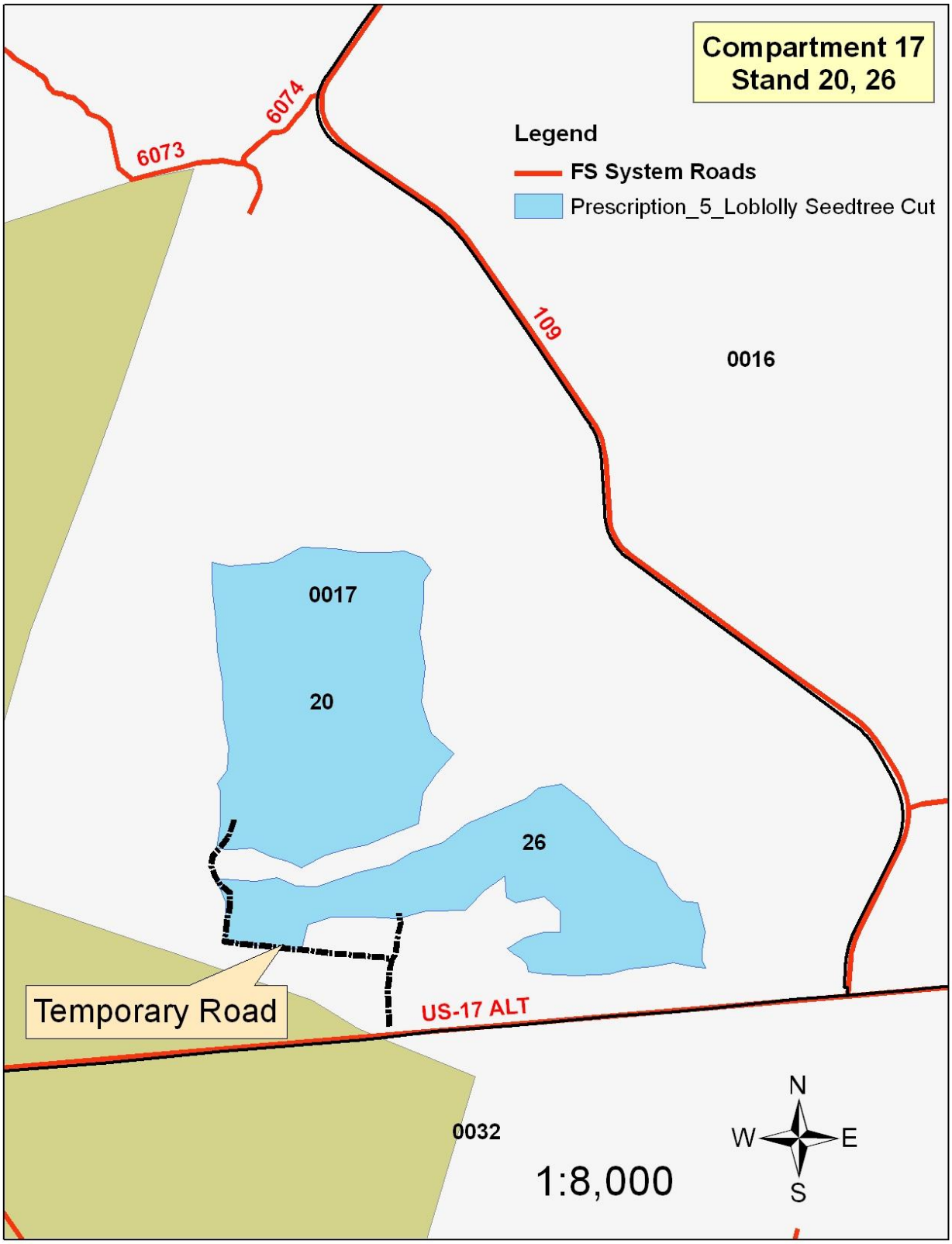
W
E
S
1:7,919

Map A-4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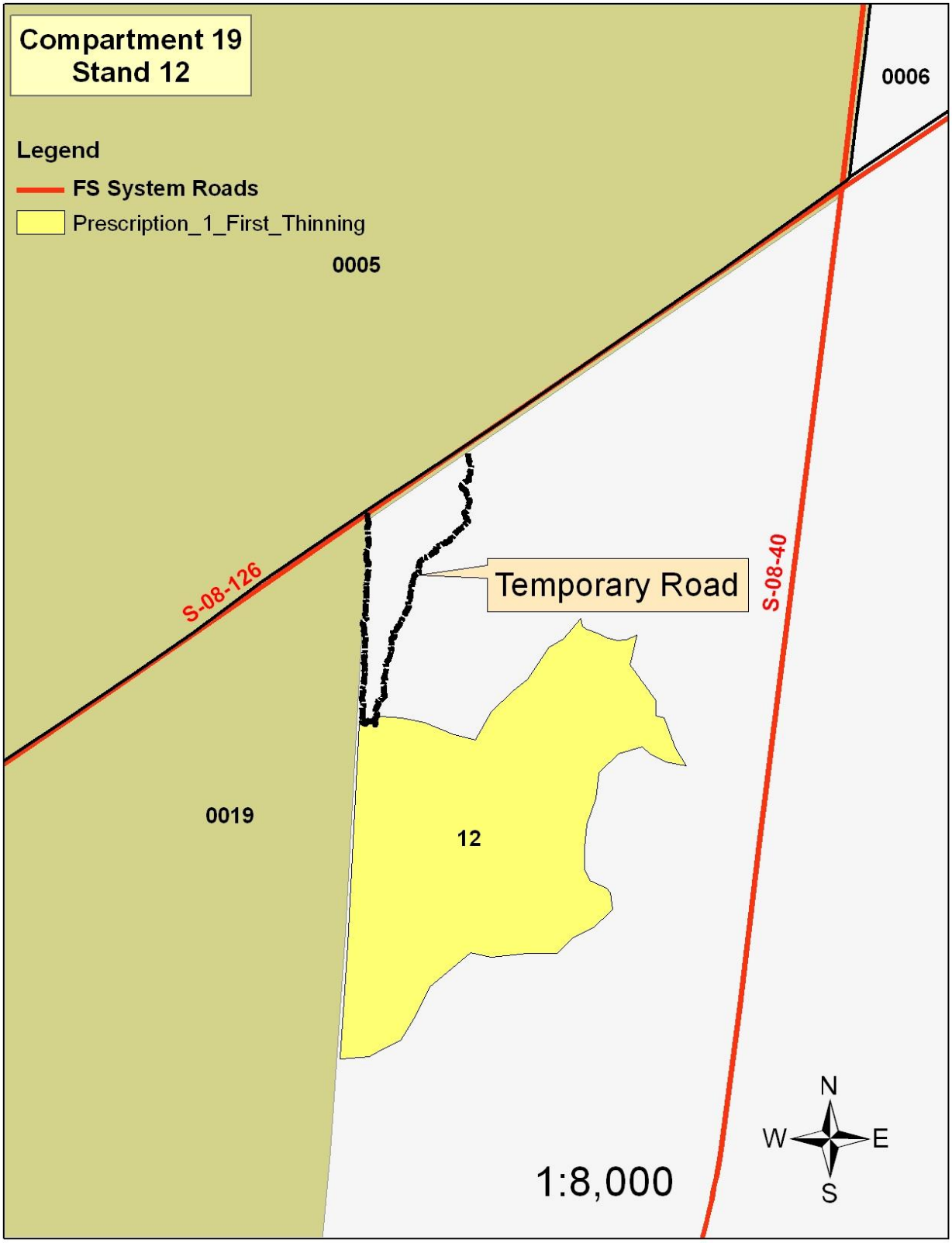
Stand 20, 26
Legend
FS System Roads
Prescription_5_Loblolly Seedtree Cut
6073
6074
109
0016
0017
20
26
Temporary Road
US-17 ALT
0032
1:8,000
N
W
E
S

Map A-5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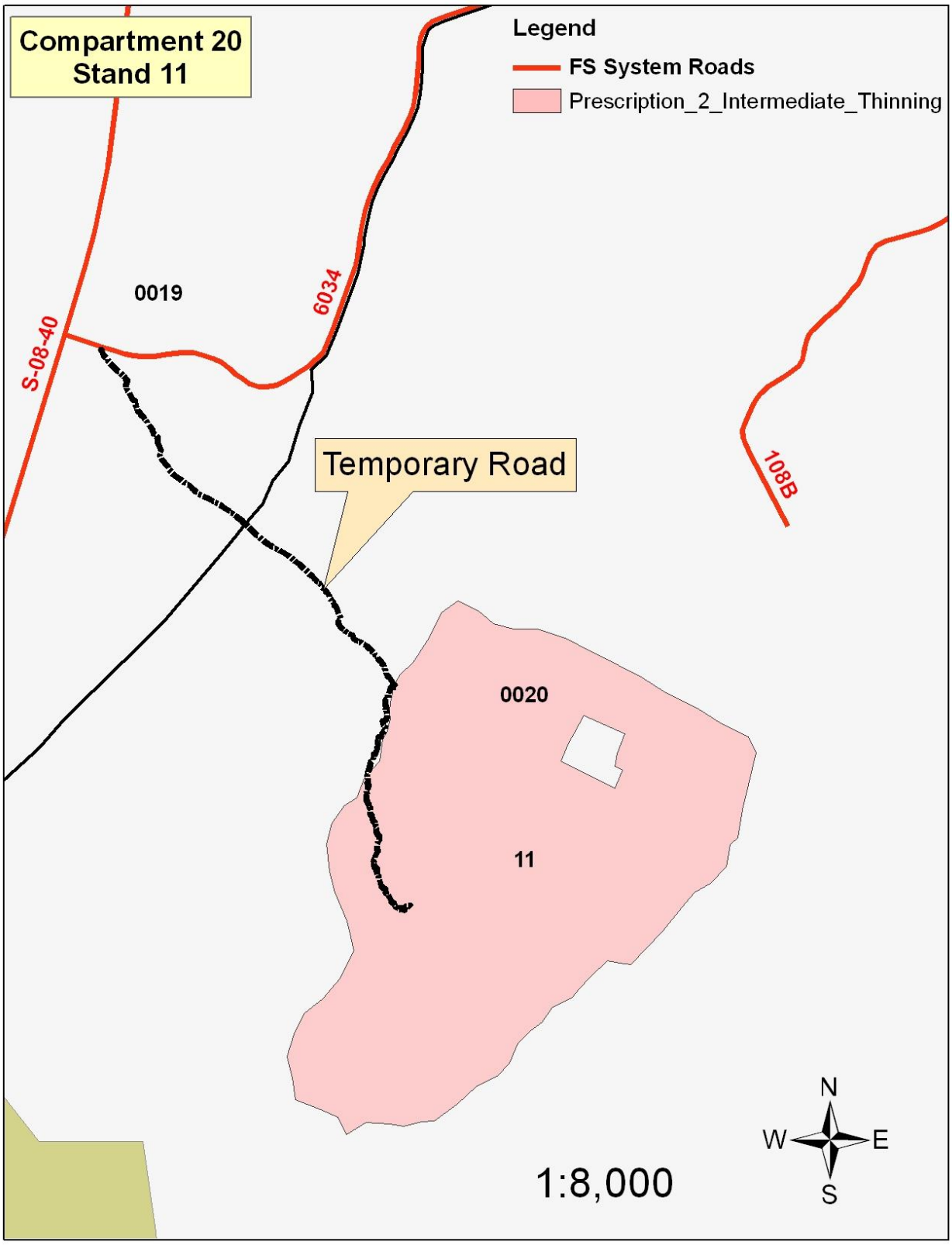
Stand 12
Legend
FS System Roads
Prescription_1_First_Thinning
0005
0006
0019
12
S-08-126
S-08-40
Temporary Road
1:8,000
N
W
E
S

Map A-6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Stand 11
Legend
FS System Roads
Prescription_2_Intermediate_Thinning
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S-08-40
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0020
11
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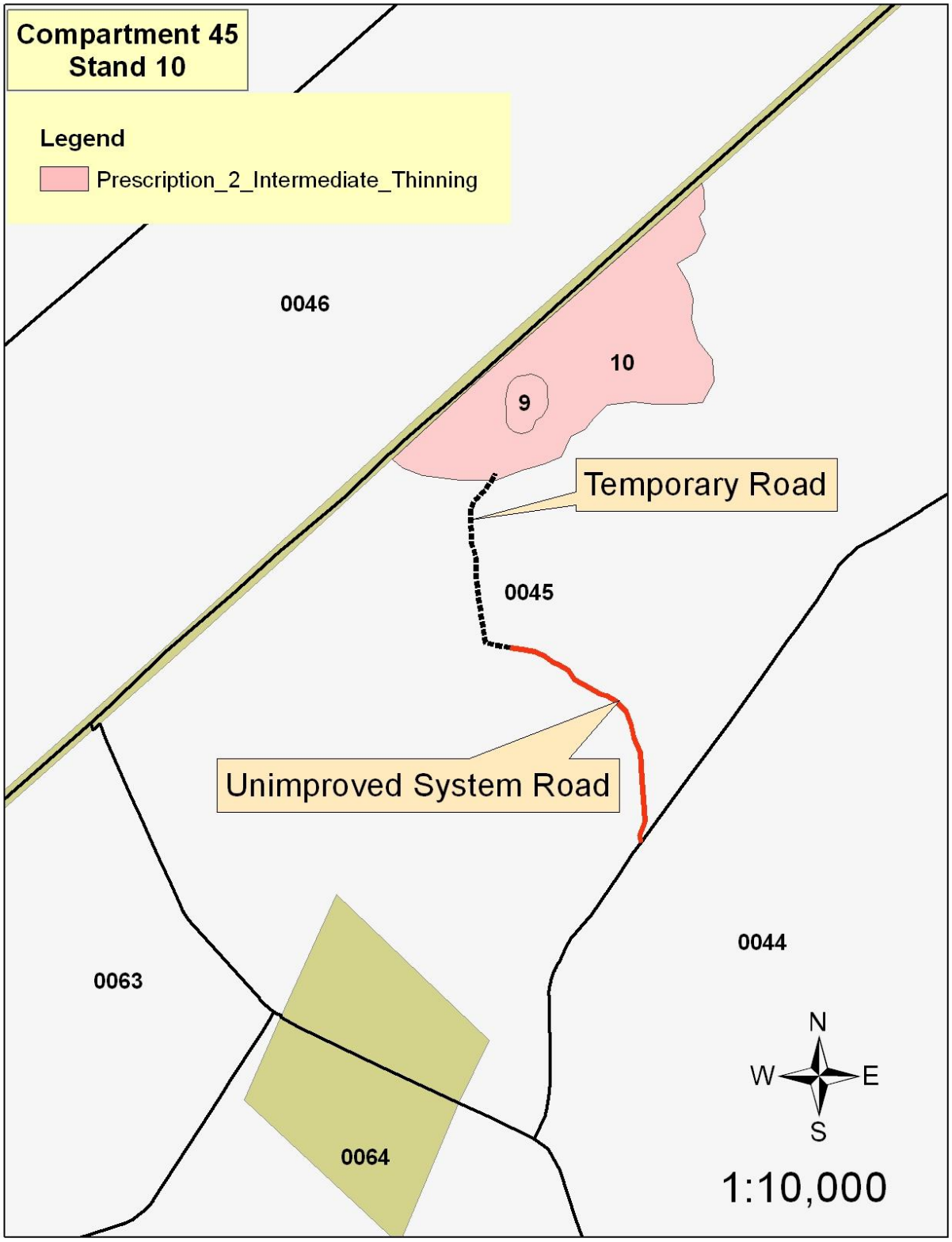
W
E
S
1:8,000

Map A-7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Temporary Road
0045
Unimproved System Road
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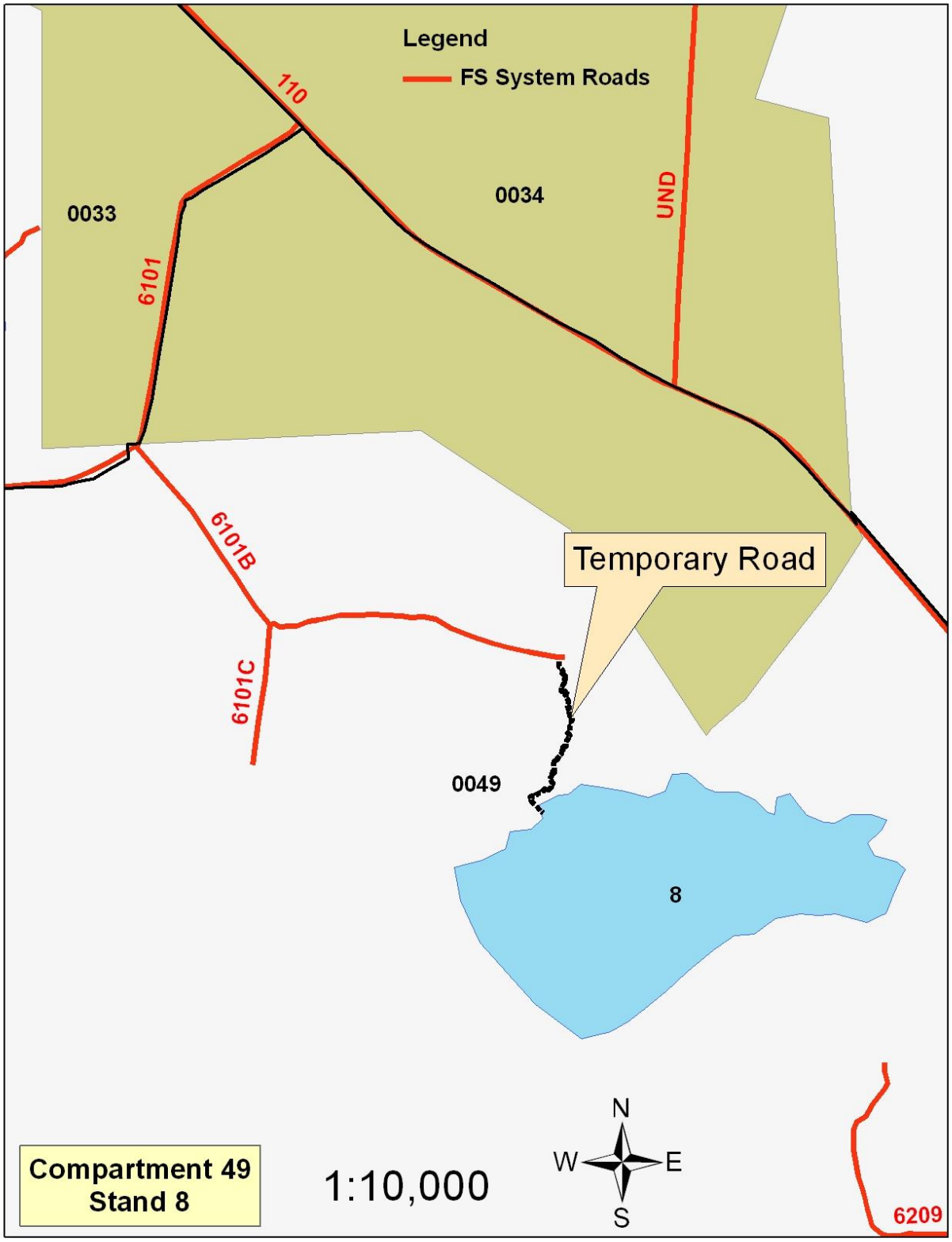
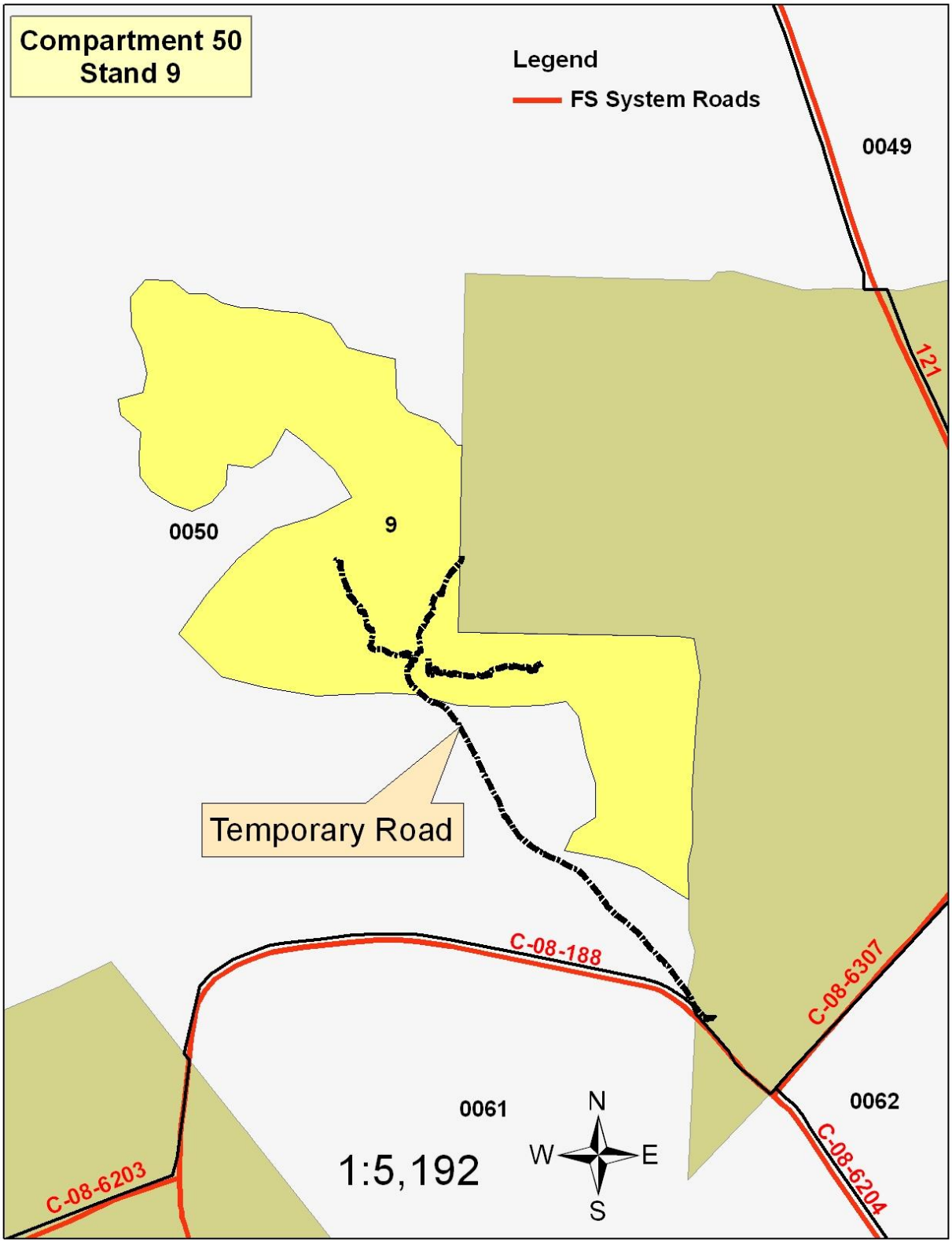
0063
0064
N
W
E
S
1:10,000

Map A-8


Legend
FS System Roads
110
0033
0034
UND
6101
6101B
6101C
Temporary Road
0049
8
6209
Compartment 49
Stand 8
1:10,000
N
W
E
S

Map A-9


Compartment 50
Stand 9
Legend
FS System Roads
0049
121
0050
9
Temporary Road
C-08-188
C-08-6307
0061
0062
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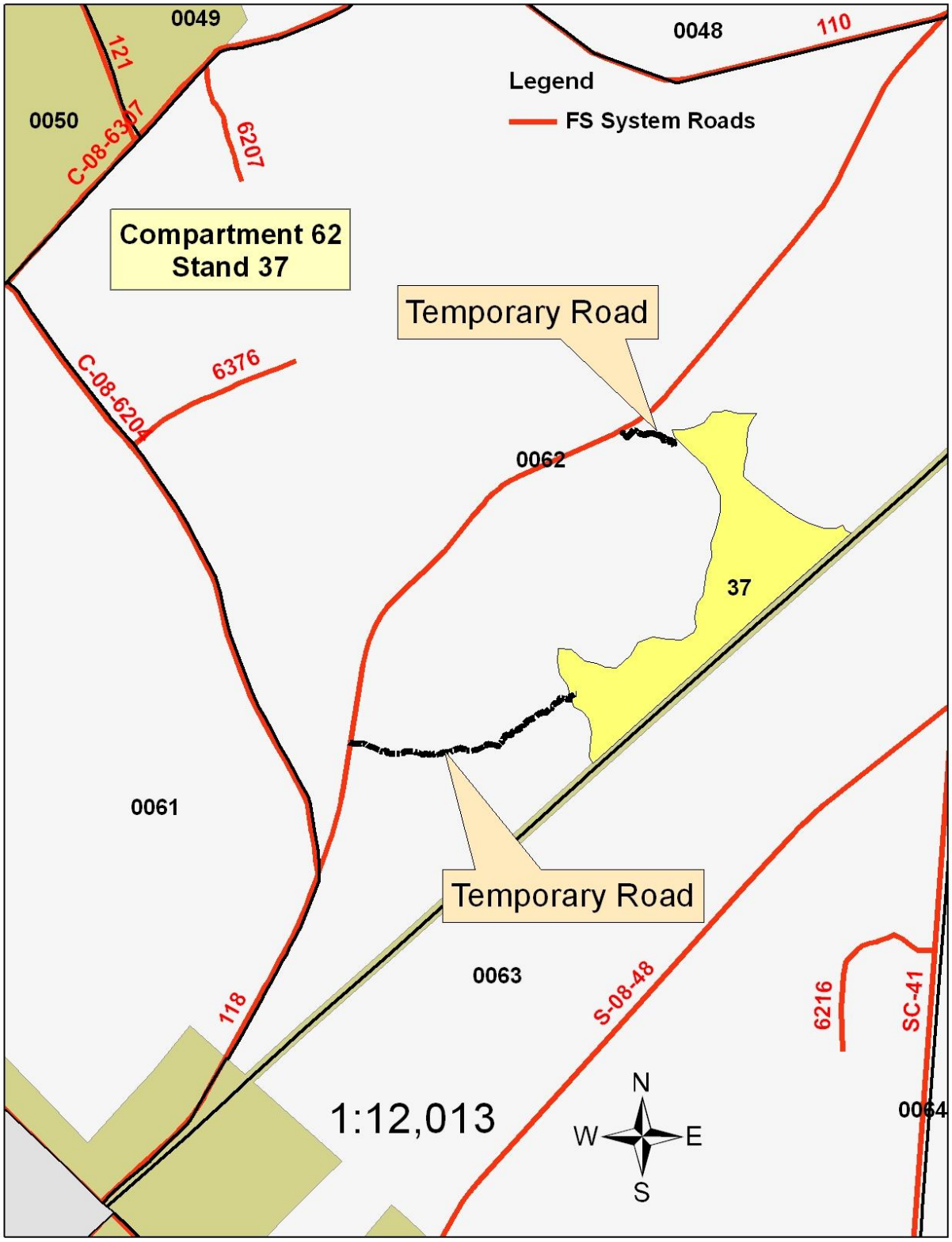
W
E
S
1:5,192
C-08-6203
C-08-6204

Map A-10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0048
110
121
Legend
FS System Roads
0050
C-08-6307
6207
Compartment 62
Stand 37
Temporary Road
C-08-6204
6376
0062
37
0061
Temporary Road
0063
118
S-08-48
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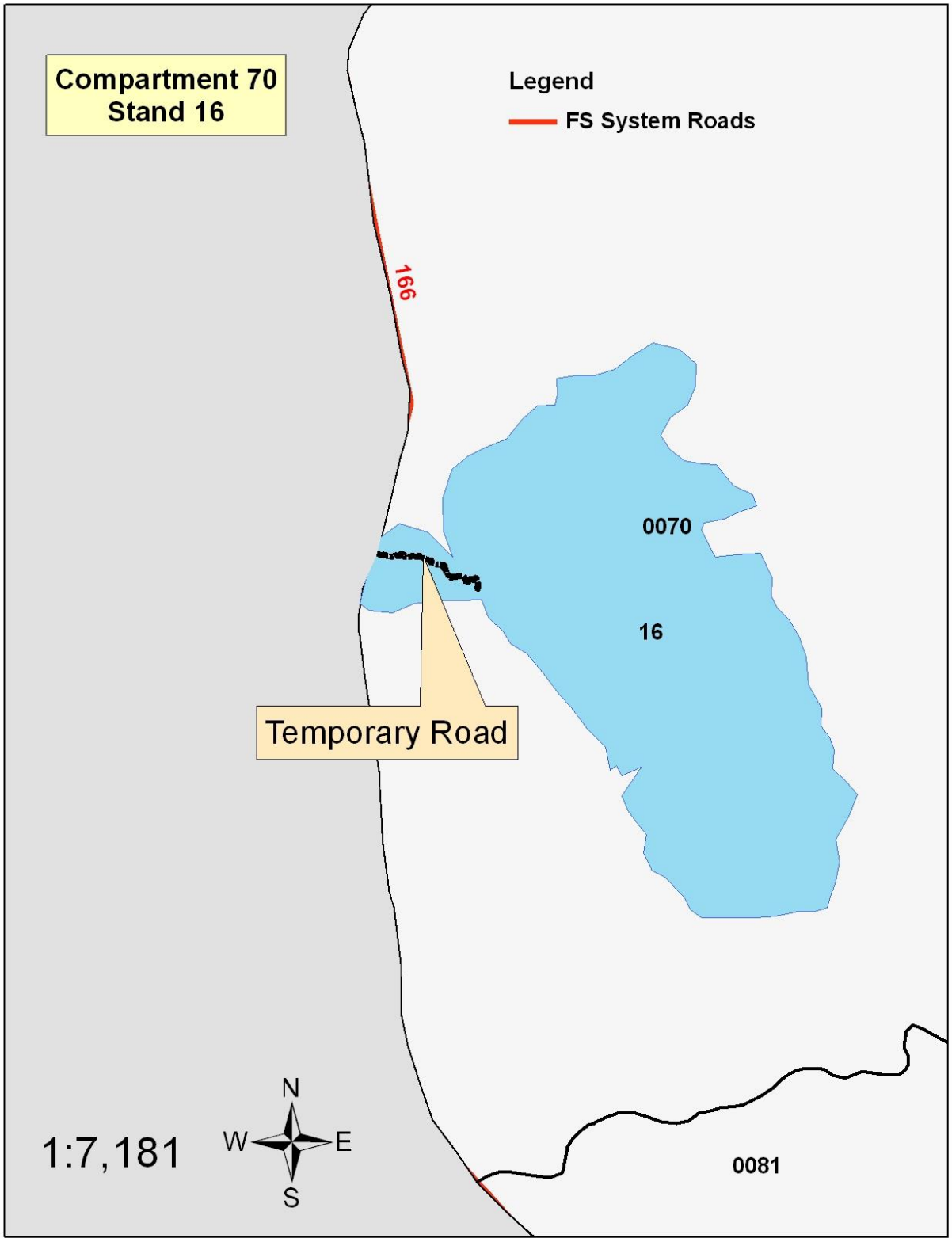
SC-41
1:12,013
N
W
E
S
0064

Map A-11


Compartment 70
Stand 16
Legend
FS System Roads
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16
Temporary Road
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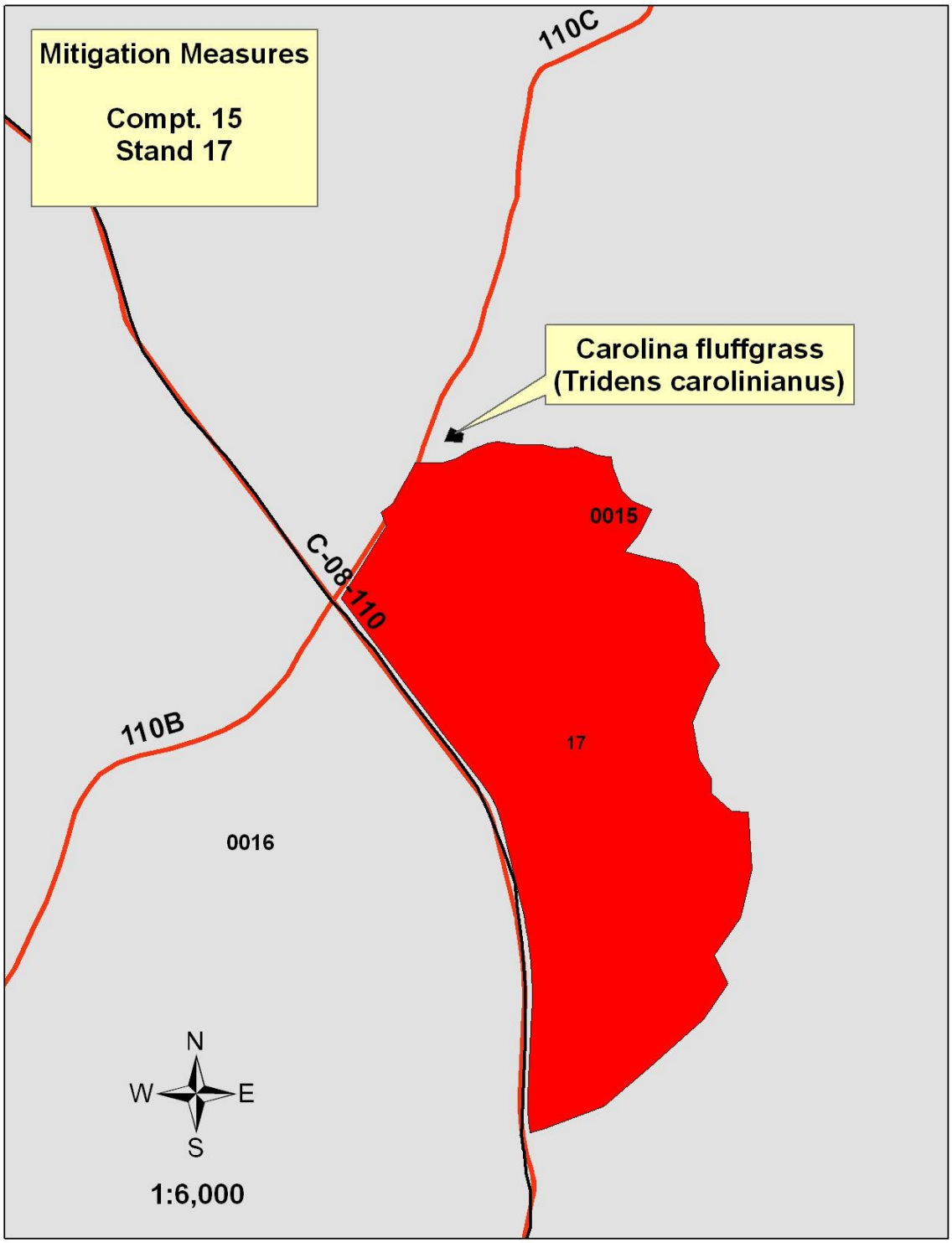
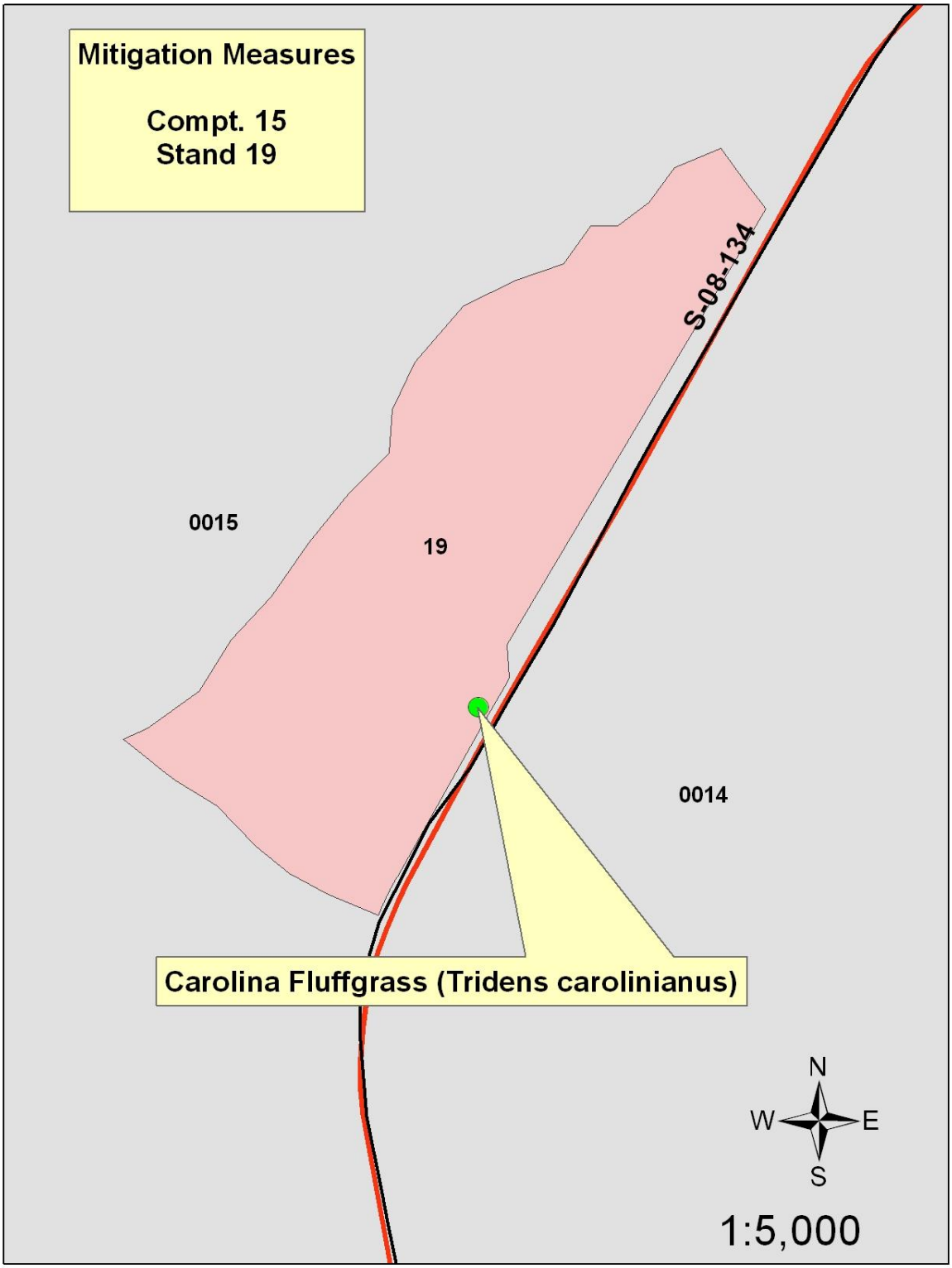
1:7,181
N
W
E
S

Appendix B – Protection of Threatened and Endangered Plants

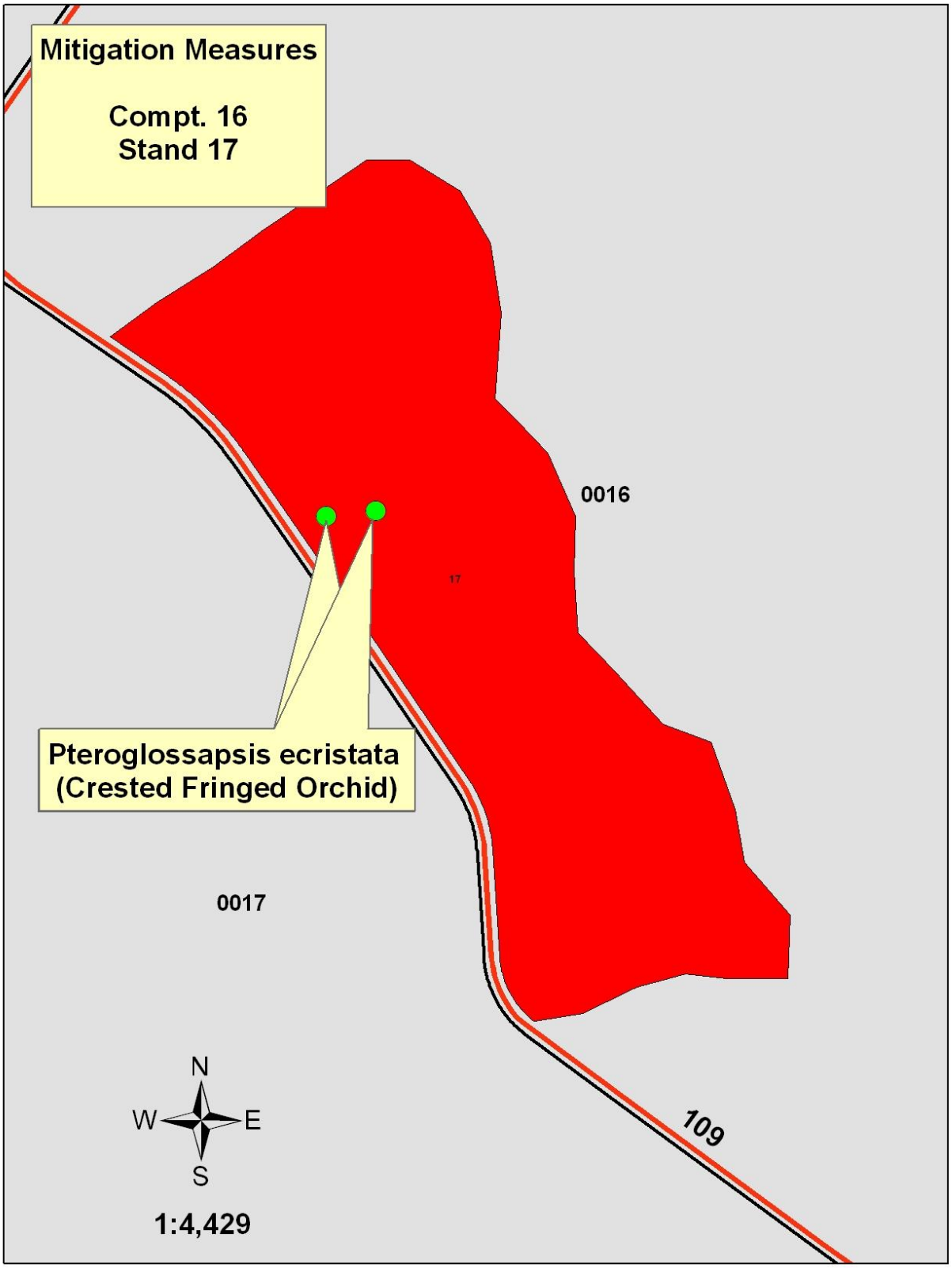
Map B-1



Map B-2


Mitigation Measures
Compt. 15
Stand 19
S-08-134
0015
19
0014
Carolina Fluffgrass (Tridens carolinianus)
N
W
E
S
1:5,000

Map B-3


Mitigation Measures
Compt. 16
Stand 17
0016
17
Pteroglossapsis ecristata
(Crested Fringed Orchid)
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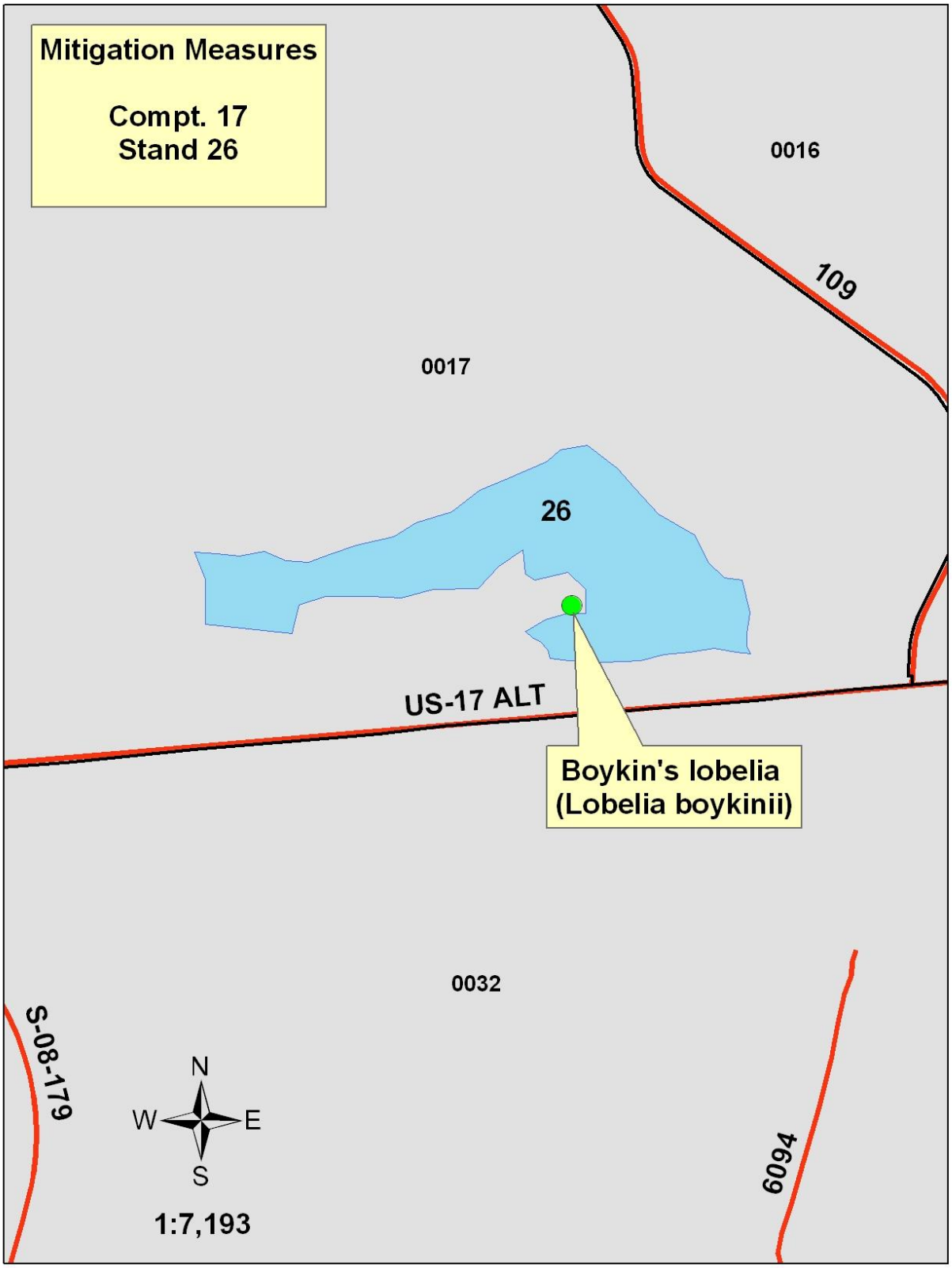
N
W
E
S
109
1:4,429

Map B-4


Mitigation Measures
Compt. 17
Stand 26
0016
109
0017
26
US-17 ALT
Boykin's lobelia
(Lobelia boykinii)
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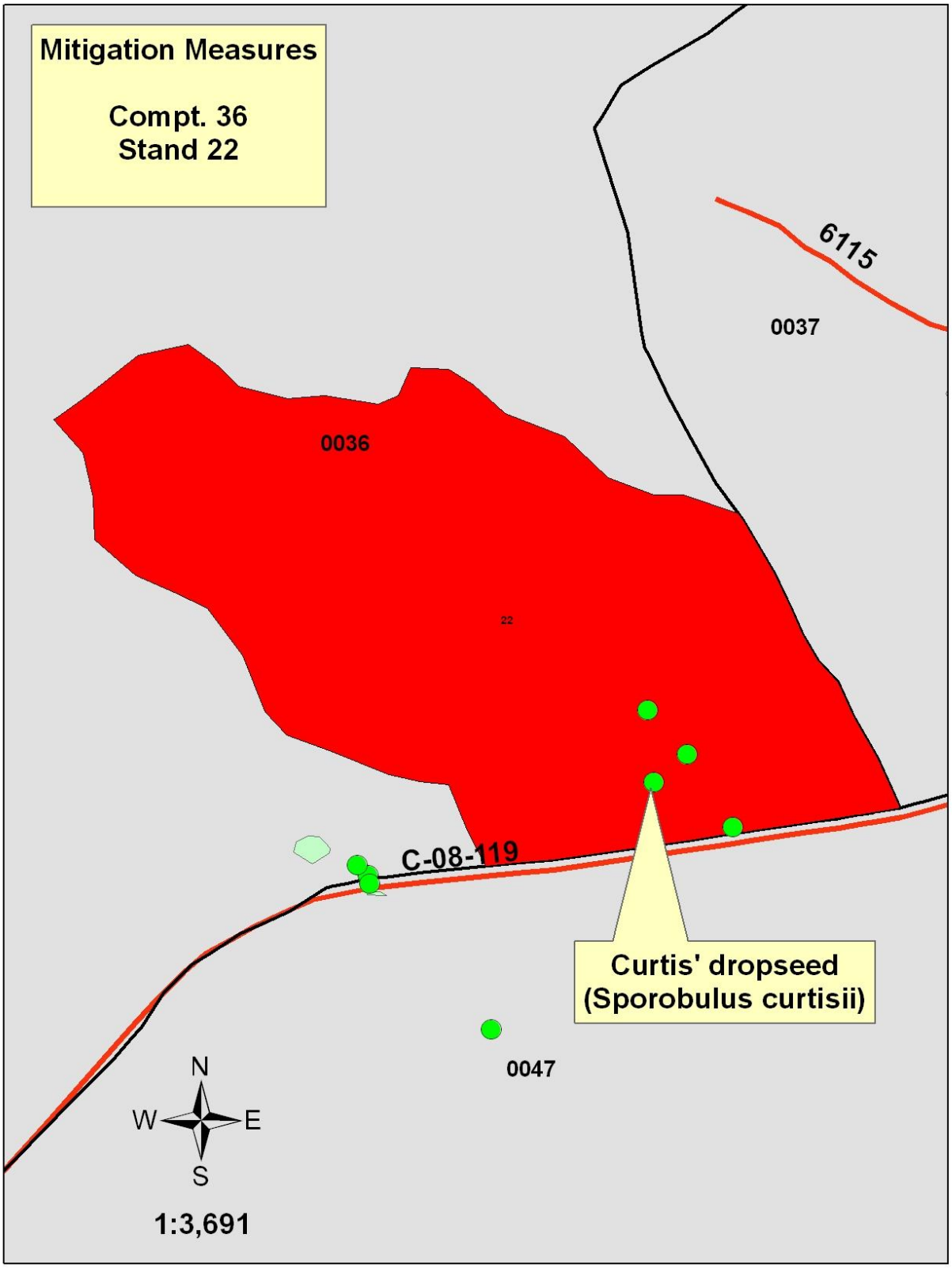
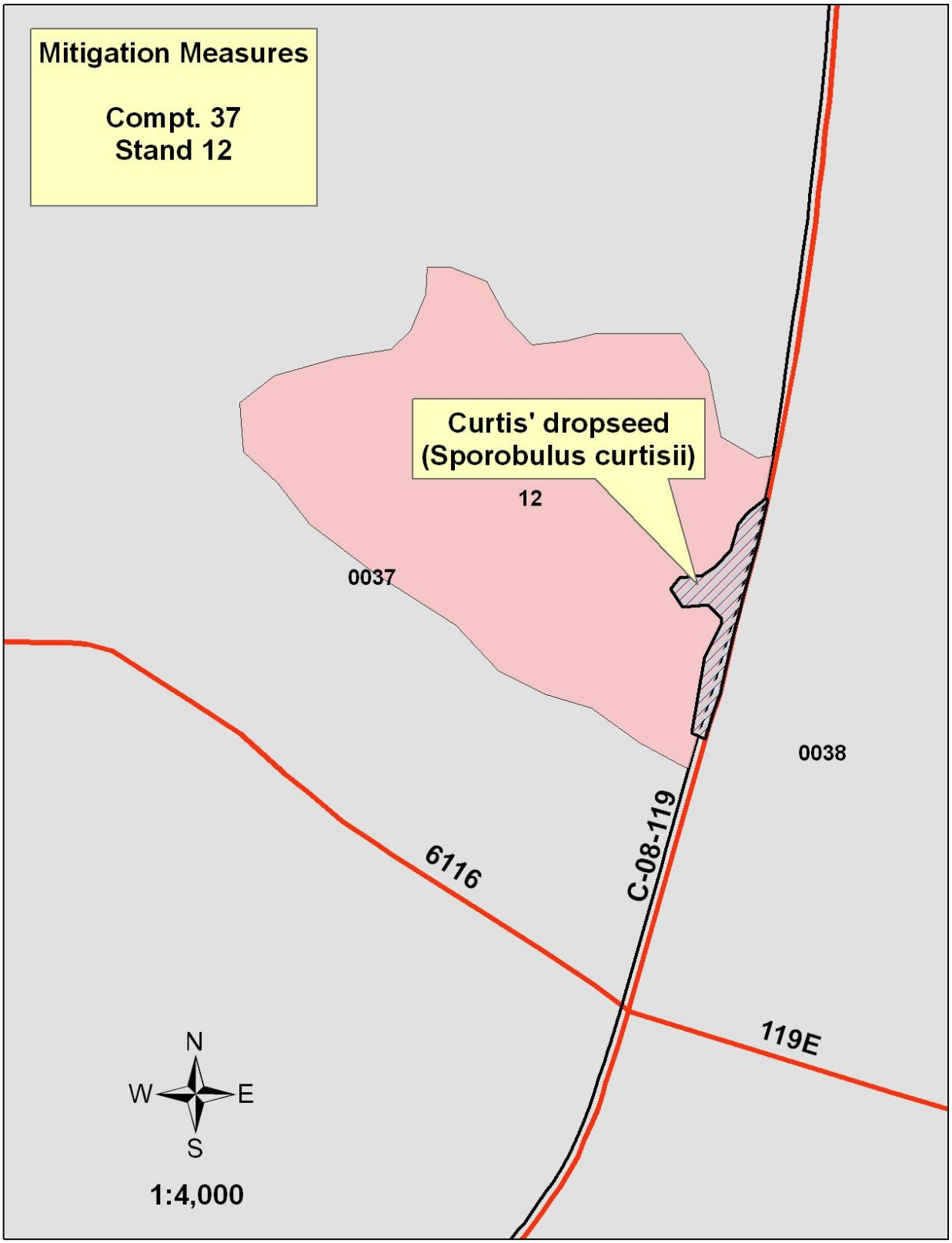
W
E
S
1:7,193
6094

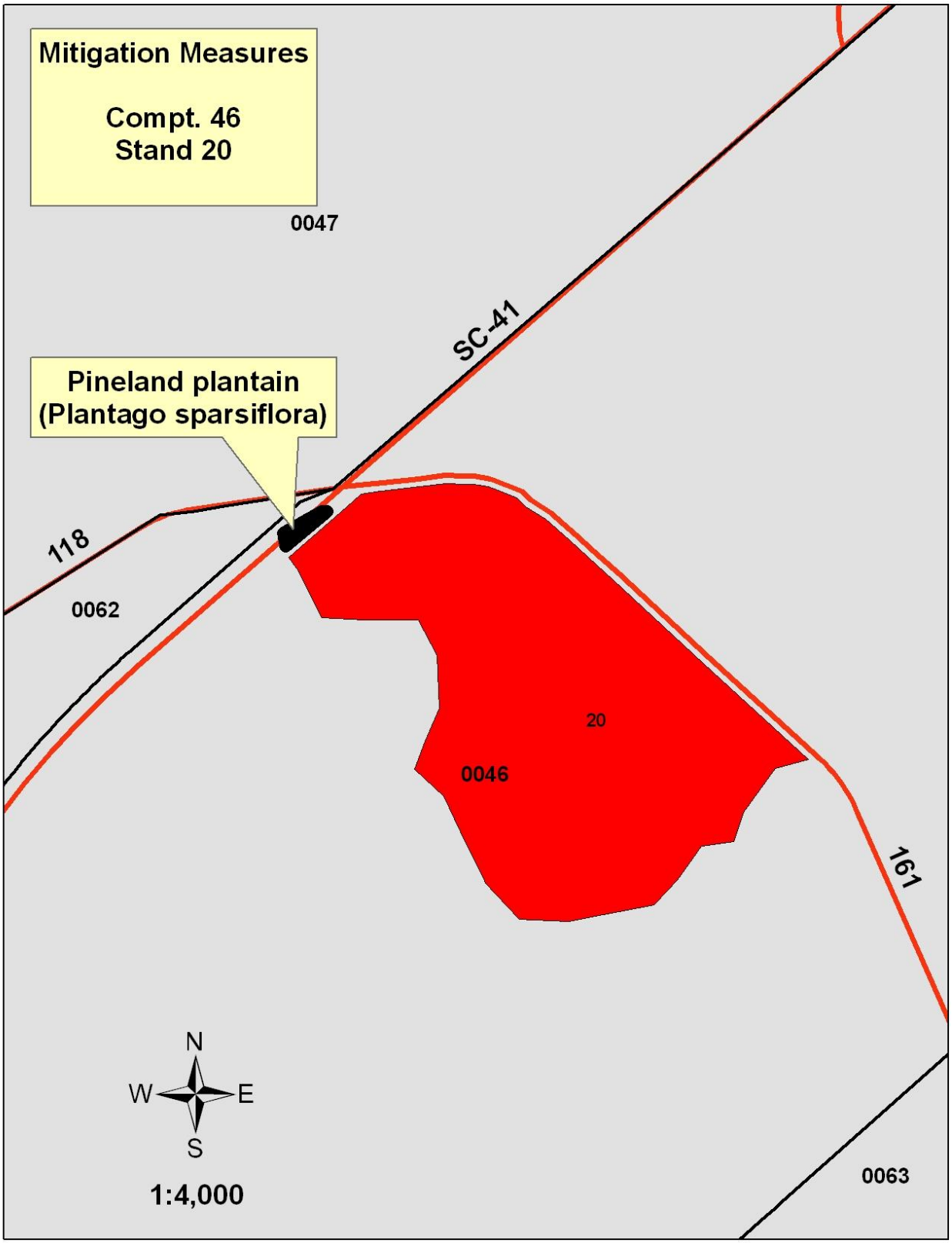
Map B-5


Mitigation Measures
Compt. 36
Stand 22
6115
0037
0036
22
C-08-119
Curtis' dropseed
(Sporobulus curtisii)
0047
N
W
E
S
1:3,691

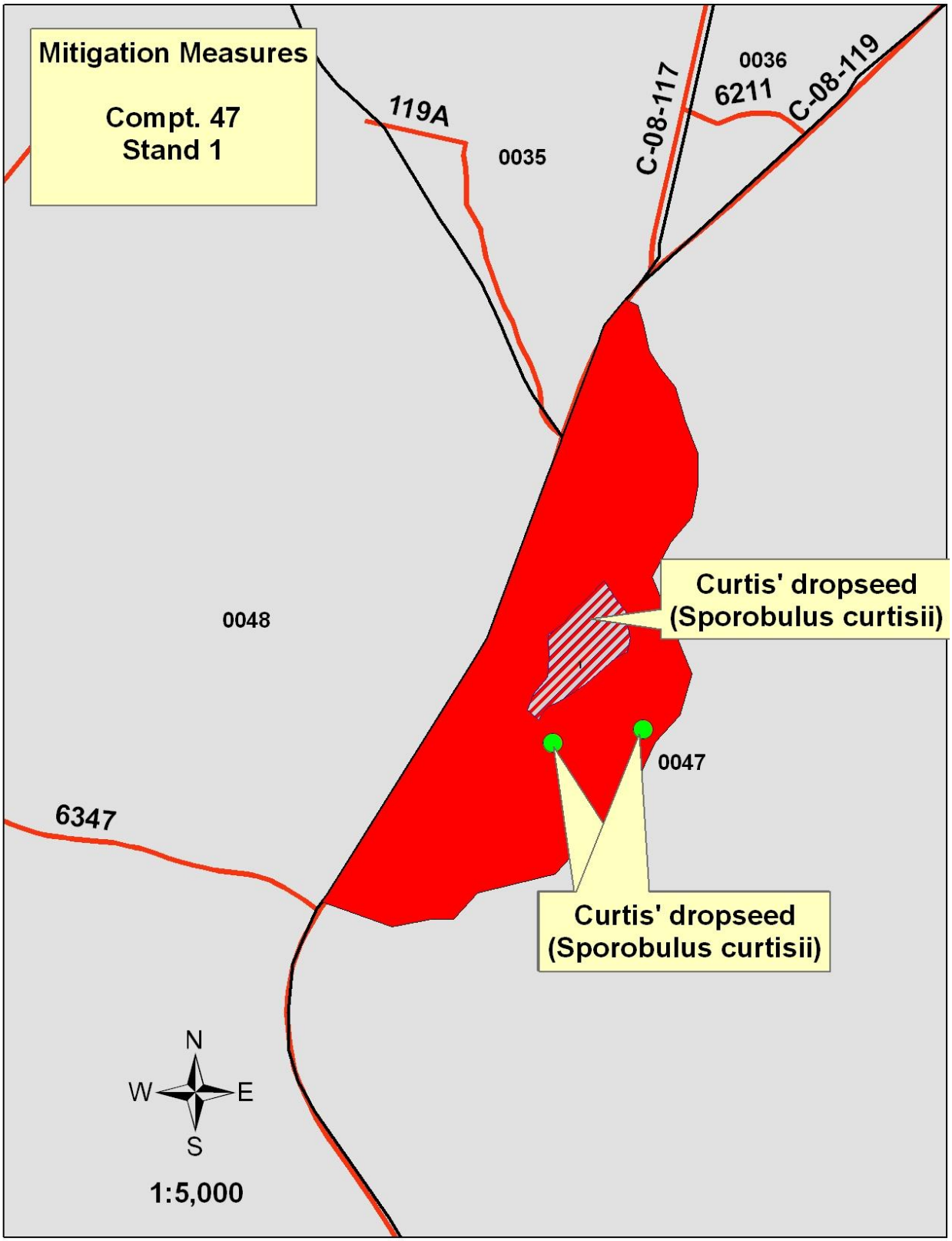
Map B-6


Mitigation Measures
Compt. 37
Stand 12
Curtis' dropseed
(Sporobulus curtisii)
12
0037
0038
6116
C-08-119
119E
N
W
E
S
1:4,000

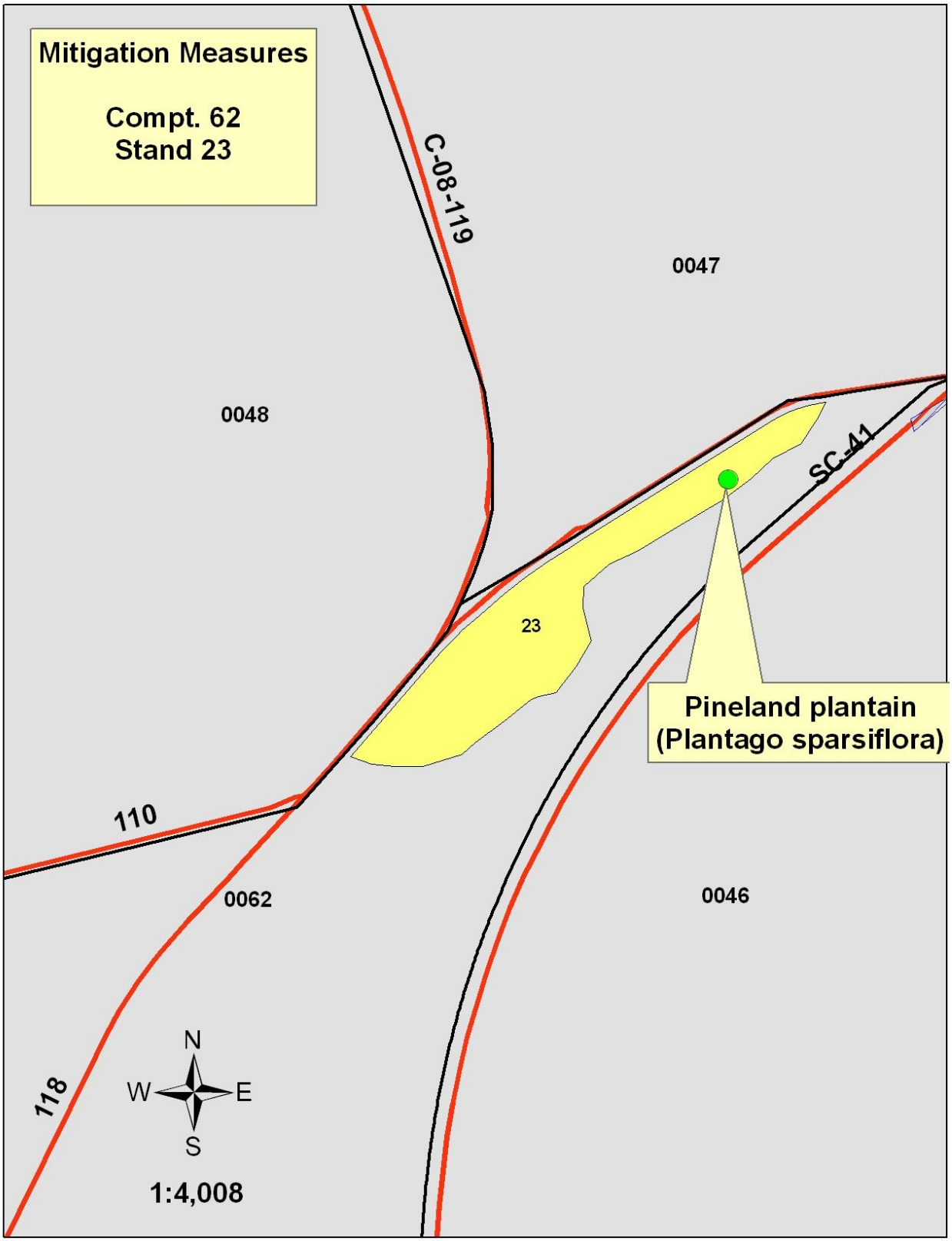
Map B-7


Mitigation Measures
Compt. 46
Stand 20
0047
SC-41
Pineland plantain
(Plantago sparsiflora)
118
0062
20
0046
161
N
W
E
S
1:4,000
0063

Map B-8


Mitigation Measures
Compt. 47
Stand 1
119A
0035
C-08-117
0036
6211
C-08-119
0048
Curtis' dropseed
(Sporobulus curtisii)
0047
6347
Curtis' dropseed
(Sporobulus curtisii)
N
W
E
S
1:5,000

Map B-9


Mitigation Measures
Compt. 62
Stand 23
C-08-119
0047
0048
SC-41
23
Pineland plantain
(Plantago sparsiflora)
110
0062
0046
118
N
W
E
S
1:4,008

Appendix C – Herbicide Risk Assessment

Summary of Risk Displayed by Hazard Quotient Calculations
Macedonia Project
Francis Marion National Forest

Hazard quotients (HQs) have been calculated using methodology from Pat Durkin of Syracuse Environmental Research Associates (SERA). Version 6.0.11 of the SERA worksheets was used. In the risk assessments, there are two terms not used in the VMEIS. These are **Reference Dose** (RfD) and **Hazard Quotient** (HQ).

- **RfD -** Derived by USEPA, this is the maximum dose in mg of herbicide active ingredient per kg of body weight per day that is <u>not</u> expected to cause injury over a lifetime of exposure. In other words, it is, in EPA's opinion, a "safe" dose. This is a conservative estimate, and is designed to be protective.
- **HQ -** This is the ratio of the estimated exposure dose to the RfD. A HQ of 1 equals exposure to the RfD; HQs less than 1 represent exposures to less than the RfD, while HQs greater than 1 represent exposures greater than the RfD. *HQs of 1.0 or less represent exposure levels that are not of concern.* HQs greater than 1.0 represent possible effects to be examined more closely. The assumptions for any exposures producing a HQ greater than 1.0 are examined to see if the exposures need to be mitigated or avoided. For the effects on wildlife, one must remember that these effects are constructed for individuals and not populations.

An important consideration with hazard quotients is that they are set at 100 times the No Observable Adverse Effect Level (NOAEL). Even single digit or double digit hazard quotients would still be below the NOAEL.

The spreadsheets of most importance within each workbook are the following:
E02: Hazard quotients for workers
E04: Hazard quotients for the general public
G02: Hazard quotients for terrestrial wildlife
G03: Hazard quotients for aquatic species

The most important hazard quotient is the general exposure HQ for workers. These are the people most likely to have direct exposure. The ***<u>central</u>*** *HQ best reflects a realistic upper exposure and risk for workers using required PPE and expected washing/hygiene habits (Paul Mistretta, personal communication 11/16/10).*

Hazard quotients derived from spill scenarios into ponds have been set to zero. The reason is that the project has mitigation measures in place that make such spills so unlikely that such an analysis would be irrelevant.

Mitigation Measures

The mitigation measures referred to above are:

1. The requirement that mix water be carried to the site by the contractor or workers.
2. The requirement that trucks containing herbicide or tank mixed herbicide will not be allowed to park within 200 feet of a stream or pond.

It must be noted that herbicide label directions require applicators to remove clothing immediately if herbicide gets inside, then wash thoroughly and put on clean clothing. This mitigates the contaminated gloves scenario analyzed with hazard quotients.

Notice signs are posted at points where public access is likely. These signs are clearly posted, and include the application date, herbicide applied, and safe reentry date.

There are threatened or endangered plants in 3 stands in the project area. These are:

- Compt. 15 Stand 17 – Carolina Tuff Grass (Tridens carolinianus)

- Compt. 16 Stand 17 – Crested Fringed Orchid (Pteroglossapsis ecristata)

- Compt. 36 Stand 22 –
    - Curtis' Dropseed (Sporobulus curtissii)
    - Carolina Tuff Grass (Tridens carolinianus)
    - Incised groovebur (Agrimonia incisa)

In these 3 stands the plants described above will be located before application and a buffer will be flagged around them so that they will be avoided.

Assumptions

This Forest corresponded with 2 Ranger Districts on a National Forest that is currently using the proposed thin line application of triclopyr (Garlon 4 or equivalent). Their total amount of mix applied per acre is generally between 1 and 1.5 gallons. Using the upper estimate of 1.5 gallons of mix per acre, with the mix consisting of 16.7% of triclopyr ester, this gives:

192 oz mix per acre * 0.167 = 32 oz Garlon 4 per acre
32 oz Garlon 4 * 1 gal/128 oz * 4 lb a.e./gal = 1.0 lb acid equivalent triclopyr ester/acre

The project also proposes using a cut surface application triclopyr amine (Garlon 3A or equivalent) to create snags for wildlife habitat. The cut surface mixture is planned as 100% Garlon 3A or equivalent. Assuming the average treated stem is 16" diameter with 2 treated trees/acre, the result is:

Circumference = πd = 3.14159 * 16" = 50.27"

Cuts/tree on 4" centers = 50.27/4 = 12.57 cuts/tree
At 1 ml mix per cut, the application rate = 12.57 ml * 2 trees/ac = 25 ml mix/acre
25 ml * 1 gal/3784 ml * 3 lbs a.e/gal = 0.02 lb triclopyr amine/acre

Hazard quotients over 1.0 for wildlife or plants are only a factor for threatened or endangered species in this assessment. This Forest and agency manages populations, not individual plants or animals, except in the case of threatened or endangered species. There are endangered red-cockaded woodpeckers in the project area in stands 9 and 10 in compartment 15. For this reason, the scenario of a small bird consuming contaminated insects has been given particular attention.

Hazard quotients for the general public involving direct spray exposures are also considered so unlikely as to be irrelevant. These have also been set to zero.

Hazard quotients were calculated for the estimated application rates for this project. HQs over 1.0 are discussed below.

Triclopyr ester, thin line application @ 1.0 lb/acre

On sheet E02, the scenarios for 1 hour exposure by contaminated gloves have hazard quotients that exceed 1. As noted above in this document, herbicide label directions require applicators to remove clothing immediately if herbicide gets inside, then wash thoroughly and put on clean clothing. This requirement mitigates this scenario.

On sheet E02, the high estimate hazard quotient for workers is 6. The central estimate is 0.5. This is not a concern because:

- The central estimate of 0.5 is less than 1, by a factor of 2. The central HQ best reflects a realistic upper exposure and risk for workers using required PPE and expected washing/hygiene habits.
- A foliar spray application model was used because this is the closest application model available. With a thin line application there should be far less herbicide exposure to applicators than with a foliar spray application, which would have much finer droplets.

On sheet E04, the scenario for acute exposure of a person to contaminated fruit has an upper estimate hazard quotient of 4. This does not give concern because:

- The central estimate of 0.2 is less than 1, by a factor of 5.
- To prevent such an occurrence, warning signs are posted where public access is likely.
- Any non-target vegetation that was sprayed with triclopyr would soon wilt and brown, becoming unappetizing.
- There are few items of wild fruit available in the project area and such gathering is not known to be common in the project area.

On sheet E04, the scenario for acute exposure of a person by contact with contaminated vegetation has a high bound estimated hazard quotient of 27 and a central estimate of 3. These do not raise a concern for the following reasons:

- To prevent such an occurrence, warning signs are posted where public access is likely.

- To get such an exposure a person would have to walk through the treated area the day of spraying.
- In the scenario, the people exposed are assumed to be wearing shorts. Very few people venture into the woods wearing shorts.

Also on sheet E04, the scenario for chronic exposure of a person to contaminated vegetation has an upper estimate of 6 The central estimate is 0.2. This does not pose a concern for the same reasons shown for acute exposure of a person to contaminated fruit. In addition to the 3 reasons above, the chronic exposure scenario assumes consumption of contaminated vegetation for 90 days, making such exposure even more unlikely.

On sheet E04, the scenario for chronic exposure of a person to contaminated fruit has an upper estimate hazard quotient of 3. This does not give concern because:

- The central estimate of 0.09 is less than 1, by a factor of over 10.
- To prevent such an occurrence, warning signs are posted where public access is likely.
- Any non-target vegetation that was sprayed with triclopyr would soon wilt and brown, becoming unappetizing.
- The chronic exposure scenario assumes consumption of contaminated vegetation for 90 days, which is most unlikely.
- There are few items of wild fruit available in the project area and such gathering is not known to be common in the project area.

On sheet G02a, several upper estimate hazard quotients for exposures of mammals exceed 1. None of the central estimates exceed 3 and most are less than 1. The upper bound estimates are not a concern because:

- The central estimates are either less than 1, or close to 1.
- There are no threatened or endangered mammal species in the project area.
- These hazard quotients address individuals, not wildlife populations.

On sheet G02b, several upper estimate hazard quotients for birds consuming different types of vegetation exceed 1. None of the central estimates exceed 3 and most are close to 1 or less than 1. The upper bound hazard quotients do not pose a concern for the following reasons:

- The central estimates are either less than 1, or close to 1.
- The endangered species of interest, the red-cockaded woodpecker feeds predominantly on insects.
- The chronic scenarios further assume a diet composed of 100% contaminated vegetation from on site for 90 consecutive days. This is most unlikely. Again, red-cockaded woodpeckers feed predominantly on insects.
- Regarding species that are not threatened or endangered, these HQs deal with individuals, not wildlife populations.

Also on sheet G02b, the scenario for a small bird consuming contaminated insects has an upper estimate hazard quotient of 1.8 with a central estimate of 0.3. The risk should be acceptable because:

- The central estimate HQ is less than 1 by a factor of over 3.

- The application had to be modeled as a backpack sprayer directed foliar application. Such an application would have finer droplets, resulting in broader dispersion onto non-target materials than the proposed thinline application.
- There are only 2 stands with RCW cavity trees inside the boundary. They are stands 9 and 10 in compartment 15.

On sheet G03, the upper estimate for non-accidental acute exposures - sensitive algae is 21. The central estimate is 0.3. The upper bound hazard quotient does not pose a concern for the following reasons:

- The central estimate is much less than 1.
- There are no threatened or endangered algae near the proposed spray area.
- These HQs deal with individuals, not aquatic plant populations.
- The modeling does not assume any buffers to streams. The proposed spray application is not adjacent to streams.
- Triclopyr is not mobile in soil (Southern Region Forestry Use Pesticides "Label Book", p244).

Triclopyr amine, cut surface application @ 0.02 lb/acre

The models available are based on foliar application, which should overestimate the effects of application.

On sheet G02a, the upper estimate hazard quotient for chronic/long term exposures of large mammals consuming contaminated short grass is 1.1. The central estimate is less than 1 at 0.09. The upper bound estimate is not a concern because:

- It is very close to 1.
- The central estimate is less than 1 by a factor of more than 10.
- The chronic scenarios assume a diet composed of 100% contaminated vegetation from on site for 90 consecutive days. This is most unlikely.
- There are no threatened or endangered large mammal species in the project area.
- These hazard quotients address individuals, not wildlife populations.
- A foliar spray application model was used because this is the closest application model available. With a cut surface application there should be far less herbicide applied to non-target vegetation than with a foliar spray application, which would have much finer droplets.

On sheet G02b, the upper estimate hazard quotient for chronic/long term exposure for a small bird consuming contaminated short grass is 1.1. The central estimate is less than 1 at 0.09. The upper bound hazard quotient does not pose a concern for the following reasons:

- The central estimate is less than 1 by a factor of more than 10.
- The endangered species of interest, the red-cockaded woodpecker feeds predominantly on insects.

- The chronic scenarios further assume a diet composed of 100% contaminated vegetation from on site for 90 consecutive days. This is most unlikely. Again, red-cockaded woodpeckers feed predominantly on insects.
- Regarding species that are not threatened or endangered, these HQs deal with individuals, not wildlife populations.
- A foliar spray application model was used because this is the closest application model available. With a cut surface application there should be far less herbicide applied to non-target vegetation than with a foliar spray application, which would have much finer droplets.

On sheet G03, the upper estimate for non-accidental acute exposures – aquatic plants is 10. The central estimate is 0.1. The upper bound hazard quotient does not pose a concern for the following reasons:

- The central estimate is much less than 1.
- There are no threatened or endangered aquatic plants near the proposed spray area.
- These HQs deal with individuals, not aquatic plant populations.
- The modeling does not assume any buffers to streams. The proposed application will not treat trees in close proximity to streams.
- Triclopyr is not mobile in soil (Southern Region Forestry Use Pesticides "Label Book", p244).

On sheet G03, the upper estimate for chronic/long term exposures – aquatic plants is 2. The central estimate is 0.04. The upper bound hazard quotient does not pose a concern for the following reasons:

- The central estimate is much less than 1, 25 times less.
- There are no threatened or endangered aquatic plants near the proposed spray area.
- These HQs deal with individuals, not aquatic plant populations.
- The modeling does not assume any buffers to streams. The proposed application will not treat trees in close proximity to streams.
- Triclopyr is not mobile in soil (Southern Region Forestry Use Pesticides "Label Book", p244).

Appendix D – Migratory Birds

Attachment 1

Total number of priority migratory bird species observed on the Francis Marion National Forest 1992-2013

	Survey Year																				
Species	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
AMERICAN KESTREL													1								
BACHMAN`S SPARROW	1		5	23	18	15	11	11	13	8	10	10	7	6	5	11	8	10	11	18	10
BLACK-THROATED GREEN WARBLER			2			1															
BROWN-HEADED NUTHATCH	2		9	14	33	34	11	26	12	11	18	20	23	19	19	44	36	45	18	37	12
HOODED WARBLER	1		29	12	10	9	14	14	15	10	19	38	27	42	39	51	44	66	39	42	36
LOGGERHEAD SHRIKE						1															
NORTHERN PARULA		3	37	40	18	29	27	24	23	17	29	26	21	13	41	70	79	82	45	71	44
PAINTED BUNTING								1		1		1			1			2			
PRAIRIE WARBLER	1		27	42	32	42	23	47	19	20	12	28	20	8	9	35	23	9	22	13	11
SWAINSON`S WARBLER			3		2	1	3	4	1		4	4	7	7	7	4	8	8	2	6	6
SWALLOW-TAILED KITE				1	2							1				2		1			
WOOD THRUSH		1	8	9	2	2	3	5	6	7	4	3	3		4	2	2	5			2
WORM-EATING WARBLER			1			1							2	1		2	7	8	3	2	5
Total Individuals Observed:	**5**	**4**	**121**	**141**	**117**	**135**	**92**	**132**	**89**	**74**	**96**	**131**	**111**	**96**	**125**	**221**	**207**	**236**	**140**	**189**	**126**
No. Species matching Criteria:	**4**	**2**	**9**	**7**	**8**	**10**	**7**	**8**	**7**	**7**	**7**	**9**	**9**	**7**	**8**	**9**	**8**	**10**	**7**	**7**	**8**
No. Points matching Criteria:	**3**	**1**	**59**	**73**	**60**	**68**	**59**	**72**	**49**	**51**	**57**	**77**	**56**	**62**	**66**	**93**	**77**	**85**	**71**	**76**	**57**

Attachment 2

Bird species relative abundance by year for 17 bird monitoring points in the Macedonia Analysis Area.

	Survey Year																		
Species	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**Mean**
ACADIAN FLYCATCHER	0.06	0.06	0.12	0.12			0.12	0.12	0.13	0.11		0.1	0.22	0.37	0.72	0.56	0.5	0.4		**0.25**
ALDER FLYCATCHER														0.11						**0.11**
AMERICAN CROW	0.38	0.39	0.82	0.77	0.5	0.65	0.53	0.53	0.31	0.5	0.17	0.15	0.33	0.11	0.44	0.61	0.78	0.13	0.33	**0.44**
ANHINGA			0.06																	**0.06**
BACHMAN`S SPARROW	0.13	0.11	0.06		0.06	0.12	0.12													**0.1**
BALD EAGLE				0.18																**0.18**
BARRED OWL					0.11												0.06			**0.08**
BLACK VULTURE		0.17	1.18			0.06								0.16	0.06	0.06				**0.28**
BLACK-AND-WHITE WARBLER										0.06		0.1								**0.08**
BLUE GROSBEAK		0.06	0.06	0.12				0.06	0.06				0.06				0.06			**0.07**
BLUE JAY	0.13	0.22	0.06		0.17	0.24	0.47	0.12	0.06	0.11	0.28	0.15	0.33	0.32	0.33	0.28	0.28	0.13		**0.22**
BLUE-GRAY GNATCATCHER	0.69	0.33	0.24	0.29	0.33	0.41	0.12	0.41	0.44	0.22	0.06	0.15	0.22	0.95	0.83	1.06	0.39	0.93		**0.45**
BLUE-WINGED WARBLER													0.06							**0.06**
BOAT-TAILED GRACKLE													0.11							**0.11**
BROAD-WINGED HAWK													0.06							**0.06**
BROWN THRASHER		0.06		0.24	0.06			0.06	0.25	0.11	0.11			0.05	0.17			0.07		**0.12**
BROWN-HEADED COWBIRD	0.06	0.28	0.29	0.41	0.06	0.12		0.12	0.19	0.39	0.11	0.05	0.06	0.05	0.06					**0.16**
BROWN-HEADED NUTHATCH	0.06	0.11	0.18	0.41					0.13	0.11	0.11	0.05	0.22	0.16	0.44	0.33		0.07		**0.18**
CAROLINA CHICKADEE	0.38	0.33	0.12	0.35	0.28	0.47	0.24	0.41	0.19				0.44	0.37	1	0.39	0.33	0.93		**0.42**
CAROLINA WREN	1	1.39	1	1.24	1.17	1.53	0.77	0.65	1	0.83	1.83	0.75	1.17	1.11	2.28	1.78	0.61	1.33		**1.19**
CATTLE EGRET		0.06									0.11									**0.08**
CHIMNEY SWIFT	0.19	0.06	0.18	0.06			0.06	0.18		0.06				0.05	0.22	0.17	0.11		1.33	**0.22**
CHIPPING SPARROW		0.11																		**0.11**
COMMON GRACKLE	0.13	0.28	0.53	0.41	0.44	0.06	0.18		0.31	0.33	1.78		0.17	0.05	0.11		0.11			**0.35**
COMMON YELLOWTHROAT	0.88	1.44	1.06	1.24	0.94	1.06	0.94	1.65	0.56	0.11	0.61	0.3	0.5	0.68	0.72	0.72	0.39	0.13	0.67	**0.77**
COOPER`S HAWK														0.05						**0.05**
DOUBLE-CRESTED CORMORANT							0.06													**0.06**
DOWNY WOODPECKER	0.31	0.33	0.29	0.29	0.22		0.06	0.24		0.11	0.06	0.05	0.17	0.37	0.17	0.11	0.11	0.4		**0.21**
EASTERN BLUEBIRD	0.19	0.17	0.06				0.12								0.11	0.06			0.33	**0.15**
EASTERN KINGBIRD	0.06																			**0.06**
EASTERN PHOEBE													0.06					0.07		**0.06**
EASTERN TOWHEE	1.19	1.67	1.71	1.41	0.89	0.88	0.82	0.94	0.81	0.61	0.78	0.4	1.11	1	0.83	1.94	1	0.4	0.67	**1**
EASTERN TUFTED TITMOUSE	0.5	0.44	0.29	0.41	0.5	0.53	0.47	0.29	0.63	0.89	0.44	0.15	0.83	1.26	1.22	0.78	0.94	0.73		**0.63**
EASTERN WOOD-PEWEE	0.44	0.17	0.24	0.12	0.17		0.06	0.12	0.06		0.06			0.11			0.22			**0.16**
EUROPEAN STARLING		0.06									0.06									**0.06**
FISH CROW	0.13	0.17	0.35	0.18		0.24	0.18	0.12	0.06	0.11			0.06	0.26	0.17	0.22	0.11			**0.17**
GRAY CATBIRD		0.11		0.06			0.06	0.12					0.11	0.05						**0.09**
GREAT BLUE HERON		0.17	0.06	0.06	0.11	0.06	0.06	0.06					0.06							**0.08**
GREAT CRESTED FLYCATCHER	0.81	0.94	0.35	1.47	0.94	0.82	1.12	0.65	0.63	0.83	0.67	0.5	1.11	0.95	0.94	1.44	0.94	0.73	0.33	**0.85**
GREAT EGRET	0.13	0.17	0.29		0.06															**0.16**
HAIRY WOODPECKER	0.06								0.06	0.06			0.17					0.13		**0.1**
HOODED WARBLER	0.19	0.22	0.24	0.35	0.17	0.06	0.06	0.12	0.5	0.5	1	0.75	0.78	0.74	0.72	1.22	0.44	0.73		**0.49**
HOUSE WREN													0.06							**0.06**
INDIGO BUNTING	0.44	0.28	0.12	0.12	0.06								0.11							**0.19**
KENTUCKY WARBLER		0.06	0.06	0.06	0.06			0.12		0.06	0.11		0.44	0.37	0.11	0.22	0.11	0.07		**0.14**
LITTLE BLUE HERON			0.06					0.06								0.06				**0.06**
LOGGERHEAD SHRIKE				0.06																**0.06**
MISSISSIPPI KITE																0.06				**0.06**
MOURNING DOVE	0.25	0.28	0.59	0.29	0.39	0.18	0.06	0.35	0.13	0.17	0.11	0.1	0.11	0.05	0.11	0.22	0.39	0.07	0.33	**0.22**
NORTHERN BOBWHITE	0.13	0.11	0.29	0.06	0.11	0.12	0.06		0.06								0.06			**0.11**
NORTHERN CARDINAL	0.81	0.72	0.94	0.65	0.83	0.71	0.59	0.82	0.69	0.94	0.5	0.95	1.33	1.79	1.33	1.33	1.06	1.07	0.33	**0.92**
NORTHERN FLICKER	0.56	0.33	0.06	0.18	0.22	0.18	0.18	0.06	0.25	0.17	0.17		0.22	0.11			0.06	0.07		**0.19**
NORTHERN MOCKINGBIRD			0.06				0.06		0.06	0.06	0.06		0.06	0.05	0.06					**0.06**
NORTHERN PARULA	0.75	0.44	0.29	0.53	0.17	0.24	0.35	0.12	0.19	0.22	0.17	0.15	0.94	0.9	1.5	1.61	0.28	0.47	0.67	**0.53**
NORTHERN ROUGH-WINGED SWALLOW														0.05	0.28					**0.17**
ORCHARD ORIOLE	0.06	0.22		0.12	0.06	0.06														**0.1**
OSPREY							0.06													**0.06**
OVENBIRD		0.06							0.06			0.2	0.22	0.11			0.11	0.33		**0.16**
PALM WARBLER												0.05								**0.05**
PILEATED WOODPECKER	0.44	0.22	0.29	0.47	0.22	0.35	0.47	0.41	0.38	0.44	0.28		0.17	0.53	0.5	0.56	0.44	0.6		**0.4**
PINE WARBLER	0.19	0.11	0.18	0.41	0.39	0.59	0.35	0.18	0.44	0.39	0.39	0.4	0.89	1	0.83	0.83	0.5	0.47	0.33	**0.47**
PRAIRIE WARBLER	0.38	0.72	0.29	0.53		0.59				0.22		0.05		0.05			0.06			**0.32**
PROTHONOTARY WARBLER	0.44	0.67	0.47	0.82	0.39	0.71	0.24	0.29	0.06	0.44	0.28	0.4	0.78	0.68	0.83	0.83	0.28	0.47		**0.5**
PURPLE MARTIN		0.06		0.18					0.19	0.17		0.05				0.17				**0.13**
RED-BELLIED WOODPECKER	1.06	0.94	1.12	0.59	0.72	0.59	0.24	0.41	0.5	0.56	0.44	0.15	0.61	0.9	0.72	1.06	0.89	1		**0.69**
RED-COCKADED WOODPECKER						0.12														**0.12**
RED-EYED VIREO	0.38	0.22	0.24	0.47	0.22	0.41	0.18	0.06	0.06	0.39		0.2	0.17	0.26	0.11	0.17	0.11	0.13		**0.22**
RED-HEADED WOODPECKER	0.44	0.44	0.24	0.88	0.28	0.29	0.06	0.18	0.13		0.06		0.17	0.05			0.11			**0.26**
RED-SHOULDERED HAWK	0.06							0.12		0.06		0.05	0.17	0.63	0.39	0.61	0.44	0.33		**0.29**
RED-TAILED HAWK													0.06	0.05						**0.05**
RUBY-THROATED HUMMINGBIRD	0.13	0.11	0.06							0.06					0.06			0.07		**0.08**
SHARP-SHINNED HAWK															0.06					**0.06**
SUMMER TANAGER	0.13	0.11	0.24	0.12	0.28	0.06	0.06	0.29	0.06	0.17	0.22	0.1	0.28	0.26	0.39	0.22	0.22	0.47		**0.2**
SWAINSON`S WARBLER					0.06	0.12			0.13	0.11	0.22	0.2	0.28		0.11			0.07		**0.14**
SWALLOW-TAILED KITE			0.12							0.06				0.05						**0.08**
TREE SWALLOW																		0.2		**0.2**
TURKEY VULTURE	0.13	0.22	0.12	0.12	0.89		0.06	0.06	0.06				0.17	0.16	0.44	0.11		0.07		**0.2**
WHITE IBIS							0.12													**0.12**
WHITE-BREASTED NUTHATCH	0.13	0.06				0.06							0.06							**0.07**
WHITE-EYED VIREO	0.31	0.28	0.94	0.41	0.56	0.71	0.24	0.59	1	0.56	0.28	0.45	0.61	0.9	1.44	1.44	0.22	0.8		**0.65**
WILD TURKEY													0.06	0.05		0.44				**0.18**
WOOD DUCK		0.06		0.06		0.06		0.06												**0.06**
WOOD STORK							0.06													**0.06**
WOOD THRUSH	0.06	0.17			0.06			0.06	0.19	0.17	0.17		0.11	0.05		0.17				**0.12**
WORM-EATING WARBLER											0.06	0.05		0.05	0.06	0.22	0.11	0.07		**0.09**
YELLOW WARBLER												0.05								**0.05**
YELLOW-BELLIED SAPSUCKER																0.06				**0.06**
YELLOW-BILLED CUCKOO	0.13	0.22	0.41	0.35	0.56	0.35	0.18	0.06	0.25	0.44	0.39	0.6	0.61	0.79	0.5	0.39	0.11	0.33		**0.37**
YELLOW-BREASTED CHAT	0.69	0.67	0.77	0.77	0.28	0.35	0.41	0.35	0.19	0.22		0.1	0.11	0.16	0.11	0.11	0.06			**0.33**
YELLOW-THROATED VIREO	0.06		0.24	0.06					0.06	0.22							0.06			**0.12**
YELLOW-THROATED WARBLER		0.11	0.12			0.18			0.06	0.11		0.1		0.21	0.28	0.06	0.22	0.07	0.33	**0.15**
No. Species matching Criteria:	**47**	**56**	**50**	**46**	**40**	**38**	**41**	**40**	**42**	**43**	**34**	**34**	**50**	**50**	**42**	**40**	**40**	**37**	**11**	
No. Points matching Criteria:	**16**	**18**	**17**	**17**	**18**	**17**	**17**	**17**	**16**	**18**	**18**	**20**	**18**	**19**	**18**	**18**	**18**	**15**	**3**	