

Double Trouble State Park

Natural Resource Stewardship Plan

January 1, 2016



State of New Jersey
Department of Environmental Protection
State Forestry Services



State of New Jersey

DEPARTMENT OF ENVIRONMENTAL PROTECTION

STATE FORESTRY SERVICES

Mail Code 501-04

P.O. Box 420

Trenton, NJ 08625-0420

Tel. (609) 292-2520 FAX (609) 984-0378

CHRIS CHRISTIE
Governor

BOB MARTIN
Commissioner

KIM GUADAGNO
Lt. Governor

Management Plan Review: Final Plan Approval

Plan Area:	Double Trouble State Park
Property Ownership:	New Jersey Division of Parks and Forestry
Plan Date:	January 1, 2015
Plan Length:	10 Years – 2015 to 2024
Plan Title:	“Double Trouble State Park Natural Resource Stewardship Plan”

The undersigned agency and their representatives accept and endorse as complete the management plan (“the plan”) named above. The undersigned state that they have participated in the development of the plan and have received and reviewed the plan in its final form. This endorsement shall constitute approval of the plan for the duration of the plan length, beginning on the date indicated above (inclusive).

Subsection for ENSP and ONLM staff:

The NJDEP staff responsible for Threatened and Endangered Species have determined that the activities in the plan will not create irreversible adverse impacts on threatened and endangered plant and animal species.

Subsection for HPO staff:

The NJDEP State Historic Preservation Office has determined that the activities in the plan will not negatively impact significant cultural resources.

I have read and agree to statement above (please check):

New Jersey State Forestry Services – State Lands Management

Signature

Name (print)

[Handwritten Signature]

[Handwritten Name: JAMES E. PLUMING]

Date *12/10/14*



State of New Jersey

DEPARTMENT OF ENVIRONMENTAL PROTECTION

STATE FORESTRY SERVICES

Mail Code 501-04

P.O. Box 420

Trenton, NJ 08625-0420

Tel. (609) 292-2520 FAX (609) 984-0378

CHRIS CHRISTIE
Governor

BOB MARTIN
Commissioner

KIM GUADAGNO
Lt. Governor

Management Plan Review:

Final Plan Approval

Plan Area:	Double Trouble State Park
Property Ownership:	New Jersey Division of Parks and Forestry
Plan Date:	January 1, 2015
Plan Length:	10 Years – 2015 to 2024
Plan Title:	“Double Trouble State Park Natural Resource Stewardship Plan”

The undersigned agency and their representatives accept and endorse as complete the management plan (“the plan”) named above. The undersigned state that they have participated in the development of the plan and have received and reviewed the plan in its final form. This endorsement shall constitute approval of the plan for the duration of the plan length, beginning on the date indicated above (inclusive).

Subsection for ENSP and ONLM staff:

The NJDEP staff responsible for Threatened and Endangered Species have determined that the activities in the plan will not create irreversible adverse impacts on threatened and endangered plant and animal species.

Subsection for HPO staff:

The NJDEP State Historic Preservation Office has determined that the activities in the plan will not negatively impact significant cultural resources.

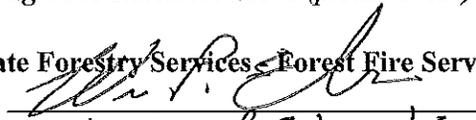
I have read and agree to statement above (please check):



New Jersey State Forestry Services - Forest Fire Service

Signature

Name (print)


William P. Edwards

Date

12/5/2014



State of New Jersey

DEPARTMENT OF ENVIRONMENTAL PROTECTION

STATE FORESTRY SERVICES

Mail Code 501-04

P.O. Box 420

Trenton, NJ 08625-0420

Tel. (609) 292-2520 FAX (609) 984-0378

CHRIS CHRISTIE
Governor

BOB MARTIN
Commissioner

KIM GUADAGNO
Lt. Governor

Management Plan Review: Final Plan Approval

Plan Area:	Double Trouble State Park
Property Ownership:	New Jersey Division of Parks and Forestry
Plan Date:	January 1, 2015
Plan Length:	10 Years – 2015 to 2024
Plan Title:	“Double Trouble State Park Natural Resource Stewardship Plan”

The undersigned agency and their representatives accept and endorse as complete the management plan (“the plan”) named above. The undersigned state that they have participated in the development of the plan and have received and reviewed the plan in its final form. This endorsement shall constitute approval of the plan for the duration of the plan length, beginning on the date indicated above (inclusive).

Subsection for ENSP and ONLM staff:

The NJDEP staff responsible for Threatened and Endangered Species have determined that the activities in the plan will not create irreversible adverse impacts on threatened and endangered plant and animal species.

Subsection for HPO staff:

The NJDEP State Historic Preservation Office has determined that the activities in the plan will not negatively impact significant cultural resources.

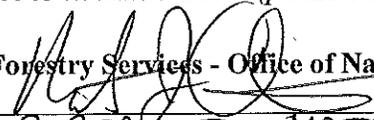
I have read and agree to statement above (please check):



New Jersey State Forestry Services - Office of Natural Lands Management

Signature

Name (print)


ROBERT J. CARTICA

Date

12/5/14



State of New Jersey

DEPARTMENT OF ENVIRONMENTAL PROTECTION

STATE FORESTRY SERVICES

Mail Code 501-04

P.O. Box 420

Trenton, NJ 08625-0420

Tel. (609) 292-2520 FAX (609) 984-0378

CHRIS CHRISTIE
Governor

BOB MARTIN
Commissioner

KIM GUADAGNO
Lt. Governor

Management Plan Review: Final Plan Approval

Plan Area:	Double Trouble State Park
Property Ownership:	New Jersey Division of Parks and Forestry
Plan Date:	January 1, 2015
Plan Length:	10 Years – 2015 to 2024
Plan Title:	“Double Trouble State Park Natural Resource Stewardship Plan”

The undersigned agency and their representatives accept and endorse as complete the management plan (“the plan”) named above. The undersigned state that they have participated in the development of the plan and have received and reviewed the plan in its final form. This endorsement shall constitute approval of the plan for the duration of the plan length, beginning on the date indicated above (inclusive).

Subsection for ENSP and ONLM staff:

The NJDEP staff responsible for Threatened and Endangered Species have determined that the activities in the plan will not create irreversible adverse impacts on threatened and endangered plant and animal species.

Subsection for HPO staff:

The NJDEP State Historic Preservation Office has determined that the activities in the plan will not negatively impact significant cultural resources.

I have read and agree to statement above (please check):

New Jersey State Park Service

Signature 

Name (print) Mark Rexert

Date 12/8/2018



State of New Jersey

DEPARTMENT OF ENVIRONMENTAL PROTECTION

STATE FORESTRY SERVICES

Mail Code 501-04

P.O. Box 420

Trenton, NJ 08625-0420

Tel. (609) 292-2520 FAX (609) 984-0378

CHRIS CHRISTIE
Governor

BOB MARTIN
Commissioner

KIM GUADAGNO
Lt. Governor

Management Plan Review: Final Plan Approval

Plan Area:	Double Trouble State Park
Property Ownership:	New Jersey Division of Parks and Forestry
Plan Date:	January 1, 2015
Plan Length:	10 Years – 2015 to 2024
Plan Title:	“Double Trouble State Park Natural Resource Stewardship Plan”

The undersigned agency and their representatives accept and endorse as complete the management plan (“the plan”) named above. The undersigned state that they have participated in the development of the plan and have received and reviewed the plan in its final form. This endorsement shall constitute approval of the plan for the duration of the plan length, beginning on the date indicated above (inclusive).

Subsection for ENSP and ONLM staff:

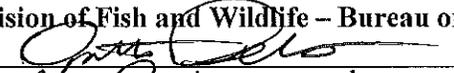
The NJDEP staff responsible for Threatened and Endangered Species have determined that the activities in the plan will not create irreversible adverse impacts on threatened and endangered plant and animal species.

Subsection for HPO staff:

The NJDEP State Historic Preservation Office has determined that the activities in the plan will not negatively impact significant cultural resources.

I have read and agree to statement above (please check):

New Jersey Division of Fish and Wildlife – Bureau of Lands Management

Signature  Date 12/8/14

Name (print) A. Petrongolo



State of New Jersey

DEPARTMENT OF ENVIRONMENTAL PROTECTION

STATE FORESTRY SERVICES

Mail Code 501-04

P.O. Box 420

Trenton, NJ 08625-0420

Tel. (609) 292-2520 FAX (609) 984-0378

CHRIS CHRISTIE
Governor

BOB MARTIN
Commissioner

KIM GUADAGNO
Lt. Governor

Management Plan Review:
Final Plan Approval

Plan Area:	Double Trouble State Park
Property Ownership:	New Jersey Division of Parks and Forestry
Plan Date:	January 1, 2015
Plan Length:	10 Years – 2015 to 2024
Plan Title:	“Double Trouble State Park Natural Resource Stewardship Plan”

The undersigned agency and their representatives accept and endorse as complete the management plan (“the plan”) named above. The undersigned state that they have participated in the development of the plan and have received and reviewed the plan in its final form. This endorsement shall constitute approval of the plan for the duration of the plan length, beginning on the date indicated above (inclusive).

Subsection for ENSP and ONLM staff:

The NJDEP staff responsible for Threatened and Endangered Species have determined that the activities in the plan will not create irreversible adverse impacts on threatened and endangered plant and animal species.

Subsection for HPO staff:

The NJDEP State Historic Preservation Office has determined that the activities in the plan will not negatively impact significant cultural resources.

I have read and agree to statement above (please check):



New Jersey Division of Fish and Wildlife – Endangered and Non-Game Species

Signature

Date 12/8/14

Name (print)

C. David Jenkins, Jr.



State of New Jersey

DEPARTMENT OF ENVIRONMENTAL PROTECTION

STATE FORESTRY SERVICES

Mail Code 501-04

P.O. Box 420

Trenton, NJ 08625-0420

Tel. (609) 292-2520 FAX (609) 984-0378

CHRIS CHRISTIE
Governor

BOB MARTIN
Commissioner

KIM GUADAGNO
Lt. Governor

Management Plan Review:
Final Plan Approval

Plan Area:	Double Trouble State Park
Property Ownership:	New Jersey Division of Parks and Forestry
Plan Date:	January 1, 2015
Plan Length:	10 Years – 2015 to 2024
Plan Title:	“Double Trouble State Park Natural Resource Stewardship Plan”

The undersigned agency and their representatives accept and endorse as complete the management plan (“the plan”) named above. The undersigned state that they have participated in the development of the plan and have received and reviewed the plan in its final form. This endorsement shall constitute approval of the plan for the duration of the plan length, beginning on the date indicated above (inclusive).

Subsection for ENSP and ONLM staff:

The NJDEP staff responsible for Threatened and Endangered Species have determined that the activities in the plan will not create irreversible adverse impacts on threatened and endangered plant and animal species.

Subsection for HPO staff:

The NJDEP State Historic Preservation Office has determined that the activities in the plan will not negatively impact significant cultural resources.

I have read and agree to statement above (please check):

New Jersey Historic Preservation Office
 Signature 
 Name (print) DANIEL D. SAUNDERS

Date 12/15/14

01/01/2016

Prepared For/By

New Jersey Department of Environmental Protection
State Forestry Services, State Lands Management
P.O. Box 239
New Lisbon, New Jersey 08064
609-726-1549

**DOUBLE TROUBLE STATE PARK
NATURAL RESOURCE STEWARDSHIP PLAN**

8,677 Total Acreage of Property
(8,004 Wooded Acres)

Beachwood, Berkeley, & Lacey Townships, Ocean County, New Jersey
Please see *Appendix C* for the full list.

MANAGEMENT PERIOD January 2016 – December 2025

Plan Date: January 1, 2016
New Jersey Pinelands Commission Application # 1982-4156.019



Double Trouble State Park Natural Resource Stewardship Plan – Summary

January 1, 2016 – Full document available at www.forestry.nj.gov

Location

Berkeley & Lacey Township,
Ocean County

Manager

New Jersey State Forestry Services

Size

8,677 Acres

2,906 acres managed this planning cycle

Timeline

2016 – 2025

Plan Goals

1. Manage forest stands to conserve biological diversity, critical habitats, and the diversity of native species associated with these various habitats.
2. Maintain the productive capacity of the landscape of Double Trouble State Park to perpetuate self-sustaining forested ecosystems available for future generations.
3. Improve the distribution of age classes and densities to provide resilience to damage causing agents and ensure forest function in the face of unplanned events.
4. Conserve soil and water resources through detailed activity planning to ensure sustained future ecosystem services.
5. Provide social and economic benefits to surrounding communities to strengthen the constituencies for active management and conservation of the forest

Background

Straddling Lacey and Berkeley Townships, Double Trouble State Park is an 8,677 acre forested area which comprises a wide array of forest types and ecological communities, such as upland pine stands to the steadily declining Atlantic white-cedar swamps, with a rich historic presence found in Double Trouble Village. Using a multi-disciplinary plan development process, the Double Trouble State Park Natural Resource Stewardship Plan was developed by a committee of representatives from several agencies within the New Jersey Department of Environmental Protection Natural and Historic Resources Group (NJ State Forestry Services: Bureau of Forestry, Forest Fire Service, NJ Office of Natural Lands Management; NJ State Parks Service; NJ Division of Fish and Wildlife) with external stakeholders' input.

Each recommended activity conveys the goals and objectives set forth by the NHR working group and guided by the internationally recognized Montreal Process for the conservation and sustainable management of temperate and boreal forests. Such goals include, but are not limited to, conserving ecologically important habitat, maintaining productive capacity of the landscape, and providing social and economic benefits through harvesting and fire management. The established objectives are achieved through the use of Best Management Practices for forestry, fire, and habitat management, with the overall result of a healthier forested ecosystem. Best management practices for forestry are trusted as guidelines for techniques that are most effective operationally yet minimize negative environmental impacts.

Overview of treatments

Management Recommendation	Activity	Acres Planned	Purpose of Management
AWC Restoration and Sandy Cedar Salvage	Removal of non-AWC species, selective herbicide, fence, planting	189	Restore the statewide presence of Atlantic white-cedar, provide beneficial spatial arrangements on the landscape, aiding in AWC restoration initiative congruent with Eastern Seaboard states.
Patch Cuts	Half-acre Shelterwood cuts	15	Provide habitat for rare species that require open areas within a diverse habitat by randomly scattered ½ acre shelterwood cuts.
Restoration Thinning	Variable-Density thinning	113	Establish rare species habitat, hazardous fuel reduction, and the prevention of overstocked conditions from prevailing.
Variable-Density Thinning	Variable-Density thinning	309	Provide uneven-aged forests for wildlife and rare plant habitat throughout DTSP. Encourages increased forest resiliency.
Pine Grassland	Mowing	30	Encourage scarce open-canopy habitat in an area recently disturbed by wildfire.
Shortleaf Pine Restoration	Modified Shelterwood cut, prescribed burning, plant	106	Aid the re-establishment of native shortleaf pine habitats into DTSP landscape, as part of multi-state Shortleaf Pine Initiative.
Fuelbreak Maintenance and Installation	Prescribed burning, plowline maintenance, plowline installation	1,691	Reduce the risk of spreading wildfire, fuel build-up, and the risk of fire reaching the canopy by disturbing ladder fuels. Create critical habitat for rare plants.

Management Recommendation	Activity	Acres Planned	Purpose of Management
Firebreak Maintenance and Installation	Mowing and Tree Removal	14	Provide a control line in order to conduct prescribed burns and control wildfires. Create an added layer of protection to conserve lowlands, decrease risk for nearby homes, and habitat for disturbance-loving species.
Safety Strip	Low Thinning, Prescribed Burning, Plowline Installation	45	Reduce ladder-fuels and strengthen a strategic fuelbreak. Maintain a canopy cover to slow regeneration/fine fuels, allows for easier maintenance with longer time intervals between prescribed burns.
Forest Stand Improvement	Thin from Below	360	Promote an overall healthier forest by allowing for better growing conditions for residual trees and advanced regeneration. Reduces risk of damaging wildfire and potential mortality from SPB.
Plantation Maintenance	Thin from Below, Prescribed Burning	34	Reduce the high risk fuel conditions and advance the stand from the current stagnation state within the areas planted by the Global ReLeaf program.

Double Trouble State Park -Treatment Map

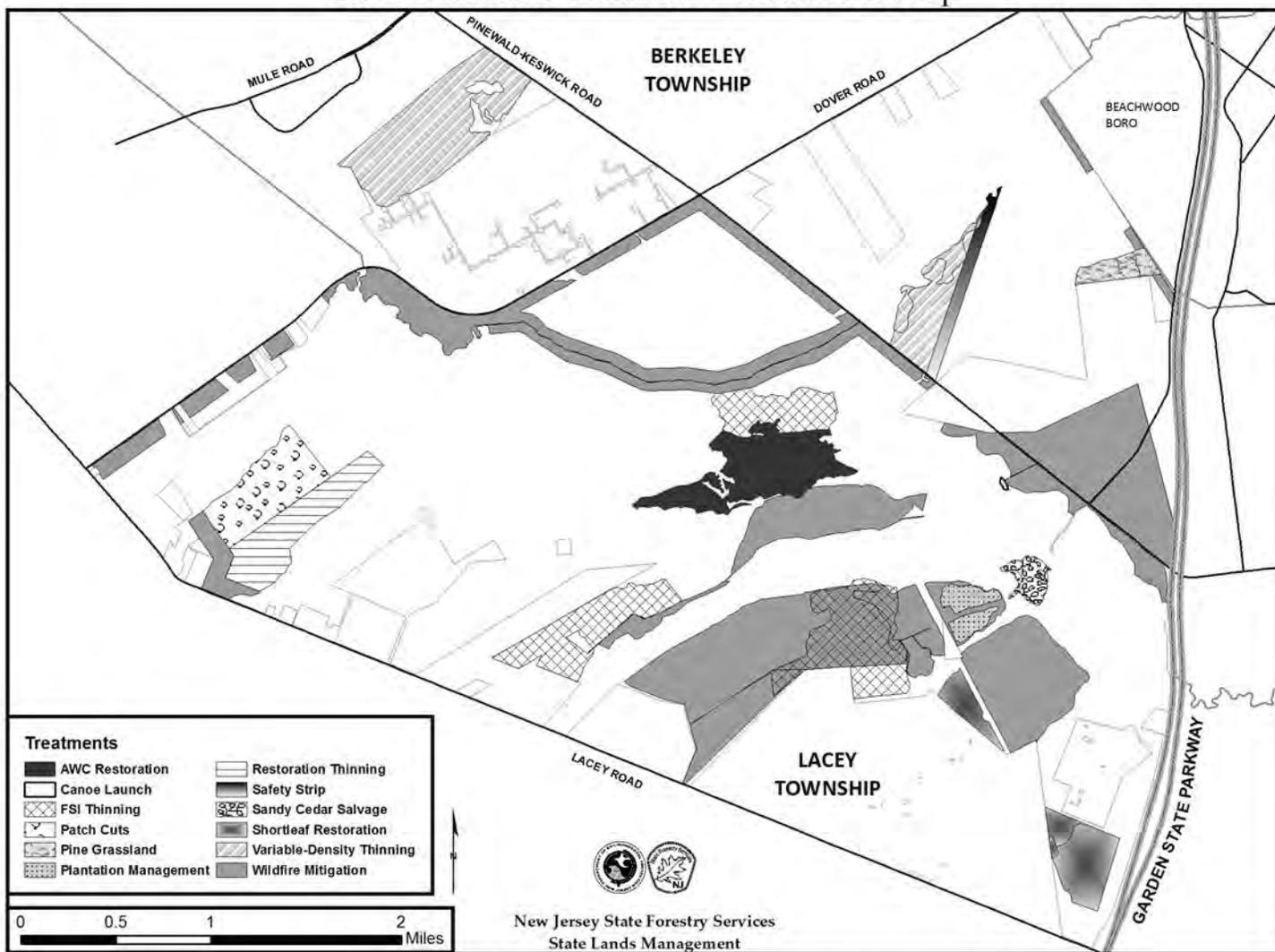


TABLE OF CONTENTS

I. OVERVIEW 3

II. GOALS AND OBJECTIVES 5

III. RESOURCE CONCERNS 7

 A. Rare, Threatened, and Endangered Species 7

 B. Historical & Cultural Resources 22

 C. Aesthetics 22

 D. Recreation 22

 E. Carbon 23

 F. Economics 24

 G. Invasive Species 24

 H. Fire 25

 I. Forest Health 26

 J. Wetlands 26

 K. Roads 27

 L. Forest Productivity 28

IV. FOREST STAND DESCRIPTIONS 29

 1. Forest Stand PPSO 30

 1a. Forest Stand PPSOb 33

 2. Forest Stand SOPP 35

 3. Forest Stand PLANT 37

 4. Forest Stand PPSTO 39

 5. Forest Stand PPO 42

 6. Forest Stand OP 45

 7. Forest Stand PPlo 47

 7a. Forest Stand PPlob 50

 8. Forest Stand PMC 52

 9. Forest Stand CED 55

 9a. Forest Stand CEDy 58

 9b. Forest Stand CEDb 59

 9c. Forest Stand CEDr 59

 10. Forest Stand MAP 60

 11. Forest Stand EM WET 63

 12. Forest Stand SS, Spung 64

 13. Forest Stand Agricultural Wetlands (BB, FARM, BOGS, DISlo) ... 65

 14. Forest Stand Non-Forest (DIS, GRASS, RES, ROW)..... 66

V. HIGH CONSERVATION VALUE FORESTS 67

VI. REPRESENTATIVE SAMPLE AREAS 69

VII. ACTIVITY SCHEDULE (10-YEAR, Anticipated) 70

VIII. MANAGEMENT RECOMMENDATIONS 75

 A. Sustainable Yield 77

 B. Rare Species Habitat 81

 C. Atlantic white-cedar Restoration 87

 D. Shortleaf Pine Restoration 90

 E. Wildfire Mitigation 93

 F. Forest Stand Improvement 98

G. Plantation Management 101

IX. WORKS CITED 103

X. APPENDICES 106

 Appendix A: Location Map 107

 Appendix B: USGS Quadrangle Map 108

 Appendix C: Property Parcel List 109

 Appendix D: Soils 111

 Appendix E: Natural Heritage Database Search Letter 117

 Appendix F: Freshwater Wetlands Map 136

 Appendix G: DTSP Streams Requiring Streamside Management Zones 137

 Appendix H: Forest Stand Types Map 138

 Appendix I: Forest Sub-Stand Map 139

 Appendix J: Representative Sample Area Map 140

 Appendix K: Overall Treatment Map 141

 Appendix L: Treatment Type Map 142

 Appendix M: Wildfire Mitigation Activities Map 143

 Appendix N: Geology 144

 Appendix O: Hydrogeology 146

 Appendix P: Hydrology 148

 Appendix Q: Climate 149

I. OVERVIEW

This document is a comprehensive natural resource stewardship plan for Double Trouble State Park that addresses many conservation issues and will serve as a guide for resource management activities important to forest stewardship. This plan was developed by a committee of representatives from several agencies within the New Jersey (NJ) Department of Environmental Protection (DEP) Natural and Historic Resources (NHR) Group (NJ State Forestry Services: Bureau of Forestry, Forest Fire Service, NJ Office of Natural Lands Management; NJ State Parks Service; NJ Division of Fish and Wildlife) as well as representatives from other outside agencies. Inventory and planning efforts were supported by two third party contractors, Land Dimensions Engineering (LDE), and Heartwood Consulting Services, LLC.

The focus of the committee was to provide insight and assistance, formulate management direction, and establish priorities and prescriptions in the development of a forest resource stewardship plan that incorporated both an ecological and stewardship approach to management of the forest resources. This management philosophy integrates human values and needs while sustaining a diverse ecosystem across the landscape. The DTSP management plan is part of a larger planning effort across the greater landscape involving many diverse stakeholders known as the Berkeley Triangle Project. Although not really triangular in shape, the Berkeley Triangle consists of lands roughly centered around Berkeley Township, Ocean County, NJ held by three major landowners, the NJ Division of Fish and Wildlife, the NJ Division of Parks and Forestry, and the NJ Audubon Society. Stakeholders include state, private, and not-for-profit individuals and organizations.

Plan development efforts required various resource managers, each with diverse backgrounds and technical expertise from different agencies and organizations to cooperatively work together and integrate a broad range of management tools and strategies. The end result was the development of a natural resource stewardship plan which sustains a desired level of biodiversity of communities and habitats, forest health, wildfire protection, and other social benefits through a carefully planned and coordinated effort.

Undoubtedly, all forest and public lands owned by the NJ DEP are today faced with many challenges and circumstances that require the preparation of natural resource stewardship plans. Environmental pressures, changing population trends, climate change, air and water quality, occurrence of forest pests and diseases, changing habitats, and recreational pressures can negatively affect these forest resources. As a result, more attention must be given to monitoring, sustainability, and management of healthy forests.

Under the jurisdiction of the New Jersey Division of Parks and Forestry the 8,677 acre property known as Double Trouble State Park (DTSP) is located in Berkeley and Lacey Townships, Ocean County (see Appendix A: Location Map). The Garden State Parkway lies to the east, with Lacey Road and various private and industrial holdings to the south. Robert J. Miller airpark is located to the northwest of DTSP, while major developments occur to the north and east of the property (South Toms River, Bayville, and Holiday City) (see Appendix B: USGS Quadrangle Map). All property acquisitions for DTSP have occurred through the Division of Parks and Forestry, and a list of parcels for the property can be found in Appendix C: Property Parcel List.

The land area is a mixture of upland and lowland forest types with pitch pine as the most dominant tree cover. Various forest management activities have been performed over more than three decades. These activities mostly included cedar salvage and restoration operations, as well as fire and fuels management through the use of prescribed burning and Wildland Urban Interface (WUI) planning.

The forest is comprised of a plethora of forest types and ecological communities that offer an excellent representation of the vegetation commonly occurring throughout much of southern New Jersey and the Pinelands. From xeric dry upland sites to pitch pine lowlands, to Atlantic white-cedar swamps, DTSP offers a wide variety of habitat for the diverse fauna and flora which occur there. Forest management goals for DTSP include conserving ecologically significant habitat, maintaining the productive capacity of the landscape, improving resilience to unplanned disturbances, conserving soil and water resources, and providing social and economic benefits through harvesting and fire management. Special consideration for endangered and threatened plant and animal species will be incorporated into planning, and where possible activities will be designed to enhance the habitats necessary for their conservation.

During the planning process all natural resource agencies were involved with the development of the plan, and all share in the responsibility of its implementation. This ultimately places the task for the plan's action upon the NJDEP's Assistant Commissioner of NHR as the plan addresses all disciplines of the DEP's Natural and Historic Resources group.

II. GOALS AND OBJECTIVES

Management goals for state park and forest properties are guided by the Montreal Process, an internationally-recognized framework for the sustainable management of forest resources (Montreal Process 2014). The Montreal Process concepts were developed as a multinational, intergovernmental answer to the global need for sustainable forest management. The Process's seven criteria and 54 indicators provide a set of standards to ensure sustainable management of temperate and boreal forests. As part of the local implementation of the Process, the United States Department of Agriculture (USDA) Forest Service has prepared a sourcebook detailing the criteria and indicators for the northeastern area of the US (USDA Forest Service, Northeastern Area State and Private Forestry 2002). The goals for the management of Double Trouble State Park's forest resources were determined through careful consideration of those criteria and indicators. For the most part, the plan goals correspond directly to the Process's criteria.

Goal 1: Manage forest stands to conserve biological diversity, critical habitats, and the diversity of native species associated with these various habitats.

Objective 1.1: Actively manage 158 acres to create or improve habitat for rare and endangered plants and animals.

Objective 1.2: Create 738 acres of early-successional habitat to benefit disturbance-obligate species.

Goal 2: Maintain the productive capacity of the landscape of Double Trouble State Park to perpetuate self-sustaining forested ecosystems available for future generations.

Objective 2.1: Determine area, growth rates and sustainable yield for the property.

Objective 2.2: Ensure that sustainable yield is not exceeded during the time scale covered by this plan.

Goal 3: Improve the distribution of age classes and densities to provide resilience to damage causing agents and ensure forest function in the face of unplanned events.

Objective 3.1: Raise crowning index to 25 miles per hour (MPH) or above within Double Trouble State Park's strategic fuel breaks.

Objective 3.2: When managing pine stands susceptible to southern pine beetle (SPB), after-treatment basal area will not exceed 80 ft²/acre to minimize stress leading to competition-induced mortality and predisposition for pest attacks.

Objective 3.3: Include the planning area in annual surveys for damage-causing agents.

Goal 4: Conserve soil and water resources through detailed activity planning to ensure sustained future ecosystem services.

Objective 4.1: Ensure management operations meet or exceed established best management practices (BMPs) for all management activities, through the use of the New Jersey Forestry and Wetland BMP manual (1995) and the Atlantic white-cedar: Ecology and BMP Manual (2003).

Goal 5: Provide social and economic benefits to surrounding communities to strengthen the constituencies for active management and conservation of the forest.

Objective 5.1: Protect public health and safety through management actions that strategically reduce unsafe fuel loads over 2,600 acres.

Objective 5.2: Reduce the likelihood of catastrophic wildfire that poses a significant threat to human life and property through the creation and maintenance of 1,700 acres of strategic fuelbreaks and 7 miles of strategic firebreaks.

Objective 5.3: Make approximately 7,300 cords of pine, 700 cords of oak, 800 cords of cedar, and 2,200 cords of hardwoods available for sale from the property over the 10-year planning cycle to support local forestry economies.

Objective 5.4: Improve access for recreational uses of the forest.

III. RESOURCE CONCERNS

A. Rare, Threatened, and Endangered Species

The species described below are those that have been identified as either “threatened,” “endangered,” or “species of concern,” by the Office of Natural Lands Management Natural Heritage Program using the Natural Heritage Database and the Landscape Project (Version 3.1). The Natural Heritage Database letter for DTSP can be found in Appendix E: Natural Heritage Database Search Letter. The descriptions following the tables provide details for those rare species listed as threatened or endangered by the Pinelands Commission or the NJDEP at the time of the writing of this plan.

Wildlife and rare plant populations, as well as our understanding of them, are dynamic; stewardship planning requires a mechanism to adapt management to emerging information. When each management activity occurs NJDEP will consider those rare species in the pertinent area whose status was stable or uncertain at the time of the writing of this plan, but for whom data becomes available in the years covered by the plan. This will be achieved through stewardship plan implementation notification/meetings that give managers and specialists a forum for bringing forward emerging information in the context of management plan activities. As rare species move into and out of regulatory categories, NJDEP will work to incorporate the best information available into actions that may affect their populations. The implementation forum should also provide an opportunity for specialist input into advances in management techniques for target species, which may guide reasonable deviations from intended actions.

Development of the management activities in this plan gave special attention to rare, threatened, and endangered species. Consideration was given not only to known locations of priority areas for these species, but also to create, expand, or connect habitats to improve conditions for their populations. Implementation of this forest stewardship plan will not result in any irreversible adverse impact to any local population of any known threatened and/or endangered species in this area.

Table 1: Plant species of concern documented on, possibly on, or in the immediate vicinity of DTSP by the Natural Heritage Database and the New Jersey Pinelands Commission.*

Common Name	Latin Name	Federal/ Regional Status	State Statu s	Global Elements Rank	State Elements Rank	Occurrenc e
Algae-like pondweed	<i>Potamogeton confervoides</i>	- / HL	-	G4	S2	IV
Bog asphodel	<i>Narthecium americanum</i>	- / LP, HL	E	G2	S2	PO
Broom crowberry	<i>Corema conradii</i>	- / LP, HL	E	G4	S1	IV
Curly grass fern	<i>Schizaea pusilla</i>	- / LP, HL	-	G3G4	S3	OIV, IV
Knieskern's beaked-rush	<i>Rhynchospora knieskernii</i>	T / LP, HL	E	G2	S2	IV
Large swollen bladderwort	<i>Utricularia inflata</i>	- / HL	-	G5	S3	IV
Little ladies'-tresses	<i>Spiranthes tuberosa</i>	- / LP, HL	-	G5	S3	IV
Mitchell's sedge	<i>Carex mitchelliana</i>	- / HL	-	G4	S2	PO, IV
Narrow-leaf fireweed	<i>Epilobium angustifolium</i> ssp. <i>circumvagum</i>	- / HL	-	G5T5	S1S2	OIV, IV
New Jersey rush	<i>Juncus caesariensis</i>	- / LP, HL	E	G2G3	S2	PO, OIV, IV
Pine barren gentian	<i>Gentiana autumnalis</i>	- / LP, HL	-	G3	S3	PO, IV
Pine barren rattlesnake-root	<i>Prenanthes autumnalis</i>	- / LP, HL	-	G4G5	S2	OIV, IV
Pine barrens reedgrass	<i>Calamovilfa brevipilis</i>	- / LP	-	-	-	IV
Sickle-leaved golden aster	<i>Pityopsis falcate</i>	- / LP, HL	-	G3G4	S3	IV
Slender nut-rush	<i>Scleria minor</i>	- / LP	-	-	-	IV
Swamp-pink	<i>Helonias bullata</i>	T / LP	E	G3	S3	PO, IV
Yellow fringed orchid	<i>Platanthera ciliaris</i>	- / LP, HL	-	G5	S2	OIV, IV

* Only those species listed as threatened or endangered at any administrative scale receive discussion in the following section.

Table 2: Rare animal species or their habitats documented at or in the immediate vicinity of DTSP by the Landscape Project (Version 3.1).*

Common Name	Scientific Name	Federal/ Pinelands Status	State Status	Occurrence
Banner clubtail	<i>Gomphus apomyius</i>	-	Threatened	O, IV
Barred owl	<i>Strix varia</i>	-	Threatened	O, IV
Black-billed cuckoo	<i>Coccyzus erythrophthalmus</i>	-	Special Concern/ Stable [†]	O, IV
Black-throated blue warbler	<i>Dendroica caerulescens</i>	-	Special Concern/ Stable	IV
Black-throated green warbler	<i>Dendroica virens</i>	-	Special Concern/ Stable	O, IV
Bobcat	<i>Lynx rufus</i>	-	Endangered	IV
Brown thrasher	<i>Toxostoma rufum</i>	-	Special Concern/ Stable	O, IV
Common nighthawk	<i>Chordeiles minor</i>	-	Special Concern	O, IV
Common tern	<i>Sterna hirundo</i>	-	Special Concern/ Stable	IV
Cooper’s hawk	<i>Accipiter cooperii</i>	-	Special Concern/ Stable	O, IV
Corn snake	<i>Elaphe g. guttatta</i>	-/LP	Endangered	O, IV
Dotted skipper	<i>Hesperia attalus slossonae</i>	-	Special Concern	O, IV
Eastern kingsnake	<i>Lampropeltis g. getula</i>	-	Special Concern	IV
Georgia satyr	<i>Neonympha helicta</i>	-	Special Concern	O, IV
Glossy ibis	<i>Plegadis falcinellus</i>	-	Special Concern/ Stable	O, IV
Golden-winged skimmer	<i>Libellula auripennis</i>	-	Special Concern	O, IV
Grasshopper sparrow	<i>Ammodramus savannarum</i>	-	Threatened/ Special Concern	O, IV
Great blue heron	<i>Ardea herodias</i>	-	Special Concern/ Stable	O, IV
Kentucky warbler	<i>Oporornis formosus</i>	-	Special Concern	O, IV

* Only those species listed as threatened or endangered at any administrative scale receive discussion in the following section.

[†] Indicates Breeding Status/Non-breeding status

Common Name	Scientific Name	Federal/ Pinelands Status	State Status	Occurrence
Little blue heron	<i>Egretta caerulea</i>	-	Special Concern	O, IV
Northern parula	<i>Parula americana</i>	-	Special Concern/ Stable	O, IV
Northern pine snake	<i>Pituophis m. melanoleucus</i>	LP	Threatened	O, IV
Pine barrens bluet	<i>Enallagma recurvatum</i>	-	Special Concern	O, IV
Pine barrens treefrog	<i>Hyla andersonii</i>	LP	Threatened	O, IV
Red-headed woodpecker	<i>Melanerpes erythrocephalus</i>	-	Threatened/ Threatened	IV
Savannah sparrow	<i>Passerculus sandwichensis</i>	-	Threatened/ Stable	O, IV
Scarlet bluet	<i>Enallagma pictum</i>	-	Special Concern	O, IV
Snowy egret	<i>Egretta thula</i>	-	Special Concern/ Stable	O, IV
Timber rattlesnake	<i>Crotalus h. horridus</i>	LP	Endangered	O, IV
Tricolored heron	<i>Egretta tricolor</i>	-	Special Concern	O, IV
Veery	<i>Catharus fuscescens</i>	-	Special Concern/ Stable	IV
Whip-poor-will	<i>Caprimulgus vociferus</i>	-	Special Concern	O
Wood thrush	<i>Hylocichla mustelina</i>	-	Special Concern/ Stable	O
Worm-eating warbler	<i>Helmitheros vermivorus</i>	-	Special Concern/ Stable	IV

Table 3: Federally listed species for project site (USDI FWS iPAC 2014)

Common Name	Scientific Name	Federal Status
Plants		
Knieskern's beaked-rush	<i>Rhynchospora knieskernii</i>	T
Swamp pink	<i>Helonias bullata</i>	T

Explanation of Federal/Regional Status Codes:

T – Threatened - taxa federally listed as threatened

HL – Indicates taxa or ecological communities protected by the Highlands Water Protection and Planning Act within the jurisdiction of the Highlands Preservation Area.

LP – Indicates taxa listed by the Pinelands Commission as endangered or threatened within their legal jurisdiction. Not all species currently tracked by the Pinelands Commission are tracked by the Natural Heritage Program.

Explanation of State Status Codes:

E – Endangered - native New Jersey plant species whose survival in the State or nation is in jeopardy.

Explanation of Global and State Element Ranks:

G2 – Imperiled globally because of rarity (6-20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extinction throughout its range.

G3 – Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (e.g., a single western state, a physiographic region in the East) or because of other factors making it vulnerable to extinction throughout its range; with the number of occurrences in the range of 21-100.

G4 – Apparently secure globally; although it may be quite rare in parts of its range, especially at the periphery.

G5 – Demonstrably secure globally; although it may be quite rare in parts of its range, especially at the periphery.

S1 – Critically imperiled in New Jersey because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres). Elements so ranked are often restricted to very specialized conditions or habitats and/or restricted to an extremely small geographical area of the state. Also included are elements which were formerly more abundant, but because of habitat destruction or some other critical factor of its biology, they have been demonstrably reduced in abundance. In essence, these are elements for which, even with intensive searching, sizable additional occurrences are unlikely to be discovered.

S2 – Imperiled in New Jersey because of rarity (6-20 occurrences). Historically many of these elements may have been more frequent but are now known from very few extant occurrences, primarily because of habitat destruction. Diligent searching may yield additional occurrences.

S3 – Rare in state with 21-100 occurrences (plant species and ecological communities in this category have only 21-50 occurrences). Includes elements which are widely distributed in the state but with small populations/acreage or elements with restricted distribution, but locally abundant. Not yet imperiled in state but may soon be if current trends continue. Searching often yields additional occurrences.

SH – Elements of historical occurrence in New Jersey. Despite some searching of historical occurrences and/or potential habitat, no extant occurrences are known. Since not all of the historical occurrences have been field surveyed, and unsearched potential habitat remains, historically ranked taxa are considered possibly extant, and remain a conservation priority for continued field work with the expectation they may be rediscovered.

Explanation of Occurrence Codes:

O - Animal species or habitat documented On Site

PO – Animal species or habitat Possibly On Project Site

OIV – Animal species or habitat On or in the Immediate Vicinity of the Project Site

IV – Animal species or habitat In the Immediate Vicinity of the Project Site

State Threatened & Endangered Wildlife Species

Banner clubtail: The banner clubtail (*Gomphus apomyius*) is a dragonfly less than 2 inches in length with various coloring including browns, yellows, and greens. This species habitat is characterized by acid streams along the coastal plains of New Jersey, especially those with sandy

bottoms and large amounts of debris. Banner clubtails are most active during the spring and early summer (late April to mid-July) (Conserve Wildlife Foundation 2014).

Management Implications: This species is listed as threatened in New Jersey primarily due to limited habitat. To avoid possible destruction of this species' critical habitat special precautions will be taken in and around banner club habitat, including implementation of adequate buffers consistent with forestry and wetlands best management practice guidelines.

Barred owl: The Barred Owl's (*Strix varia*) habitat is characterized as heavy mature woods with nearby open country for foraging. These vary from upland woods to lowland swamps usually near creeks, lakes, or river valleys. The area should include densely foliated trees for daytime roosts, conifers or deciduous trees with year round leaves for winter roosts, and the presence of large trees (at least 20 in. in breast-height diameter) with suitable cavities for nesting. For southern New Jersey, mature, low density, closed canopy swamps with Atlantic white-cedar, hardwoods, and sometimes pine provide the primary forest interior habitats used by barred owl in this subregion of the Pinelands. Larger diameter hardwood trees are suitable for critical nesting habitat. The Barred Owl is almost always resident year round except during exceptionally harsh winter conditions or depending on prey availability.

Management Implications: Mature, closed canopy swamps with Atlantic white-cedar, hardwoods and sometimes pine provide the primary forest interior habitats used by barred owl in this subregion of the Pinelands. While this plan calls for management activities in hardwood and mixed-species swamps, the long-term purpose of these activities is to develop a large closed-canopy cedar swamp connecting extant patches of this plant community. The end result will provide large, beneficial interior forest habitat. The thinning of overstocked pitch pine lowlands adjacent to swamps will not impact the required older, larger diameter hardwood trees suitable for critical nesting habitat. Burned, thinned or cleared openings in pitch pine lowlands create habitat heterogeneity that benefits barred owl when adjacent to mature swamp habitats.

Bobcat: The bobcat (*Lynx rufus*), approximately two-feet in height and weighing up to 35 pounds, is a North American feline. The preferred habitat of this species includes coniferous and mixed forests, swamps and coastal areas, as well as desert and scrublands in the southwestern US. Dens are typically located within rock crevices, under logs, in thick vegetation, or under root mats of downed trees. The diet of a bobcat mainly consists of rabbits, mice, squirrels, birds, and even small deer. Overhunting, excessive trapping, widespread deforestation, and land-use changes by early settlers originally led to bobcat declines range wide. While the species is recovering at the continental scale and is increasing in New Jersey, it is listed as endangered in this state due to habitat loss, habitat fragmentation, and dispersal barriers, all of which lead to population isolation and decline. Vehicular collisions are a major source of mortality in New Jersey. (NJ Div. of Fish and Wildlife 2014).

Management Implications: Most of the area of DTSP will remain forested following this management plan, and those areas where canopy will be reduced are planned to re-grow as forest. Thus, forested habitats suitable to bobcat populations should be created as well as maintained, bolstering populations. As the management actions of this plan maintain the extent of forest across the 8600 acres of DTSP, management is not expected

to negatively impact this species.

Corn snake: The corn snake (*Elaphe g. guttatta*), native to the southeastern US, is a type of rat snake that kills its prey by constriction. Open sandy pine-oak woods, early successional uplands, and abandoned structures are preferred habitats for this species. While they usually remain on the ground for the first few months of life, they are able climbers and will ascend trees, cliffs, and other tall features. In the colder portions of their range, they hibernate in winter, though in the more moderate portion of the range, cool weather induces them to shelter in rock crevices and logs. They are also prolific burrowers, and will find or create cover in underground burrows, rotten stumps, old railroad ties, sand mounds, boards, logs, rubble, or concrete. Abandoned and overgrown foundations also provide suitable hibernating space. The New Jersey Natural Heritage Program considers the corn snake to be “demonstrably secure globally,” yet “critically imperiled in New Jersey because of extreme rarity” (NJDEP Div. of Fish and Wildlife 2014). Documented corn snake sites are currently protected through the Pinelands Protection Act and environmental reviews of proposed development.

Management Implications: The thinning, scarification, and prescribed burning treatments being proposed are expected to greatly enhance the open pine-shrub oak and early successional habitats preferred by the corn snake.

As habitat loss is recognized as the primary cause of this species’ decline, management activities that increase available habitat to this species will provide a net benefit. To avoid impacts to this species during management activities in forested upland habitats, adjacent management activities should be staggered to dilute the potential impact to the species from forest management. In this way, potential damage to individuals outside of critical areas is countered by an overall increase in habitat, which relieves the most harmful pressure on the population.

Inside critical habitats, management activities will be adjusted to avoid impacts to this species. In areas proximate to documented nesting sites, operations will be adjusted using buffers, timing restrictions, and equipment restrictions so as not to result in any irreversible adverse impact to any local population. Within 1000’ around known nest areas or known den areas, no forestry equipment that exerts a ground pressure greater than four pounds per square inch (> 4 psi) will be allowed at any time of year, although activities are allowed provided this standard is met. Given the broad dispersal of overwintering neonates outside of known critical habitats, and the potential hazard posed to them by the use of the forest management equipment, incentive-based contracts will be used in areas identified as “occupied habitat” by the Landscape Project version 3.1 (NJDEP 2015). This will encourage completion of activities while young snakes are able to move to safety. Management that takes place in potential snake habitat as identified by NJDEP will make use of incentives to discourage activities after September 15th and before May 16th. This contracting approach was selected due to the comprehensive nature and complexity of the plan, which addresses multidisciplinary goals and objectives.

Similarly, the installation of plowlines for forest fire management will occur during the summer if the plowlines will be inside of the nest area buffers. This should

minimize the risk to this species, as snakes will not be in the dens that could possibly be disturbed. Refreshing/maintaining plowlines can occur in any season.

Grasshopper sparrow: The grasshopper Sparrow (*Ammodramus savannarum*) is a small American sparrow associated with grasslands and marshes. This species typically breeds in grasslands, upland meadows, pastures, hayfields, and old field habitats. They also prefer areas with short- to medium-height bunch grasses interspersed with patches of bare ground, a shallow litter layer, scattered forbs, and few shrubs (shrub layers too dense may be unsuitable for nesting). Sparrow breeding habitat consists of open fields, grasslands, upland meadows, pastures, hayfields, old field habitats, and prairies across southern Canada, the United States, Mexico, and Central America. Like many grassland birds, grasshopper sparrow numbers have declined across many parts of its range. Nests consist of a well-concealed open cup on the ground under vegetation. These birds forage in vegetation on the ground mainly eating insects (especially grasshoppers) and seeds (NJ Div. of Fish and Wildlife 2014, Conserve Wildlife Foundation 2014).

Management Implications: In New Jersey, the survival of grasshopper sparrows is critically linked with management practices for grassland birds on airports, agricultural lands, pastures, and through the encouragement of natural grassland habitats. Shrubs, while beneficial as perches, make habitat unsuitable for the species when they become too dense (NJ Div. of Fish and Wildlife 2014). Suitable open habitats in DTSP will not be disturbed in this plan.

Northern pine snake: The northern pine snake (*Pituophis melanoleucus melanoleucus*) is a relatively large (48-68 inch) black and dull white, to yellowish or light gray snake. These snakes have blotches that are dark towards the front of the body, but may fade to brown near and on the tail. Known for their noisy hiss, pine snakes are typically ground dwellers and rarely climb vegetation. Since this species is both secretive and fossorial, meaning it burrows underground, it can easily go undetected even in locations where it is known to be common (NJDEP Div. of Fish and Wildlife 2014; and Conserve Wildlife Foundation of NJ 2012). Pine snakes in New Jersey require dry pine-oak forest types growing on very infertile sandy soils such as Lakehurst or Lakewood sands (Burger & Zappalorti 1988; Burger & Zappalorti 1989). Both human-caused and natural disturbances (e.g. agriculture, forestry, and fire) create the types of openings important for snake nesting and basking areas. Sandy infertile soil not only provides for persistent openings in disturbed sites but is also important since pine snakes are among the few types known to dig hibernacula and summer dens. The secretive nature of this snake has led to a degree of uncertainty about its overall status in the northeastern United States. However, all indications seem to suggest that pine snake abundance has decreased throughout its northeastern range. It is also believed that pine snakes have been extirpated from West Virginia and Maryland. The New Jersey Pinelands may hold some of the largest populations of pine snake in the Northeast, but even in the Pinelands this species is at risk.

Management Implications: Management implications for the Corn snake will also apply to the Northern pine snake. See the section headed, “Management Implications” for the Corn snake, above.

Pine Barrens treefrog: Vibrant green and boldly marked, the Pine Barrens treefrog (*Hyla andersonii*) is arguably one of New Jersey’s most beautiful amphibians. A purple stripe with a

yellowish-white border extends from the snout through the eye, down each side of the body. Although the under parts are white, there is a vibrant orange patch beneath each hind leg that shows a flash of color when the frog jumps. Its throat has a purplish tinge which is particularly visible on the male. Adults measure 1.13 to 1.75 inches in length (Conant and Collins 1991). The call of the Pine Barrens treefrog is a rapid and nasal quonk-quonk-quonk, which is repeated frequently. The series may be reiterated faster on warm evenings and slower on cool nights.

The Pine Barrens treefrog requires specialized acidic habitats such as Atlantic white-cedar swamps, and pitch pine lowlands that are carpeted with dense mats of sphagnum moss. Plant species found at breeding sites include highbush blueberry, greenbriar, red maple, swamp azalea, swamp magnolia, viburnum, inkberry, mountain laurel, sheep laurel, black jack oak, scrub oak, sundew, pitcher plant, sweet pepperbush, and various orchids. Structural characteristics of preferred habitats include an open canopy, a dense shrub layer, and heavy ground cover. Typical soil types include sands and mucks. Temporary woodland ponds, Atlantic white-cedar or cranberry bogs, and seepage areas along tributaries of major rivers and streams serve as breeding ponds for the Pine Barrens treefrog. Occasionally, disturbed areas such as borrow pits, roadside ditches, vehicle ruts, or pools found along power line corridors may be used as breeding sites provided that appropriate shrubby and herbaceous vegetation is present. Treefrogs prefer ponds which support sphagnum moss, sedges, grasses, and/or various aquatic plants and are surrounded by dense woody vegetation. Breeding ponds which may dry up by mid-summer contain shallow water with depths often less than 23.6 inches and in some cases less than 3.9 inches. The water is clean, yet acidic with pH values ranging from 3.4 to 5.9 (NJDEP Div. of Fish and Wildlife 2014; Conserve Wildlife Foundation 2014).

The preference for acidic water serves to reduce competition by other frog species that cannot tolerate the lower pH. In 1979 the Pine Barrens treefrog was listed as a state-endangered species in New Jersey due to its restricted range and declining population, habitat loss, and pollution of breeding ponds. The New Jersey Natural Heritage Program considers this species to be “apparently secure globally,” yet “rare in New Jersey,” (NJDEP Div. of Fish and Wildlife 2014; Conserve Wildlife Foundation 2014). Although its state status has been downgraded to the species currently being listed as threatened, the Pine Barrens treefrog is considered stable within select habitats of New Jersey. Large expanses of protected habitat within the Pinelands National Reserve of southern New Jersey allows the state to serve as a stronghold for this species throughout its entire range. In areas of suitable habitat particularly on public land, Pine Barrens treefrogs may seem abundant. However, protection of this species is warranted as suitable habitat is limited to specialized Pine Barrens ecosystems that are patchily distributed throughout the southeastern U.S.

Management Implications: No activity is proposed within 100 feet of any potential breeding pond. An inner buffer of at least 100-feet surrounding a water body can prevent direct physical disturbance of breeding habitat. Continuity between adjacent forest and breeding habitat is best maintained by leaving portions of outer buffers (100 – 300 feet) uncut, as treefrogs spend time within the forest during the non-breeding period. No major soil disturbance, such as drumchopping, should occur in the outer buffer. Creation of slash piles causes no major concern and may even be beneficial by providing protection against desiccation and predators. Applications of chemicals such as soil amendments or pesticides should be avoided entirely. The impact to treefrogs from harvesting within the outer buffer and beyond is minimal. In this plan, no activities are proposed inside the

inner buffers for known treefrog sites. Variable-density thinning is proposed at the edge of one of the outer buffers from a known site, but this patchy thinning will leave much vegetation uncut, in accordance with recommendations for this species, and no drumchopping is proposed in this area.

Red-headed woodpecker: The red-headed woodpecker (*Melanerpes erythrocephalus*) is a relatively small individual, approximately 8.5 to 9.5 inches in length. Breeding habitat includes river bottom forests, swamps, ponds, open deciduous forests, orchards, agricultural areas, forested edges, and forests with many soft decaying trees and snags. Favored nesting trees include large diameter red maple, pitch pine, and oak. The red-headed woodpecker also prefers habitats composed of scattered, large and mature trees with open understories and burned areas. This species tends to forage in open locations where dead limbs are numerous, especially on oak trees. This species is currently listed as threatened in the state of New Jersey due to road-induced mortality, competition with other species for nesting habitat, and loss of breeding habitat (Zampella 1996).

Management Implications: Habitat improvements for the red-headed woodpecker should include opening of the understory in oak-pine and oak dominated forest types with retention of large scattered snags which can be accomplished through operations such as thinning, prescribed burning, shelterwood cuts, seedtree cuts, and/or girdling. The shelterwoods, forest stand improvements, and shortleaf restoration actions described in this plan should provide desirable habitat for this species.

Savannah sparrow: The savannah sparrow (*Passerculus sandwichensis*) is a small, streaked sparrow that is brown above and white below. Of the major geologic provinces of New Jersey, savannah sparrows breed in the Ridge and Valley, the Highlands, as well as the inner coastal plain regions of New Jersey, nesting in a variety of open habitats. Suitable fields require a mix of short and tall grasses, a thick litter layer, dense ground vegetation, and scattered wood plants. Relatively tolerant of vegetative succession, they will occupy fields of varied ages, including those with early woody growth. Outside of breeding season, they will utilize dunes, fallow fields, and pastures. Food sources include insects and seeds (Conserve Wildlife Foundation 2014).

Management Implications: Habitat for the savannah sparrow in DTSP lies in the fields and grassy areas. Several of these areas will continue to be burned outside of nesting season, which will maintain habitat for the savannah sparrow within DTSP.

Timber rattlesnake: The timber rattlesnake (*Crotalus horridus horridus*) is one of only two venomous reptiles found in the Garden State, the other being the northern copperhead. The rattlesnake is unique in itself since it is the only animal that nature has equipped with a rattle, found at the end of its black-colored tail. The timber rattlesnake is a member of the family Viperidae and sub-family Crotalinae, known as pit vipers. Pit vipers are aptly named for the two facial pits found midway between the nostrils and the eyes on each side of the head. In addition, its head is noticeably wider than the portion of its body directly behind the head. Other distinguishing characteristics include a single row of scales on the ventral, or underneath side of the snake from the vent to the end of the tail, and vertical, elliptical shaped pupils. These features are found only on our two venomous snakes and are not found on any non-venomous species of snake found in New Jersey.

There are two different color phases to the timber rattlesnake. On light (yellow) phased snakes the background colors vary from brilliant to pale, to brownish yellow. Dark (black) phased timber rattlesnakes have black or almost black heads and pattern, the pattern outlined in a lighter color while the background color varies from gray to dark brown to black. Both the light- and dark-phased rattlesnakes have a discoloration along the center of the dorsal (or back) side that ranges from a different shade of yellow (on light-phased snakes) to a reddish-brown to olive-green color in both color phases. A completely black dark-phased timber rattlesnake is extremely rare in New Jersey; only one has ever been reported (more than 20 years ago in the Pinelands). While dark-phased timber rattlesnakes can have a dark background coloration with a dark pattern, that pattern is outlined in a lighter color (white to cream), differentiating it from a black rat snake or black racer. In addition, the timber rattlesnake has a shovel-shaped head, a rattle, and strongly keeled scales unlike the black rat snakes' weakly keeled scales and black racers' smooth scales.

Timber rattlesnake habitat varies greatly between northern and southern New Jersey. In the north rattlesnakes are primarily associated with deciduous upland forest habitats. In these locations rattlesnakes use hardwood and hemlock forests, seeps, open fields, floodplains, talus slopes, and rock outcrops to varying degrees based on season and physiological state (e.g. ecdysis, shedding their skins; their current reproductive state; etc.). In northern New Jersey the typical timber rattlesnake den is located on rocky, sparsely- to moderately-wooded steep slopes that face southeast to southwest. Extensive survey work by Martin 1992 described dens in the mountainous habitat of the northeastern U.S. as being either a fissure in a ledge or crevice between the ground and a rock outcrop, talus slopes, or fallen rock partially covered by soil. In these sites snakes are able to gain access to underground cavities and voids below the frost line.

Populations in southern New Jersey are typically found in pinelands habitats that consist primarily of pitch pine, shortleaf pine, scrub oak, blackjack oak, and blueberry. Dens in the Pinelands are typically found in Atlantic white-cedar swamps and along stream banks. The summer ranges of male and non-gravid female timber rattlesnakes typically include forested habitats with greater than 50% canopy cover and approximately 75% vegetative ground cover (Reinert and Zappalorti 1988). Gravid (pregnant) females prefer areas with approximately 25% canopy cover, nearly equal amounts of vegetation and leaf litter covering the ground, and numerous fallen logs (Reinert and Zappalorti 1988). Both populations hibernate in communal dens sharing the hibernacula with other rattlesnakes as well as northern copperheads (northern population only), black rat snakes, and other species (Martin 1992). Once thriving throughout New Jersey loss of habitat and wanton killings have limited the population. The timber rattlesnake was listed as an endangered species in New Jersey in 1979. Under state endangered species laws it is illegal to kill, harm, harass, or collect the timber rattlesnake.

Management Implications: Activities in this plan that are expected to be beneficial to this species include patch-cuts, variable-density thinning, and Atlantic white-cedar restoration. The first two balance small openings with canopy maintenance to provide habitat for non-gravid females as well as gravid females, and the latter will expand potential wintering habitat.

As habitat loss is recognized as the primary cause of this species' decline, management activities that increase available habitat to this species will provide a

net benefit. To avoid impacts to this species during management activities in forested upland habitats, adjacent management activities should be staggered to dilute the potential impact to the species from forest management. In this way, potential damage to individuals outside of critical areas is countered by an overall increase in habitat, which relieves the most harmful pressure on the population.

The formation of temporary small open sunny locations through cutting forest between dens sites and sand roads will benefit gravid females, in addition to snakes in need of basking habitat to shed or heal, by providing basking areas away from roads. Slash piles from harvesting activities may also be beneficial in providing cover from predators. Prescribed burning occurring during the winter months has little direct effect on timber rattlesnakes.

Inside critical habitats, management activities have been adjusted to avoid impacts to this species. In areas proximate to documented nesting sites, operations will be adjusted using buffers, timing restrictions, and equipment restrictions so as not to result in any irreversible adverse impact to any local population.

In the pine region of the state, rattlesnake hibernation sites are generally associated with wet areas, including stream embankments, wetlands, and swamps. Known stream-associated dens will receive a 330' buffer that extends 1000' up and down stream of the den site. Known wetland-associated dens will receive the above-described stream-associated buffer along the nearest stream, a 330' buffer around the den location, and the area inside of lines drawn from the ends of the stream-associated buffer and the tangent of the 330' buffer. In isolated wetlands with no surface connection to nearby hydrography, the extent of the isolated wetland itself as well as a 330' buffer out from the perimeter will be used.

In each of these known den areas, no forestry equipment that exerts a ground pressure greater than four pounds per square inch (> 4 psi) will be allowed at any time of year, although activities are allowed at some times of year provided this standard is met. From November 1 to March 31, if the ground is frozen, equipment that exerts ≤ 4 psi may be used in the buffer areas; this equipment may also be used from May 16 to September 10 in buffer areas. During ingress and egress, no vehicular traffic is allowed in the buffer areas. Site preparation that disturbs the ground surface may only be conducted May 16 to September 10.

During the active period for ingress (September 10-November 15) and egress (April 1 – May 31), the use of herbicides within den buffers will be avoided unless required to complete targeted management objectives and agreed upon at stewardship plan implementation notification/meetings.

Endangered Plants and Plant Species of Concern

Bog Asphodel: The bog asphodel (*Narhecium americanum*), also known as yellow asphodel, is a perennial lily that can be found along streams, cedar swamps, and bogs, or generally in areas

that regularly flood along the coastal plain of New Jersey. The species blooms from mid-June to July, grows to roughly seven inches tall and showing a cluster of plentiful yellow flowers at the top of the stem. The bog asphodel has a range from New Jersey to South Carolina with small populations scattered throughout the New Jersey Pine Barrens (eFloras 2014; USDA, NRCS 2014).

Management Implications: To avoid possible destruction of this species' critical habitat special precautions will be taken in and around wetland areas, including implementation of adequate buffers consistent with forestry and wetlands best management practice guidelines.

Broom crowberry: Broom crowberry (*Corema conradii*) is a low, early successional ground cover plant restricted in New Jersey to the central Pinelands, in frequently-burned pine plains, pitch pine-shrub oak barrens, and open successional communities. The species relies on fire to maintain most open habitats, but is sensitive to shading, litter buildup and severe fire after prolonged fire exclusion. It is a State endangered species protected by New Jersey Pinelands Commission, and is ranked by New Jersey Natural Heritage Program as a G4S1 species. Broom crowberry's endangered status and state rank of S1 is due to its very limited geographic distribution within New Jersey, its location at the southern limit of its range, the transient nature of many open habitats and populations, and the modern decline in frequent fire and disturbance which are needed to maintain open habitats. Critical habitats for broom crowberry in the Pinelands include natural sandy openings created by fire, mild slope erosion, animal burrowing and xeric paleodune soils, or by severe man-made disturbances such as bulldozer scrapes, shallow sand pits, land clearing with slash removal, and charcoaling. Threats to the species include prolonged exclusion of fire, exclusion of disturbance, impaction by off-road-vehicles, deer browse (Center for Plant Conservation 2013), and slash or wood chip burial during forestry operations.

Management Implications: The restoration thinning activity, as well as variable-density thinning in this plan is expected to directly benefit this species. Maintenance and creation of open sandy habitat which is optimal for this species is critical for its management on this property. Slash or wood chips generated during forestry operations must not cover existing or created sandy openings, to help maintain open sandy habitats critical for broom crowberry and other rare species.

Curly grass fern: This small perennial herb occurs primarily throughout Delaware, New York, and New Jersey. The curly grass fern (*Schizaea pusilla*) is generally found in open moist depressions of peat or sphagnum bogs, as well as low lying forested land along the coastal plain. The curly grass fern is listed as a plant species of concern in New Jersey (USDA, NRCS 2014; Citizens United 2014; University of Texas – Austin 2014).

Management Implications: Conservation and maintenance of the habitat best suited to the curly grass fern is essential for its management. No management activities are planned in this document in open wetland habitats on DTSP.

Knieskern's beaked-rush: Knieskern's beaked-rush (*Rhynchospora knieskernii*) was federally listed as a threatened species in 1991 and is listed as State endangered In New Jersey. A semi-perennial member of the sedge family, Knieskern's beaked-rush is a grass-like plant that grows

0.6 to 24 inches tall and is distinguished from other species by its fruit (achene) which typically appears from July to September. Knieskern's beaked-rush is endemic to New Jersey. An obligate wetland species, Knieskern's beaked-rush occurs in early successional wetland habitats often on bog-iron substrates adjacent to slow-moving streams in the Pinelands region. In the past, fire may have played an important role in creating and maintaining suitable habitat for Knieskern's beaked-rush. This species is also found in human-disturbed wetland areas that exhibit similar early successional stages due to water fluctuation or periodic disturbance from vehicles, mowing, or fire. These human-influenced habitats include abandoned borrow pits, clay pits, ditches, rights-of-way, and unimproved roads. Knieskern's beaked-rush is often associated with other sedge and grass species. However, it is intolerant of shade and competition (especially from woody species) and is sometimes found on relatively bare substrates. Threats to Knieskern's beaked-rush include: habitat loss from development, agriculture, hydrologic modification, and other wetland alterations; excessive disturbance from vehicle-use, trash dumping, and other activities; and natural vegetative succession of the open, sparsely-vegetated substrate preferred by this species (USDA, NRCS 2014).

Management Implications: No management activities are planned in the open wetlands and buffers. This tract does not exhibit suitable habitat for the species at this time.

Little ladies'-tresses: This small perennial plant species (*Spiranthes tuberosa*) occurs primarily in the eastern United States as far west as Texas, north to Michigan, and south to Florida. Little ladies'-tresses favor dry open woodlands, outcrops, grasslands, and disturbed areas. This species is listed as a plant species of concern in New Jersey (USDA, NRCS 2014; eFloras 2014).

Management Implications: Maintenance and creation of habitat which is optimal for this species is critical for its management on this property. This species should benefit from canopy reductions in the variable-density thinning, patch cuts, restoration thinning, and shortleaf pine restoration called for in this plan.

New Jersey rush: This perennial plant species (*Juncus caesariensis*) occurs in Maryland, North Carolina, Pennsylvania, Virginia, and Nova Scotia in addition to New Jersey. Typical New Jersey rush habitat consists of bogs, swamps, edges of forested wetlands, and salt water shorelines. This species is listed as State endangered in New Jersey (University of Texas – Austin 2014; USDA, NRCS 2014; eFloras 2014).

Management Implications: There will be no forestry activities executed in areas containing suitable New Jersey rush habitat. Implementation of adequate buffers consistent with forestry and wetlands best management practice guidelines will reduce the risk of any possible habitat deterioration.

Pine Barren Gentian: The pine barren gentian (*Gentiana autumnalis*) is a perennial flowering plant found pitch pine lowland areas subject to frequent fire within the Pine Barrens of New Jersey, along roadsides, and areas that temporarily flood. The gentian, a five-petal blue flower with pale green spots, grows approximately 6 to 7 inches tall. This species is listed as a plant species of concern in New Jersey (eFloras 2014).

Management Implications: This disturbance-dependent species should benefit from management activities proposed within the plan.

Pine Barren rattlesnake-root: This perennial herb (*Prenanthes autumnalis*) occurs along the Atlantic coastal plain from as far north as New Jersey, and extends southward to Florida. Habitat best suited to Pine Barren rattlesnake-root consists of low savannas, sandy pinelands, clearings, forest edges, and moist areas. This species is a plant species of concern in New Jersey (USDA, NRCS 2014; eFloras 2014; Delaware DNREC 2014).

Management Implications: Maintenance and creation of optimal habitat for this species is critical for management and success of the population on this tract. Forest stand improvement activities called for in this plan on DTSP's the pitch pine lowlands should benefit this species.

Pine Barren Reedgrass: This perennial grass (*Calamovilfa brevipilis*) is not a species tracked by NJNHP, although dense patches are tracked by NJNHP as a G1, S1 ecological community, and it is listed and protected under the Pinelands Commission CMP. Pine barrens reedgrass is found in open areas of pitch pine lowlands and savannas on wet sandy soils which are seasonally saturated or slightly flooded. It flowers and spreads in response to severe fire and disturbance, and will sometimes form a solid grassland or savanna where burned by repeated growing season fires.

Management Implications: This disturbance-dependent species will benefit from forestry and fire management activities proposed within the plan.

Sickle-leaf Golden-aster: This perennial herb (*Pityopsis falcata*) is tracked by NJNHP as a G3G4, S3 species, and is listed and protected under the Pinelands Commission CMP. Sickle-leaf Golden-aster is found on dry sandy soils of disturbances and inland sand dunes, often in open habitats with full sun.

Management Implications: This disturbance-dependent species will benefit from forestry and fire management activities proposed within the plan.

Slender Nut Rush: This perennial graminoid (*Scleria minor*) is not a species tracked by NJNHP but is listed and protected under the Pinelands Commission CMP. Slender nutrush is found in wet acidic bogs and savannas of the Pinelands on peaty or sandy soils, in open canopy habitats created by seasonal flooding, fire or disturbance.

Management Implications: This disturbance-dependent species will benefit from forestry and fire management activities proposed within the plan.

Swamp pink: Swamp pink (*Helonias bullata*) occurs across the mid-Atlantic region occupying sites located in Georgia, North Carolina, South Carolina, Delaware, Maryland, New York, and Virginia in addition to New Jersey. This species prefers wetland habitats including Atlantic white-cedar swamps, Blue Ridge swamps, and borders of small streams, meadows, deciduous swamps, mixed swamps, and spring seepages. Swamp pink is also associated with species such as pitch pine, American larch, and black spruce. This species is Federally threatened and State endangered in New Jersey due to wetland draining and/or filling, pollution, habitat loss and degradation, trampling, and collection (Center for Plant Conservation 2013).

Management Implications: Protection of wetland areas containing hydrology preferred by swamp pink will be enhanced and maintained: no forest management activities is planned to occur in these locations.

Yellow fringed orchid: The yellow fringed orchid (*Platanthera ciliaris*), a perennial herb, occurs across the eastern portion of the United States and southern Canada. The range extends west to Texas, and south to Florida. This species prefers wetland habitats such as sandy peaty meadows, marshlands, sphagnum bogs, moist forested flats, as well as pine savannas, dry wooded slopes, and sandy thickets. This species is a plant species of concern in New Jersey (University of Texas – Austin 2014; USDA, NRCS 2014; eFloras 2014).

Management Implications: To avoid possible destruction of this species' critical habitat special precautions will be taken in and around wetland areas, including implementation of adequate buffers consistent with forestry and wetlands best management practice guidelines.

B. Historical & Cultural Resources

Historically the village of Double Trouble was a complete working company town. Currently the old sawmill as well as a cranberry sorting and packing house remain open to the public for guided tours, helping to depict the importance of preserving these industries which shaped the landscape of the Pine Barrens. No ground-penetrating disturbances are planned within 300 feet of any wetland areas. The planned forest management activities will not result in any adverse impact to any potential cultural resources. The New Jersey Historic Preservation Office will be notified if any artifacts are discovered during the process of conducting any forest management operations.

C. Aesthetics

Although the aesthetic values of a forest can vary from person to person, the uniqueness of the New Jersey Pinelands draws many to the surrounding area. DTSP is being managed for its several ecological and recreational values, and as such will conserve the integrity of native pinelands vegetation types. All activities being conducted in DTSP will take aesthetic values into account to the greatest extent practical while managing to meet the goals and objectives set for this planning cycle. Informing the public about activities that are going to occur in DTSP plays a critical role in how these activities are perceived. The public will be kept informed via NJ DEP public information policies. These policies provide outlets for information and processes for public comment.

D. Recreation

As a state park, the primary focus is on public recreational opportunities. This forest stewardship plan will provide specific management strategies aimed to provide quality outdoor experiences, while minimizing social and ecological conflicts in an effort to safely continue and allow for future recreational uses within the forest. Along with the forests, wildlife, and the historic village, Double Trouble has different recreational activities within the park enjoyed by many people year-round; among these activities are canoeing and kayaking. To better accommodate the public in utilizing DTSP, a new launch along Cedar Creek near the historic village is proposed in sub-stand PPSO-58. The installation of this new launch will give more options for paddlecraft trips on Cedar Creek making a more enjoyable recreational experience. Details for the layout of this park improvement will be developed by the New Jersey State Park Service. Once details are finalized, SPS will be responsible for applying to the NJ Pinelands Commission for approval of the installation.

Another recreation possibility is the expansion of trails within Double Trouble to make a route in which a person can hike/walk through the park. In the grand vision for New Jersey's open space, a proposed trail will run the length of the state, connecting many state parks. A connecting trail system within Double Trouble will greatly benefit both the patrons of the park and the design of this trail. Locations of potential trails are not located in the map provided. During the implementation and monitoring of the management activities outlined within this plan, common hiking routes and roads should be monitored for hazard trees as a safety precaution. Refer to the Goals and Objectives section for specific management details regarding recreation.

E. Carbon

Collectively, forest ecosystems represent the largest terrestrial carbon sink on earth. The accumulation of carbon in forests through sequestration helps to mitigate emissions of carbon dioxide to the atmosphere from sources such as forest fires and the burning of fossil fuels. Early in stand development most forest ecosystem carbon is in the soil organic matter and belowground tree components. Statewide analysis in 2011 of data collected by the US Forest Service Forest Inventory and Analysis program in 2008 shows that as forest stands mature, the ratio of above-to-belowground carbon shifts and by age 61 to 80 years the aboveground components represent the bulk of ecosystem carbon. This trend continues well into stand development as carbon accumulates in live and dead aboveground components (Crocker, et. al. 2011).

Part of the strategy of this plan is to mitigate wildfire by creating conditions less favorable to producing crown fires. With carbon shifting from belowground to aboveground components in New Jersey, it is assumed that these activities could be of benefit by preventing the rapid release of aboveground carbon associated with crown fires. Retention policies associated with the activities proposed for this planning cycle also encourage maintenance of forested cover, albeit at lower densities, to protect the integrity of native pinelands vegetation types which sequester carbon.

F. Economics

Wood and fiber production to support employment and local economies is one of the Montreal Process's criteria for sustainable forest management (Montreal Process 2014, USDA Forest Service Northeastern Area State and Private Forestry 2002). Sustainable production activities create constituencies whose existence is dependent on healthy forests and their proper management. Further, wood products have economic value that may be used to support further stewardship activities. Economics and local economies must be considered to determine whether management ideas are feasible and self-sustaining at the landscape level.

As DTSP is a public resource with many management goals outside of wood production, its management must not be determined solely based upon maximizing net present value of timber. Adherence to this principle is reflected in the volume, quality, and type of wood produced from several activities in this plan.

In consideration of the forest economy whose sustainable harvest activities support management goals other than wood production, measurable objectives for this plan include rough outlines of the amount and type of wood to be made available in this plan. This information should provide a foundation of confidence to develop businesses that make future forest management possible.

G. Invasive Species

Present observations indicate that invasive species are not a major concern on DTSP. Due to the overall droughty, sandy, low fertility characteristics of the park's soils and unique fire ecology, invasive species do not often get a strong foothold. There has been no indication of spread within the forested areas.

With the proper implementation of responsible forest resource management practices and an active monitoring program that utilizes adaptive management strategies it is not anticipated that invasive species will be an ongoing or future concern. However, special measures will be practiced in order to prevent the potential spread of invasive species during harvesting and management operations, including the implementation of appropriate best management practices (BMPs). Invasive species found in the future within DTSP will be eliminated using appropriate techniques, if necessary. Techniques for invasive control will be species-specific, utilizing all available technologies for a targeted approach. If mechanical means prove impractical, targeted chemical applications (herbicides) will be used as a method of last resort. All chemical applications (herbicides) will adhere to the standards set forth in N.J.A.C. 7:50-6.46(a)9ii.

H. Fire

Historically, fire has influenced landscape patterns within the pinelands region and DTSP. Fires occurred through natural disturbances such as lightning strikes and by Native American land management practices. Prior to development of the area, fire was able to spread at various intensities and frequencies across the forest creating a very complex structure as well as distinct fire regime. Various wildfires have burned the majority of the land area of DTSP over the last 80 years. The wildfire which burned the largest amount of acreage within DTSP (2,288 acres) occurred in 1942 and burned a total of about 2,353 acres of forestland. During more recent times the ecology of the forest within DTSP has experienced less influence from wildfire, with the exception two recent wildfires The “Jakes Branch Fire” of 2002 burned approximately 654 acres of forestland in the northeastern portion of DTSP. Also, during development of this stewardship plan the “Berkeley Crossroads Fire” occurred in late April of 2014. The fire burned roughly 220 acres, not affecting any stands designated for management prescriptions during this planning cycle.

In contrast to declining frequencies of wildfire, areas in the Wildland-Urban Interface (WUI) zone have experience prescribed fire regimes through management by the New Jersey Forest Fire Service. The WUI has been intensely managed with prescribed fire in an effort to reduce hazard fuel loads, increase public safety, and reduce the risk of harm or damage due to wildfire. In areas not burned by recent wildfires or WUI zones, fuel conditions have become increasingly dangerous, escalating the likelihood of a major wildfire. Active fire management strategies described in the management section of this plan attempt to reduce fuels and mitigate unplanned fire risks.

Wildfire

DTSP is critically at risk to wildfire, posing an even greater threat to ecological integrity as well as human life and infrastructure of the surrounding locations. In addition to smaller developments, Holiday City to the north, South Toms River to the northeast, as well as Carriage Road and Bamber Lakes to the south remain severely threatened if wildfire were to occur on the property. This is especially evident if forestlands adjacent to DTSP are ignited, since winds in the area typically prevail from the west, with oscillations to the north and south. Due to fire suppression on private lands as well as state-owned lands (Berkeley Triangle) fuel loads have increased. These conditions can lead to rapid fire spread, making wildfire control difficult and containment treacherous. Tactics and strategies for managing wildfire shift based on factors like weather, site history, fuels, and safety.

Prescribed Fire

Prescribed burning is a complex tool utilized in forest and natural resources management. The process involves the deliberate use of fire in a controlled manner to reduce fuel loads and mitigate wildfire hazards, ensure public health and safety, control understory conditions and structure, manipulate wildlife habitat, reduce insect and disease issues, and encourage fire-adapted species composition within the forest. The primary goal of prescribed fire in DTSP is

direct and strategic hazard fuel reduction. This ensures public health and safety through diminution of surface and ladder fuels in the WUI.

The techniques used by the New Jersey Forest Fire Service can perpetuate many of the native Pinelands forest types and the unique structure reminiscent of historical fire conditions. The implementation of prescribed fire however, depends on numerous conditions including weather, proximity to infrastructure, forest fuels, and most importantly safety. Also as with wildfires, prescribed fire techniques vary according to site- and time-specific details.

Due to the dynamic and often complex site factors involved, the execution of a prescribed burn may not achieve its intended goals in an individual event. It is up to the discretion of the New Jersey Forest Fire Service to determine whether a burn properly reduced fuel; at their discretion, prescribed burns may be repeated within a burn cycle to achieve hazard reduction goals. Refer to the management recommendations section for details on the planned use of prescribed fire.

I. Forest Health

A forest in good health exhibits an overwhelming capacity for resistance, resilience, and recovery from an array of disturbances. Management recommendations aim to establish more robust systems to prevent major forest health problems, and enable the forest to recover from disturbance.

Major threats to forest health in DTSP include southern pine beetle (SPB), sirex woodwasp, gypsy moth, pine looper, bacterial leaf scorch, sudden oak death, extreme weather conditions, and damaging wildfire. Southern pine beetle, an eruptive pest with an alarming trend of increasing damage, places many of the older, denser stands of pine in DTSP at risk for damaging outbreaks. To mitigate the risk from this forest insect pest, one of the goals of this plan is to ensure that after-treatment stand basal area is below the threshold at which SPB becomes a problem (80 ft² of basal area per acre). Other activities to proactively deal with forest pests include attention to the residual proportions of chestnut/white/scarlet/black oaks in shortleaf pine restoration areas to minimize future losses from bacterial leaf scorch.

Further forest health activities within DTSP include surveying and monitoring of forest conditions throughout the planning period. An adaptive management approach will aid in responses if disturbances become significantly adverse to overall forest health conditions during the planning cycle.

J. Wetlands

Unique freshwater wetland sites exist within DTSP, in which special precautions must be taken in order to maintain and protect their function and integrity including water quality. To mitigate adverse impacts to wetlands and water resources, activities described in the “Management Recommendations” section of this plan will adhere to Best Management Practices (BMPs) provided in the New Jersey Forestry and Wetlands Best Management Practices Manual (1995) and the Forest Stewardship Council U.S. Forest Management Standards (Forest

Stewardship Council US 2010). This includes careful placement of harvest landings in and around locations defined as wetlands (refer to Appendix F: Freshwater Wetlands Map), and protection of streamside management zones (SMZ's) through proper buffer size and placement (refer to Appendix G: DTSP Streams Requiring Streamside Management Zones). Other BMPs for addressing water resources incorporate adapting harvest schedules for poor weather conditions, as well as logging debris management.

As the terrain across DTSP is fairly flat streamside management zones were determined using the 0 – 10% slope category in the New Jersey Forestry and Wetlands BMP Manual (1995) and the 1 – 10% slope category in the FSC US Forest Management Standards for the Appalachia region (Forest Stewardship Council US 2010). For perennial streams the stricter SMZ requirements defined in the FSC guidelines were adhered to; these consist of a 25' inner zone and a 55' outer zone for an 80' minimum SMZ width around. This buffer distance is greater than the distance specified in the Pinelands Comprehensive Management Plan (CMP, Pinelands Commission 2012), but does not apply to Atlantic white-cedar restoration activities.

Any treatment activities proposed through the DTSP plan should not adversely impact threatened or endangered species, modify the flow or hydrology of wetland sites, or manipulate the extent of freshwater wetland habitat. Management treatments on DTSP as outlined in this document will be in compliance with the Freshwater Wetlands Protection Act (NJ Department of Environmental Protection 2009) through compliance with the Pinelands CMP.

K. Roads

Roads are often a deciding factor in planning management across the forest landscape. Their placement directly impacts the ability of managers to access portions of a property, both for silvicultural treatments and fire control activities. Further, their locations and characteristics affect the economic value of standing trees, and hence the self-sufficiency (cost-balance) of forest management prescriptions. Unfortunately, road access may create unintended negative consequences that follow from non-target uses. Similarly, roads in poor condition create greater erosion hazards, pose more significant threats to environmental quality, and reduce the utility of existing roads. The New Jersey Forestry and Wetlands BMP Manual (1995) provides an essential guide for the planning, installation, maintenance, and decommissioning of roads, as well as stream crossings for forest operations. The manual's practices will be followed to mitigate damage from siltation and erosion.

In order to perpetuate the positive benefits of existing roads, the roads in Double Trouble State Park should be placed on a maintenance schedule. As detailed in the New Jersey Forestry and Wetlands BMPs, road surface grading and drainage structure maintenance are needed on an annual basis to avoid potential damage to water resources resulting from road use. Limbing and brushing are required to maintain access, especially in emergency situations; these activities can be performed less frequently than road surface and drainage work. Both types of work increase the value of existing roads.

In situations where roads are not intended to be maintained or in use beyond a single management activity, it is crucial that temporary access routes are decommissioned. This

includes actions such as utilizing the most temporary materials possible, increasing the safe conveyance capacity of drainage structures, re-vegetating exposed soil surfaces, and installing structures to reduce or eliminate vehicular use, such as berms, debris barricades, or other structures. Closed roads should be periodically inspected to ensure drainage structures and erosion measures are properly functioning.

L. Forest Productivity

In order to maintain the productive capacity of the forest, it is important to ensure that management does not remove more wood products across successive harvests than can be grown in the same timeframe. This concept is referred to as the “sustained yield harvest” in the FSC guidelines (Forest Stewardship Council US 2010), and “sustainable yield” for this plan. This view of sustainability uses the growth rates of the forest as well as the area of potential activity to determine growth.

The USDA Forest Service suggests that states use Forest Inventory Analysis (FIA) data to determine potential sustained yield (USDA Forest Service, Northeastern Area State and Private Forestry 2002), although this is intended for setting sustained yield at a broad, state-wide scale. Finer scale measurements may be appropriate for determining sustainable yield on a specific parcel of public land. As NJSFS transitions into more detailed measurements of site productivity, sharper growth estimates will be made. In the meantime, NJSFS used FIA data for Ocean County across all forest types to determine estimated growth within DTSP over the planning cycle. The estimates for growth are very conservative, particularly in wetlands, and especially so in Atlantic white-cedar wetlands. A detailed breakdown of expected sale volumes and their impact on total growth is included at the end of the “Management Recommendations” section of this document.

IV. FOREST STAND DESCRIPTIONS

The 8,677 acres in DTSP were divided into fourteen overall stand types according to overstory and midstory composition, density, and major recent disturbance history during the landscape inventories in 2009 by Land Dimensions Engineering (LDE) and Heartwood Consulting Services, LLC (HCS), as well as the New Jersey State Forestry Services in 2011 and 2013.

Forest inventory data included measurements of tree height, diameter at breast height (DBH), species, form, understory composition, and other tree and site qualities. These data were collected at the landscape level for the purpose of describing forest stands. A further operational inventory used to fine-tune volume calculations for smaller, specific sub-stands will be conducted prior to commencing all prescribed management activities.

The overstory consists of the tree component that grows above 20 feet and forms the canopy. The midstory is the tree and shrub component that grows between 5 - 20 feet and forms a sub-canopy level. The understory is composed of all ground cover less than 5 feet. The woodland forest types developed are:

1. Pitch Pine-Scrub Oak (PPSO) with a subset of Pitch Pine-Scrub Oak Burned (PPSO_b);
2. Scrub Oak-Pitch Pine (SOPP);
3. Pitch Pine Plantation (PLANT);
4. Pitch Pine-Shrub Tree Oak (PPSTO);
5. Pitch Pine-Tree Oak (PPO);
6. Tree Oak-Pitch Pine (OP);
7. Pitch Pine lowland (PPlo) with a subset of Pitch Pine lowland burned (PPlob);
8. Pitch Pine-Red Maple-Atlantic white-cedar (PMC);
9. Atlantic white-cedar (CED) with subsets of Cedar Young (CED_y), Cedar Burned (CED_b), and Cedar Regeneration (CED_r);
10. Maple Swamp (MAP);
11. Emergent Wetland (EM WET);
12. Scrub/Shrub Wetland (SS) grouped with Spung;
13. Agricultural Wetlands which groups the types of Abandoned Blueberry Fields (BB), Farmland (FARM), agricultural bogs (BOGS), and Disturbed Lowland (DISlo); as well as
14. Non-Forest which groups the types of Disturbed (DIS), Grass Fields (GRASS), Resource Extraction Areas (RES), and Right of Ways (ROW)

For a map of these types on the property, refer to Appendix H: Forest Stand Types Map and Appendix I: Forest Sub-Stand Map.

1. Forest Stand PPSO

Pitch Pine-Scrub Oak: 3,587.9 Acres



This is an upland forest stand characteristic of the Pine-Shrub Oak native Pinelands type. Pitch pine dominates the overstory with shortleaf pine, upland tree oaks, and sassafras spaced throughout. Shrub oaks such as scrub oak, post oak, and blackjack oak dominate the midstory and understory of this stand. PPSO occurs on approximately 3,588 acres comprised of 63 sub-stands scattered across DTSP (referred to as PPSO – 1 through 63, see stand map).

The canopy consists of 95 to 100 percent pitch pine with white oak, black oak, scarlet oak, shortleaf pine, and sassafras making up the remainder. Canopy tree heights average about 45 feet, but there are some larger pines scattered throughout; the largest measured tree was 20 inches in diameter and 50 feet tall. The stand contains roughly 409 trees per acre (TPA), and 98 square feet of basal area per acre (ft^2/acre). Canopy cover is mostly closed for a pine overstory, with cover between 40 and 60 percent; some open areas as well as thicker patches also occur throughout. The pines are mostly 4 to 10 inches in diameter at breast height (DBH) with a quadratic mean diameter (QMD) of 6.6 inches.

Most of the overstory trees form even-aged sub-stands within the type and range from about 75 to 100 years old. Younger densely stocked sub-stands are also evident ranging from 40 to 50 years of age, most likely regenerated as a result of the 1950 wildfire.

The midstory layer is mainly comprised of 60 to 70 percent shrub oak, while shrub/tree oak,

advanced regeneration of pitch pine, inkberry, and greenbriar make up the remainder. Overall the midstory layer is approximately 50 to 80 percent closed, with some more open patches due to recent fires. The understory contains about 60 to 70 percent lowbush blueberry/huckleberry and 10 percent or less of bare ground. Inkberry, fern, sheep laurel, greenbriar, and partridgeberry make up the majority of the ground cover.

Volume Estimation and Stock Table*

Forest Stand: PPSO – 3,587.9 Acres

Summary

Species	Per Acre			Total Across Forest Stand	
	Trees	Basal Area (ft ²)	Cords	Trees	Cords
Pitch Pine	394	96	16.56	1,413,991	58,964.20
Oak	15	2	0.23	52,383	1,512.37
Total	409	98	16.79	1,466,374	60,476.57

Pitch Pine

DBH	Per Acre			Total Across Forest Stand	
	Trees	Basal Area (ft ²)	Cords	Trees	Cords
4	134	14	0.00	481,496	0.00
6	151	29	4.10	541,055	14,701.31
8	65	22	4.64	232,137	16,636.05
10	26	14	3.32	92,927	11,921.82
12	13	10	2.56	47,001	9,178.67
14	4	4	1.13	13,993	4,060.23
16	1	1	0.35	3,229	1,239.87
18	<1	1	0.18	1,076	631.29
20	<1	1	0.17	1,076	594.96
Total	394	96	16.45	1,413,991	58,964.20

* Estimates based on Forest Vegetation Simulator (FVS) projections to 2014 using inventory information collected by LDE and the NJSFS. Slight numerical differences in totals are the result of rounding error.

Oak

	<i>Per Acre</i>			<i>Total Across Forest Stand</i>	
DBH	Trees	Basal Area (ft²)	Cords	Trees	Cords
4	7	1	0.00	22,245	0.00
6	8	1	0.19	27,627	1380.66
8	1	0	0.04	2,512	131.71
Total	16	2	0.23	52,383	1,512.37

1a. Forest Stand PPSOb**Pitch Pine-Scrub Oak Burned: 393.0Acres**

This forest stand was the same as PPSO but was burned by the Jake's Branch wildfire in 2002. It corresponds to the Pinelands Pine-Shrub Oak Native Forest Type. Species composition is similar to PPSO, with pitch pine dominating the overstory, and scattered white oak, black oak, and sassafras present. Tree heights average about 40 feet, and canopy cover is around 30%. At about 190 TPA, a QMD of 7.0 inches, and a basal area of 50 ft²/acre, the stand has about half the stocking of the unburned PPSO type; the slightly higher QMD reflects increased survival of large trees in the 2002 wildfire.

The midstory is more open due to fire-induced mortality of the shrubs and other vegetation in the midstory and understory, although new growth has developed considerably in the years since disturbance. PPSOb forest types can be found in the northeastern section of DTSP and comprise a total of eight sub-stands (referred to as PPSOb – 1 through 8, see stand map) making up approximately 393 acres.

Volume Estimation and Stock Table*

Forest Stand: PPSOb – 393.0 Acres

Summary

	<i>Per Acre</i>			<i>Total Across Forest Stand</i>	
Species	Trees	Basal Area (ft²)	Cords	Trees	Cords
Pitch Pine	190	51	9.26	100,860	4,921.17
Total	190	51	9.26	74,760	3,639.18

Pitch Pine

	<i>Per Acre</i>			<i>Total Across Forest Stand</i>	
DBH	Trees	Basal Area (ft²)	Cords	Trees	Cords
4	76	7	0.00	40,493	0.0
6	34	7	0.99	18,014	524.0
8	25	7	1.31	13,232	696.2
10	42	20	4.21	22,531	2,237.93
12	10	7	1.67	5,367	889.93
16	2	3	1.08	1,275	573.10
Total	190	51	9.26	74,670	3,639.18

* Estimates based on Forest Vegetation Simulator (FVS) projections to 2014 using inventory information collected by LDE and the NJSFS. Slight numerical differences in totals are the result of rounding error.

2. Forest Stand SOPP

Scrub Oak-Pitch Pine: 186.4 Acres



This stand has an overstory of primarily pitch pine, which exhibits characteristics much like that of PPSO. However, the canopy structure of SOPP is vastly more open with an abundant and dense shrub layer. This stand is the result of wildfires that burned through the area killing the canopy trees but failing to burn through the root mat, which increased the growth of scrub oak in place of the pitch pine. Smaller blackgum, aspen, and sassafras are scattered throughout the stand as well. The majority of SOPP sub-stands are located just north and just south of the Factory Branch tributary. One small patch has also been identified along Dover Road, just north of the Lacey and Dover Road intersection. SOPP occurs on approximately 186 acres across DTSP with a total of three sub-stands (referred to as SOPP – 1 through 3, see stand map). The abundance of shrub oak and dominance of remaining pine cause this stand to correspond to the Pine-Shrub Oak upland native forest type of the Pinelands CMP.

The overstory in this type is not quite as dense as PPSO, resulting in approximately 186 trees per acre, though many of these stems are larger shrub oaks. Pitch pines range from about 8 to 14 inches in DBH with dominant heights of 30 to 40 feet. Basal area is highly variable, with significant areas devoid of canopy, but some as high as 64 ft²/acre. Canopy cover is similarly variable but ranges up to 45%. QMD is 7.9 inches, demonstrating the contrast between smaller shrub oaks and larger pines.

A thick shrub layer exists, made up mostly of scrub oak and blackjack oak, although some mountain laurel and American holly is present as well. The shrub layer consists primarily of scrub oak with densities much greater than the overstory. Understory species consist of lowbush blueberry, huckleberry, inkberry holly, ferns, greenbriar, and bare ground. Very little tree regeneration is present within SOPP at this time.

Volume Estimation and Stock Table*

Forest Stand: SOPP – 186.4 Acres

Summary

	<i>Per Acre</i>			<i>Total Across Forest Stand</i>	
Species	Trees	Basal Area (ft²)	Cords	Trees	Cords
Pitch Pine	73	53	10.89	13,551	2,029.64
Oak	113	11	0.00	21,100	0.00
Total	186	64	10.89	34,651	2,029.64

Pitch Pine

	<i>Per Acre</i>			<i>Total Across Forest Stand</i>	
DBH	Trees	Basal Area (ft²)	Cords	Trees	Cords
8	29	11	1.95	5,331	362.89
10	18	11	1.88	3,411	350.38
14	19	21	4.72	3,486	879.15
16	7	10	2.35	1,342	437.21
Total	73	53	10.89	13,551	2,029.64

Oak

	<i>Per Acre</i>			<i>Total Across Forest Stand</i>	
DBH	Trees	Basal Area (ft²)	Cords	Trees	Cords
4	113	11	0.00	21,100	0.00
Total	113	11	0.00	21,100	0.00

* Estimates based on Forest Vegetation Simulator (FVS) projections to 2014 using inventory information collected by LDE and the NJSFS. Slight numerical differences in totals are the result of rounding error.

3. Forest Stand PLANT

Pitch Pine Plantation: 34.4 Acres



This upland plantation was part of a reforestation project with the Global ReLeaf Heritage Forest Program. The stand was burned intensely in a wildfire in 1992, and replanted in 1994 with pitch pine, shortleaf pine, and a mixture of oaks. This composition corresponds to the Pineland CMP upland pine-dominated upland native forest. The PLANT stand is composed of two sub-stands (referred to as PLANT – 1 and PLANT – 2, see stand map) consisting of approximately 34 acres on DTSP.

The overstory is dominated by small, young pitch pine with few large pines scattered throughout. Canopy cover is around 48%. Most of the pines range between 4 to 6 inches in DBH; QMD is 5.2 inches. Canopy height is 20-25 feet, although a handful of taller remnant trees (3-4/acre) remain. Currently, the stand is stocked with 643 trees per acre and 97 ft²/acre of basal area.

A sparse midstory has begun formation, consisting of inkberry, scrub oak, and some pitch pine regeneration. The understory is mostly comprised of patchy lowbush blueberry, huckleberry, and bare ground.

Volume Estimation and Stock Table*

Forest Type: PLANT – 34.4 Acres

Summary

	<i>Per Acre</i>			<i>Total Across Forest Type</i>	
Species	Trees	Basal Area (ft²)	Cords	Trees	Cords
Pitch Pine	644	97	6.52	22,153	224.17
Total	644	97	6.52	22,153	224.17

Pitch Pine

	<i>Per Acre</i>			<i>Total Across Forest Type</i>	
DBH	Trees	Basal Area (ft²)	Cords	Trees	Cords
4	429	49	0.00	14,758	0.00
6	215	48	6.52	7,396	224.17
Total	644	97	6.52	22,153	224.17

* Estimates based on Forest Vegetation Simulator (FVS) projections to 2014 using inventory information collected by LDE and the NJSFS. Slight numerical differences in totals are the result of rounding error.

4. Forest Stand PPSTO

Pitch Pine-Shrub Tree Oak: 460.2 Acres



This is an upland forest stand where pitch pine dominates the overstory and shrub tree oaks such as blackjack oak and post oak dominate the midstory. Sassafras and mature tree oaks such as scarlet oak, white oak or chestnut oak are occasionally found in the overstory. The shrub tree oaks periodically grow taller than 20 feet and enter the overstory. This stand exhibits characteristics typical of the upland pine-dominated native Pinelands forest type. PPSTO occurs on 460 acres in nine sub-stands across DTSP (referred to as PPSTO – 1 through 9, see stand map).

The canopy consists of 95 - 100 percent pitch pine, with white oak, scarlet oak, chestnut oak, sassafras, blackjack oak, and post oak comprising the other 0 - 5 percent. The canopy is somewhat open with canopy cover ranging from 50 to 60%. Some thicker and thinner patches are also scattered throughout the type. Basal area is around 91ft²/acre for the stand, with QMD at 7.4 inches. The pines are mostly 6 - 12 inches in diameter with heights mainly around 45 feet tall, though larger pines are scattered throughout. The tallest pine measured was 73 feet tall and 15 inches in diameter. The tree oaks mainly range from 4 - 11 inches in DBH and 20 - 40 feet in height, although some reach the canopy. The shrub tree oaks are 2 - 4 inches in DBH and 10 - 20 feet tall. There are approximately 302 trees per acre in the stand.

The midstory typically contains a greater percentage of shrub tree oaks and scrub oak than the canopy, with roughly 10 - 20 percent advanced pitch pine regeneration. The remaining midstory

consists of sassafras, greenbriar, inkberry, mountain laurel. The understory is comprised of 40-50 percent lowbush blueberry/huckleberry and 10 - 30 percent bare ground, with inkberry, fern, sheep laurel, and greenbriar making up the remainder. There is little new regeneration currently occurring within stands. Fire exclusion and lack of disturbance has allowed for overstocking of the overstory and understory plant communities.

Volume Estimation and Stock Table*

Forest Type: PPSTO– 460.2 Acres

Summary

	<i>Per Acre</i>			<i>Total Across Forest Stand</i>	
Species	Trees	Basal Area (ft²)	Cords	Trees	Cords
Pitch Pine	201	74	14.61	92,598	6,720.66
Oak	101	17	1.72	46,276	790.73
Total	302	91	16.33	138,874	7,511.39

Pitch Pine

	<i>Per Acre</i>			<i>Total Across Forest Stand</i>	
DBH	Trees	Basal Area (ft²)	Cords	Trees	Cords
4	61	7	0.00	28,152	0.00
6	52	11	1.50	23,782	688.25
8	39	14	2.58	18,124	1,187.85
10	14	8	1.47	6,440	676.03
12	20	16	3.86	9,292	1,777.11
14	11	12	3.15	5,014	1,446.96
16	3	4	1.29	1,242	592.18
18	1	1	0.37	322	171.77
20	1	1	0.39	276	180.51
Total	201	74	14.61	92,598	6,720.66

* Estimates based on Forest Vegetation Simulator (FVS) projections to 2014 using inventory information collected by LDE and the NJSFS. Slight numerical differences in totals are the result of rounding error.

Oak

	<i>Per Acre</i>			<i>Total Across Forest Stand</i>	
DBH	Trees	Basal Area (ft²)	Cords	Trees	Cords
4	62	6	0.00	28,290	0.00
6	27	5	0.44	12,328	203.22
8	7	2	0.45	3,312	206.71
10	3	1	0.29	1,150	133.34
12	2	1	0.18	736	83.27
14	1	1	0.36	460	163.62
Total	101	17	1.72	46,276	790.73

5. Forest Stand PPO

Pitch Pine-Tree Oak: 188.8 Acres



This is another upland forest stand located on DTSP and characterized as the Pinelands pine-dominated native forest type. Like PPSO, pitch pine dominates the overstory in this stand, but the canopy also contains tree oaks such as white oak, scarlet oak, and chestnut oak. Subordinate black gums may also be present in the upper stratum of the stand. This stand occurs in four sub-stands throughout DTSP (referred to as PPO – 1 through 4, see stand map) on approximately 189 acres. The largest of the four sub-stands is located on the east side of Deep Hollow branch, while two smaller sub-stands are located to the north and south of Dover Road adjacent the Lacey/Berkeley Township line.

At 60-80%, the canopy cover is somewhat higher than in PPSO, mostly due to the increased deciduous component of the overstory. The canopy ranges from 40-45 feet in height, but some taller pines may extend up to 50 feet tall. Shrubs in this stand consist mostly of shrub tree oaks, scrub oak, pitch pine regeneration, and some sassafras. Understory species include lowbush blueberry, huckleberry, sheep laurel, mountain laurel, American holly, and greenbriar.

The largest tree measured in this stand was a 50-foot tall pitch pine 18 inches in diameter, but QMD for the stand is around 6.9 inches. The oak stems increase TPA to about 448; of that number, roughly one-third is pine. Basal area for this stand is around 119 ft²/acre.

Volume Estimation and Stock Table*

Forest Stand: PPO – 188.8 Acres

Summary

	<i>Per Acre</i>			<i>Total Across Forest Stand</i>	
Species	Trees	Basal Area (ft²)	Cords	Trees	Cords
Pitch Pine	169	74	16.46	11,252	1,097.85
Oak	198	29	2.42	13,193	161.60
Blackgum	81	15	2.18	5,403	145.22
Total	448	118	21.06	84,582	3,976.13

Pitch Pine

	<i>Per Acre</i>			<i>Total Across Forest Stand</i>	
DBH	Trees	Basal Area (ft²)	Cords	Trees	Cords
4	72	8	0.00	4,829	0.00
6	17	4	0.75	1,121	49.73
8	0	0	0.00	0	0.00
10	42	25	5.58	2,828	372.08
12	21	17	4.44	1,407	296.27
14	9	10	2.84	620	189.21
16	5	7	1.90	320	126.98
18	2	4	0.95	127	63.49
Total	169	74	16.46	31,907	3107.65

Oak

	<i>Per Acre</i>			<i>Total Across Forest Stand</i>	
DBH	Trees	Basal Area (ft²)	Cords	Trees	Cords
4	144	15	0.00	9,605	0.00
6	50	11	1.83	3,315	121.83
12	4	3	0.60	273	39.77
Total	198	29	2.42	37,382	456.90

* Estimates based on Forest Vegetation Simulator (FVS) projections to 2014 using inventory information collected by LDE and the NJSFS. Slight numerical differences in totals are the result of rounding error.

Blackgum

	<i>Per Acre</i>			<i>Total Across Forest Stand</i>	
DBH	Trees	Basal Area (ft²)	Cords	Trees	Cords
4	38	4	0.00	2,528	0.00
6	34	8	1.41	2,248	93.80
8	10	4	0.77	634	51.42
Total	81	15	2.18	15,293	411.58

6. Forest Stand OP

Oak-Pitch Pine: 20.5 Acres



This stand, characterized by one sub-stand approximately 20 acres in size (referred to as OP, see stand map), is similar to PPO. However, in this stand, the tree oaks present are the dominant functional group. OP is located off of Dover Road adjacent the township line, and also bordering a stand of PPO. The dominant tree oaks present are white oak, black oak, and scarlet oak, with a small pitch pine component. This structure is the result of pine harvests that took place decades earlier. This stand corresponds to the Pinelands CMP upland oak-dominated native forest type.

Canopy cover ranges between 65 and 75 percent, made up mostly of the canopy oaks. Midstory vegetation is made up mostly of oak regeneration, and mountain laurel, with some scrub oak, though midstory cover is around 25%. The understory is made up of lowbush blueberry, huckleberry, sheep laurel, and mountain laurel, and is only slightly higher in cover than the midstory, at around 35%. There is no pitch pine regeneration in either layer.

The overstory oaks range between 4 and 10 inches in DBH, and 30 to 40 feet in height with pitch pine between 6 and 14 inches in DBH, and 40 to 50 feet in height. Overall QMD is 6.0 inches, and there are 334 trees per acre, excess of 95% of which are oak stems. Basal area for the stand is currently at 67 ft²/acre.

Volume Estimation and Stock Table*

Forest Type: OP – 20.5 Acres

Summary

	<i>Per Acre</i>			<i>Total Across Forest Stand</i>	
Species	Trees	Basal Area (ft²)	Cords	Trees	Cords
Pitch Pine	9	11	2.97	193	60.98
Oak	325	57	5.05	6,652	103.59
Total	334	68	8.02	6,845	164.57

Pitch Pine

	<i>Per Acre</i>			<i>Total Across Forest Stand</i>	
DBH	Trees	Basal Area (ft²)	Cords	Trees	Cords
14	9	11	2.97	193	60.98
Total	9	11	2.97	193	60.98

Oak

	<i>Per Acre</i>			<i>Total Across Forest Stand</i>	
DBH	Trees	Basal Area (ft²)	Cords	Trees	Cords
4	227	24	0.00	4,654	0.00
6	51	11	1.27	1,037	26.05
8	29	11	1.78	586	36.54
10	18	11	2.00	375	40.97
Total	325	57	5.05	6,652	103.59

* Estimates based on Forest Vegetation Simulator (FVS) projections to 2014 using inventory information collected by LDE and the NJSFS. Slight numerical differences in totals are the result of rounding error.

7. Forest Stand PPlo

Pitch Pine Lowland: 1,076.6 Acres



This forest stand is located in poorly drained sites adjacent to red maple and Atlantic white-cedar stands throughout DTSP. Pitch pine dominates the overstory, though there is an Atlantic white cedar component, with additional encroachment by red maple and blackgum. PPlo occurs on approximately 1,076 acres comprised of 56 sub-stands across DTSP (referred to as PPlo – 1 through 56, see stand map).

Much of the canopy is overstocked pitch pine, and canopy cover is about 70%. The understory is densely covered in highbush blueberry, sweet pepperbush, fetterbush, sheep laurel, swamp azalea, leatherleaf, as well as bracken fern and wintergreen. Greenbriar also makes up a large portion of the understory, thickly draping over the shrub layer forming an almost impassable wall. Regeneration of pine is patchy throughout this forest stand. Average tree heights are around 50 feet, with a QMD of 6.7 inches. There are roughly 537 trees per acre, and 133 ft²/acre of basal area.

The trees in this stand are mainly between 45 - 65 years of age with scattered younger and older patches, likely resultant of severe stand-replacing fires during the 1950's. The present forest stand structure however, is due in part to the lack of fire integration, making any proposed fire prescriptions difficult to control without prior forest management.

Volume Estimation and Stock Table*

Forest Stand: PPl0 – 1,076.6 Acres

Summary

	<i>Per Acre</i>			<i>Total Across Forest Stand</i>	
Species	Trees	Basal Area (ft²)	Cords	Trees	Cords
Pitch Pine	403	106	20.69	433,776	22,260.29
Hardwoods	122	24	3.68	131,284	3,965.22
Atlantic white-cedar	12	4	0.71	12,913	764.17
Total	537	134	25.08	577,973	26,989.68

Pitch Pine

	<i>Per Acre</i>			<i>Total Across Forest Stand</i>	
DBH	Trees	Basal Area (ft²)	Cords	Trees	Cords
4	121	13	0.00	130,531	0.00
6	166	33	5.51	178,202	5,929.45
8	67	24	5.45	72,314	5,861.34
10	28	15	3.78	30,238	4,071.47
12	12	10	2.75	13,236	2,964.04
14	6	6	1.84	6,134	1,975.12
16	2	3	0.96	2,260	1,032.51
18	1	1	0.39	753	424.99
Total	403	106	20.69	433,776	22,260.29

* Estimates based on Forest Vegetation Simulator (FVS) projections to 2014 using inventory information collected by LDE and the NJSFS. Slight numerical differences in totals are the result of rounding error.

Hardwoods (Red maple and Blackgum)

	<i>Per Acre</i>			<i>Total Across Forest Stand</i>	
DBH	Trees	Basal Area (ft²)	Cords	Trees	Cords
4	51	5	0.00	54,881	0.00
6	53	10	1.55	56,710	1,664.55
8	13	5	1.06	13,559	1,145.57
10	4	2	0.57	4,520	614.33
12	1	1	0.20	1,184	217.94
16	0	0	0.16	323	177.08
22	0	0	0.13	215	144.39
Total	122	24	3.68	131,284	3,965.22

Atlantic white-cedar

	<i>Per Acre</i>			<i>Total Across Forest Stand</i>	
DBH	Trees	Basal Area (ft²)	Cords	Trees	Cords
4	5	1	0.00	5,058	0.00
6	4	1	0.16	4,520	171.63
8	1	0	0.09	1,291	98.07
12	1	0	0.09	538	99.44
14	1	1	0.18	861	197.51
16	1	1	0.18	646	197.51
Total	12	4	0.71	12,913	764.17

7a. Forest Stand PPlob

Pitch Pine Lowland – burned: 53.1 Acres

This stand is the same as PPlo, however, due to the wildfire in 2002 the structure and composition has changed slightly. In contrast to PPlo, this stand has a significantly less dense understory which is much more conducive to the establishment of pitch pine regeneration. PPlob occurs in the northeastern corner of DTSP on approximately 53 acres comprised of two sub-stands (referred to as PPlob – 1, and PPlob – 2, see stand map).

Volume Estimation and Stock Table*

Forest Stand: PPlob – 53.1 Acres

Summary

	<i>Per Acre</i>			<i>Total Across Forest Stand</i>	
Species	Trees	Basal Area (ft²)	Cords	Trees	Cords
Pitch Pine	67	24	5.54	3,536	294.34
Hardwoods	20	5	1.06	1,057	87.04
Total	87	29	6.60	4,593	381.38

Pitch Pine

	<i>Per Acre</i>			<i>Total Across Forest Stand</i>	
DBH	Trees	Basal Area (ft²)	Cords	Trees	Cords
6	31	6	1.07	1,630	57.00
8	21	7	1.53	1,088	81.53
10	10	5	1.30	510	68.83
12	3	2	0.66	165	35.22
14	2	2	0.48	85	25.68
16	< 1	1	0.27	37	15.59
18	< 1	< 1	0.14	16	7.80
20	< 1	< 1	0.07	5	3.70
Total	67	23	5.54	3,537	294.34

* Estimates based on Forest Vegetation Simulator (FVS) projections to 2014 using inventory information collected by LDE and the NJSFS. Slight numerical differences in totals are the result of rounding error.

Hardwoods (Red maple and Blackgum)

	<i>Per Acre</i>			<i>Total Across Forest Stand</i>	
DBH	Trees	Basal Area (ft²)	Cords	Trees	Cords
6	13	2	0.36	701	19.29
8	4	1	0.29	223	15.66
10	2	1	0.23	101	12.64
12	< 1	< 1	0.07	16	3.83
14	< 1	< 1	0.04	11	2.08
16	< 1	< 1	0.04	5	1.61
24	< 1	< 1	0.02	0	1.28
Total	20	5	1.06	1,057	87.04

8. Forest Stand PMC

Pitch Pine- Red Maple- Atlantic white-cedar: 852.2 Acres



This forest stand is located along streams, drainages, and some isolated poorly drained depressions. The red maple, pitch pine, and blackgum populations now intertwined with Atlantic white-cedar within the PMC stand are an outcome of open patch reclamation. These openings were created as a result of cedar mortality from causes such as wildfire, increased water salinity, poor forest management practices, or changes in hydrology due to beaver and/or residential development. Pitch pine and red maple dominate the overstory but some white-cedar persists. Blackgum also dominates in some areas of PMC. The midstory of this forest stand is traditionally denser than that of pitch pine lowlands or pure cedar stands. PMC occurs on 852 acres of DTSP and is comprised of 45 sub-stands (referred to as PMC- 1 through 45, see stand map).

The proportion of canopy species within PMC is highly variable throughout, with some areas of pitch pine being more prevalent than hardwoods, and some areas where hardwoods predominate. However, one constant of this type is that cedar is consistently the lesser component. Overall, the canopy is very closed throughout PMC, with canopy cover at 70% percent. QMD for the stand is 7.3 inches, with 339 trees/acre and 98 ft²/acre of basal area. Average tree height is about 47 feet, though the largest measured tree was a pitch pine 65 feet tall and 20 inches in DBH. Most of the trees in this stand are in the 80 to 100 year old range.

The midstory or shrub layer is dominated by highbush blueberry, inkberry, greenbriar, sweet

pepperbush, and in some areas, mountain laurel. Remaining midstory is made up swamp azalea, dangleberry, pitch pine regeneration and red maple regeneration. Due to the presence of flowing and standing water the vegetative ground layer is patchy in most places, with bare soil in others. The remainder of the ground cover is mainly composed of moss, greenbriar, grass, fern, and sheep laurel. Little regeneration is currently present in this forest type.

Volume Estimation and Stock Table*

Forest Stand (PMC) – 852.2 Acres

Summary

	<i>Per Acre</i>			<i>Total Across Forest Stand</i>	
Species	Trees	Basal Area (ft²)	Cords	Trees	Cords
Pitch Pine	103	46	11.15	84,831	9,203.59
Hardwoods	223	49	7.68	184,185	6,336.28
Atlantic white-cedar	13	3	0.66	10,315	546.30
Total	339	98	19.49	279,331	16,086.17

Pitch Pine

	<i>Per Acre</i>			<i>Total Across Forest Stand</i>	
DBH	Trees	Basal Area (ft²)	Cords	Trees	Cords
4	9	1	0.00	7,344	0.00
6	22	5	0.81	18,154	667.47
8	43	15	3.41	35,071	2,817.17
10	9	5	1.28	7,509	1,056.05
12	13	11	2.85	10,810	2,352.34
14	3	4	0.96	2,806	788.64
16	3	4	0.98	2,063	808.49
18	1	2	0.57	825	466.92
20	0	1	0.30	330	247.56
Total	103	46	11.15	84,831	9,203.59

* Estimates based on Forest Vegetation Simulator (FVS) projections to 2014 using inventory information collected by LDE and the NJSFS. Slight numerical differences in totals are the result of rounding error.

Hardwoods (Red Maple and Blackgum)

	<i>Per Acre</i>			<i>Total Across Forest Stand</i>	
DBH	Trees	Basal Area (ft²)	Cords	Trees	Cords
4	93	9	0.00	76,909	0.00
6	76	15	2.39	62,633	1,976.30
8	36	12	2.49	29,460	2,058.82
10	11	6	1.47	9,077	1,210.64
12	7	5	1.13	5,364	931.74
14	1	1	0.19	743	158.77
Total	223	49	7.68	184,185	6,336.28

Atlantic white-cedar

	<i>Per Acre</i>			<i>Total Across Forest Stand</i>	
DBH	Trees	Basal Area (ft²)	Cords	Trees	Cords
4	9	1	0.00	7,179	0.00
8	2	1	0.18	1,980	150.42
12	1	1	0.23	908	190.11
20	0	1	0.25	330	205.78
Total	13	3	0.66	10,315	546.30

9. Forest Stand CED

Atlantic white-cedar: 523.8 Acres



This forest stand is located along the major streams and drainages throughout DTSP. CED occurs on approximately 524 acres across DTSP and comprises 34 sub-stands (referred to as CED – 1 through 34, see stand map). Atlantic white-cedar dominates the overstory, and red maple, blackgum, and pitch pine occur as very minor components.

The canopy consists of 90 - 100 percent Atlantic white-cedar. Occasionally pitch pine will be present in the overstory, while red maple and blackgum form a sub-canopy rarely reaching 40 feet tall. Canopy cover is about 55%, and the canopy is taller than in other forest stands, with a height of about 70 feet. While the largest tree measured in this stand was 22 inches in diameter and 70 feet tall, DBH for the stand ranges from 8-22 inches, with a QMD of 14.5 inches. Basal area for this stand is very high, at 195 ft²/acre, spread through 172 trees per acre.

The midstory consists of highbush blueberry, sweet pepperbush, mountain laurel, sweetbay magnolia, red maple, blackgum, swamp azalea, dangleberry, and inkberry. Interior locations of the midstory tend to be rather sparse as a result of the closed canopy. The understory is also sparse, not only because of the closed canopy, but because of overland flow. Where there is ground to grow, the understory is mostly composed of sphagnum moss, skunk cabbage, and pitcher plants. There is little regeneration currently occurring in this forest stand.

Volume Estimation and Stock Table*

Forest Stand: CED – 523.8 Acres

Summary

	<i>Per Acre</i>			<i>Total Across Forest Stand</i>	
Species	Trees	Basal Area (ft²)	Cords	Trees	Cords
Atlantic white-cedar	161	176	64.05	84,331	33,632.32
Sassafras	5	10	3.16	2,836	1,657.72
Red Maple	6	9	2.83	3,308	1,486.23
Total	172	195	70.04	90,475	36,776.27

Atlantic white-cedar

	<i>Per Acre</i>			<i>Total Across Forest Stand</i>	
DBH	Trees	Basal Area (ft²)	Cords	Trees	Cords
8	25	9	3.20	12,917	1,682.31
10	16	9	3.21	8,244	1,682.98
12	33	27	9.66	17,223	5,074.86
14	32	35	12.84	16,856	6,741.89
16	31	44	15.99	16,121	8,396.95
18	10	18	6.39	5,093	3,355.32
20	12	26	9.57	6,196	5,024.34
22	3	9	3.19	1,680	1,673.01
Total	161	176	64.05	84,331	33,632.32

Sassafras

	<i>Per Acre</i>			<i>Total Across Forest Stand</i>	
DBH	Trees	Basal Area (ft²)	Cords	Trees	Cords
16	3	5	1.58	1733	831.52
20	2	5	1.57	1103	826.87
Total	5	10	3.16	2,836	1,657.72

* Estimates based on Forest Vegetation Simulator (FVS) projections to 2014 using inventory information collected by LDE and the NJSFS. Slight numerical differences in totals are the result of rounding error.

Red Maple

	<i>Per Acre</i>			<i>Total Across Forest Stand</i>	
DBH	Trees	Basal Area (ft²)	Cords	Trees	Cords
16	6	9	2.83	3,308	1,486.23
Total	6	9	2.83	3,308	1,486.23

9a. Forest Stand CEDy

Atlantic white-cedar Young: 56.5 Acres

This forest stand has conditions similar to CED, whereas these stands are located within nearby drainages and in very poorly drained sites throughout DTSP. Sub-stands within the CEDy type consist of young, small, dense, and extremely overstocked trees. Frequently, these stands are present after a harvest or wildfire occurs. CEDy occurs on approximately 56 acres comprised of three sub-stands across DTSP (referred to as CEDy – 1 through 3, see stand map).

Volume Estimation and Stock Table*

Forest Stand: CEDy – 56.5 Acres

Summary

	<i>Per Acre</i>			<i>Total Across Forest Stand</i>	
Species	Trees	Basal Area (ft²)	Cords	Trees	Cords
Atlantic white-cedar	2,323	309	25.30	131,221	1,429.24
Total	2,323	309	25.30	131,221	1,429.24

Atlantic white-cedar

	<i>Per Acre</i>			<i>Total Across Forest Stand</i>	
DBH	Trees	Basal Area (ft²)	Cords	Trees	Cords
4	1,779	179	0.00	100,514	0.00
6	465	101	18.84	26,278	1,064.42
8	79	29	6.46	4,435	364.82
Total	2,323	309	25.30	131,221	1,429.24

* Estimates based on Forest Vegetation Simulator (FVS) projections to 2014 using inventory information collected by LDE and the NJSFS. Slight numerical differences in totals are the result of rounding error.

9b. Forest Stand CEDb**Atlantic white-cedar Burned: 7.3 Acres**

This forest stand consists primarily of Atlantic white-cedar snags as a result of past wildfire damage. Sub-stands within the CEDb type are located along the edges of Atlantic white-cedar areas where the exposure to wildfire from neighboring upland forest is much greater. Past wildfire damages have created areas dominated by dense cedar regeneration. CEDb occurs on approximately 7 acres across DTSP and is comprised of two sub-stands (referred to as CEDb – 1, and CEDb – 2, see stand map).

9c. Forest Stand CEDr**Atlantic white-cedar Regeneration: 23.5 Acres**

This forest stand is composed of Atlantic white-cedar sub-stands that were recently cleared from harvest or had considerable mortality due to wildfire and/or inundation. These areas were previously dominated by red maple, which have since died, allowing for the reclamation of cedar through regeneration. This stand is dominated by young, small, and densely stocked trees characteristic of typical southern New Jersey cedar stands. CEDr occurs on approximately 23 acres of DTSP and is comprised of four sub-stands (referred to as CEDr – 1 through 4, see stand map).

10. Forest Stand MAP

Maple Swamp: 540.1 Acres



This forest stand is located along major streams and drainages throughout DTSP. Red maple swamps occupy locations similar to CED stands. Red maple dominates the overstory with Atlantic white-cedar, blackgum, and pitch pine also occurring regularly. The canopy in MAP stands is variable, but averages 90% canopy cover. MAP occurs on approximately 540 acres, comprised of 12 sub-stands across DTSP (referred to as MAP – 1 through 12, see stand map).

Tree heights average around 50 feet, with individuals reaching 60 feet in places. Maple and blackgum range in diameter between 4 and 24 inches in DBH while cedars and pines range between 8 and 28 inches in DBH. Overall QMD for the stand is 6.5 inches, and there are 680 trees per acre. The higher density of trees and broad range of diameters leaves the stand with 161 ft²/acre of basal area.

Generally, the midstory consists of sweet pepperbush, highbush blueberry, inkberry and American holly, sweetbay magnolia, as well as regeneration of red maple and blackgum. The understory is made up of lowbush blueberry, huckleberry, inkberry and American holly, and greenbriar, with significant areas of bare ground and standing water.

Volume Estimation and Stock Table*

Forest Stand: MAP – 540.1 Acres

Summary

Species	Per Acre			Total Across Forest Stand	
	Trees	Basal Area (ft ²)	Cords	Trees	Cords
Pitch Pine	10	10	2.86	5,236	1,528.50
Hardwoods	640	115	14.15	342,112	7,557.98
Atlantic white-cedar	30	35	10.43	15,815	5,570.25
Total	680	160	27.44	363,163	14,656.73

Pitch Pine

DBH	Per Acre			Total Across Forest Stand	
	Trees	Basal Area (ft ²)	Cords	Trees	Cords
12	6	5	1.44	3,366	768.31
16	4	5	1.42	1,870	760.19
Total	10	10	2.86	5,236	1,528.50

Hardwoods (Red Maple and Blackgum)

DBH	Per Acre			Total Across Forest Stand	
	Trees	Basal Area (ft ²)	Cords	Trees	Cords
4	423	44	0.00	226,009	0.00
6	172	37	6.72	91,793	3,587.93
8	27	10	1.83	14,533	979.32
12	11	9	2.08	6,091	1,109.18
16	4	5	1.17	1,870	626.28
22	2	5	1.17	1,015	627.63
24	2	5	1.17	855	627.63
Total	640	115	14.15	342,112	7,557.98

* Estimates based on Forest Vegetation Simulator (FVS) projections to 2014 using inventory information collected by LDE and the NJSFS. Slight numerical differences in totals are the result of rounding error.

Atlantic white-cedar

	<i>Per Acre</i>			<i>Total Across Forest Stand</i>	
DBH	Trees	Basal Area (ft²)	Cords	Trees	Cords
8	14	5	1.35	7,587	723.67
12	6	5	1.04	3,206	557.97
18	3	5	1.61	1,496	858.26
20	2	5	1.61	1,229	858.26
24	3	10	3.21	1,710	1,714.49
28	1	5	1.60	641	856.91
Total	30	35	10.43	15,815	5,570.25

11. Forest Stand EM WET

Emergent Wetland: 27.3 Acres



This forest stand is composed of a single sub-stand (referred to as EM WET, see stand map) located on approximately 27 acres of DTSP. The stand is comprised primarily of herbaceous plants including native grasses and sedges which have reclaimed the historic Dover Forge Dam and cranberry bog. Some small scattered pitch pine and hardwood trees are evident as well as sparsely distributed shrubs.

12. Forest Stand SS, Spung**Scrub/Shrub Wetland 235.5 Acres****Spung: 0.5 Acres**

The SS stand, consisting of five sub-stands (referred to as SS -1 through 5, see stand map), makes up approximately 235 acres in DTSP, whereas the Spung stand is comprised of one site approximately half an acre in size. The SS type has structural characteristics similar to those of former cranberry bogs. Similar to EM WET, several species of trees are openly scattered throughout each stand in both the SS and Spung stands, with the majority of cover comprised of native wetland herbaceous plants and shrubs. Some of the SS patches are located near Factory Branch, while others are located along Cedar Creek. The Spung however, is an isolated wetland located northwest of Dover Road.

13. Forest Stand Agricultural Wetlands (BB, FARM, BOGS, DISlo)

Abandoned Blueberry Fields: 17.6 Acres

Farmland: 7.6 Acres

Agricultural Bogs: 215.9 Acres

Disturbed Lowland: 30.5 Acres



This type, which is a conglomeration of similar forest stands, makes up approximately 272 acres of DTSP. The BB type consists of three sub-stands (referred to as BB – 1 through 3), the FARM type consists of one sub-stand (referred to just as FARM), the BOGS type consists of five individual sub-stands (referred to as BOGS – 1 through 5), and the DISlo type is comprised of one sub-stand (referred to just as DISlo). The majority of these agricultural wetlands are located in the eastern half of DTSP.

Sites within the BB stand are abandoned commercially planted and operated blueberry fields which have slowly begun to revert to forestland via natural successional processes. Species regenerating in these areas include red maple, blackgum, pitch pine, and Atlantic white-cedar, along with shrub species such as sweet pepperbush and fetterbush. The FARM (located in the northeast corner of DTSP) and BOGS are currently operational cranberry growing facilities that are utilized by local outside companies through agreements with the New Jersey State Park Service. DISlo is a highly disturbed location that was once cleared in strips, leaving a current structure highly varied in vegetative composition. Regeneration of pitch pine and Atlantic white-cedar, as well as a patchy distribution of native wetland understory species is present in this stand.

14. Forest Stand Non-Forest (DIS, GRASS, RES, ROW)

Disturbed: 17.2 Acres

Grass Fields: 31.3 Acres

Resource Extraction Areas: 34.8 Acres

Right of Way: 25.8 Acres



The Non-Forest stand, which is also an assemblage of similar stands, makes up approximately 109 acres of DTSP. The DIS stand comprises three sub-stands (referred to as DIS – 1 through DIS – 3), the GRASS stand consists of three sub-stands (referred to as GRASS – 1 through 3), the RES stand consists of four sub-stands (referred to as RES – 1 through 4), and the ROW stand is comprised of three sub-stands (referred to as ROW – 1 through ROW – 3). Non-Forest is scattered across DTSP, but a majority of the areas are adjacent to roads or the park boundary.

The DIS stand includes areas that were significantly disturbed, previously developed, or planned to be developed for mining or agricultural reasons. This has resulted in areas of bare sand and gravel with trees openly scattered throughout. One of these stands includes the historic Double Trouble Village. The stands within the GRASS stand are remnants of old farms and historic businesses including Dover Forge. The vegetation in these locations is primarily native grasses maintained through the use of regular prescribed burning. No buildings persist in these areas. RES is quite similar to that of DIS; these locations are used as sand mines for maintenance of the nearby cranberry bogs and therefore have large areas of bare sand with sparsely distributed trees. The ROW stands are highly disturbed continuously maintained strips of native trees and vegetation including pitch pine, grasses, and scrub oak.

V. HIGH CONSERVATION VALUE FORESTS

High Conservation Value Forests (HCVF) are managed to protect and maintain their identified high conservation value attributes. HCVF are defined in the Forest Stewardship Council (FSC), US Forest Management Standards as those that possess one or more of the following high conservation values (HCV) (Forest Stewardship Council 2010):

1. HCV forest areas containing globally, regionally, or nationally significant concentrations of biodiversity values (e.g., endemism, endangered species refugia), including rare, threatened and endangered species and their habitats;
2. HCV forest areas containing globally, regionally, or nationally significant large landscape level forests, contained within, or containing the management unit, where viable populations of most if not all naturally occurring species exist in natural patterns of distribution and abundance;
3. HCV forest areas that are in or contain rare, threatened, or endangered ecosystems;
4. HCV forest areas that provide basic services of nature in critical situations (e.g. watershed protection, erosion control);
5. HCV forest areas fundamental to meeting basic needs of local communities (e.g. subsistence, health); or,
6. HCV forest areas critical to local communities' traditional cultural identity (areas of cultural, ecological, economic or religious significance identified in cooperation with such local communities).

Specific HCVF in DTSP

The most regionally significant forest areas in Double Trouble State Park are clearly the Atlantic white-cedar (AWC) lowlands present in many of the drainages. Atlantic white-cedar (*Chamaecyparis thyoides*) ranges along the Atlantic and Gulf coasts in the US from southern Maine to central Florida and as far west as Mississippi, generally within a narrow coastal belt 50 to 100 miles wide (Harlow and Harrar 1937). From an estimated 500,000 acres throughout its range at the time of European settlement, the prevalence of AWC has declined to approximately 115,000 acres range wide (Kuser and Zimmerman 1995). This decline is the result of a variety of reasons including pressure from white-tailed deer (*Odocoileus virginianus*), wildfire, improper logging, development (including building of roads and man-made lakes), hydrologic change, excessive flooding from beaver (*Castor canadensis*) dams, theft, salt water intrusion, and succession (Mylecraine and Zimmermann 2000).

AWC is found in swampy areas with acidic soils consisting of organic peat overlaying sandy subsoil (Little 1950). In DTSP, this corresponds mainly to Manahawkin Muck and Berryland soils, although AWC can and does grow in other soil types. Suitable sites in New Jersey typically form dense, even-aged stands of AWC. The trees in these stands are so dense that they suppress movement of air and modify the climate in which they grow. Cedar swamps are cooler than the surrounding forest in the spring and summer and warmer in the winter (Harshberger 1916); this unique attribute provides a year-round benefit to many species. In addition to the

benefits to plants and animals, cedar ecosystems are extremely valuable to water resources. Despite the significance of AWC lowlands, to designate the most core AWC lowlands as HCVF would be self-defeating on this particular property.

Even though AWC bottomlands meet several of the High Conservation Values, saddling their management in DTSP with further restrictions would both hinder efforts to restore AWC and contradict the sixth High Conservation Value, that of local cultural use. The New Jersey Pinelands Commission has already recognized the environmental and cultural importance of AWC through its privileged treatment in the Pinelands CMP (NJ Pinelands Commission 2012) and a multi-party collaborative effort that produced a BMP manual specific to the handling of AWC (Mylecraine and Zimmerman 2003). The historic sawmill in DTSP is recorded to have been present at least as far back as 1765; the employment associated with and wood products derived from the harvest of AWC associated with the resource quite literally built the village that stands to this day (NJDEP State Park Service 2014). As the intent of HCVF designation is to specifically preclude nearly all active management, such a designation would be at variance with the guidance of the BMPs, its treatment in the Pinelands CMP, and the cultural role of AWC lowlands in DTSP.

Further, it is worth noting the impact of the economics of AWC harvests. AWC easily produces the most valuable wood products in southern New Jersey. Forgoing the harvest of properly-managed, successfully regenerated AWC stands would deprive other areas of the forest the management subsidy provided from AWC. Keeping the option of harvesting AWC on a property provides more flexibility in management prescriptions elsewhere on the property. However, a finely-tuned balance must be established to prevent the over-harvest of AWC that could degrade the resource. Efforts in this plan to restore AWC to its local and regional prominence can only improve this balance.

VI. REPRESENTATIVE SAMPLE AREAS

Representative Sample Areas (RSA) are ecologically viable representatives designated to serve one or more of three purposes:

1. To establish and/or maintain an ecological reference condition; or
2. To create or maintain an under-represented ecological condition (i.e. includes samples of successional phases, forest types, ecosystems, and/or ecological communities); or
3. To serve as a set of protected areas or refugia for species, communities and community types not captured in other areas of the Forest Stewardship Council Standards (e.g. to prevent common ecosystems or components from becoming rare).

The purpose of having RSA under the FSC standards is to provide a mechanism for protecting ecosystems in their natural state that might not qualify for other protections under the standards such as HCVF (Forest Stewardship Council 2010).

Specific RSA in DTSP

It can be tempting to designate many areas with special conditions using just the second purpose of RSAs; at different scales, every ecosystem is unique. However, the constant process of change can make such designations fleeting. Careful consideration of a site's value and ecosystem services is needed.

Of many unique sites in DTSP, the area designated as RSA is near the western fringe of the property. Sub-stand MAP-8 was deemed RSA, so active forest management in that sub-stand was set aside as a result of discussions that took place during the internal NJDEP planning process.

The area near MAP-8 is host to a documented population of a rare species of interest. While this species thrives in an AWC ecosystem, it is sensitive to human activities. Further, forestry operations in this area would be complicated by boundary issues and poor access into sensitive wetland areas. For this planning cycle, avoiding this area provides an ecological benefit, as well as a reference condition to use for comparisons with the AWC restoration activities in MAP-4.

The hummock-hollow microtopography and closed canopy of AWC wetlands provide both habitat and control of competition for species interest in MAP-8. As the sites proposed for AWC restoration in MAP-4 are in the same watershed as MAP-8, have the same soil type, and have very similar current conditions, it is hoped that AWC restoration may eventually provide habitat for those rare species in MAP-8. Designation of MAP-8 as an experimental control for comparison with MAP-4 justifies its inclusion in RSA. The location of the MAP-8 can be found in Appendix J: Representative Sample Area Map.

VII. ACTIVITY SCHEDULE (10-YEAR, Anticipated)

Table 7.1: Management activity timing by year interval

Activity	Year Interval (acres)				
	1-2	3-4	5-6	7-8	9-10
AWC Restoration portion 1				54	
AWC Restoration portion 2		54			
AWC Restoration portion 3			56		
FSI Thinning 1			77		
FSI Thinning 2					117
FSI Thinning 3		166			
Patch Cuts			15		
Pine Grassland					30
Plantation Management	34				
Restoration Thinning	113				
Safety Strip	44				
Sandy Cedar Salvage	25				
Shortleaf Restoration 1**			28		
Shortleaf Restoration 2**			80		
Variable Density Thinning 1				222	
Variable Density Thinning 2		87			
Fire Break Installation	4				
Fuel Break Installation*	253*				
Total Acres For Year Interval	221*	308	256	276	147

* Area for years 1-2 does not involve management where the only activity occurring is prescribed burning. Totals for all years reflect only the acreage on which tree cutting will occur, and do not include prescribed burning activities such as fuel break maintenance.

** Two-acre discrepancy between the Shortleaf Restoration activities here and in the “Management Recommendations” section of the plan are the result of inclusion in this table of the 2-acre, non-forested, “RES-4” sub-stand. It was only included in text, and not in volume tables, as its current lack of trees does not contribute to harvest volumes.



Double Trouble State Park

Management Activity Schedule

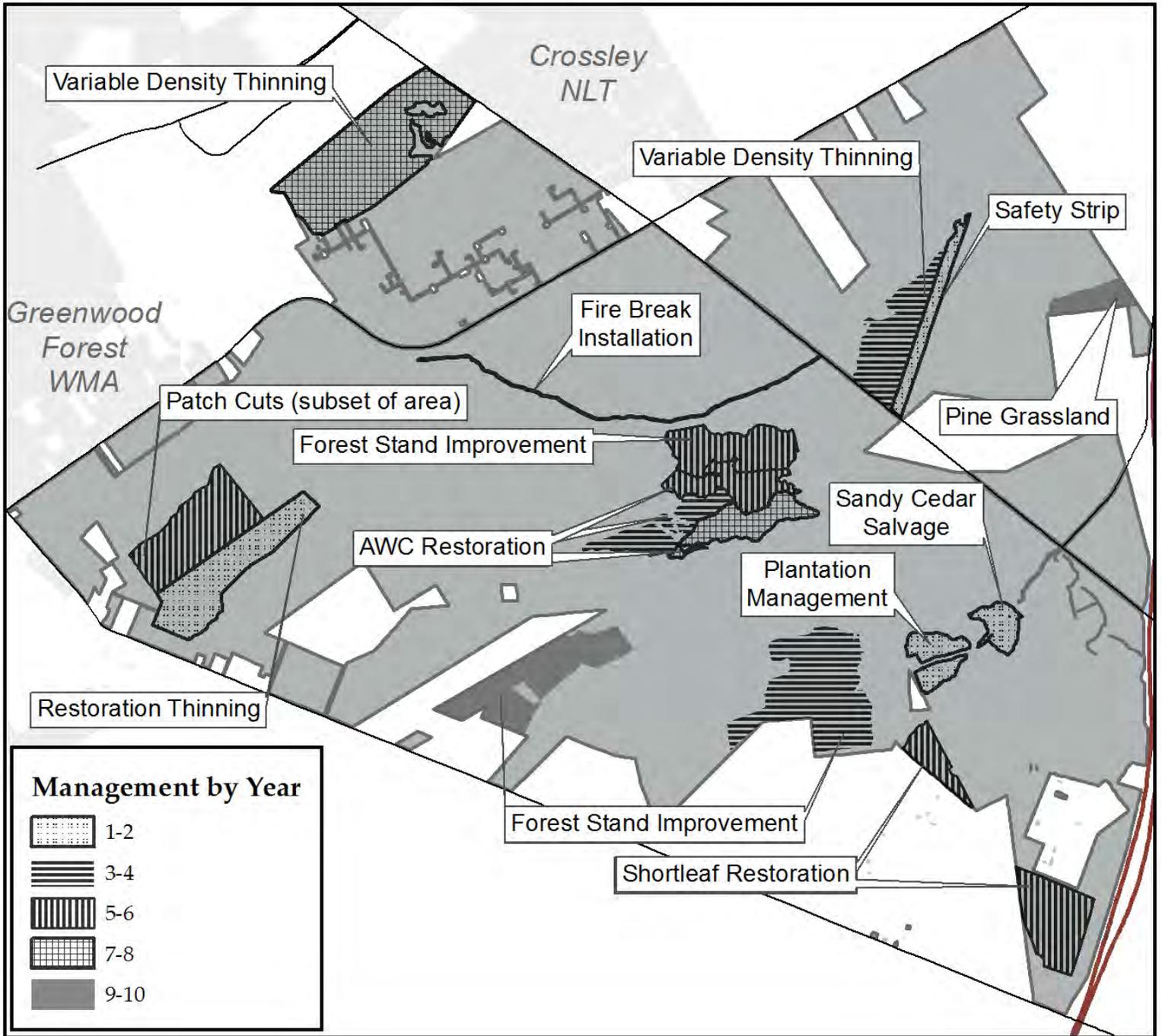


Table 7.2: Management activities, sub-stands affected, and associated goals and objectives

Management Recommendation	Activities	Sub-stands Affected	Activity Acres	Goal & Objective Associations
Fuelbreak Maintenance	-Prescribed Burning -Plowline maintenance	PPSO-36 PPlO-36 PPlO-37 SOPP-3 PPSO-38 PPlO-38 PPSO-40 PPSO-41 OP PPO-2 GRASS-3 PPlO-42 PPSTO-6 PPSO-11 PPlO-14 PPSO-17 PPlO-11 PPSO-10 PPSO-55 PPSTO-8 PPSO-58 PPSTO-9 PPSO-57 PPSO-56	1344	G5-05.1,05.2;
Fuelbreak Installation	-Prescribed Burning -Installation of new plowlines	PMC-7 PMC-36 PPlO-11 PPlO-12 PPlO-14 PPlO-15 PPlO-42 PPO-2 PPSO-10 PPSO-11 PPSO-17 PPSO-19 PPSO-34 PPSO-41 PPSTO-6	347	G5-05.1,05.2;

Management Recommendation	Activities	Sub-stands Affected	Activity Acres	Goal & Objective Associations
Firebreak Maintenance	-Mowing	DIS-1 PMC-17 PMC-18 PMC-21 PPlo-24 PPSO-20 PPSO-25 PPSO-26 PPSO-27 SOPP-1 SOPP-2	10	G5-05.1,05.2;
Firebreak Installation	-Mowing -Tree removal	GRASS-3 MAP-4 PPlo-42 PPSO-11 PPlo-14	4	G5-05.1,05.2;
Safety Strip	-Low thinning	PPSO-7	43	G5-05.1,05.2; G3-03.1;
	-Prescribed burning -Plowline installation	PPSTO-2	1	
Atlantic white-cedar Restoration	-Remove non-AWC	MAP-4	117	G5-05.3; G4-04.1; G2-02.1, 02.2; G1-01.1
	-Selective Herbicide	PMC-7	33	
	-Fence -Plant	PMC-8	14	
Pine Grassland	-Mowing	PPlob-2	7	G1-01.1, 01.2
		PPSOB-5	23	

Management Recommendation	Activities	Sub-stands Affected	Activity Acres	Goal & Objective Associations
Rare Species Habitat	Variable Density Thinning	PPSTO-7	222	G1-01.1, 01.2; G2-02.1,02.2; G3-03.2; G4-04.1 G5-05.3
		PPSO-7	87	
		PPSTO-2		
		PPSTO-3		
	Patch Cuts	PPSO-34	15	
Restoration Thinning	PPSO-34	113		
Shortleaf Pine Restoration	-Shelterwood harvest	PPO-4	80	G2-02.1,02.2; G3-03.2; G4-04.1 G5-05.3
	-Prescribed Burning	PPSO-63		
		RES-4		
	-Planting	PPSO-22	28	
Forest Stand Improvement	-Thin from below	PPlO-15	77	G2-02.1,02.2; G3-03.2; G4-04.1 G5-05.1,05.3
		PPSO-20	117	
		PPSO-25	166	
		PPlO-22		
Plantation Maintenance	-Thin from below	PLANT-1	34	G2-02.1,02.2; G3-03.2; G5-05.1,05.3
	-Prescribed burning	PLANT-2		
Cedar Salvage	-Remove non-AWC -Selective Herbicide -Fence -Replant	CED-9	25	G5-05.3; G4-04.1; G2-02.1, 02.2; G1-01.1

VIII. MANAGEMENT RECOMMENDATIONS

Major wildfires in the early to mid-20th century set much of Double Trouble State Park on successional tracks with heavy regeneration. Since these disturbances many areas have grown back with vigor, building significant levels of fuels while decreasing available light for disturbance-loving species. Not only has this increased the risk of uncontrollable fires, it has also gradually eliminated habitat for imperiled species. With a shortage of early-seral habitat for rare fauna and flora, combined with significant fuel buildup, forest management provides an opportunity to mitigate these problems and provide other benefits. Prescriptions detailed in this section aim to achieve the goals presented in the “Goals and Objectives” section of this plan.

The portion for the forest targeted for silvicultural management during this management cycle (2015-2025) constitutes 15% of the total forested area or 36% if wildfire mitigation activities are included. These areas were selected as priorities for this cycle by the NJDEP agencies involved in the planning process. As a result of this prioritization, some areas did not receive an activity prescription.

The choice of “no management” is a choice of management in itself, as the forest is constantly growing and changing in response to biotic and abiotic pressures. While in some circumstances, the optimal management activity is to passively allow the forest to grow, explicit inclusion and justification of this recommendation on a sub-stand by sub-stand basis would make this planning document excessively long and difficult to interpret. Therefore, this section of the forest stewardship plan only includes those management recommendations that involve active management. Areas that clearly merit a lack of active management can be found in the Representative Sample Area and High Conservation Value Forest sections of the plan, although these tools provide limited flexibility to justify an absence of active management in a planning cycle.

Prescriptions for forest management activities in this and other state lands forest stewardship plans are based on landscape-scale forest inventory data. These data provide a broad-scale look at a property and yield greater information about a broad spectrum of natural resource attributes. When it comes to enacting a prescription and establishing tree marking guidelines, however, supplemental fine-scale data are needed. For this operational inventory, many more sample points are taken in a smaller area and foresters can calculate more detailed measurements of wood product volumes.

The operational inventory provides an additional opportunity to inspect a site and further develop note of fine-scale site features. These attributes may be unique ecological features such as nest trees or vernal pools, or implementation features such as conditions of existing access roads and trails, stream crossing points, and erodible soils.

From the beginning of the management planning process, biologists working for the New Jersey Division of Fish and Wildlife’s Endangered and Non-game Species Program and the New Jersey State Forestry Services Office of Natural Lands Management provide input on known and anticipated occurrences or habitat of rare species on a parcel. At the same time, staff from the New Jersey State Forestry Services Forest Fire Service and Bureau of Forest Management share

input on likely implementation features to plan successful activities. The operational inventory provides a chance to supplement the information provided by the different agencies.

If previously unknown features are found, such as stick nests or sugar sand spots on haul roads, observations are reported to the appropriate agency staff involved. Direct notification followed up with stewardship plan implementation notification/meetings provide a forum to revise management activities to conserve or mitigate such features. For properties within the jurisdiction of the New Jersey Pinelands Commission, Commission staff will be notified of features of interest and pertinent activity adjustments.

Implementation of this forest stewardship plan will not result in any irreversible adverse impact to any local population of any known threatened and/or endangered species in this area. All management activities will adhere to management recommendations and timing restrictions for those species of interest outlined in the “Rare, Threatened, and Endangered Species” section of this document. NJSFS personnel will oversee all activities conducted under this plan through development of contract provisions, site visits with contractors both prior to bidding and after contract award, and site inspections throughout the implementation process to ensure the prescriptions are implemented. Further, all site preparation used for silvicultural management will not penetrate below 6 inches of the soil surface and be conducted during the appropriate seasons to avoid unintended impacts. No new roads will be created to carry out the management activities described in this plan. Should there need a need for the installation of any new road, an application to the New Jersey Pinelands Commission will be completed for their approval.

All treatments were evaluated using the Forest Vegetation Simulator (FVS) from the USDA Forest Service (USDA 2013). This program simulates forest growth under interactive management scenarios and is based upon decades of natural resource management research. After receiving input from the different stakeholders involved, NJSFS used this software to model different activities and make iterative solutions that achieved the goals and objectives stated above. Agencies within the NHR group provided input on the different alternatives modeled in FVS, with final management recommendations based on the results.

Estimated harvest volumes are for informational purposes only, and were determined using FVS. Simulations were modeled to have management take place over the course of the 10-year planning cycle (2016-2025), so harvested volumes in some cases reflect anticipated growth between 2014 and the time of harvest. Simulations were also used to predict the long-term impact of these activities on the activity area.

A spatial summary of the management activities planned in this document can be found in Appendix K: Overall Treatment Map, Appendix L: Treatment Type Map, and Appendix M: Wildfire Mitigation Activities Map.

Forest stewardship requires consideration of diverse goals and objectives from the beginning of the planning process through to activity execution. The natural resource concerns described earlier all impact and are impacted by management activities. It is critical that contractors carrying out the actions in the plan understand the considerations involved and adhere to the specifics laid out in the plan. State contract monitoring procedures ensure that contractors adhere to the management prescriptions and rare species guidelines.

A. Sustainable Yield

Maintaining forest productivity is one of the sustainability goals of the Montreal Process, as well as the Forestry Stewardship Council Guidelines for the US and the USDA Forest Service Criteria and Indicators for Forest Sustainability (Montreal Process 2014; Forest Stewardship Council US 2010; USDA Forest Service, Northeastern Area State and Private Forestry 2002). In accordance with this principle, NJSFS set out to determine whether and how the management actions detailed in this document meet the intent of sustaining forest productivity on DTSP.

It should be noted that sustainability is most appropriately evaluated at a broad spatial scale (e.g. region- or state-wide) so that overall trends rather than locally-intense actions are used for evaluation. For example, to re-establish a young forest, a seed-tree cut drastically changes local conditions and removes more biomass than can be grown in a 10-year plan. However, this action can be sustainable if it takes place in a landscape context that balances out this harvest with growth elsewhere.

For the DTSP plan, NJSFS sought to evaluate the impact of the planned activities on the standing volume and expected growth on the property over the management plan cycle. Harvest activities across all management prescriptions were compiled to determine the volume of wood cut on the property in the planning cycle. These numbers were roughly broken into species categories: cedar, pine, oak, and other hardwoods. The total number of forested acres and the estimated volumes by activity are provided in table 8.1. The proportions of the total harvest that these activities each cover is provided in figure 8.1.

Table 8.1: Estimated Harvest Volume Table

Prescription	Forested Acreage receiving Prescription	Estimated Volume (Cords)				
		Total Removed	Pine	Oak	Other Hardwood	Cedar
AWC Restoration	164	2,906	865	0	2,041	0
Firebreak Installation	4	71	70	1	0	0
Firebreak Maintenance	10	0	0	0	0	0
Forest Stand Improvement	360	2,062	1,784	63	181	34
Fuelbreak Installation	347	0	0	0	0	0
Fuelbreak Maintenance	1,304	0	0	0	0	0
Pine Grassland	30	126	120	0	5	1
Plantation Management	34	0	0	0	0	0
Restoration Thinning	113	756	756	0	0	0
Safety Strip	44	30	30	0	0	0
Sandy Cedar Salvage	25	780	0	0	0	780
Shortleaf Restoration	106	1,437	977	460	0	0
Patch Cuts	15	198	198	0	0	0
Variable-density Thinning	309	2,809	2,561	246	2	0
All Activities	2,866	11,174	7,360	770	2,229	815

For this plan NJSFS used FIA data (USDA Forest Service 2014) for Ocean County across all forest types to predict estimated growth within DTSP over the planning cycle (2015-2024). Grouping all forest types together to determine growth carries with it limitations; most obvious are underestimating growth on younger, more nutritious, and wetter sites, and overestimating growth on older, nutrient-poor, and drier sites. Fine-scale spatial growth measurements may provide a more precise measurement to predict overall forest growth.

However, such detailed data are currently unavailable, as more extensive long-term continuous forest inventory plots specific to this area do not yet exist. In the absence of such data, utilizing FIA data for all forest types in the county is a useful guide. By grouping all forest types together, the differences between growth rates in different forest types are integrated so that the variability between those types is already captured in the growth estimate. Also, the

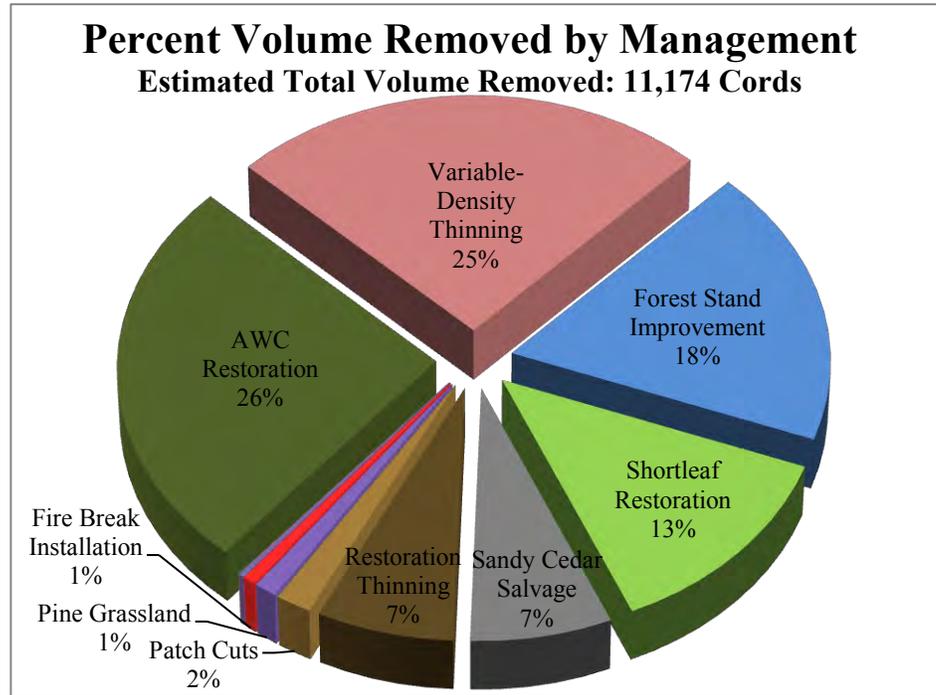


Figure 8.1: Percent of Harvest Volume by Activity

limited number of points that would be available for a single sub-stand would increase the variance in the growth rate for that forest patch, yielding a number with less certainty.

A more conclusive measurement can be obtained by using FIA data for growth in all forest types in Ocean County. At 26.3 ft³/acre/year, or roughly 1/3 cord/acre/year, the rate obtained from the FIA data is a conservative estimate of forest growth. From these same data, the only other growth rate with as much certainty is for the sub-category of Pitch Pine forests; these are measured to grow 38% faster than the all-forest-type average. Similarly, this estimate of 26.3 ft³/acre/year is particularly low in AWC wetlands, which are known to grow faster.

NJSFS used this conservative Ocean County all-forest-type growth rate to calculate sustainable yield for the property by determining the forested area of the parcel (from NJDEP GIS data) and multiplying by the expected mean growth rate and the number of years in the plan. This produced an estimated total net growth number for the 10-year planning cycle, which we treated as the ‘sustained yield’ limit. In order to conserve forest growing stock, in most cases it is crucial to ensure that no more than the volume grown in the planning period is cut. Significantly, especially so in the New Jersey Pinelands, adherence to this principle may not be appropriate, as disturbance agents have been excluded for so long that forest density exceeds historic norms. For DTSP, figures for estimated ingrowth and harvest can be found in table 8.2.

The numbers in table 8.2 were compared to total current volume standing in DTSP (determined from FVS projections to 2014; see footnotes in part V. Forest Stand Descriptions) to provide scale to show the anticipated impact of management on volume. A comparison of these values can be found in Figure 8.2; dark green represents current (2014) living volume, light green represents predicted net growth, and the black outlined area represents total harvest volume. Each dot represents 100 cords of wood.

Table 8.2: Estimated Ingrowth and Removal Proportion Table

Metric	Value	Units	Source
Forested Area of DTSP	8,004	Acres	NJDEP GIS
Mean Growth Rate of DTSP	26.3	Ft ³ /acre/year	USDA FIA, Ocean County, NJ: all forest types
	0.33	Cords/acre/year	
Annual Growth in DTSP	2,661	Cords/year	
Estimated 10 Year Growth in DTSP	26,610	Cords/10-year planning cycle	
Estimated Volume Removed in Planning Cycle	11,174	Cords	NJSFS Forest Vegetation Simulator (FVS) Data
Net Growth in Planning Cycle (Ingrowth-Cutting)	15,436		
Percentage of 10-year Growth Removed	42%		

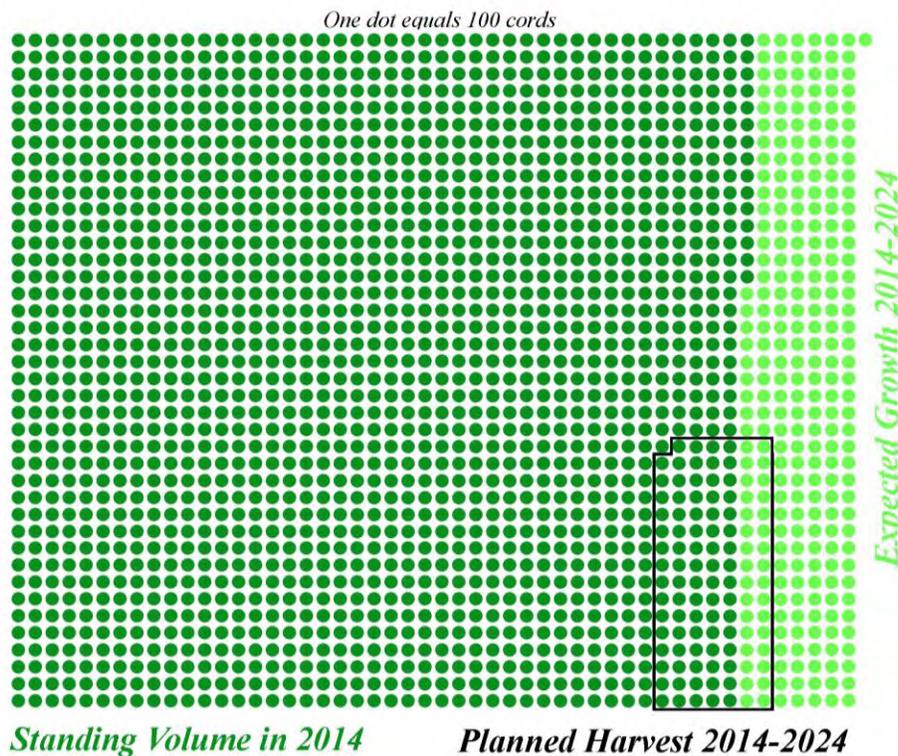


Figure 8.2: Current Volume, Expected Growth during planning cycle, and Planned Harvest from activities outlined in plan. One dot equals 100 cords.

B. Rare Species Habitat

Management Activities: Patch Cuts, Restoration Thinning, Variable-Density Thinning, Pine Grassland

Sub Stands affected: PPSO-7, PPSO-34, PPSTO-2, PPSTO-3, PPSTO-7, PPSOb-5, PPlOb-4

Three prescriptions on forest stands PPSTO and PPSO aim to encourage the proliferation of rare species. Paleodunes present in these sub-stands will be avoided when mechanized equipment is used for the prescribed treatments below. These and all other prescriptions will adhere to management recommendations for those species of interest outlined in the “Rare, Threatened, and Endangered Species” section of this document, and will not result in any irreversible adverse impact to any local population of any known threatened and/or endangered species in this area.

Restoration Thinning - PPSO-34

Restoration Thinning - PPSO-34					Area: 113 acres	
	Basal Area (ft ² /acre)	QMD (in.)	TPA	Canopy Cover (%)	Crowning Index (MPH)	Expected Volume to be Removed (cords/acre)
2014 Conditions	95	4.7	774	48	22	6.7
After Treatment	5	9.2	11	4	181	
2024	10	3.1	111	4	167	<i>Estimates based on Forest Vegetation Simulator (FVS) projections using LDE/NJSFS data</i>
2034	20	3.6	109	6	154	
2054	40	4.5	105	9	119	

In the short term, this activity is meant to immediately establish habitat for rare species, deal with hazardous fuels buildup, and prevent a ‘reset’ back to the current overstocked, stagnating condition. In the longer term, the goal is to utilize the sub-stand’s naturally poor productivity as a logical location for an enduring patch of open canopy forest, extending the short-term benefits for a longer time.

The portion of the sub-stand re-burned in the early 1960s presents an opportunity to both reduce fuels and provide improved habitat for disturbance-dependent rare species. The trees on this site that regenerated after the 1960s fire are seriously stunted, and competition has limited the growth of all species on the site since the 1970s. Trees on the site are densely stocked and exhibiting characteristics of prolonged stem exclusion. Over these 113 acres most aboveground vegetation will be removed, slashed, or mowed in a cut that provides habitat for disturbance-loving species. The density of residual trees on site will mimic the appearance of a seed-tree cut, but the function of the site will not. A harvest will be attempted, but if it is not economically feasible, the material will be slashed and left onsite or mowed with a forestry mower. Trees that survived the 1960s fire ($\geq 8''$ DBH) will be left on site, while all others will be cut and removed, slashed, or mowed. Based on the limited volume on the site, a deep layer of shredded wood is not anticipated from this activity. This treatment is expected to reduce canopy cover from roughly 48% to 4%, trees per acre from 774 to 11, and basal area from 95 to 5 ft²/acre. All snags present

will be left standing onsite unless they pose a safety hazard. Very little merchantable material is present on the site, but 6.7 cords/acre of small diameter trees are estimated to be cut or mowed under this treatment. Access to the restoration thinning portion of sub-stand PPSO-34 will follow a fire control line running roughly south off of Horseshoe Road.

Patch Cuts – PPSO-34

Patch Cuts - PPSO-34					Area: 15 acres within 115	
	Basal Area (ft ² /acre)	QMD (in.)	TPA	Canopy Cover (%)	Crowning Index (MPH)	Expected Volume to be Removed (cords/acre)
2014 Conditions	110	6.0	547	54	27	13.1
After Treatment	29	9.9	54	18	64	
2024	33	3.2	593	21	61	<i>Estimates based on Forest Vegetation Simulator (FVS) projections using LDE/NJSFS data</i>
2034	43	3.7	582	28	55	
2054	68	4.7	560	41	44	

The short-term objectives of this activity are to provide habitat for rare open-canopy species, create localized site conditions that encourage regeneration, and utilize the resources on-site to pay for management. In the longer term, the objective is to develop an additional age class and to repeat the treatment in the surrounding forest. This will extend the short-term benefits of habitat creation by periodically refreshing early-successional patches while developing a more resilient forest.

Northwest of the burned area, roughly 30 patch shelterwood cuts, each ½ acre in size, will be randomly scattered throughout the forest. This will provide habitat for rare species that require open areas within a matrix of more diverse habitat. Currently stocked with 110ft²/acre of basal area, these patches will be reduced to roughly 29ft²/acre. Most pitch pines less than 10” DBH will be cut, leaving approximately 18% canopy cover and 54 trees/acre, down from 55% and 526, respectively. Merchantable material will be removed, while unmerchantable material will be cut and piled. Naturally hollow and fire-scarred trees will also be included in piles. The 3-4’ tall piles will have larger material in the bottom and will be located towards the northern portion of the patch cut. These cuts should remove approximately 13.2 cords/acre across 15 acres, for a total harvest of roughly 198 cords from these openings. Skidding will be somewhat dispersed to encourage scarification of the soil surface, preparing a seedbed amenable to pitch pine, and reducing the appearance of access trails.

The patch cuts will be evaluated at the end of the planning cycle to assess their function. If regenerating trees close the patches, and the prescription was successful, similar activities will be evaluated for application in the next planning cycle (after 2024).

Horseshoe Road will provide vehicle access off of Lacey Road. Landings for these patch cuts will be placed in sub-stand PPSO-34 along Horseshoe Road.

Variable Density Thinning - PPSTO-2; PPSTO-3; PPSTO-7

Variable Density Thinning - PPSTO-2 / 3 / 7					Area: 14 / 9 / 222 acres	
	Basal Area (ft ² /acre)	QMD (in.)	TPA	Canopy Cover (%)	Crowning Index (MPH)	Expected Volume to be Removed (cords/acre)
2014 Conditions	91	7.4	302	55	33	6.1-11.6
After Treatment	30-60	7.6	95-189	23-36	48-79	
2024	29-56	3.2-5.8	307-518	22-39	51-77	<i>Estimates based on Forest Vegetation Simulator (FVS) projections using LDE/NJSFS data</i>
2034	44-68	4.0-6.4	301-508	33-45	46-69	
2054	80-94	5.5-7.8	284-485	50-55	33-39	

The short-term objectives of these management activities are to develop uneven-aged forests that will provide spatially-diverse sub-stands within DTSP. This generates a mosaic of habitat for many wildlife and rare plant species, and encourages resiliency in the forest. Some areas are intended to begin regeneration, while the less intensely cut areas are intended to be more open mature forest. Additionally, the size and intensity of the activities should provide local employment in the forest sector. In the longer-term, the goal is to maintain an uneven-aged forest for the same habitat and forest health benefits of the short-term.

Forest management in PPSTO-7 will take place as an independent activity from activities in PPSTO-2 and PPSTO-3, but the three sub-stands will receive the same prescription. Activities in sub-stands PPSTO-2 and PPSTO-3 will take place with activities in sub-stand PPSO-7, detailed in the next section.

Variable density thinning across diameter classes in sub-stands PPSTO-2, PPSTO-3, and PPSTO-7 should achieve many of the same objectives as the prescription for PPSO-34. However, rather than spatially discrete patch cuts, areas with higher residual density will be gradually transitioned into lower density, masking edges between areas with different cutting intensity. Soils in these sub-stands are similar to the portion of PPSO-34 selected for management therefore, access and timing considerations will again be crucial to activity success.

Activities on sub-stands PPSTO-2, and PPSTO-3 will be coordinated to occur with the activity in sub-stand PPSO-7. PPSTO-2, PPSTO-3, and PPSTO-7 are currently stocked with just over 300 trees per acre and have a basal area of 91 ft²/acre. Acreage for the treatment areas in each stand is 14, 9, and 222 acres, respectively. Target residual basal area will vary from 30 to 60 ft²/acre, with approximately 95 to 190 trees per acre left standing. Merchantable material will be removed, and slash will be left on site. After allowing 1-2 years for decomposition, the treated area will be burned, reducing fuels, releasing nutrients, and providing conditions beneficial to species of interest. Following the thinning and burning, canopy cover is expected to range from 23-36 percent, down from 55%. The intensity of the cuts will vary, removing between 6.1 and 11.6 cords per acre. Between 2/3's of a cord and 1.2 cords of oak will be removed per acre, and between 5.5 and 10.4 cords per acre of pine will be harvested. Over the 222 acres of the PPSO-

7, approximately 1,972 cords will be removed. Across the 23 acres of PPSTO-2 and PPSTO-3, 207 cords are estimated to be removed.

For effective implementation, small, low-ground pressure equipment that can maneuver between retained trees should be used. To increase superficial scarification of soil for the purpose of encouraging germination of disturbance-loving plant species, skidding will be dispersed across the site. As the younger age class of trees grows, and understory species utilize their window of habitat availability, access trails will be obscured, inhibiting illegal ORV access.

Some of the activities scheduled for PPSTO-2 and PPSTO-3 will take place within wetland buffers. For these activities, the guidelines outlined in the wetland section of this plan will be applied. Access to PPSTO-2 and PPSTO-3 will be provided via the power line corridor that runs roughly north off of Pinewald-Keswick Road adjacent to sub-stand PPSO-7. Existing woods roads in PPSO-7 will provide additional access. Landings will be placed along these existing roads or adjacent to the power line right-of-way, in both cases outside of the wetland buffer.

Access to PPSTO-7 will mainly be provided via an existing woods road running SW into the sub-stand, off of Pinewald-Keswick Road. The other end of this road meets up with Dover Road to the south, which may also be possible to use for access. As this sub-stand shares a large boundary with Miller Airpark, the boundary road of the airpark may be a possible access route. This needs to be explored as an option, and permission from Miller Airpark would need to be secured in order to utilize this access.

Variable Density Thinning - PPSO-7

Variable Density Thinning - PPSO-7					Area: 64 acres	
	Basal Area (ft ² /acre)	QMD (in.)	TPA	Canopy Cover (%)	Crowning Index (MPH)	Expected Volume to be Removed (cords/acre)
2014 Conditions	98	6.6	409	51	29	7.2-12.4
After Treatment	30-60	6.8	118-237	19-35	44-73	
2024	32-55	2.4-4.7	452-994	22-33	45-67	<i>Estimates based on Forest Vegetation Simulator (FVS) projections using LDE/NJSFS data</i>
2034	50-68	3.1-5.3	443-975	35-40	39-50	
2054	93-98	4.5-6.6	406-846	51-53	27-28	

The objectives for this sub-stand are the same as those for the variable-density thinning in the PPSTO stand. The short-term objectives of these management activities are to develop uneven-aged forests that will provide spatially-diverse sub-stands within DTSP. This generates habitat for many wildlife and rare plant species, and encourages resiliency in the forest. Some areas are intended to begin regeneration, while the less intensely cut areas are intended to be more open mature forest. Additionally, the size and intensity of the activities should provide local employment in the forest sector. In the longer-term, the goal is to maintain an uneven-aged forest for the same habitat and forest health benefits of the short-term.

Similarly to sub-stand PPSTO-7, the portion of sub-stand PPSO-7 beyond 450' from the power line right-of-way (see "Safety Strip" within Wildfire Mitigation section) also presents an opportunity to create habitat for rare species. This sub-stand is adjacent to sub-stands PPSTO-2 and PPSTO-3, and the management for this sub-stand will take place as part of the same activity as the management of those sub-stands. Growing space for plants on the site is tight; overstocked conditions prevail, with 409 trees per acre, QMD of 6.6 inches, 98 ft²/acre of basal area, and 51% canopy cover. This affects any species dependent on more open conditions or young forests. To create habitat and diversify growing conditions, variable density thinning followed by prescribed burning is appropriate.

The 64 acre portion of the sub-stand will be thinned across diameter classes to leave between 30 and 60 ft²/acre of basal area. Trees will be removed from all species, though most of the site is occupied by pitch pine. Trees removed per acre will vary between 172-291, yielding between 7.2 and 12.4 cords/acre (7.1 – 12.2 cords of pine, the rest in oak). Over this portion of the sub-stand, an estimated 629 cords will be removed. Following thinning, the area will be burned, possibly in conjunction with the prescribed burning in the portion of the sub-stand managed for the right-of-way. Canopy cover will drop to a level varying between 19 and 35%. Thinning will take place with the use of mechanized equipment, and low ground pressure equipment will be given preference for working in the area. Access to this sub-stand can be provided off of Pinewald-Keswick Road via the power line right-of-way noted for PPSTO-2 and PPSTO-3, as well as through the use of existing woods roads. As with PPSTO-2 and PPSTO-3, landings will be placed in the sub-stand on the west side of the power line corridor. Particular care will be used to avoid critical habitats.

These treatments will create a mosaic of habitats within the sub-stands. Some spots will produce little regeneration, but will be warmer and slightly brighter than before. Others will be sufficiently sparse in the canopy to produce a response in the understory, aiding in the development of needed young-forest habitats. The thinning proposed in PPSTO-2, PPSTO-3, and PPSO-7 will work in tandem with each other creating more plant and wildlife habitat.

Pine Grassland - PPSOb-5, PPlob-4

Pine Grassland - PPSOb-5					Area: 23 acres	
	Basal Area (ft ² /acre)	QMD (in.)	TPA	Canopy Cover (%)	Crowning Index (MPH)	Expected Volume to be Removed (cords/acre)
2014 Conditions	51	7.0	190	31	44	4.1
After Treatment	28	7.0	85	19	66	
2024	34	7.8	103	23	59	<i>Estimates based on Forest Vegetation Simulator (FVS) projections using LDE/NJSFS data</i>
2034	41	5.6	101	26	53	
2054	46	10.0	84	29	48	

Pine Grassland - PPlob-4					Area: 7 acres	
	Basal Area (ft ² /acre)	QMD (in.)	TPA	Canopy Cover (%)	Crowning Index (MPH)	Expected Volume to be Removed (cords/acre)
2014 Conditions	32	5.6	185	26	96	4.3
After Treatment	14	5.6	65	10	180	
2024	16	6.8	64	14	138	<i>Estimates based on Forest Vegetation Simulator (FVS) projections using LDE/NJSFS data</i>
2034	20	3.8	256	17	123	
2054	46	5.8	246	32	73	

The short-term goal of this activity is to re-create now-disappearing open-canopy habitat created in the “Jake’s Branch Fire” of 2002. In the longer-term, the activity should encourage utilization of the site by species needing disturbance on nutrient-poor mesic sites.

The product of severe disturbance, pine grasslands are not currently abundant in Double Trouble State Park. The overstory in these sites is very open, between 5 and 25 percent cover, and is made up of pine and oak species, comprising 50-60 ft² of basal area. Under this sparse canopy, ground cover is comprised of native grasses, i.e. little bluestem switchgrass and broomsedge; the shrub layer is scarce vegetation of lowbush blueberry, huckleberry and other like species.

Within the northeastern corner of DTSP, sub-stands PPSOb-5 and PPlob-4 reflect the recent disturbance of the 2002 “Jake’s Branch Fire.” The wildfire left an open overstory and shrub layer within the aforementioned stands, and to continue the persistence on the site of open habitat, a mechanical thinning of hardwoods and pitch pine will need to take place to reach a desired basal area (between 5 and 40 ft²/acre). This will most likely take place through the use of a low-pressure forestry mower, unless sufficient merchantable material is removed to make the use of a low-pressure harvester economically feasible. In the drier portions of the site, as many as 95 trees per acre of the current 190 will be removed, yielding as much as 4.1 cords/acre. In the wetter sub-stand, as many as 120 trees per acre will be removed, yielding as much as 4.3

cords/acre. With the upland portion of the site covering 23 acres, and the wetter portion covering 7 acres, the total volume to be removed from this area is approximately 127 cords. Average residual cover is intended to be very low, at 10%, and basal area at around 14 ft²/acre.

This substantial thinning will allow for the open stratum species and native grasses to flourish. As this site will be on the threshold between forest and non-forest, care must be taken to maintain vegetative cover, both for erosion problems and to avoid conversion to a non-forested ecosystem.

C. Atlantic white-cedar Restoration

Management Activities: AWC Restoration, Superstorm Sandy Cedar Salvage

Sub Stands Affected: PMC-7, PMC-8, MAP-4

Much of the historic use of Double Trouble State Park involved heavy utilization of Atlantic white-cedar (AWC). Unfortunately, many of the areas historically occupied by AWC did not re-establish as cedar due to the absence of silvicultural management, pressure from deer, and competition with hardwood species. As a result, many sites along Cedar Creek with soils capable of supporting healthy AWC are instead occupied by red maple and blackgum. In order to restore a globally and locally significant forest ecosystem that provides a host of ecosystem services, as well as setting in motion the future conservation and use of AWC, portions of several sub-stands should receive management to restore AWC. Restoration activities on these sites will greatly encourage local businesses interested in the utilization of cedar, increasing the likelihood of a beneficial cycle of AWC restoration, utilization, and conservation.

This activity not only aids the New Jersey State Forestry Services objective of restoring the statewide presence of Atlantic white-cedar, but also provides a beneficial spatial arrangement of AWC on the landscape and contributes to the efforts put forth by other states along the Eastern Seaboard participating in the Atlantic white-cedar initiative. Additionally, restoring the sub-stands of interest will serve to create new age classes within a larger contiguous stands.

These and all other prescriptions will adhere to management recommendations for those species of interest outlined in the “Rare, Threatened, and Endangered Species” section of this document, and will not result in any irreversible adverse impact to any local population of any known threatened and/or endangered species in this area.

AWC Restoration – MAP-4, PMC-7, PMC-8

AWC Restoration - MAP-4					Area: 117 acres	
	Basal Area (ft ² /acre)	QMD (in.)	TPA	Canopy Cover (%)	Crowning Index (MPH)	Expected Volume to be Removed (cords/acre)
2014 Conditions	161	6.6	680	90	53	17.2
After Treatment	35	14.8	29	10	67	
2024	36	2.9	817	10	66	<i>Estimates based on Forest Vegetation Simulator (FVS) projections using LDE/NJSFS data</i>
2034	42	3.1	794	15	60	
2054	58	3.8	750	24	43	

AWC Restoration - PMC-7 / PMC-8					Area: 33 / 14 acres	
	Basal Area (ft ² /acre)	QMD (in.)	TPA	Canopy Cover (%)	Crowning Index (MPH)	Expected Volume to be Removed (cords/acre)
2014 Conditions	99	7.3	342	71	46	18.9
After Treatment	4	7.0	13	2	386	
2024	4	0.9	863	2	326	<i>Estimates based on Forest Vegetation Simulator (FVS) projections using LDE/NJSFS data</i>
2034	11	1.6	838	10	51	
2054	32	2.7	791	25	38	

The short-term objective of the AWC restoration activity is to remove forest species that will compete with AWC for the site, allowing the establishment of unique AWC forests. In the long-term, the goal of the activity is to grow cedar for their many ecological and economic benefits and to restore AWC to prominence in this portion of Cedar Creek. Restoration activities will mitigate historic silvicultural practices from before the site was acquired by the state that neglected AWC regeneration. It is hoped that this prescription will link sub-stands of AWC that are currently separated to develop a more extensive AWC site. This fits into the multi-state AWC restoration initiative, which aims to restore and conserve AWC and its associated values (Atlantic White Cedar Initiative 2014).

Sub-stands chosen for restoration include portions of stand MAP-4, PMC-7, and PMC-8. These areas were selected for several reasons: their continuity with existing cedar resources, their proximity to suitable existing access roads, the underlying soil’s suitability for strongly competitive cedar trees, their reduced threat from potential saltwater inundation under predicted sea level changes, and the potential for fence consolidation to reduce future costs for deer fencing.

Currently, the forest sub-stand MAP-4 is stocked with an average of 680 trees/acre and 161 ft²/acre of basal area, mostly in red maple and blackgum, with scattered pitch pines and a minor

AWC component. Canopy cover is at roughly 90%. The hardwoods have poor form and little commercial value, with a QMD of 6.6 inches and a volume of 14.3 cords/acre. There are 2.9 cords/acre of merchantable pine, mostly in larger diameter classes. MAP-4 can be accessed from the south via a woods road running parallel to Cedar Creek along the drainages south side. This road connects with Cow's Head Road on its southwest end and the power line right-of-way on its eastern end. Activities in MAP-4 will be staged in the uplands between this road and the lowland areas.

Sub-stands PMC-7 and PMC-8 are currently stocked with an average of 342 trees/acre and 99 ft²/acre of basal area, consisting mostly of red maple and pitch pine with AWC scattered throughout. Canopy cover is at roughly 70%. Pines constitute about 11.3 cords/acre. The majority of the hardwoods within this forest type, red maple and blackgum, are of very poor economic value with volume at roughly 7.8 cords/acre. Nearly no hardwoods in these sub-stands achieve 14" diameter.

Access to PMC-7 will come from two woods-roads running south from Steps Road (also known as Old Dover Forge Road). These roads also run through sub-stand Pplo-15, making it logical to do the AWC restoration activities in PMC-7 at the same time as the forest stand improvement work in Pplo-15. Landings and staging areas for activities in PMC-7 will be placed along Steps road or along the woods roads running off of Steps Road, always in uplands.

PMC-8 is separate from PMC-7, and is on the south side of Cedar Creek. Access for this sub-stand will come from the south, from the same woods road used to access MAP-4. Activities for PMC-8 will occur around the same time as activities scheduled for MAP-4 since these two areas are adjacent.

Management for these areas will adhere to the BMP's established for AWC in the AWC Ecology and Best Management Practices Manual, Second Edition by Mylecraine and Zimmerman (2003). Although there are no official records of Barred Owls nesting in the sub-stands being considered for this activity, all areas will be visually inspected for their nesting sites. During the winter, the hardwoods and non-merchantable pine in the sub-stands will be cut and chipped, or cut and sold, using low ground pressure equipment. Merchantable pines will be harvested using low ground pressure equipment, or will be cut and left on site. Residual AWC, when present, will be left standing as the only species uncut on the site to provide seed for regeneration. Residual stand conditions in the MAP sites will have approximately 29 trees per acre, 35 ft² of basal area, and 10% canopy cover. Residual stand conditions in the PMC sites will have approximately 13 trees per acre, 4 ft² of basal area, and 2% canopy cover. Total acreage considered for MAP-4 is 117 acres for an estimated total of 2,019 cords in hardwood and pine. Total acreage of PMC-7 and PMC-8 considered for treatment is approximately 33 and 14 acres, respectively, for a total of 892 cords of hardwoods and pine.

Actions must be taken to suppress stump sprouts from the hardwoods that will result from cutting. In order to be successful, mowing would require repeated re-entries into the site, and would not discriminate between desirable AWC regeneration and undesirable hardwoods. Further, the repeated area-covering re-entries to the site that occur with mowing would deteriorate the site's soil condition. To achieve the desired results of a vigorous AWC stand the most practical solution will most likely be to apply herbicide from the air followed up with spot-spraying and/or frilling, if needed. This procedure has been successfully performed by NJSFS in

past projects. Salt of imazapyr would be used for aerial application and salt of imazapyr and/or glyphosate could be used for spot spraying and frilling. Herbicide application will eliminate vegetation competing with the AWC seedlings while protecting site quality and desirable regeneration. All herbicides used for cedar restoration would be expressly labeled for forestry use and/or control of hardwood species in wetland environments. This would take place towards the end of the summer subsequent to cutting.

During the following autumn, the perimeter of the site will be fenced with 6' tall plastic-coated mesh supported by high-tensile wires, with an additional foot of height added by the wires above the mesh. This should exclude white-tailed deer, whose browsing can be a major inhibitor to successful AWC establishment. In areas with remnant cedar trees there is likely a seedbank present, providing some natural regeneration for the site. Depending on the amount of AWC regeneration observed in the 2-3 years following fencing, supplemental seedlings may be planted. These would be planted in early spring at a variable rate to achieve a density of 1,000 trees per acre. The site will be monitored for successful regeneration, and if establishment of AWC fails (successful establishment of less than approximately 800 seedlings/acre), the herbicide and planting treatments will be repeated. In the unfortunate case that seedlings fail to establish, no more than three attempts at re-planting will be made. All AWC seedling material will adhere to the standards set forth in N.J.A.C. 6.46(a) 11.ii.

Superstorm Sandy Cedar Salvage – CED-9

As a direct result of Super Storm Sandy, roughly 25 acres of Atlantic white-cedar was damaged through wind throw just south of the historic village, in sub-stand CED-9. During the development of this plan, salvage of those 25 acres were put out to bid and sold. Both the salvage harvest, which was under way at the time of the drafting of this plan, as well as the planned restoration activities will follow the BMPs and prescription outlined in the Pinelands application previously submitted for this activity. These activities match the ones provided above for restoration of AWC to sites where AWC has lost dominance. This activity sold 785 cords of standing cedar, though there was more cedar on the ground in the stand.

D. Shortleaf Pine Restoration

Management Activities: Shortleaf Restoration

Sub-Stands affected: PPSO-22, PPSO-63, PPO-4, RES-4

Shortleaf pine, with the widest geographic range of the southeastern pine species, is today rarely abundant in New Jersey. Historically, its economic value and utility resulted in it being targeted for harvest, and the cumulative effect over hundreds of years has left it with a diminished presence on the landscape relative to associated species (Mattoon 1915). As a native species of higher economic value in the outer coastal plain, increasing its frequency in appropriate areas will aid to subsidize future management of less economical, but still important habitats.

To increase shortleaf pine's portion of the growing space, while conserving the diversity of the species present, a modified shelterwood cut is proposed for this planning cycle in two areas across four sub-stands, with planting of shortleaf to aid in re-establishment. This activity will allow sunlight to reach the forest floor, providing light for early-successional plant species as

well as naturally-seeded and planted tree regeneration. All planted material will adhere to the standards set forth in N.J.A.C. 6.46(a) 11.ii. Portions of sub-stand PPSO-22, PPSO-63, PPO-4, and RES-4 that occur on Downer series soils have been selected as prime sites for shortleaf pine, as these soils provide favorable growing conditions for this species. These areas occupy approximately 28, 14, 64, and 2 acres, respectively (108 acres total). RES-4 is currently not forested as a result of resource extraction, but is included in the prescription as a staging area and for rehabilitation.

Activities will be broken into two blocks. Sub-stands PPO-4, PPSO-63, and RES-4 will be grouped together in activity, as they are adjacent. Work in sub-stand PPSO-22 will take place separately.

The short-term objectives for this activity include the creation of habitat for open-canopy species and the establishment of tree regeneration that includes Shortleaf pine. In the longer-term, the objective is to restore Shortleaf pine forests and their associated habitats on the landscape as part of the multi-state Shortleaf Pine Initiative.

These and all other prescriptions will adhere to management recommendations for those species of interest outlined in the “Rare, Threatened, and Endangered Species” section of this document, and will not result in any irreversible adverse impact to any local population of any known threatened and/or endangered species in this area.

Shortleaf Restoration - PPSO-22 & PPSO-63

Shortleaf Restoration - PPSO-22, 63					Area: 28, 14 acres	
	Basal Area (ft ² /acre)	QMD (in.)	TPA	Canopy Cover (%)	Crowning Index (MPH)	Expected Volume to be Removed (cords/acre)
2014 Conditions	98	6.6	409	51	29	9.4
After Treatment	40	11.0	60	25	53	
2024	36	11.2	52	22	57	<i>Estimates based on Forest Vegetation Simulator (FVS) projections using LDE/NJSFS data</i>
2034	42	3.7	546	28	53	
2054	63	4.7	526	42	46	

The preferred conditions for the modified shelterwood harvest within sub-stands PPSO-22 and PPSO-63 are a basal area at approximately 40 ft²/acre spread across 60 trees per acre, with a resulting canopy cover of about 25%. These represent a reduction from the current levels of 98ft²/acre, 409 TPA, and 51%, respectively. Total volume removed will be approximately 12 cords/acre, with 253 trees removed per acre. In the 28 acres of PPSO-22 targeted for this treatment, 268 cords are estimated to be removed. In the 14 acres of PPSO-63 considered, adjacent to PPO-4 and RES-4, approximately 128 cords are expected to be removed. Trees favored for removal will be pitch pines of poorer form, while pitch pines exhibiting high potential for use as growing stock and all shortleaf trees on the site will be retained.

PPSO-22 can be accessed along the power line right-of-way at the activity area’s eastern boundary. Landings for this activity can be placed adjacent to the right-of-way in the activity area.

Access for the work in PPSO-63 can come from three directions: the right-of-way, an adjacent forest road running parallel to the right-of-way, and from the east side a woods road running north-south, roughly paralleling the Garden State Parkway. Landing and staging for the activity in PPSO-63, PPO-4, and RES-4 will be placed along the east side of the right-of-way in RES-4.

Shortleaf Restoration - PPO-4

Shortleaf Restoration - PPO-4					Area: 64 acres	
	Basal Area (ft ² /acre)	QMD (in.)	TPA	Canopy Cover (%)	Crowning Index (MPH)	Expected Volume to be Removed (cords/acre)
2014 Conditions	110	7.8	325	70	37	16.1
After Treatment	35	12.2	43	26	75	
2024	33	1.9	1653	26	68	<i>Estimates based on Forest Vegetation Simulator (FVS) projections using LDE/NJSFS data</i>
2034	36	3.7	480	29	86	
2054	64	5.0	463	45	57	

The preferred conditions for the modified shelterwood in sub-stand PPO-4 is similar to that of the PPSO sub-stands. Basal area will be reduced to 35 ft²/acre spread across 33 trees per acre, dropping from 110 ft² and 325 trees per acre, respectively. Canopy cover is expected to be reduced from 70% to 26%, providing sunlight at the forest floor for early-successional, open-woodland species. Much of the volume in this sub-stand is in oak; total volume removed will be roughly 16 cords/acre, 7 cords/acre of which are oak, for a total of 1041 cords expected to be removed.

During the burn season following the cut, PPSO-22, PPSO-63, PPO-4, and RES-4 will be prescribe burned as site preparation for establishment of vegetation. In order to burn this area safely, the New Jersey Forest Fire Service Section Warden may determine that a firebreak or firelane should be established north of the activity area to both provide access for fire control and to prevent fire from spreading to the private inholdings to the north. Once these sub-stands are burned, limited supplemental planting (<500 seedlings/acre) of shortleaf pine will take place in PPSO-22, PPSO-63, PPO-4, and RES-4 to aid in the preferential establishment of this species. As stated above, all planted material will adhere to the standards set forth in N.J.A.C. 6.46(a) 11.ii. Up to three cycles of burning on a 3-5 year return interval may be used to aid the pines against competition. If the early burn cycles insufficiently remove competing vegetation, a woods disc will be used to break up the root mat. Such site preparation will be followed by re-planting of shortleaf pine seedlings at the same rate (<500 seedlings/acre) to restore a shortleaf pine component to this area. Again, all planted material will adhere to the standards set forth in N.J.A.C. 6.46(a) 11.ii. All site preparation mentioned will not penetrate below 6 inches of the soil and be conducted during the appropriate seasons to avoid impacts to ground-nesting birds.

Access and landings for this area are described in the section for PPSO-63, as sub-stand PPO-4 is adjacent to PPSO-63, and the activities for these areas will occur as part of one sale.

E. Wildfire Mitigation

Management Activities: Fuelbreak Maintenance, Firebreak Maintenance, Fuelbreak Installation, Firebreak Installation, Safety Strip

Sub Stands affected: PPSO-7, PPSO-10, PPSO-11, PPSO-17, PPSO-19, PPSO-34, PPSO-36, PPSO-37, PPSO-38, PPSO-40, PPSO-41, PPSO-55, PPSO-56, PPSO-57, PPSO-58, PPSTO-2, PPSTO-6, PPSTO-8, PPSTO-9, OP, PPO-2, SOPP-3, PPlO-11, PPlO-14, PPlO-15, PPlO-36, PPlO-37, PPlO-38, PPlO-42, Grass-3, PMC-7, PMC-36, MAP-4

Prolonged fire exclusion after major wildfires in the early to mid-20th century set much of Double Trouble State Park on successional tracks with heavy regeneration. Portions of Double Trouble State Park require attention to address significant wildfire risks. Prescriptions developed by Forest Fire Service Wardens for targeted areas of the property will address wildfire containment in a greater spatial context, providing strategic planning to address the movement of fire across the landscape. A scaffolding of completed fuelbreaks, partially-established fuelbreaks, firebreaks, and natural obstacles already exists, but comprehensive improvements are planned to tie together these safety features. Prescribed burning and the clearing and maintenance of fire breaks are exempt from the Pinelands Comprehensive Management Plan (Pinelands Commission 2012) but are included in this plan to tie together resource management that is planned to occur on this property.

All treatments pertaining to wildfire mitigation were developed with close coordination from the New Jersey Forest Fire Service. These include the use of fuelbreaks, or a manipulated reduction in fuel levels to constrain fire behavior to a controllable manner, as well as firebreaks, which are natural or constructed barriers used to stop or check fires that occur.

These and all other prescriptions will adhere to management recommendations for those species of interest outlined in the “Rare, Threatened, and Endangered Species” section of this document, and will not result in any irreversible adverse impact to any local population of any known threatened and/or endangered species in this area.

Safety Strip – PPSO-7& PPSTO-2

Safety Strip - PPSO-7, PPSTO-2					Area: 45 acres	
	Basal Area (ft ² /acre)	QMD (in.)	TPA	Canopy Cover (%)	Crowning Index (MPH)	Expected Volume to be Removed (cords/acre)
2014 Conditions	99	6.6	406	51	29	< 1.0
After Treatment	80	11.0	239	44	33	
2024	75	8.3	199	42	36	<i>Estimates based on Forest Vegetation Simulator (FVS) projections using LDE/NJSFS data</i>
2034	84	8.9	195	46	29	
2054	102	10.1	184	52	24	

The short-term goal of this activity is to reduce ladder-fuels and strengthen a strategic fuelbreak. In the long-term, the goal is to maintain sufficient canopy to slow down the regeneration of fuels, allowing a lower-maintenance fuelbreak with a longer interval between time-intensive burns. In both the short and long-term, this prescription is intended not to appear like distantly-spaced trees, but rather as a nearly complete pine canopy with a park-like understory.

Fuels reductions are desired to establish a protective space along the utility right-of-way to the north of the Berkeley Township municipal offices. This area corresponds to burn block dtp-pwl-01, and extends 450’ from the edge of the right-of-way. At roughly 45 acres, the sub-stand is currently stocked with approximately 99ft²/acre of basal area spread over 406 trees. Most of these are pitch pines, which comprise 16.7 of the 17 cords/acre present on the site. The current site conditions, with a QMD of 6.6 inches, put the site nearly in an overstocked condition.

This higher current density of trees allows some flexibility in reducing crowning index. A low thinning treatment where basal area is reduced to approximately 80ft²/acre will help to eliminate ladder fuels, while retaining sufficient canopy cover to significantly reduce pine seedling growth. On this site, the presence of understory oaks does not increase crowning index, so they will not be targeted as part of the thinning. Removal will consist of felling roughly 167 trees per acre, all in the smallest diameter pine classes. While this is less than one cord per acre, over the 36 acres to receive this treatment, there will be a reduction in volume of 24 cords. Felled trees will be slashed to keep remaining material close to the ground. Within 1-2 years of the thinning treatment, prescribed fire will be used to eliminate lower fuels and make the activities have a longer-lasting impact.

Low thinning and burning should create an understory environment with lower light levels, inhibiting the growth of new seedlings, and allowing a much longer return interval for prescribed burning. Low thinning and limited burning on this section of the sub-stand is in contrast to activities planned for the rest of the sub-stand (beyond 450’ from the eastern edge), which are detailed in the “Rare Species Habitat” section.

Fuelbreaks

Fuelbreaks, in some areas, have already been established in Wildland-Urban Interfaces (WUI), and will be created in others along roads, near houses, and other developed areas within Double Trouble State Park. Fuelbreaks are created by disturbing the ladder fuel from groundcover to the canopy within the designated stands, while maintaining canopy cover. Fuelbreaks to be maintained and installed will be managed by prescribed burning on a rotation of no less than 3 to 5 or 5 to 7 year intervals, as indicated specifically for each fuelbreak. Burn cycles are to be viewed with the understanding that fuel reduction may necessitate repeat burns within a cycle to compensate for burns that fail to properly reduce fuels, as evaluated by the New Jersey Forest Fire Service Section Warden responsible. To safely use fire as a defensive tool, access roads and plowlines are used to contain all burns within fuelbreaks. If/when used, plowlines will avoid wetland areas and buffers to prevent any negative impacts within Double Trouble State Park.

The present and proposed fuelbreaks cross several different forest sub-stands throughout Double Trouble: SOPP, PPSTO, PPlo, PPSO, OP, Grass, PMC, and MAP, with the majority of the acreage found in PPSO. The sub-stands within stand PPSO containing developed and proposed fuelbreaks are sub-stands 10, 11, 17, 34, 40, 41, 55, 56, 57, and 58. Within forest stand SOPP, only sub-stand SOPP-3 is included. Stand PPSTO contains three sub-stands within fuelbreaks, PPSTO-6, PPSTO-8, and PPSTO-9; forest stand PPlo includes fuelbreaks over small acreage in sub-stands, PPlo-11, PPlo-12, PPlo-14, PPlo-36, PPlo-37, PPlo-38, and PPlo-42. Forest stand PMC includes areas of sub-stands PMC-7 and PMC-36 to be part of the fuelbreak, and forest stand MAP includes sections of sub-stand MAP-4 to be part of the fuelbreak, as well.

Fuelbreak Maintenance

To protect the Double Trouble Historic Village and the Garden State Parkway from wildfire, five burn blocks will continue to be burned in the park area around the village. From the eastern edge of the village's historic bogs to Pinewald-Keswick Road lies burn block dtp-05, covering 26 acres, and burned on a 3-5 year rotation, not to exceed 7 years. To the north, bounded by Pinewald-Keswick Road, the park boundary, and Double Trouble Road is burn block dtp-pwk-01, covering 99 acres and burned on a 3-5 year rotation, not to exceed 7 years. North of the park entrance is block dtp-pwk-02, 150 acres burned on a 3-5 year rotation, not to exceed 7 years. West of the park entrance is block dtp-04, covering 24 acres, and block dtp-07, covering 33 acres; these are to be burned on a 3-5 year rotation, not to exceed 7 years, also.

Running along the south side of Dover Road from its intersection with Pinewald-Keswick Road and Lacey Road is a series of burn blocks designed to aid in containment and protection of homes on Dover Road. From Pinewald-Keswick Road to sub-stand GRASS-3, 55-acre break dtp-dvr-ss-5 is 300 feet wide, and is burned on a 3-5 year rotation, not to exceed 7 years. The grass field, approximately 12 acres, at the bend in the road is burned every year, providing connectivity from the 300 foot wide buffer to the uplands east of Cedar Creek. These uplands, burn block dtp-dfg-ss01, cover 60 acres and are burned on a 3-5 year rotation. Continuing from Cedar Creek to Dover Road are blocks dtp-dvr-ss-3, dtp-dvr-ss-2, dtp-dvr-ss-4, and dtp-dvr-ss-1, which extend 500' from Dover Road. These areas cover approximately 61 acres, and will be burned on a 3-5 year rotation, not to exceed 7 years.

In the interior of Double Trouble between Newbold's Branch and Factory Branch along Cow's Head Road, three burn blocks covering most of the uplands will continue to receive prescribed fire. Block dtp-chr-ss, covering 42 acres, spans the high ground between Cow's Head Road and Factory Branch, and is the southernmost of these three blocks. The middle burn block, dtp-cwh, runs from the 1992 wildfire scar eastward to the right-of-way, and north to the unnamed road running east-west, covering 80 acres. The north burn block, dtp-ccr-01, extends from the unnamed road north to the lowlands around Cedar Creek, covering 50 acres. Blocks dtp-ccr-01 and dtp-chr-ss will be burned on a 3-5 year interval until fuels have been sufficiently reduced as determined by the New Jersey Forest Fire Service Section Warden, at which point it will be burned on a 5-7 year interval. Block dtp-cwh will be burned on a 5-7 year interval.

South of Factory Branch an extensive burn block system is in place to provide wildfire containment from the southern end of Double Trouble. Carriage Road bisects much of this area. Leaving the village and passing through the Atlantic white-cedar stand the road runs through burn block dtp-pp-01. This 55-acre area covers the plantations and buffers of the Global ReLeaf plantings detailed in the "Plantation Management" subsection of this plan, and will be burned on a 3-5 year cycle, extending out to 5-7 years if the New Jersey Forest Fire Service Section Warden determines that plantation management activities have successfully reduced fuels. Continuing west on Carriage Road after the ROW, sitting to the north are: dtp-dbt-02 (9 acres), burned on a 5-7 cycle; and dtp-dbt-04 (103 acres) burned on a 5-7 year cycle. Along the same stretch, but south of the road, are: dtp-dhb-02 (13 acres), burned on a 5-7 year cycle; block dtp-ptf (15 acres), burned annually; and dtp-dhb-04 (40 acres) burned on a 5-7 year cycle. West of these blocks is a firebreak that runs north-south; to the west are blocks dtp-crd-01 (82 acres), dtp-crd-02 (106 acres), dtp-crd-04 (69 acres) south of the road, and dtp-crd-03 (23 acres), burned on a 3-5 year cycle. Included in dtp-crd-01 are the annually-burned open fields of block dtp-abf (13 acres).

Sandwiched between Deep Hollow Branch to the north and Huckleberry Branch to the south lies burn block dtp-swp-01. This 185 acre block aids the Carriage Road blocks in containment for wildfires from the south, and is planned to be burned on a 5-7 year cycle. Burn block dtp-swp-01 area contains Sworden's Pond and other low-lying areas, it is recommended decommissioning any plowlines within 100 feet of this area to deter any ORV use and environmental impacts associated with ORVs.

Fuelbreak Installation

Five burn blocks are proposed for this planning cycle to tie into existing wildfire containment resources. Similar to the burn blocks already in place along Dover Road, a 300' block is proposed running along Pinewald-Keswick Road from its intersection with Dover Road to the transmission line right-of-way roughly 1.5 miles to the SE, with the wettest lowlands excluded. This block is roughly 55 acres, and will be burned on a 3-5 year cycle until the New Jersey Forest Fire Service Section Warden determines that fuels have been sufficiently reduced to warrant a less frequent burning cycle.

Running east-west within the heart of Double Trouble State Park is the established, but gated, Steps Road (aka Old Dover Forge Road). A 300' fuelbreak is proposed along both sides the Old Dover Forge Road, similar to the buffers along Dover and Pinewald-Keswick Roads. This proposed break occupies approximately 141 acres, and will be burned on a 3-5 year cycle until

the New Jersey Forest Fire Service Section Warden determines that fuels have been sufficiently reduced to warrant a less frequent burning cycle.

In conjunction with habitat management that provides fuel reductions in the interior of the sub-stand, a 500' burn block is proposed to separate homes along Lacey Road from the interior of sub-stand PPSO-34. This block would run from Horseshoe Road, along the park boundary, down to the wetlands around Daniel's Brook. Covering 36 acres, this block will likely require more frequent burning (3-5 year cycle) to reduce its fuel load.

At the very northeastern most section of Double Trouble, along the shared boundary with Jake's Branch County Park, two further burn blocks are planned. These areas avoid the wetter lowlands, and are accessible by the boundary road between the parks. Blocks dtp-jbb-01 and dtp-jbb-02 cover 11.7 and 11.1 acres respectively, and will be burned on a 3-5 year cycle (not to exceed 7 years) as part of the fuelbreak system along historic wildfire routes.

Fuelbreak Burn Frequency

Fuelbreaks can only be effectively used in the defense against wildfire when rotation intervals are properly dispersed. All prescribed burns are used on a rotation; meaning within an allotted time the New Jersey Forest Fire Service will burn, and then revisit the site repeating the process within the pre-determined interval. This rotation is usually 5 to 7 year intervals, as stated in this plan. However, some burn blocks will begin on a 3-5 year rotation extending to 5-7 years, once the New Jersey Forest Fire Service is satisfied with the reduction of fuels.

If within any burn block, an area is deemed a potential area to be excessively burned because of an abbreviated rotation period; that area will be re-evaluated to avoid conversion of the forest type. Extending the rotation to a 5-7 year interval will reduce the likelihood of conversion greatly, while still maintaining the integrity of the burn block for New Jersey Forest Fire Service. Monitoring burn blocks will be an important tool to evade this complication.

Firebreaks

Firebreaks are natural or constructed barriers that stop or check fires, providing a control line from which to conduct prescribed burns and wildfire control. These areas require the elimination of flammable materials over a specified width, but can be narrow. In the areas selected here, firebreaks provide an added layer of protection to conserve beneficial Atlantic white-cedar lowlands, decrease risk for homes along Carriage Road, and provide habitat for xeric-adapted, disturbance-loving species.

Firebreak Maintenance

Firebreak maintenance proposed in this plan will be maintained through mowing, whether by a forestry mower, brush hog, or sidearm mower. Maintenance will take place on a rolling 1-3 year interval. Two break systems, in the uplands to the north and south of Factory Branch, are scheduled for maintenance. The first break runs along Cows Head Road and the branch off of it to the north, where it divides burn blocks dtp-chr-ss, dtp-cwh, and dtp-ccr-01. The second break

provides the western, northern, and eastern boundaries of burn blocks dtp-crd-01, dtp-crd-02, and dtp-crd-03, linking to Carriage Road. These breaks will be mowed to maintain a 16' width.

Firebreak Installation

In tandem with the proposed burn block running along Old Dover Forge Road, a firebreak will be installed along the same length of the road on both sides, from the rear of the buffers established adjacent to the paved roads. This area will be cleared of vegetation using a forestry mower, brush hog, or sidearm mower to a width approximately two times the width of a mower's cutting head. Trees in this strip will be cleared, with the potential for the material to be removed and sold. Slash from the tree removals will be left on site and masticated or mowed along with other vegetation. Following clearing, maintenance mowing will take place on a 1-3 year interval. Cumulatively, the area covers 4.2 acres, over which approximately 72 cords will be removed.

F. Forest Stand Improvement

Management Activities: Forest Stand Improvement

Sub-Stands affected: PPl0-15, PPl0-22, PPSO-20, PPSO-25

Forest Stand Improvement (FSI) is a common forestry activity to promote healthier forests. FSI is a thinning used in dense forest allowing for better growth of the residual trees; thinning benefits those trees selected to remain by minimizing competition from trees or other vegetation, and improves the resiliency of the stand by promoting advanced regeneration. Increased density not only eliminates habitat for understory species of interest, but predisposes the pines present in a stand to suffer from southern pine beetle (SPB) infestation, as well as other factors impeding the growth of trees. Further, FSI treatments reduce the likelihood of damaging wildfire occurrences and often enable the use of prescribed fire in the stand treated, as well as in adjacent stands. For sub-stands PPl0-15, PPl0-22, PPSO-20, and PPSO-25, FSI thinning is needed to remediate these issues.

These and all other prescriptions will adhere to management recommendations for those species of interest outlined in the "Rare, Threatened, and Endangered Species" section of this document, and will not result in any irreversible adverse impact to any local population of any known threatened and/or endangered species in this area.

Forest Stand Improvement - PPlo-15

Forest Stand Improvement - PPlo-15					Area: 77 acres	
	Basal Area (ft ² /acre)	QMD (in.)	TPA	Canopy Cover (%)	Crowning Index (MPH)	Expected Volume to be Removed (cords/acre)
2014 Conditions	133	6.7	537	70	29	8.7
After Treatment	70	8.7	170	47	43	
2024	79	9.3	167	51	41	<i>Estimates based on Forest Vegetation Simulator (FVS) projections using LDE/NJSFS data</i>
2034	89	10.0	163	55	34	
2054	109	11.4	153	60	29	

The short-term goals for this stand are to reduce potential mortality from SPB, reduce ladder fuels and the likelihood of damaging wildfire, and provide some light at the forest floor for lowland species that require disturbance. In the longer-term, the goals are to provide habitat for currently-rare species, suppress tree regeneration, and allow standing trees to accrue growth. Keeping sufficient canopy to fully utilize the site’s resources and suppress regeneration will reduce stress on the canopy trees, increasing their vigor and resilience to disturbance agents, as well as their economic value.

Pitch pine lowlands are host to a wide range of plant species, many of which benefit from increased light levels below the forest canopy. However, these same sites are more saturated than adjacent uplands, giving rise to larger and more densely arranged trees. Sub-stand PPlo-15 presents an opportunity to decrease tree density and improve habitat for understory species through thinning. Existing access routes already pass into the heart of the sub-stand from PPSO-11 to the north, and the sub-stand is adjacent to other areas proposed for management. The access described for AWC regeneration in PMC-7 is the same for PPlo-15. The soft soils of the site require that the same types of low-pressure equipment used in the planned Atlantic white-cedar restoration in the neighboring sub-stand to the south, yielding the possibility of combing the activities to simplify operations. Equipment will be kept off of paleodunes that may be present on the site, and landings will not be placed in these areas. Thinning activities will exclude paleodunes if harvesting equipment is deemed unsuitable for use on paleodunes; if thinning is conducted on these habitats, no slash will be piled on the paleodunes.

To achieve the above objectives, the pitch pines will be thinned from below, while all other species will be thinned throughout their diameter range. This will concentrate growth in the most robust pitch pines, immediately retain the position and diversity of the woody species on site, and maintain shrub habitat and canopy structure within the sub-stand. Across all species, the number of trees per acre will be reduced from 537 trees per acre to 170; pitch pine will be reduced from 413 trees per acre to 110, retaining the most robust, large trees, and those with good form. This will reduce pitch pine basal area from 105 ft²/acre to 58 ft²/acre, removing 6.5 cords/acre of pine. Hardwood species and Atlantic white-cedar in the sub-stand will be thinned across all diameters, removing half of all trees of all non-pine species. The hardwood

component will be reduced from 124 trees per acre to 60, hardwood basal area from 24 ft²/acre to 12, and 1.8 cords will be harvested. An additional 6 cedars per acre will be cut across all size classes, contributing roughly 1/3 of a cord per acre to the total volume removed, which for all species amounts to about 8.7 cords/acre. Slash will be left on site. Over the approximately 77 acres of sub-stand PPlo-15 targeted with this management, about 670 cords will be harvested. Canopy cover is expected to decline from around 70% to 47%.

Forest Stand Improvement - PPSO-20, PPSO-25 & PPlo-22

Forest Stand Improvement - PPSO-20 / PPSO-25 / PPlo-22					Area: 117 / 147 / 19 acres	
	Basal Area (ft ² /acre)	QMD (in.)	TPA	Canopy Cover (%)	Crowning Index (MPH)	Expected Volume to be Removed (cords/acre)
2014 Conditions	98	6.6	409	51	29	4.6
After Treatment	60	9.5	121	35	40	
2024	62	8.8	147	36	39	<i>Estimates based on Forest Vegetation Simulator (FVS) projections using LDE/NJSFS data</i>
2034	69	9.4	145	39	34	
2054	84	10.5	139	45	28	

The short-term goals for this stand are to reduce potential mortality from SPB, reduce ladder fuels and the likelihood of damaging wildfire, and provide light at the forest floor for disturbance-requiring species. This level of harvest should preclude most tree regeneration, furthering the goal of hazard reduction. In areas that will be burned by the NJFFS as part of fuelbreak maintenance, the more open canopy and repeated burning will free more of the site’s resources to enable growth of understory species. In the longer-term, the goal is to suppress some tree regeneration while allowing the standing trees to accrue growth. This will help to slow the movement of wildfire, make more vigorous canopy trees, aid understory species limited to open forest, and improve the economic value of the stand.

The soil type and site history within these sub-stands has resulted in the healthy growth of trees currently present on site. Site indices for these areas are high relative to the surrounding area, and good growth in the large trees leaves these sites fully stocked to overstocked. To ensure this successful growth continues in these particular areas, a FSI will be implemented in all three sub-stands, over 117 acres in PPSO-20, 147 acres in PPSO-25, and 19 acres in PPlo-22. PPSO-25 and PPlo-22 are adjacent to one another, while PPSO-20 is further west. Activities in PPSO-25 and PPlo-22 will be coordinated to take place at the same time.

Sub-stands PPSO-20 and PPSO-25 will be thinned from 105 to 60 ft²/acre of basal area, down from 395 to 122 trees per acre. PPlo-22 will be thinned from 105 to 56 ft²/acre of basal area, down from 524 to 170 trees per acre. It is expected that canopy cover will be reduced from 53 to 35% in the upland sub-stands, and from 70% down to 47% in the lowland portions of the activity area.

Material removed will almost entirely consist of pine, although there are scattered smaller sassafras and oaks in the upland portions, and lowland hardwoods in PPlo-22. The thinning will result in about 4.6 cords per acre harvested from mainly from pitch pines 4-8 inches in diameter. Slash will remain onsite. Volume harvested from PPSO-20, PPSO-25, and PPlo-22 is expected to be 542, 682, and 165 cords, respectively.

Existing roads and plowlines will provide the access required to facilitate the FSI thinning. Cow's Head Road provides access to PPSO-20 from the south, and landings will be placed in the sub-stand along the north side of the road. For PPSO-25 and PPlo-22 access comes from Carriage Road, which runs through the middle of the activity area. Access to the back side of this area will also come from an old road embankment linking other woods roads. Landings will be placed along Carriage Road.

G. Plantation Management

Management Activities: Plantation Management

Sub Stands affected: PLANT-1, PLANT-2

Sub-stands PLANT-1 and PLANT-2 were burned in a wildfire between 1974 and 1994 which left roughly 4 trees per acre remaining. Regeneration in the area was failing, and the sub-stands were selected for re-planting through the Global ReLeaf program. The 34 acre area was planted with a mix of pitch and shortleaf pine, with scattered oaks throughout.

Currently, the sub-stands are growing densely, which represents a wildfire hazard and a hindrance to the utilization of the site by plant species of interest. Prolonged stagnation of growth, considering the hardy species on site, will cause the overstocked condition to persist for many years. Thinning followed by prescribed burning will address management goals identified for the sites, while simultaneously improving the pest-resilience and vigor of the sub-stands.

These and all other prescriptions will adhere to management recommendations for those species of interest outlined in the "Rare, Threatened, and Endangered Species" section of this document, and will not result in any irreversible adverse impact to any local population of any known threatened and/or endangered species in this area.

Plantation Management – PLANT-1, PLANT-2

Plantation Management - PLANT-1, PLANT-2					Area: 34 acres	
	Basal Area (ft ² /acre)	QMD (in.)	TPA	Canopy Cover (%)	Crowning Index (MPH)	Expected Volume to be Removed (cords/acre)
2014 Conditions	98	5.3	637	49	18	0
After Treatment	50-60	6.0-6.4	220-306	29-34	26-30	
2024	49-56	6.8-7.2	171-223	29-33	34-37	<i>Estimates based on Forest Vegetation Simulator (FVS) projections using LDE/NJSFS data</i>
2034	59-68	7.6-8.0	168-219	35-39	33-37	
2054	80-95	9.1-9.5	162-210	44-49	26-33	

The short-term goals of this activity are to reduce the dangerous fuels conditions and to advance the sub-stands from their stagnation. Current density on site puts the trees in the stem-exclusion phase of their growth, which can be very prolonged in this forest type, exacerbating the density and fuels issues. Long-term goals include a release of the most vigorous trees in these plantations so that rapid, robust growth may occur, and the reduction of ladder fuels and fuel buildup. The prescribed residual density after thinning intends to keep the canopy closed, suppressing fuels buildup, and partitioning growth into the best trees on site.

A moderate thinning will be performed across the full area of the plantations. Currently stocked with 98ft²/acre of basal area and 637 trees per acre, the area will be thinned to between 50-60ft²/acre of basal area, removing between 331 and 417 trees per acre. Since the current QMD of the stand is only slightly over 5” DBH, the thinning won’t produce merchantable material; cut trees will be slashed and left on site. After the slash has had a chance to decompose and the Section Warden feels that a light burn is possible, prescribed fire will be used to safely reduce fuel loading in the stands. These treatments will serve to increase light availability while decreasing fuel loads, as well as improving the vigor and quality of the remaining trees. The prescribed burn will take place after fuels have been reduced through mechanical means, with the intent of reducing fire intensity and sparing desirable understory species. Canopy cover is currently at 50%; thinning will reduce it to approximately 28%, with prescribed fire expected to keep it there for several years beyond the initial thinning. Carriage Road provides excellent access into both of these sub-stands. Landings are not needed for plantation maintenance activities, as this activity will not produce material to be harvested. Staging will take place along the road.

IX. WORKS CITED

- Atlantic White Cedar Initiative. "Our Cause: The Atlantic White Cedar Initiative." *Atlantic White Cedar Initiative*, Raleigh NC. Accessed 2014. <http://atlantic-white-cedar.org/welcome.html>
- Burger, J. and Zappolarti, R. T. 1988. Habitat use in free-ranging pine snakes (*Pituophis melanoleucus*) in the New Jersey Pine Barrens: individual and sexual variation. *Herpetologica* 44(1):44-55.
- Burger, J. and Zappolarti, R. T. 1989. "Habitat use by pine snakes (*Pituophis melanoleucus*) in the New Jersey Pine Barrens: individual and sexual variation. *J. of Herpetology* 23(1) 68:-73.
- Citizens United to Protect the Maurice River and Its Tributaries, Inc. "Plants of Southern New Jersey." Accessed 2014. <http://www.cumauriceriver.org/botany/>
- Conant, R. and Collins, J.T. *A Field Guide to Reptiles and Amphibians of Eastern and Central North America*. Boston, MA: Houghton Mifflin Company, 1991.
- Conserve Wildlife Foundation of New Jersey. "New Jersey Endangered and Threatened Species Field Guide." Accessed July 2014. <http://www.conservewildlifenj.org/species/fieldguide/>
- CPC. "CPC National Collection." *Center for Plant Conservation*. Accessed August 2013. <http://www.centerforplantconservation.org/Collection/NationalCollection.asp>
- Crocker, S.J., et al. 2011. *New Jersey's Forests 2008*. USDA Forest Service, Newtown Square, PA.
- Delaware Department of Natural Resources and Environmental Control. "The Flora of Delaware." *Delaware Natural Heritage and Endangered Species Program*. Accessed 2014. http://www.wra.udel.edu/wp-content/heritage/flora-res.php?criteria=common_name&val=Slender+Rattlesnake-root&level=3
- eFloras. "Flora of North America." *eFloras*, Missouri Botanical Garden, St. Louis, MO & Harvard University Herbaria, Cambridge, MA. Accessed 2014. http://www.efloras.org/flora_page.aspx?flora_id=1
- "FSC-US Forest Management Standard (1st Ed.)." *Forest Stewardship Council US*. Minneapolis, MN. 2010.
- Harlow, W.M. and E.S. Harrar. *Textbook of Dendrology Covering the Important Forest Trees of the United States and Canada*. New York: McGraw-Hill Book Co., Inc. 1937.
- Harshberger, J.W. *The Vegetation of the New Jersey Pine Barrens*. Philadelphia, PA:

- Christopher Sower Company. 1916.
- Kuser, J.E. and G.L. Zimmermann. 1995. "Restoring Atlantic white-cedar Swamps: Techniques Propagation and Establishment." *Tree Planters' Notes* 46(3):78-85.
- Little, S. 1950. "Ecology and Silviculture of White Cedar and Associated Hardwoods in Southern New Jersey." *Yale University School of Forestry Bulletin* 56:1-103.
- Martin, W.H. "The timber rattlesnake: its distribution and natural history," in *Conservation of the timber rattlesnake in the northeast*, ed. Tying, T.F. (Lincoln, MA: Massachusetts Audubon Society, 1992), 13-22.
- Mattoon, W.R. 2002. *Sourcebook on Criteria and Indicators of Forest Sustainability in the Northeastern Area (NA-TP-03-02)*. USDA Forest Service, Newtown Square, PA.
- Montreal Process. 2014. "*Montreal Process Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests: Technical Notes on the Implementation of the Montreal Process Criteria and Indicators*. (3rd Ed., revised)."
- Mylecraine, K.A. and Zimmermann, G.L. *Atlantic white-cedar Ecology and Best Management Practices Manual*, edited by New Jersey Atlantic white-cedar Initiative Steering Committee. Trenton, NJ: Department of Environmental Protection, 2003.
- New Jersey Department of Environmental Protection. "Double Trouble State Park Historic Village." *New Jersey State Park Service, Double Trouble State Park*. Bayville, NJ. Accessed 2014. http://www.state.nj.us/dep/parksandforests/parks/docs/Double_Trouble_Historic_Village_Guide.pdf
- NJDEP. "Freshwater Wetlands Protection Act Rules." *N.J.A.C. 7:7A*. Trenton, NJ. 2009.
- NJDEP. "New Jersey Forestry and Wetlands Best Management Practices Manual." *New Jersey Bureau of Forest Management*. Trenton, NJ. 1995.
- NJDEP. "New Jersey's Endangered and Threatened Wildlife." *New Jersey Division of Fish and Wildlife*. Accessed 7/2014. <http://www.njfishandwildlife.com/tandespp.htm>
- Office of the New Jersey State Climatologist. "NJ: Climate." *Rutgers University, 2013*. Accessed 2013. <http://climate.rutgers.edu/stateclim/?section=njcp&target=NJCoverview>
- Pennsylvania Department of Conservation and Natural Resources. "Species Lists." *Pennsylvania Natural Heritage Program*. Accessed 2013. <http://www.naturalheritage.state.pa.us/>
- Pinelands Commission. "Pinelands Comprehensive Management Plan." *N.J.A.C. 7:50*. New Lisbon, NJ. 2012
- Reinert, H.K., and R.T. Zappalorti. 1988. "Timber rattlesnakes (*Crotalus horridus*) of the Pine Barrens: their movement patterns and habitat preference." *Copeia* 4:964-978.

- University of Texas – Austin. “Native Plant Database.” *Lady Bird Johnson Wildflower Center*. Accessed 2014. <http://www.wildflower.org/plants/>
- University of Wisconsin – Stevens Point. “Plants of Wisconsin.” *Robert W. Freckmann Herbarium*. Accessed 2014. <http://wisplants.uwsp.edu/WisPlants.html>
- United States Department of Agriculture Forest Service. “Forest Inventory Data Online (FIDO).” *Forest Inventory and Analysis Program*, 2014. Accessed 2014. <http://apps.fs.fed.us/fia/fido/index.html>.
- USDA Forest Service, “Forest Vegetation Simulator.” *Forest Management Service Center*, 2013, version 11-20-2013.
- USDA Forest Service, Northeastern Area State and Private Forestry. 2002. *Sourcebook on Criteria and Indicators of Forest Sustainability in the Northeastern Area (NA-TP-03-02)*. Newtown Square, PA.
- USDA, Natural Resources Conservation Service. “Official Soil Series Descriptions.” *Soil Survey Staff*, 2002. Accessed 12/2013. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_053587
- USDA, NRCS. “The PLANTS Database.” *National Plant Data Team*, Greensboro, NC, 2014. Accessed 2014. <http://plants.usda.gov>
- USDA, NRCS. “Web Soil Survey.” *Soil Survey Staff*, 2002. Accessed 12/2013. <http://websoilsurvey.nrcs.gov/>
- United States Department of the Interior Fish and Wildlife Service. “IPaC – Information, Planning, and Conservation System.” Environmental Conservation Online System, 2014. Accessed September 2014. <http://ecos.fws.gov/ipac/>
- United States Environmental Protection Agency (US EPA). “New Jersey Coastal Plain Aquifer.” *US EPA Region 2: Water*, 2010. Accessed 2013. <http://www.epa.gov/region2/water/aquifer/coast/coastpln.htm>
- Zampella, R.A. “Forestry and Threatened or Endangered Animal Species.” Memorandum from the Pinelands Commission Science Coordinator to the Members of the Policy and Implementation Committee, New Lisbon, NJ, 1996.

X. APPENDICES

Appendix A: Location Map

Appendix B: USGS Quadrangle Map

Appendix C: Property Parcel List

Appendix D: Soils

Appendix E: Natural Heritage Database Search Letter

Appendix F: Freshwater Wetlands Map

Appendix G: DTSP Streams Requiring Streamside Management Zones

Appendix H: Forest Stand Types Map

Appendix I: Forest Sub-Stand Map

Appendix J: Representative Sample Area Map

Appendix K: Overall Treatment Map

Appendix L: Treatment Type Map

Appendix M: Wildfire Mitigation Activities Map

Appendix N: Geology

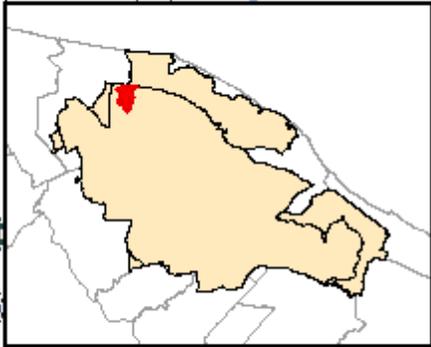
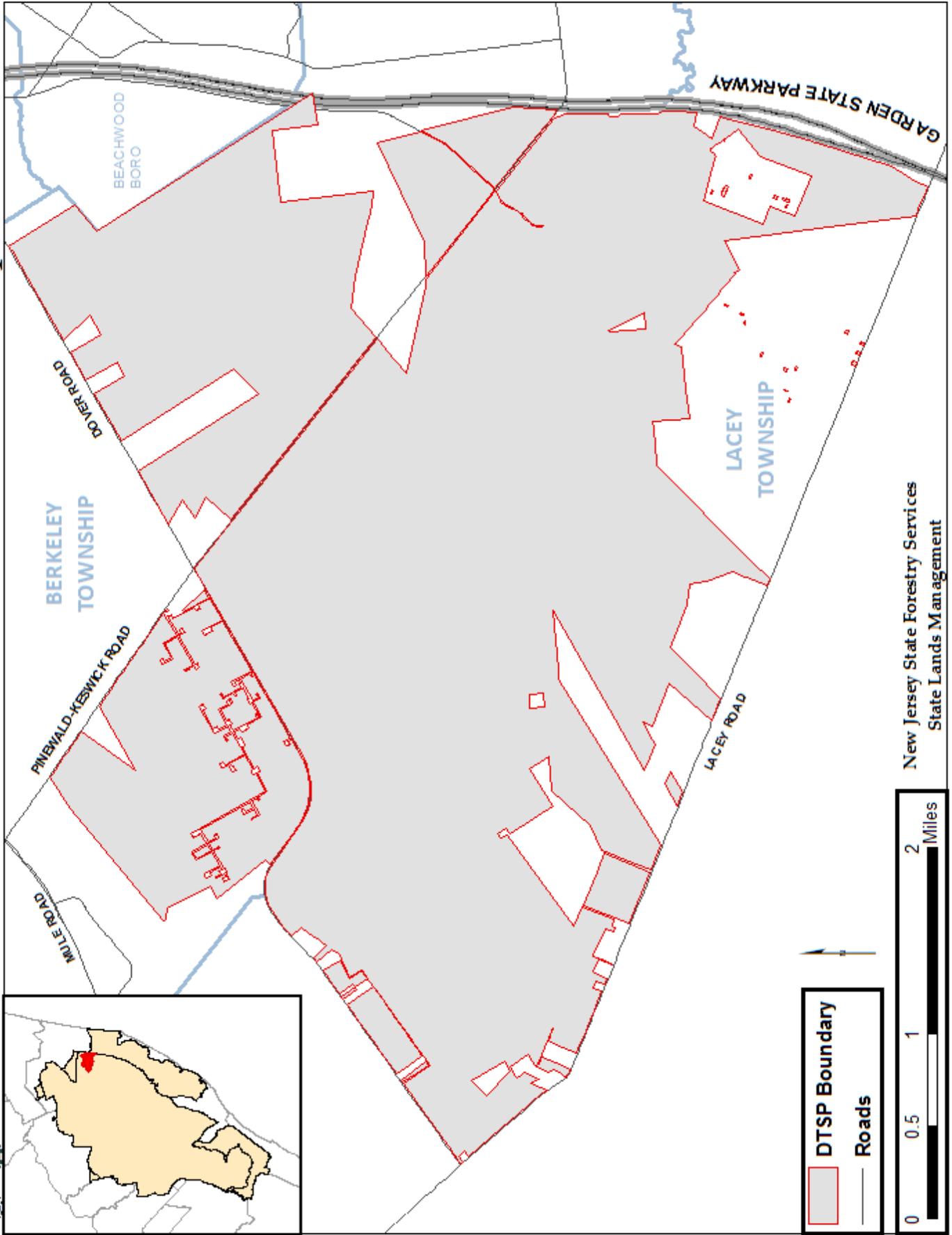
Appendix O: Hydrogeology

Appendix P: Hydrology

Appendix Q: Climate

Double Trouble State Park - Location Map

Appendix A: Location Map



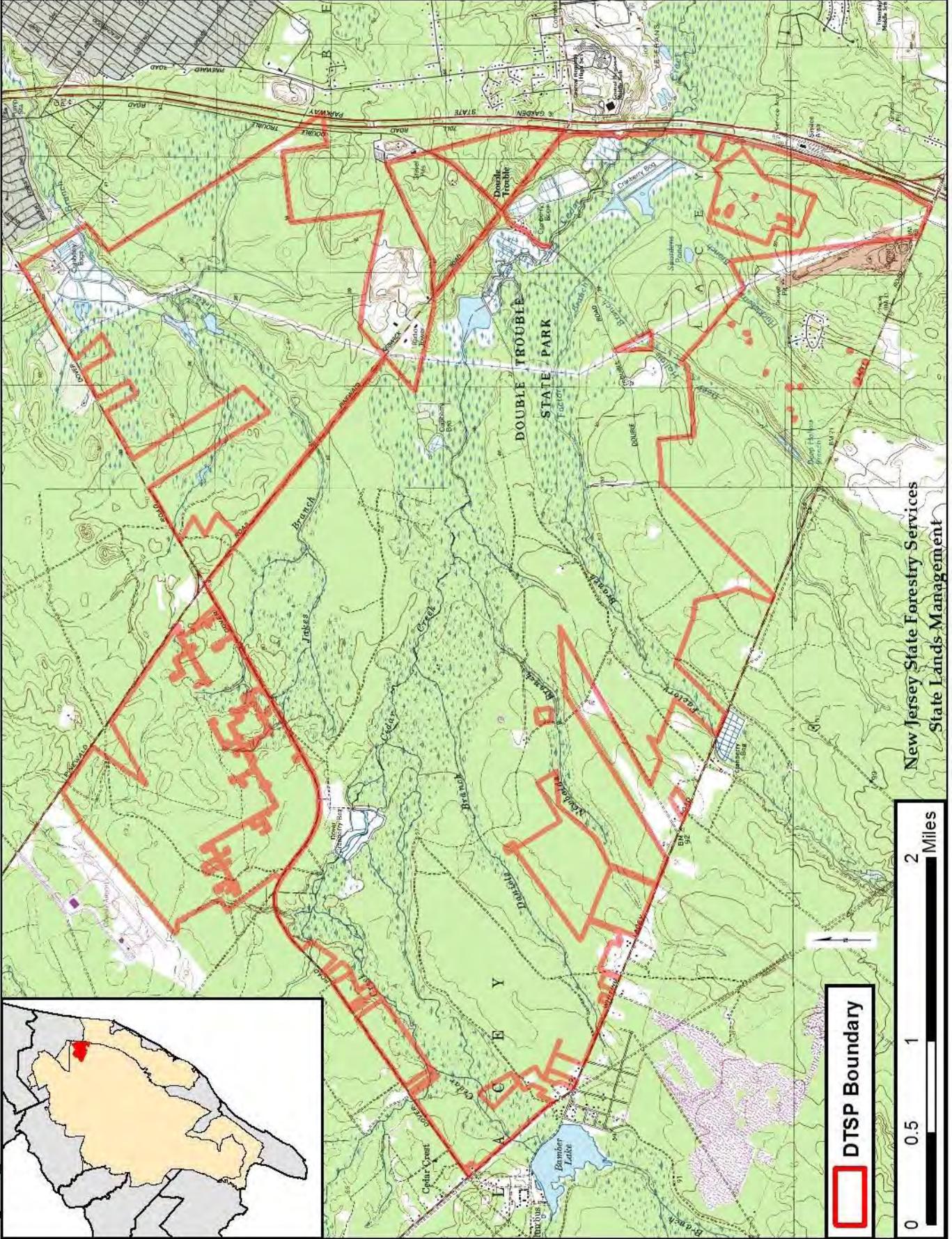
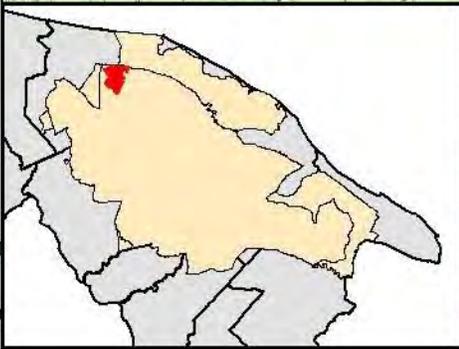
DTSP Boundary
Roads



New Jersey State Forestry Services
State Lands Management

Appendix B: USGS Quadrangle Map

Double Trouble State Park- USGS Quadrangle Map



New Jersey State Forestry Services
State Lands Management

 DTSP Boundary



Appendix C: Property Parcel List

Management Activity	Color
Fire Management (Fuelbreak/Firebreak Maintenance/Installation)	Red
Safety Strip	Orange
Pine Grassland	Yellow
AWC Restoration	Dark Green
Shortleaf Restoration	Light Green
Variable-Density Thinning	Light Blue
FSI Thinning	Blue
Plantation Management	Purple
Patch Cuts	Brown
Restoration Thinning	Black
Sandy Cedar Salvage	Grey
No Activities Planned This Cycle	White

Municipality_Block_Lot (PAMS PIN)				
1506 - Berkeley Township		1513 - Lacey Township		
1506_15_5	1506_17_218	1506_17_737	1513_2343_26	1513_2500_10
1506_15_7	1506_17_219	1506_17_738	1513_2343_27	1513_2500_11
1506_17.01_4	1506_17_220	1506_17_739	1513_2343_28	1513_2500_11
1506_17_119	1506_17_221	1506_17_780	1513_2343_29	1513_2500_12
1506_17_120	1506_17_222	1506_17_781	1513_2356_33	1513_2500_12
1506_17_121	1506_17_223	1506_17_782	1513_2356_34	1513_2500_13
1506_17_122	1506_17_224	1506_22.01_1	1513_2356_35	1513_2500_13
1506_17_123	1506_17_225	1506_22_1	1513_2356_36	1513_2500_13
1506_17_124	1506_17_4	1506_22_1	1513_2476_31	1513_2500_13.02
1506_17_125	1506_17_4.01	1506_22_1.01	1513_2476_32	1513_2500_13.03
1506_17_126	1506_17_4.02	1506_22_1.01	1513_2476_33	1513_2500_13.03
1506_17_127	1506_17_4.03	1506_22_1.01	1513_2476_34	1513_2500_14
1506_17_128	1506_17_4.04	1506_22_1.01	1513_2476_35	1513_2500_15
1506_17_169	1506_17_4.05	1506_22_2	1513_2476_36	1513_2500_16
1506_17_170	1506_17_4.06	1506_22_3	1513_2476_37	1513_2500_17
1506_17_171	1506_17_528	1506_22_3	1513_2476_38	1513_2500_17
1506_17_172	1506_17_529	1506_22_5	1513_2476_39	1513_2500_17
1506_17_173	1506_17_530	1506_23.07_1	1513_2476_40	1513_2500_17
1506_17_174	1506_17_531	1506_23_1	1513_2476_41	1513_2500_17
1506_17_2	1506_17_580	1506_23_1	1513_2476_42	1513_2500_17
1506_17_2.01	1506_17_647.05	1506_23_1	1513_2476_43	1513_2500_19
1506_17_2.02	1506_17_650	1506_23_1	1513_2476_44	1513_2500_7
1506_17_2.03	1506_17_651	1506_23_28	1513_2500_1.01	1513_2500_7
1506_17_216	1506_17_652	1506_23_5	1513_2500_1.02	1513_2500_7.02
1506_17_217	1506_17_736	1513_2343_25	1513_2500_10	1513_2500_8

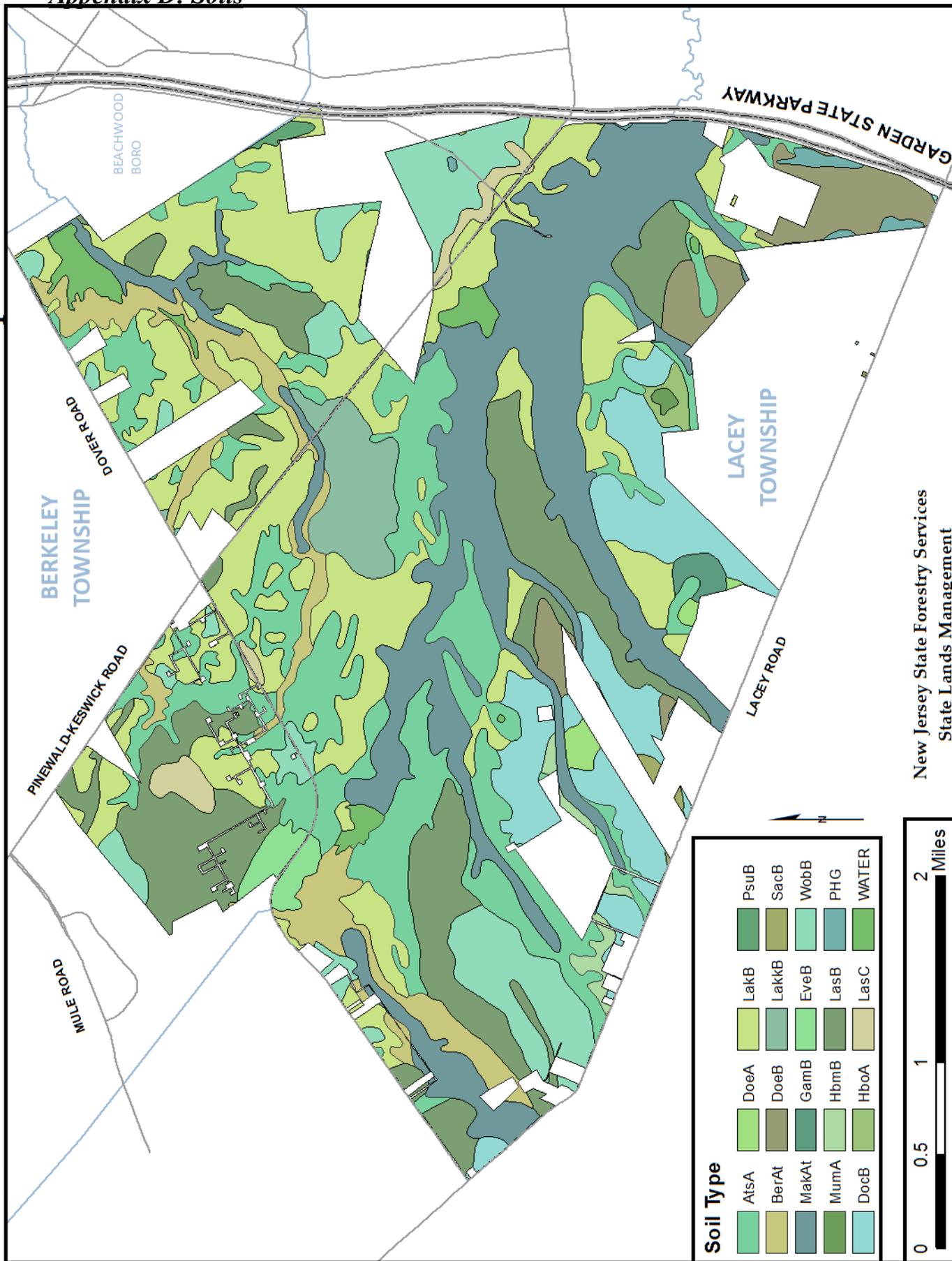
Note: Parcels on which multiple activities are planned to occur are listed multiple times. In most cases, the activity indicated is not planned to occur over the entire area of the parcel. See Appendices K through M for a detailed location map of planned activities and their extent.

Municipality_Block_Lot (PAMS PIN)				
1506 - Berkeley Township		1513 - Lacey Township		
1513_2500_8	1513_2600_26	1513_2701_12	1513_2818_23	1513_2818_49
1513_2500_8.01	1513_2600_27	1513_2701_13	1513_2818_24	1513_2818_5
1513_2500_8.01	1513_2600_28	1513_2701_14	1513_2818_25	1513_2818_50
1513_2500_8.02	1513_2600_29	1513_2701_15	1513_2818_26	1513_2818_51
1513_2500_8.02	1513_2600_34	1513_2701_16	1513_2818_27	1513_2818_52
1513_2500_8.03	1513_2600_36	1513_2701_18.05	1513_2818_28	1513_2818_53
1513_2500_8.03	1513_2600_6	1513_2701_20.05	1513_2818_29	1513_2818_54
1513_2500_8.04	1513_2600_7	1513_2701_27	1513_2818_3	1513_2818_55
1513_2500_8.04	1513_2600_7	1513_2701_28	1513_2818_30	1513_2818_56
1513_2500_9	1513_2600_8	1513_2701_29	1513_2818_31	1513_2818_57
1513_2500_9	1513_2600_9.01	1513_2701_30	1513_2818_32	1513_2818_58
1513_2500_9.01	1513_2675_1	1513_2701_31	1513_2818_33	1513_2818_59
1513_2500_9.01	1513_2675_2	1513_2701_32	1513_2818_34	1513_2818_6
1513_2600_10.01	1513_2675_3	1513_2701_33	1513_2818_35	1513_2818_60
1513_2600_13	1513_2675_3	1513_2701_34	1513_2818_36	1513_2818_61
1513_2600_14	1513_2675_4.03	1513_2701_4	1513_2818_37	1513_2818_62
1513_2600_15	1513_2675_4.08	1513_2818_1	1513_2818_38	1513_2818_63
1513_2600_15	1513_2675_4.10	1513_2818_10	1513_2818_39	1513_2818_64
1513_2600_16	1513_2675_4.11	1513_2818_13	1513_2818_4	1513_2818_65
1513_2600_17	1513_2700_2.01	1513_2818_14	1513_2818_40	1513_2818_66
1513_2600_18	1513_2700_3	1513_2818_15	1513_2818_41	1513_2818_67
1513_2600_19	1513_2700_3	1513_2818_16	1513_2818_42	1513_2818_69
1513_2600_20	1513_2700_3	1513_2818_17	1513_2818_43	1513_2818_7
1513_2600_21	1513_2700_3	1513_2818_18	1513_2818_44	1513_2818_70
1513_2600_22	1513_2700_4	1513_2818_19	1513_2818_45	1513_2818_71
1513_2600_23	1513_2700_5	1513_2818_2	1513_2818_46	1513_2818_72
1513_2600_24	1513_2701_1	1513_2818_20	1513_2818_47	1513_2818_73
1513_2600_25	1513_2701_11.02	1513_2818_21	1513_2818_48	1513_2818_8

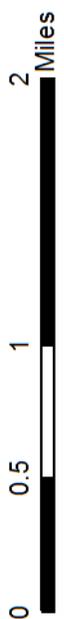
Note: Parcels on which multiple activities are planned to occur are listed multiple times. In most cases, the activity indicated is not planned to occur over the entire area of the parcel. See Appendices K through M for a detailed location map of planned activities and their extent.

Double Trouble State Park - Soil Map

Appendix D: Soils



New Jersey State Forestry Services
State Lands Management



SOILS DESCRIPTION

Nineteen soil types are present at DTSP with different drainage conditions and physical and chemical properties that influence forest structure, species composition, and management. Site index is a standard measure of the productivity of soils defined as the average height of dominant or codominant trees at a reference age of 50 years. Thus, a soil with a site index of 80 will generally have dominant trees 80 feet tall at 50 years of age. Brief descriptions of soil properties and site indices follow, derived from the USDA Natural Resources Conservation Service (USDA NRCS 2009; USDA NRCS 2002). Best Management Practices, such as seasonal logging and evaluating specific types of equipment for certain areas should ensure problems will not occur during management activities.

AtsA - Atsion sand, 0 to 2 percent slopes

The Atsion series consists of poorly-drained hydric soils, with a depth to seasonal high water table of 0 – 12 inches. Atsion-Lakehurst intermediate sites have a depth to seasonal high water table of 12 - 18 inches. This soil is not flooded and it is not ponded. Slopes range from 0 to 2 percent. The Atsion series is found on flats at the edges of swampy wetlands, in headwater swales, or natural depressions. Typically these soils have a dark gray sand surface layer over 10 inches of light gray sand. The subsoil from 18 to 24 inches is very dark brown sand, and from 24 to 36 inches is very dark gray sand. The substratum from 36 to 60 inches is brown loose sand. Native vegetation on Atsion sands is usually pitch pine with a minor component of red maple and blackgum, while highbush blueberry, huckleberries, and sheep laurel often create thickets in the understory. The site index for pitch pine is 65.

This soil occurs in all forest stands except CEDb, CEDr, FARM, and DIS.

BerAt – Berryland sand, 0 to 2 percent slopes, frequently flooded

This Berryland series consists of deep, very poorly-drained hydric soils with a depth to seasonal high water table of 0 inches. This soil is frequently flooded and frequently ponded. Slopes range from 0 to 2 percent. This Berryland series is found on flats, depressions, and coastal plains. Typically these soils exhibit a black sand surface layer about 10 inches thick over a 2 inch layer of gray sand. The subsoil from 12 to 20 inches is a firm, but weakly cemented dark reddish brown loamy sand. From 20 to 30 inches the soil becomes dark gray loose sand. The substratum from 30 to 72 inches is grayish brown loose sand. Native vegetation on the Berryland series consists mostly of pitch pine with a site index of 60.

This soil occurs in forest stands such as BOGS, CED, CEDr, CEDy, EM WET, MAP, OP, PMC, PPlo, PPO, PPSO, PPSTO, RES, SOPP, and SS.

DocB – Downer loamy sand, 0 to 5 percent slopes

DoeA – Downer sandy loam, 0 to 2 percent slopes

DoeB – Downer sandy loam, 2 to 5 percent slopes

The Downer series consists of very deep well-drained soils mostly in upland areas. These soils are typically not flooded and not ponded. Slopes range from 0 to 5 percent for Downer loamy sand, and from 0 to 2 or 2 to 5 percent for Downer sandy loam. These series are found on low hills, knolls, and coastal plains. The surface layer extends to approximately 18 inches of dark grayish brown loamy sand. The subsoil between 18 to 30 inches is yellowish brown sandy loam. The substratum from 30 to 40 inches is loose loamy sand, and below 40 inches stratified layers of gravel and sandy clay loam exist. Native vegetation on the Downer series includes pitch pine

and various tree oaks. The site index for black oak, scarlet oak, and white oak is 70.

This soil occurs in forest stands such as BB, CED, CEDb, DIS, GRASS, MAP, PMC, PPlo, PPSO, SOPP, and PPO.

EveB – Evesboro sand, 0 to 5 percent slopes

The Evesboro series consists of very deep excessively-drained soils mostly in upland locations. This soil typically does not flood or pond. Slopes range from 0 to 5 percent. The Evesboro series is found primarily on low hills in coastal plains. These soils have a grayish brown sand surface layer to approximately 3 inches, overtop of a yellowish brown sand layer which ranges from 3 to 16 inches. The subsoil between 16 to 30 inches is yellowish brown sand while the substratum from 30 to 72 inches is loose yellowish brown sand. Native vegetation on the Evesboro series consists primarily of pitch pine and various tree oaks. The site index for pitch pine, chestnut oak, and white oak is 60.

This soil occurs in forest stands such as CED, OP, PMC, PPlo, PPO, and PPSO.

GamB – Galloway loamy sand, 0 to 5 percent slopes

The Galloway series consists of very deep, somewhat poorly-drained soil with a depth to seasonal high water table of 15 inches. This soil does not typically flood or pond. Slopes range from 0 to 5 percent. The Galloway series is found on coastal plains, dunes, and flats. These soils typically have a dark grayish brown loamy sand surface layer from 2 to 9 inches above a light yellowish brown loamy sand layer from 20 to 45 inches. The substratum from 28 to 58 inches is comprised of white gravelly sand, while white sand makes up the layer from 58 to 72 inches. Native vegetation on the Galloway series includes mixed oaks, sweetgum, red maple, and various species of pine. Site index for this soil series is not currently available from the NRCS.

This soil occurs in forest stands such as PPSO and SOPP.

HbmB – Hammonton loamy sand, 0 to 5 percent slopes

HboA – Hammonton sandy loam, 0 to 2 percent slopes

The Hammonton series consists of very deep, moderately well-drained soil with a depth to seasonal high water table of approximately 30 inches. This soil is typically not flooded and not ponded. Slopes range from 0 to 5 percent for loamy sand, and 0 to 2 percent for sandy loam. The Hammonton series is found on coastal plains, depressions, and flats. Typically these soils have a dark grayish brown loamy sand surface layer extending to 8 inches and a yellowish brown loamy sand layer from 8 to 18 inches. The subsoil layer, between 18 to 36 inches, is mottled with yellowish brown sandy loam and the substratum layer, from 36 to 60 inches, is composed of loose brownish yellow sand. Vegetation native to Hammonton sandy loam soils consists of pitch pine, shortleaf pine, Virginia pine, black oak, and white oak. Site index is 80 for black and white oaks.

This soil occurs in forest stands such as GRASS, MAP, PMC, PPlo, and PPSO.

LakB - Lakehurst sand, 0 to 5 percent slopes

The Lakehurst series consists of very deep, moderately well-drained soil with a depth to seasonal high water table of 18 - 42 inches. This soil is typically not flooded and not ponded. Slopes range from 0 to 5 percent. The Lakehurst series is found on flats and paleodunes in uplands frequently adjacent to wetlands with Atsion soils. Typically in woodland areas these soils have a dark gray sand surface 3 inches thick and a light gray sand layer from 3 to 15 inches. The subsoil between 15 to 18 inches is dark brown loamy sand. The lower part of the subsoil from 18 to 36

inches is yellowish brown sand. The substratum from 36 to 60 inches is pale brown loose sand. Native vegetation on Lakehurst series is pitch pine and oaks or where wildfires have been severe, pitch pine, scrub, and black jack oaks. The site index for pitch pine is 60.

This soil occurs in every forest stand within DTSP.

LakKB - Lakehurst sand, clayey substratum, 0 to 5 percent slopes

This Lakehurst series consist of deep, moderately well-drained or somewhat poorly drained soils with a depth to seasonal high water table of 18 - 42 inches. This soil is not flooded and not ponded. Slopes range from 0 to 5 percent. This Lakehurst series is found on flats and paleodunes in uplands frequently adjacent to wetlands with Atsion soils. Typically in woodland areas these soils have a dark gray sand surface layer extending 3 inches and a light gray sand layer from 3 to 15 inches. The subsoil between 15 to 18 inches is dark brown loamy sand. The lower part of the subsoil from 18 to 40 inches is yellowish brown sand. The substratum from 40 to 60 inches is brownish yellow sandy clay loam and light gray sandy clay. Native vegetation on this Lakehurst series is pitch pine, blackgum, and tree oaks, or where wildfires have been severe, pitch pine, scrub and black jack oaks. The site index for pitch pine, blackgum, black oak, and white oak is 60.

This soil series occurs in forest stand such as CED, PMC, PPlo, PPSO, and PPSTO.

LasB - Lakewood sand, 0 to 5 percent slopes

The Lakewood series consist of deep, excessively drained soils with a depth to seasonal high water table of more than 80 inches. This soil is not flooded and not ponded. Slopes range from 0 to 25 percent. The Lakewood series is found on flats and knolls in uplands. Typically in woodland areas these soils have a black loose sand surface layer 1 inch thick and a light brownish gray loose sand layer from 1 to 10 inches. The subsoil between 10 and 14 inches is yellowish brown loose sand. The lower part of the subsoil is yellowish brown loose sand. The substratum from 36 to 60 inches is brownish yellow loose sand. Native vegetation on Lakehurst series is pitch pine, shortleaf pine, and tree oaks or where wildfires have been severe, pitch pine, scrub oak, and black jack oaks. The site index for pitch pine is 60.

This soil series occurs in forest stands such as BOGS, CED, CEDb, CEDy, DIS, MAP, PMC, PPlo, PPO, PPSO, PPSOb, PPSTO, ROW, SOPP, and SS.

LasC - Lakewood sand, 5 to 10 percent slopes

The Lakewood series consist of deep, excessively drained soils with a depth to seasonal high water table of about 48 to 122 inches. This soil is not flooded and not ponded. Slopes range from 0 to 25 percent. The Lakewood series is found on fluvio-marine terraces in uplands. Typically in woodland areas these soils have a black loose sand surface layer 1 inch thick and a light brownish gray loose sand layer from 1 to 10 inches. The subsoil between 10 and 14 inches is yellowish brown loose sand. The lower part of the subsoil is yellowish brown loose sand. The substratum from 36 to 60 inches is brownish yellow loose sand. Native vegetation on Lakehurst series is pitch pine, shortleaf pine, Virginia pine, and tree oaks or where wildfires have been severe, pitch pine, scrub oak, and black jack oaks. The site index for pitch pine and shortleaf pine is 50, and for Virginia pine is 60.

This soil series occurs in forest stands such as MAP, PMC, PPlo, PPSO, and PPSTO.

MakAt - Manahawkin muck, 0 to 2 percent slope, frequently flooded

The Manahawkin series consists of very deep, very poorly-drained hydric soils formed in organic muck deposits, over sand and gravel alluvium, with a depth to seasonal high water table of 0 – 6

inches. This soil is frequently flooded and frequently ponded. Slopes range from 0 to 2 percent. The Manahawkin series is found in wetland swamps and flood plains, as well as in low positions in lake basins and along fresh water channels as they open to tide water. Typically, soils in the series have a black surface and subsurface layer of highly decomposed organic material 39 inches thick. The substratum to a depth of 60 inches is gray sand. Native vegetation on Manahawkin series is Atlantic white-cedar, red maple, and sometimes black gum. The site index for Atlantic white-cedar is 50 and for red maple is 75.

This soil series occurs in all forest stands except Spung, FARM, GRASS, and RES.

MumA - Mullica sandy loam, 0 to 2 percent slopes

The Mullica series consists of very deep, very poorly-drained soil with a depth to seasonal high water table of approximately 0 - 12 inches. This series is closely related to Berryland sand. This soil is rarely flooded and rarely ponded. Slopes range from 0 to 2 percent. The Mullica series is found on flood plains, coastal plains, depressions located on coastal plains, and drainageways on coastal plains. Typically in woodland areas these soils have a black sandy loam layer approximately 3 to 13 inches deep over a gray sandy loam layer from 13 to 21 inches. The subsoil between 21 to 31 inches is also composed of a gray sandy loam. The substratum from 31 to 43 inches is gray gravelly sand, and from 43 to 63 inches the soil is composed of grayish brown sand. Native vegetation on the Mullica series is composed primarily of pitch pine and various tree oaks as well as red maple, sweetbay magnolia, sweetgum, and blackgum. Site index for pitch pine is 80, sweetgum is 90, and pin oak is 85.

This soil occurs in forest stand PPSO.

PHG – Pits, sand, and gravel

This soil series consists of excessively drained to well-drained smoothed sandy fill ranging from 24 to 48 inches in thickness. Slopes range from 0 to 5 percent. These soils tend to exist in miscellaneous areas.

This soil occurs in forest stands such as PMC and PPSO.

PsuB - Psamments, waste substratum, 0 to 8 percent slopes

The Psamments series consists of very deep, excessively-drained soils. Psamments are defined as Entisol soils consisting of unconsolidated sand deposits. This soil typically does not flood or pond. Slopes range from 0 to 8 percent. The Psamments series is found on upland hills and fills along with shifting sand dunes with parent material composed primarily of coarse-textured laterally spread deposits subjected to millions of years of weathering. Level, fast draining but often saturated, these soils present limitations to use of equipment during times of inundation. Acidity may limit establishment and productivity of certain species of tree seedlings. Site index is not available for this soil series from NRCS.

This soil occurs in forest stand PPSOb.

SacB – Sassafras sandy loam, 2 to 5 percent slopes

The Sassafras series consists of very deep, well-drained soil with a depth to seasonal high water table of approximately 72 inches. This soil is typically not flooded and not ponded. Slopes range from 2 to 5 percent. The Sassafras series is primarily found on low hills and knolls on coastal plains. These soils have a brown sandy loam surface from 0 to 9 inches overtop a yellowish brown loam from 9 to 21 inches. The subsoil between 21 to 32 inches is a brown sandy clay loam with a lower subsoil layer from 32 to 40 inches of a strong brown sandy loam. The substratum from 40 to 52 inches is a strong brown gravelly sandy loam, while the soil layer

from 52 to 70 inches consists of a brownish yellow loamy sand. Native vegetation of the Sassafras series includes mixed upland hardwood species as well as shortleaf pine and Virginia pine. Site index for this soil series is 80 for white oak, 80 for Virginia pine, and 90 for yellow poplar.

This soil occurs in forest stand PPSO.

WobB - Woodmansie sand, 0 to 5 percent slope

The Woodmansie series consists of deep, well-drained soils with a depth to seasonal high water table of about 48 to 122 inches. This soil is not flooded and not ponded. Slopes range from 0 to 10 percent. The Woodmansie series is found on hilltops, ridges, interfluvies on coastal plains, and slopes in uplands. Typically these soils in wooded areas have a dark gray sand surface layer 2 inches thick; from 2 to 8 inches is gray sand and from 8 to 17 inches is light yellowish brown sand. The subsoil between 17 to 30 inches is yellowish brown sandy loam. The substratum from 30 to 60 inches is stratified yellow sand and reddish yellow sandy loam. Native vegetation on the Woodmansie series is pitch pine, scrub oak and black jack oaks, and sometimes shortleaf pine and tree oaks. The site index for pitch pine is 60.

These soils occur in forest stands such as CED, FARM, MAP, PMC, PPlo, PPSO, PPSOb, PPSTO, RES, and ROW.

Appendix E: Natural Heritage Database Search Letter



State of New Jersey

DEPARTMENT OF ENVIRONMENTAL PROTECTION

State Forestry Services
Mail Code 501-04
ONLM - Natural Heritage Program
P.O. Box 420
Trenton, NJ 08625-0420
Tel #609-984-1339
Fax #609-984-1427

CHRIS CHRISTIE
Governor

KIM GUADAGNO
Lt. Governor

BOB MARTIN
Commissioner

June 5, 2014

Todd Wyckoff
New Jersey State Forestry Services
501 E. State Street
Trenton, NJ 08625

Re: Double Trouble State Park - Natural Resource Stewardship Plan

Dear Mr. Wyckoff:

Thank you for your data request regarding rare species information for the above referenced project site in Berkeley and Lacey Townships, Ocean County.

Searches of the Natural Heritage Database and the Landscape Project (Version 3.1) are based on a representation of the boundaries of your project site in our Geographic Information System (GIS). We make every effort to accurately transfer your project bounds from the topographic map(s) submitted with the Request for Data into our Geographic Information System. We do not typically verify that your project bounds are accurate, or check them against other sources.

We have checked the Landscape Project habitat mapping and the Biotics Database for occurrences of any rare wildlife species or wildlife habitat on the referenced site. The Natural Heritage Database was searched for occurrences of rare plant species or ecological communities that may be on the project site. Please refer to Table 1 (attached) to determine if any rare plant species, ecological communities, or rare wildlife species or wildlife habitat are documented on site. A detailed report is provided for each category coded as 'Yes' in Table 1.

We have also checked the Landscape Project habitat mapping and Biotics Database for occurrences of rare wildlife species or wildlife habitat in the immediate vicinity (within ¼ mile) of the referenced site. Additionally, the Natural Heritage Database was checked for occurrences of rare plant species or ecological communities within ¼ mile of the site. Please refer to Table 2 (attached) to determine if any rare plant species, ecological communities, or rare wildlife species or wildlife habitat are documented within the immediate vicinity of the site. Detailed reports are provided for all categories coded as 'Yes' in Table 2. These reports may include species that have also been documented on the project site.

The Natural Heritage Program reviews its data periodically to identify priority sites for natural diversity in the State. Included as priority sites are some of the State's best habitats for rare and endangered species and ecological communities. Please refer to Tables 1 and 2 (attached) to determine if any priority sites are located on or in the vicinity of the site.

A list of rare plant species and ecological communities that have been documented from the project site, referenced above, can be downloaded from <http://www.state.nj.us/dep/parksandforests/natural/heritage/countylist.html>. If suitable habitat is present at the project site, the species in that list have potential to be present.

Status and rank codes used in the tables and lists are defined in EXPLANATION OF CODES USED IN NATURAL HERITAGE REPORTS, which can be downloaded from http://www.state.nj.us/dep/parksandforests/natural/heritage/nhpcodes_2010.pdf.

If you have questions concerning the wildlife records or wildlife species mentioned in this response, we recommend that you visit the interactive NJ-GeoWeb website at the following URL, <http://www.state.nj.us/dep/gis/geoweb splash.htm> or contact the Division of Fish and Wildlife, Endangered and Nongame Species Program at (609) 292-9400.

PLEASE SEE 'CAUTIONS AND RESTRICTIONS ON NHP DATA', which can be downloaded from <http://www.state.nj.us/dep/parksandforests/natural/heritage/newcaution2008.pdf>.

Thank you for consulting the Natural Heritage Program. The attached invoice details the payment due for processing this data request. Feel free to contact us again regarding any future data requests.

Sincerely,



Robert J. Cartica
Administrator

c: NHP File No. 14-3907483-5622

Mail Code 501-04
 Department of Environmental Protection
 State Forestry Services
 Office of Natural Lands Management
 P.O. Box 420 Trenton, New Jersey 08625-0420
 (609) 984-1339 Fax: (609) 984-1427

Invoice

		Date	Invoice #
		6/5/2014	5622
Bill to: New Jersey State Forestry Services 501 E. State Street Trenton, NJ 08625		Make check payable to: Office of Natural Lands Management And forward with a copy of this statement to: Mail Code 501-04 Office of Natural Lands Management P.O. Box 420 Trenton, New Jersey 08625-0420	
Quantity (hrs.)	Description	Rate (per hr.)	Amount
1	Charge for Natural Heritage Database search for rare species and ecological communities locational information. Project: 14-3907483-5622 This Invoice has No Charge – State DEP Agency	\$ 70.00	\$ 70.00
Todd Wyckoff Project Name: Double Trouble State Park - Natural Resource Stewardship Plan		Total	\$ 70.00

Table 1: On Site Data Request Search Results (7 Possible Reports)

Rare Plants/Ecological Communities Possibly On Site:	Yes
Rare Plants/Ecological Communities On Site/Immediate Vicinity:	Yes
Natural Heritage Priority Sites On Site:	Yes
Landscape 3.1 Species Based Patches On Site:	Yes
Landscape 3.1 Vernal Pool Habitat On Site:	Yes
Landscape 3.1 Stream/Mussel Habitat On Site:	No
Other Animals Tracked by ENSP On Site:	No

**Possibly on Project Site Based on Search of
Natural Heritage Database: Rare Plant Species and
Ecological Communities Currently Recorded in the New
Jersey Natural Heritage Database**

Scientific Name	Common Name	Federal Protection Status	State Protection Status	Regional Status	Grank	Strank	Identified	Last Observed	Location
<i>Vascular Plants</i>									
<i>Carex mitchelliana</i>	Mitchell's Sedge		HL	G4	S2	Y - Yes	1985-05-10	Approximately 200 feet downstream from the bridge at Whiting-Lacey Rd. which crosses over Middle Branch Cedar Creek.	
<i>Gentiana autumnalis</i>	Pine Barren Gentian		LP, HL	G3	S3	Y - Yes	2012-10-23	Along Dover Road near the Dover Forge Walk-In Trail.	
<i>Helortias bullata</i>	Swamp-pink	LT	LP, HL	G3	S3	Y - Yes	2006-05-02	Bamber, below railroad station; both sides of Whiting-Lacey Road.	
<i>Juncus caesariensis</i>	New Jersey Rush	E	LP, HL	G2G3	S2	Y - Yes	1907-09-09	DOVER FORGE, RD. SIDE E. SIDE OF MILL POND.	
<i>Narthecium americanum</i>	Bog Asphodel	E	LP, HL	G2	S2	Y - Yes	2009-10-26	2009: Savanna habitat on tributary of Cedar Creek, 550 meters west of Dover Forge Canoe Launch, 50 meters south of Route 618 near Miller Air Field property. [2011-06-08: Lacey Township, Ocean County - ROS].	
T total number of records: 5									
<i>Terrestrial Community - Other Classification</i>									
<i>Pinus rigida</i> / <i>Quercus</i> (<i>marilandica</i> , <i>ilicifolia</i>) / <i>Pyxidanthera barbulata</i> Woodland	New Jersey Pitch Pine / Scrub Oak Barren		HL	G2	S2	Y - Yes	2002-10-15	Two main patches are located south of Jakes Branch, north of Pinewald-Keswick Grove Road, east of JCPL powerline, and west of the Garden State Parkway. Patches are located 0.5 to 2.3 miles north of the Double Trouble State Park entrance, partly within Jakes Branch County Park in Beachwood Boro, and partly within Double Trouble State Park and private lands in Berkeley	

Scientific Name	Common Name	Federal Protection Status	State Protection Status	Regional Status	Grank	Srank	Identified	Last Observed	Location
Pinus rigida saturated woodland alliance	Pitch Pine Lowlands (Undifferentiated)				G3	S3	Y - Yes	2003-01-25	Several patches S of Jakes Branch, N of Pinewald-Keswick Grove Road, east of the JCPL powerline, and W of the Garden State Parkway.
Pinus rigida-(p. echinata)-quercus spp./quercus (marilandica, ilicifolia) woodland	Pine-oak-shrub Oak Woodland (Pow)				G3	S3	Y - Yes	2003-01-25	Twelve scattered patches located south of Jakes Branch, mostly north of Pinewald-Keswick Grove Road, mostly east of the JCPL powerline, and west of the Garden State Parkway.

Total number of records: 3

**On or In the Immediate Vicinity of the
Project Site Based on Search of the
Natural Heritage Database: Rare Plant Species and
Ecological Communities Currently Recorded in the New
Jersey Natural Heritage Database**

Scientific Name	Common Name	Federal Protection Status	State Protection Status	Regional Status	Grank	Sranks	Identified	Last Observed	Location
<i>Epilobium angustifolium</i> ssp. <i>circumvagum</i>	Narrow-leaf Fireweed		HL		G5T5	S1S2	Y - Yes	1909-08-25	Clearing near PRR [Pennsylvania Railroad] and a house, Southeast of Bamber.
<i>Juncus caesariensis</i>	New Jersey Rush	E	LP, HL		G2G3	S2	Y - Yes	1995-10-11	Wetlands associated with the Cedar Creek; on the south side of Cedar Creek and just west of the sand road that runs parallel to the Cedar Creek on the north side of Lacey Road.
<i>Juncus caesariensis</i>	New Jersey Rush	E	LP, HL		G2G3	S2	Y - Yes	1975-08-26	SOUTH OF RR STATION, WEST SIDE OF RR, BAMBER.
<i>Platanthera ciliaris</i>	Yellow Fringed Orchid		LP, HL		G5	S2	Y - Yes	1909-08-25	Southeast of Bamber.
<i>Prenanthes autumnalis</i>	Pine Barren Rattlesnake-root		LP, HL		G4G5	S2	Y - Yes	1909-08-25	Sandy bogs along the PRR [Pennsylvania Railroad], southeast of Bamber.
<i>Schizaea pusilla</i>	Curly Grass Fern		LP, HL		G3G4	S3	Y - Yes	1907-07-25	LAKE INLET AT DOUBLE TROUBLE.

Total number of records: 6

**Rare Wildlife Species or Wildlife Habitat on the Project
Site Based on Search of
Landscape Project 3.1 Species Based Patches**

Class	Common Name	Scientific Name	Feature Type	Rank	Federal Protection Status	State Protection Status	Grank	Strank
<i>Amphibia</i>								
	Pine Barrens Treefrog	Hyla andersonii	Breeding Sighting	3	NA	State Threatened	G4	S2
	Pine Barrens Treefrog	Hyla andersonii	Vernal Pool Breeding	3	NA	State Threatened	G4	S2
<i>Aves</i>								
	Barred Owl	Strix varia	Breeding Sighting	3	NA	State Threatened	G5	S2B,S2N
	Barred Owl	Strix varia	Non-breeding Sighting	3	NA	State Threatened	G5	S2B,S2N
	Black-billed Cuckoo	Coccyzus erythrophthalmus	Breeding Sighting	2	NA	Special Concern	G5	S3B
	Black-throated Green Warbler	Dendroica virens	Breeding Sighting	2	NA	Special Concern	G5	S3B
	Brown Thrasher	Toxostoma rufum	Breeding Sighting	2	NA	Special Concern	G5	S3B,S4N
	Common Nighthawk	Chordeiles minor	Breeding Sighting	2	NA	Special Concern	G5	S3B,S3N
	Cooper's Hawk	Accipiter cooperii	Breeding Sighting	2	NA	Special Concern	G5	S3B,S4N
	Glossy Ibis	Plegadis falcinellus	Foraging	2	NA	Special Concern	G5	S3B,S4N
	Grasshopper Sparrow	Ammodramus savannarum	Breeding Sighting	3	NA	State Threatened	G5	S2B,S3N

Class	Common Name	Scientific Name	Feature Type	Rank	Federal Protection Status	State Protection Status	Grank	Strank
	Great Blue Heron	Ardea herodias	Foraging	2	NA	Special Concern	G5	S3B,S4N
	Kentucky Warbler	Oporornis formosus	Breeding Sighting	2	NA	Special Concern	G5	S3B,S3N
	Little Blue Heron	Egretta caerulea	Foraging	2	NA	Special Concern	G5	S3B,S3N
	Northern Parula	Parula americana	Breeding Sighting	2	NA	Special Concern	G5	S3B
	Savannah Sparrow	Passerculus sandwichensis	Breeding Sighting	3	NA	State Threatened	G5	S2B,S4N
	Snowy Egret	Egretta thula	Foraging	2	NA	Special Concern	G5	S3B,S4N
	Tricolored Heron	Egretta tricolor	Foraging	2	NA	Special Concern	G5	S3B,S3N
	Whip-poor-will	Caprimulgus vociferus	Breeding Sighting	2	NA	Special Concern	G5	S3B
	Wood Thrush	Hylocichla mustelina	Breeding Sighting	2	NA	Special Concern	G5	S3B
	Banner Clubtail	Gomphus apomyius	Breeding/Courtship	3	NA	State Threatened	G3G4	S2
	Dotted Skipper	Hesperia attalus slossonae	Casual Flyby	2	NA	Special Concern	G3G4T3	S3
	Georgia Satyr	Neonympha helicta	Casual Flyby	2	NA	Special Concern	G3G4	S3
	Golden-winged Skimmer	Libellula auripennis	Occupied Habitat	2	NA	Special Concern	G5	S3
	Pine Barrens Bluet	Enallagma recurvatum	Breeding/Courtship	2	NA	Special Concern	G3	S3
	Scarlet Bluet	Enallagma pictum	Breeding/Courtship	2	NA	Special Concern	G3	S3
	Scarlet Bluet	Enallagma pictum	Occupied Habitat	2	NA	Special Concern	G3	S3

Insecta

Class	Common Name	Scientific Name	Feature Type	Rank	Federal Protection Status	State Protection Status	Grank	Srank
<i>Reptilia</i>	Corn Snake	<i>Pantherophis guttatus</i>	Occupied Habitat	4	NA	State Endangered	G5	S1
	Northern Pine Snake	<i>Pituophis melanoleucus melanoleucus</i>	Occupied Habitat	3	NA	State Threatened	G4T4	S2
	Timber Rattlesnake	<i>Crotalus horridus horridus</i>	Occupied Habitat	4	NA	State Endangered	G4T4	S1

**Vernal Pool Habitat on the
Project Site Based on Search of
Landscape Project 3.1**

Vernal Pool Habitat Type	Vernal Pool Habitat ID
Potential vernal habitat area	1303
Potential vernal habitat area	1315
Potential vernal habitat area	1317
Potential vernal habitat area	1338
Total number of records:	4

Table 2: Vicinity Data Request Search Results (6 possible reports)

Rare Plants/Ecological Communities within the Vicinity:	Yes
Natural Heritage Priority Sites within the Vicinity:	Yes
Landscape 3.1 Species Based Patches within the Vicinity:	Yes
Landscape 3.1 Vernal Pool Habitat within the Vicinity:	Yes
Landscape 3.1 Stream/Mussel Habitat within the Vicinity:	No
Other Animals Tracked by ENSP within the Vicinity:	No

**Immediate Vicinity of the Project Site
Based on Search of Natural Heritage Database
Rare Plant Species and Ecological Communities Currently Recorded in
the New Jersey Natural Heritage Database**

Scientific Name	Common Name	Federal Protection Status	State Protection Status	Regional Status	Grank	Strank	Identified	Last Observed	Location
<i>Carex mitchelliana</i>	Mitchell's Sedge		HL		G4	S2	Y - Yes	1917-08-31	BELOW LARGE POND [ON] CHAMBERLAIN BRANCH OF CEDAR CREEK, CEDAR CREST.
<i>Corema conradii</i>	Broom Crowberry	E	LP, HL		G4	S1	Y - Yes	2007-03-21	Along a sand road in Greenwood Forest Wildlife Management Area, east of Cedar Creek and approximately 0.2 mile north of Dover Road.
<i>Epilobium angustifolium</i> ssp. <i>circumvagum</i>	Narrow-leaf Fireweed		HL		G5T5	S1S2	Y - Yes	1909-08-25	Clearing near PRR [Pennsylvania Railroad] and a house, Southeast of Bamber.
<i>Gentiana autumnalis</i>	Pine Barren Gentian		LP, HL		G3	S3	Y - Yes	2012-10-23	Along Dover Road near the Dover Forge Walk-In Trail.
<i>Helonias bullata</i>	Swamp-pink	LT	LP, HL		G3	S3	Y - Yes	2006-05-02	Bamber, below railroad station; both sides of Whiting-Lacey Road.
<i>Juncus caesariensis</i>	New Jersey Rush	E	LP, HL		G2G3	S2	Y - Yes	1995-10-11	Wetlands associated with the Cedar Creek; on the south side of Cedar Creek and just west of the sand road that runs parallel to the Cedar Creek on the north side of Lacey Road.
<i>Juncus caesariensis</i>	New Jersey Rush	E	LP, HL		G2G3	S2	Y - Yes	1975-08-26	SOUTH OF RR STATION, WEST SIDE OF RR, BAMBER.
<i>Platanthera ciliaris</i>	Yellow Fringed Orchid		LP, HL		G5	S2	Y - Yes	1909-08-25	Southeast of Bamber.
<i>Potamogeton confervoides</i>	Algae-like Pondweed		HL		G4	S2	Y - Yes	2007-10-02	2009: Located in northeast section of Bamber Lake, 0.5 mile south-southeast of Lacey Road and Dover Road, in Lacey Township, Ocean County.
<i>Prenanthes autumnalis</i>	Pine Barren Rattlesnake-root		LP, HL		G4G5	S2	Y - Yes	1909-08-25	Sandy bogs along the PRR [Pennsylvania Railroad], southeast of Bamber.

Vascular Plants

Scientific Name	Common Name	Federal Protection Status	State Protection Status	Regional Status	Grank	Strank	Identified	Last Observed	Location
<i>Rhynchospora knieskernii</i>	Knieskeru's Beaked-rush	LT	E	LP, HL	G2	S2	Y - Yes	2009-08-20	2009: Located approximately 4000 feet north of Exit 74 along north bound Garden State Parkway, directly opposite (east) of the service area, in Lacey Township.
<i>Schizaea pusilla</i>	Curly Grass Fern			LP, HL	G3G4	S3	Y - Yes	1907-07-25	LAKE INLET AT DOUBLE TROUBLE.
<i>Spiranthes tuberosa</i>	Little Ladies'-tresses			LP, HL	G5	S3	Y - Yes	2000-08-16	Adjacent to an old cranberry bog along the Factory Branch south of Lacey Road, approximately 2 miles east of Bamber Lake.
<i>Utricularia inflata</i>	Large Swollen Bladderwort			HL	G5	S3	Y - Yes	2009-07-31	Along the shorelines of Bamber Lake, Lacey Township.
Total number of records:		14							
Nonvascular Plants									
<i>Sphagnum cyclophyllum</i>	Sphagnum			HL	G3	S2	Y - Yes	1988-03-11	1988: Bamber Lake.
<i>Sphagnum macrophyllum</i>	Sphagnum			HL	G3G5	S2	Y - Yes	1988-03-11	1988: Bamber Lake.
<i>Sphagnum perichaetiale</i>	Sphagnum			HL	G5	S2	Y - Yes	1988-03-11	1988: Shore of Bamber Lake.
Total number of records:		3							
Terrestrial Community - Other Classification									
<i>Pinus rigida</i> / <i>Quercus</i> (marilandica, ilicifolia) / <i>Pyxidanthera barbulata</i> Woodland	New Jersey Pitch Pine / Scrub Oak Barren			HL	G2	S2	Y - Yes	2002-10-15	Two main patches are located south of Jakes Branch, north of Pinewald-Keswick Grove Road, east of JCPL Parkway. Patches are located 0.5 to 2.3 miles north of the Double Trouble State Park entrance, partly within Jakes Branch County Park in Beachwood Boro, and partly within Double Trouble State Park and private lands in Berkeley
<i>Pinus rigida</i> saturated woodland alliance	Pitch Pine Lowlands (Undifferentiated)				G3	S3	Y - Yes	2003-01-25	Several patches S of Jakes Branch, N of Pinewald-Keswick Grove Road, east of the JCPL powerline, and W of the Garden State Parkway.

Scientific Name	Common Name	Federal Protection Status	State Protection Status	Regional Status	Grank	Strank	Identified	Last Observed	Location
<i>Pinus rigida</i> -(p. <i>echinata</i>)- <i>quercus</i> spp./ <i>quercus</i> (<i>marilandica</i> , <i>ilicifolia</i>) woodland	Pine-oak-shrub Oak Woodland (Pow)				G3	S3	Y - Yes	2003-01-25	Twelve scattered patches located south of Jakes Branch, mostly north of Pinewald-Keswick Grove Road, mostly east of the JCPL powerline, and west of the Garden State Parkway.
<i>Pinus rigida-calamovilfa</i> <i>brevipilis</i> savanna	Pitch Pine-pinelands Reedgrass Savanna				G1	S1	Y - Yes	2003-01-25	Four main patches are located 1.55 to 1.75 mi. NNE (bearing 5 deg) of the Double Trouble State Park entrance, and 0.3 mi. W of the Garden State Parkway at the Jakes Branch headwater crossing. Within Jakes Branch County Park (Beachwood Boro) from 0.05 to 0.25 mi. NE of the township line road.

Total number of records: 4

**Rare Wildlife Species or Wildlife Habitat Within the
Immediate Vicinity of the Project Site Based on Search of
Landscape Project 3.1 Species Based Patches**

Class	Common Name	Scientific Name	Feature Type	Rank	Federal Protection Status	State Protection Status	Grank	Srank
<i>Amphibia</i>	Pine Barrens Treefrog	<i>Hyla andersonii</i>	Breeding Sighting	3	NA	State Threatened	G4	S2
	Pine Barrens Treefrog	<i>Hyla andersonii</i>	Vernal Pool Breeding	3	NA	State Threatened	G4	S2
<i>Aves</i>	Barred Owl	<i>Strix varia</i>	Breeding Sighting	3	NA	State Threatened	G5	S2B,S2N
	Barred Owl	<i>Strix varia</i>	Non-breeding Sighting	3	NA	State Threatened	G5	S2B,S2N
	Black-billed Cuckoo	<i>Coccyzus erythrophthalmus</i>	Breeding Sighting	2	NA	Special Concern	G5	S3B
	Black-throated Blue Warbler	<i>Dendroica caerulescens</i>	Breeding Sighting	2	NA	Special Concern	G5	S3B
	Black-throated Green Warbler	<i>Dendroica virens</i>	Breeding Sighting	2	NA	Special Concern	G5	S3B
	Brown Thrasher	<i>Toxostoma rufum</i>	Breeding Sighting	2	NA	Special Concern	G5	S3B,S4N
	Common Nighthawk	<i>Chordeiles minor</i>	Breeding Sighting	2	NA	Special Concern	G5	S3B,S3N
	Common Tern	<i>Sterna hirundo</i>	Foraging	2	NA	Special Concern	G5	S3B,S4N
	Cooper's Hawk	<i>Accipiter cooperii</i>	Breeding Sighting	2	NA	Special Concern	G5	S3B,S4N
	Glossy Ibis	<i>Plegadis falcinellus</i>	Foraging	2	NA	Special Concern	G5	S3B,S4N

Class	Common Name	Scientific Name	Feature Type	Rank	Federal Protection Status	State Protection Status	Grank	Srank
	Grasshopper Sparrow	<i>Ammodramus savannarum</i>	Breeding Sighting	3	NA	State Threatened	G5	S2B,S3N
	Great Blue Heron	<i>Ardea herodias</i>	Foraging	2	NA	Special Concern	G5	S3B,S4N
	Kentucky Warbler	<i>Oporornis formosus</i>	Breeding Sighting	2	NA	Special Concern	G5	S3B,S3N
	Little Blue Heron	<i>Egretta caerulea</i>	Foraging	2	NA	Special Concern	G5	S3B,S3N
	Northern Parula	<i>Parula americana</i>	Breeding Sighting	2	NA	Special Concern	G5	S3B
	Red-headed Woodpecker	<i>Melanerpes erythrocephalus</i>	Non-breeding Sighting	3	NA	State Threatened	G5	S2B,S2N
	Savannah Sparrow	<i>Passerculus sandwichensis</i>	Breeding Sighting	3	NA	State Threatened	G5	S2B,S4N
	Snowy Egret	<i>Egretta thula</i>	Foraging	2	NA	Special Concern	G5	S3B,S4N
	Tricolored Heron	<i>Egretta tricolor</i>	Foraging	2	NA	Special Concern	G5	S3B,S3N
	Veery	<i>Catharus fuscescens</i>	Breeding Sighting	2	NA	Special Concern	G5	S3B
	Whip-poor-will	<i>Caprimulgus vociferus</i>	Breeding Sighting	2	NA	Special Concern	G5	S3B
	Wood Thrush	<i>Hylocichla</i>	Breeding Sighting	2	NA	Special Concern	G5	S3B
	Worm-eating Warbler	<i>Helmitheros vermivorum</i>	Breeding Sighting	2	NA	Special Concern	G5	S3B
	Banner Clubtail	<i>Gomphus apomyius</i>	Breeding/Courtship	3	NA	State Threatened	G3G4	S2
	Dotted Skipper	<i>Hesperia attalus slossonae</i>	Casual Flyby	2	NA	Special Concern	G3G4T3	S3
	Georgia Satyr	<i>Neonympha helicta</i>	Casual Flyby	2	NA	Special Concern	G3G4	S3
	Golden-winged Skimmer	<i>Libellula auripennis</i>	Occupied Habitat	2	NA	Special Concern	G5	S3

Insecta

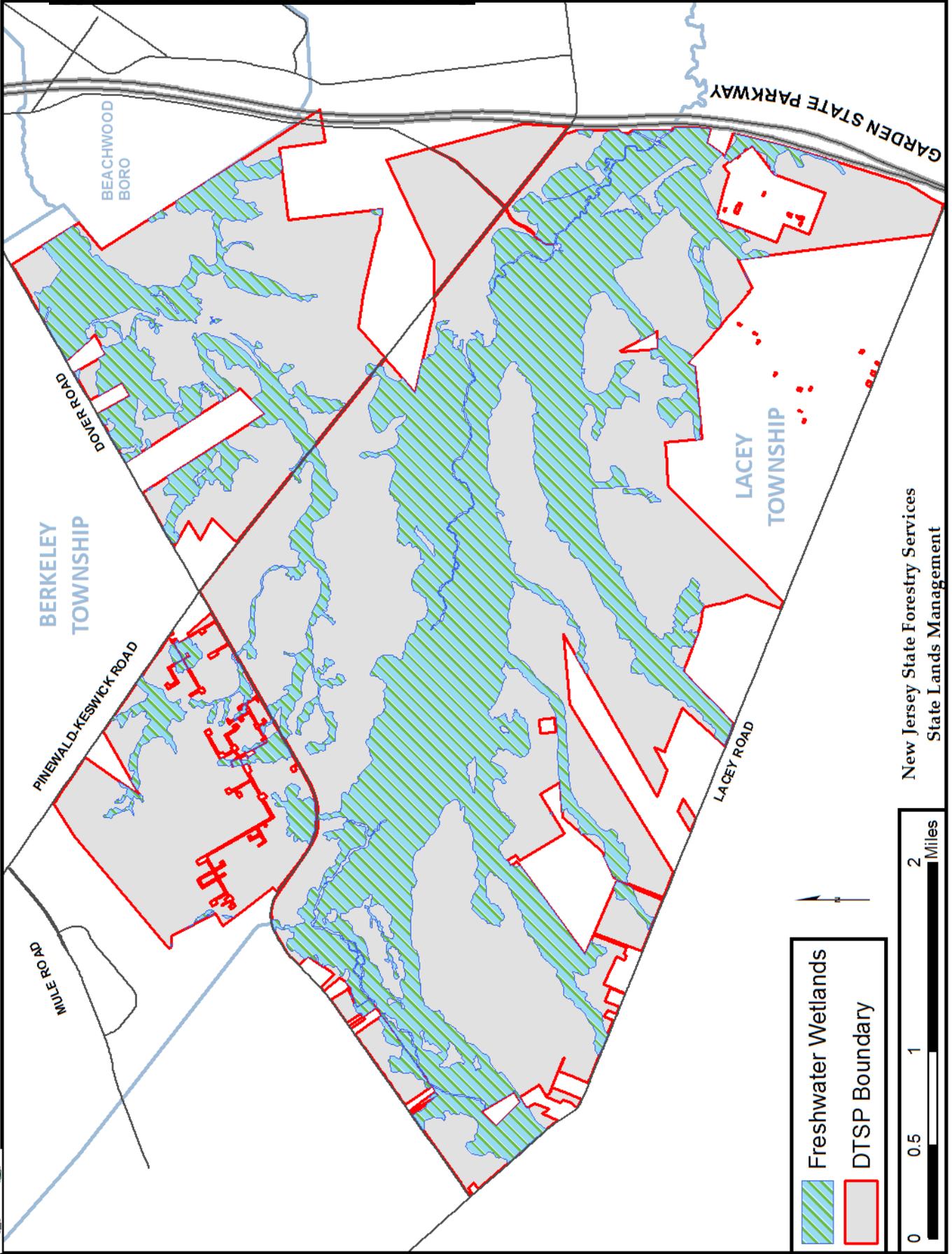
Class	Common Name	Scientific Name	Feature Type	Rank	Federal Protection Status	State Protection Status	Grank	Srank
	Pine Barrens Bluet	Enallagma recurvatum	Breeding/Courtship	2	NA	Special Concern	G3	S3
	Pine Barrens Bluet	Enallagma recurvatum	Occupied Habitat	2	NA	Special Concern	G3	S3
	Scarlet Bluet	Enallagma pictum	Breeding/Courtship	2	NA	Special Concern	G3	S3
	Scarlet Bluet	Enallagma pictum	Occupied Habitat	2	NA	Special Concern	G3	S3
	Scarlet Bluet	Enallagma pictum	Territorial Display	2	NA	Special Concern	G3	S3
Mammalia								
	Bobcat	Lynx rufus		4	NA	State Endangered	G5	S1
Reptilia								
	Corn Snake	Pantherophis guttatus	Occupied Habitat	4	NA	State Endangered	G5	S1
	Eastern Kingsnake	Lampropeltis getula getula	Occupied Habitat	2	NA	Special Concern	G5T5	S3
	Northern Pine Snake	Pituophis melanoleucus melanoleucus	Occupied Habitat	3	NA	State Threatened	G4T4	S2
	Timber Rattlesnake	Crotalus horridus horridus	Occupied Habitat	4	NA	State Endangered	G4T4	S1

**Vernal Pool Habitat
In the Immediate Vicinity of Project Site
Based on Search of
Landscape Project 3.1**

Vernal Pool Habitat Type	Vernal Pool Habitat ID
Vernal habitat area	1333
Potential vernal habitat area	1276
Potential vernal habitat area	1317
Potential vernal habitat area	1338
Total number of records:	4

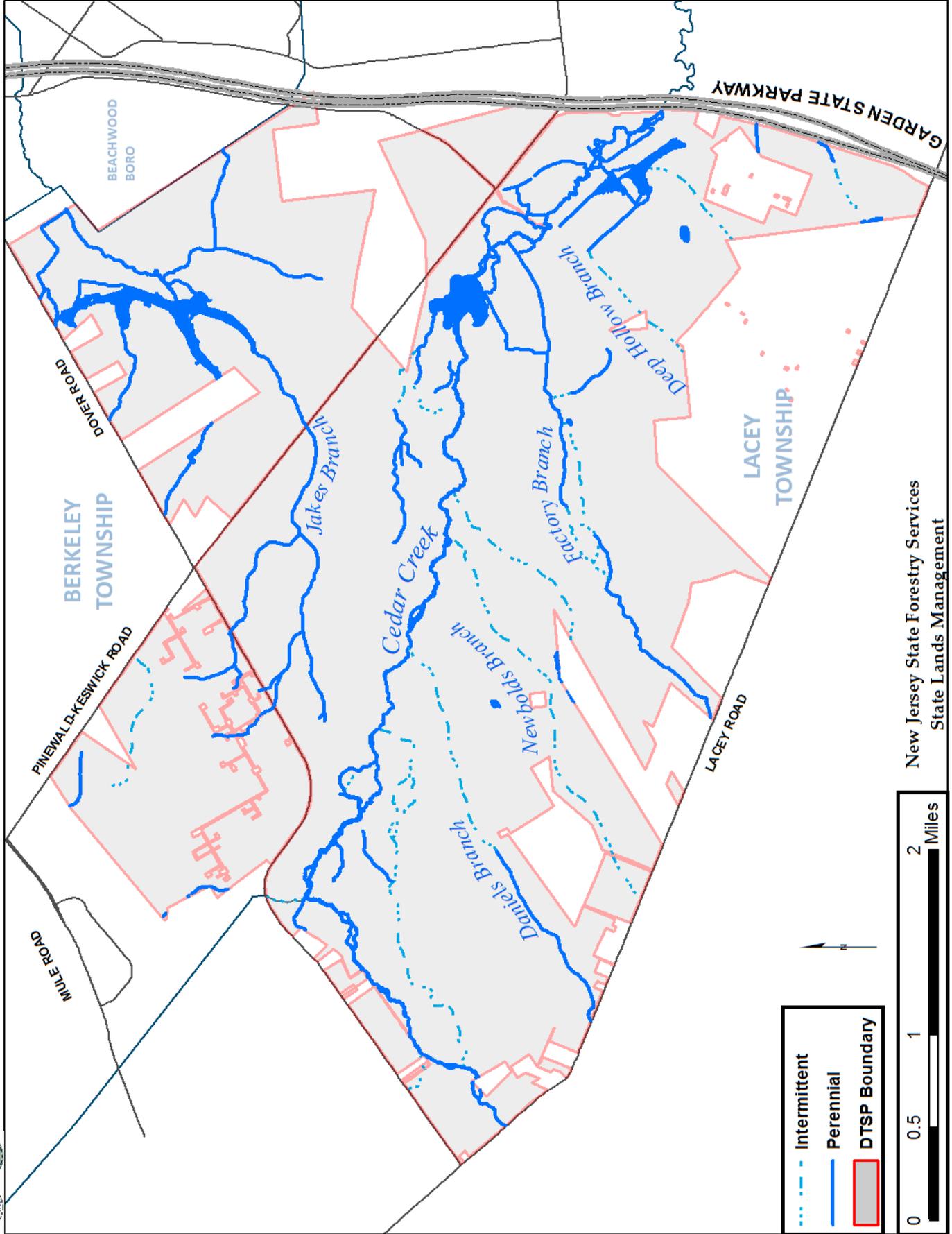
Double Trouble State Park- Wetlands Map

Appendix E: Freshwater Wetlands Map



Double Trouble State Park - Streams

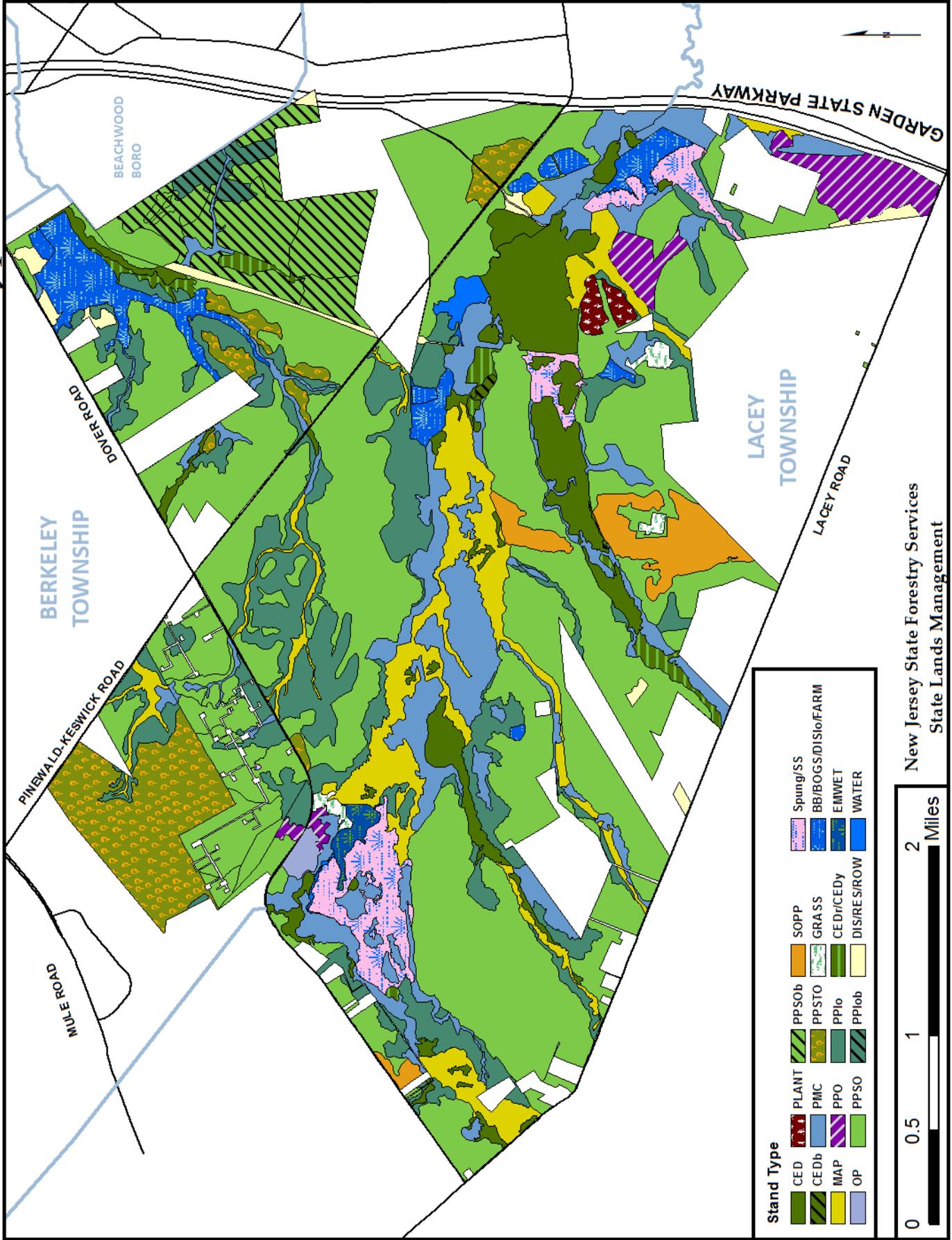
Appendix G: DTSP Streams Requiring Streamside Management Zones





Double Trouble State Park - Forest Stand Types

Appendix H: Forest Stand Types Map



Stand Type			
CED	PLANT	SOPP	Spung/SS
CEDb	PMC	GRASS	BB/BOGS/DISlo/FARM
MAP	PPO	CEDr/CEDy	EMWET
OP	PPSO	DIS/RES/ROW	WATER
	PPSOB		
	PPSTO		
	PPlo		
	PPlob		

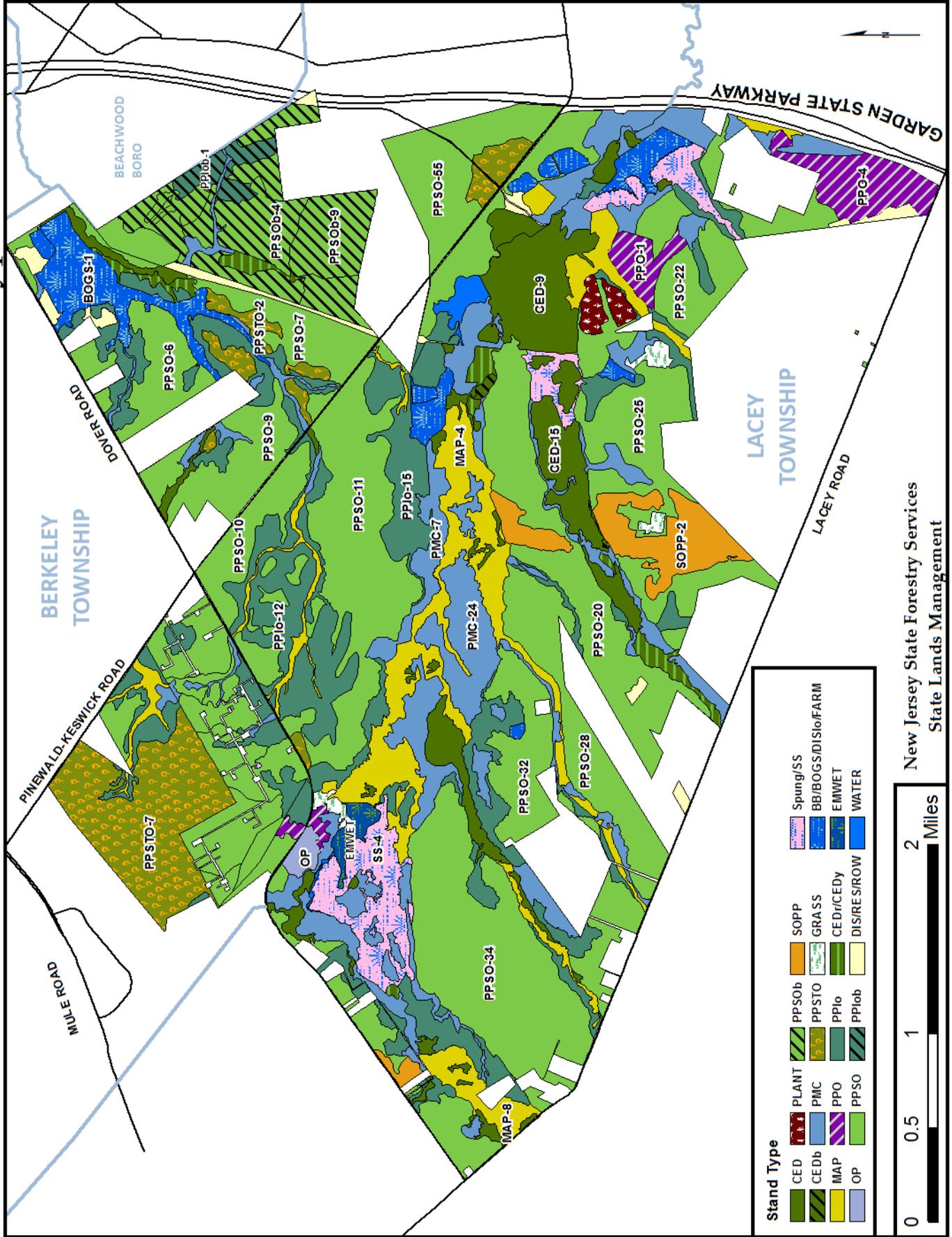
New Jersey State Forestry Services
State Lands Management





Double Trouble State Park - Forest Stand Types

Appendix I: Forest Sub-Stand Map



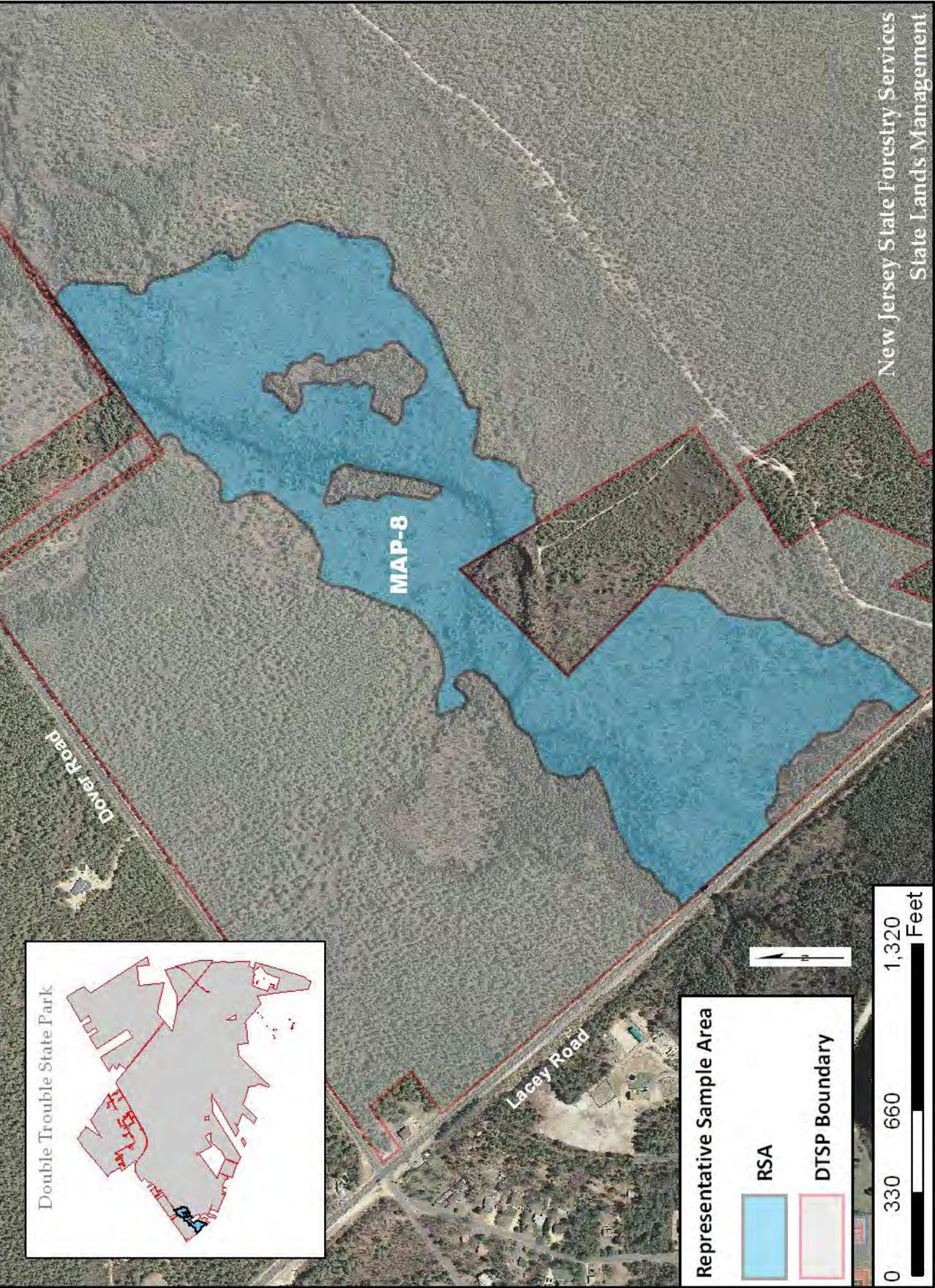
Stand Type	Color/Pattern	Stand Type	Color/Pattern
PLANT	Red with black dots	PPSO-11	Light green
PMC	Blue with black dots	PPSO-12	Light green
PPO	Blue with black dots	PPSO-13	Light green
PPSO	Light green	PPSO-14	Light green
OP	Light green	PPSO-15	Light green
EMMET	Light green with black dots	PPSO-16	Light green
SS-4	Light green with black dots	PPSO-17	Light green
SPUNG/SS	Light green with black dots	PPSO-18	Light green
BB/BOGS/DIS/IO/FARM	Light green with black dots	PPSO-19	Light green
EMMET	Light green with black dots	PPSO-20	Light green
WATER	Blue	PPSO-21	Light green
SOPP	Orange	PPSO-22	Light green
GRASS	Yellow	PPSO-23	Light green
CEDr/ICEDy	Dark green	PPSO-24	Light green
DIS/RES/ROW	Yellow	PPSO-25	Light green

New Jersey State Forestry Services
State Lands Management





Double Trouble State Park - Representative Sample Areas

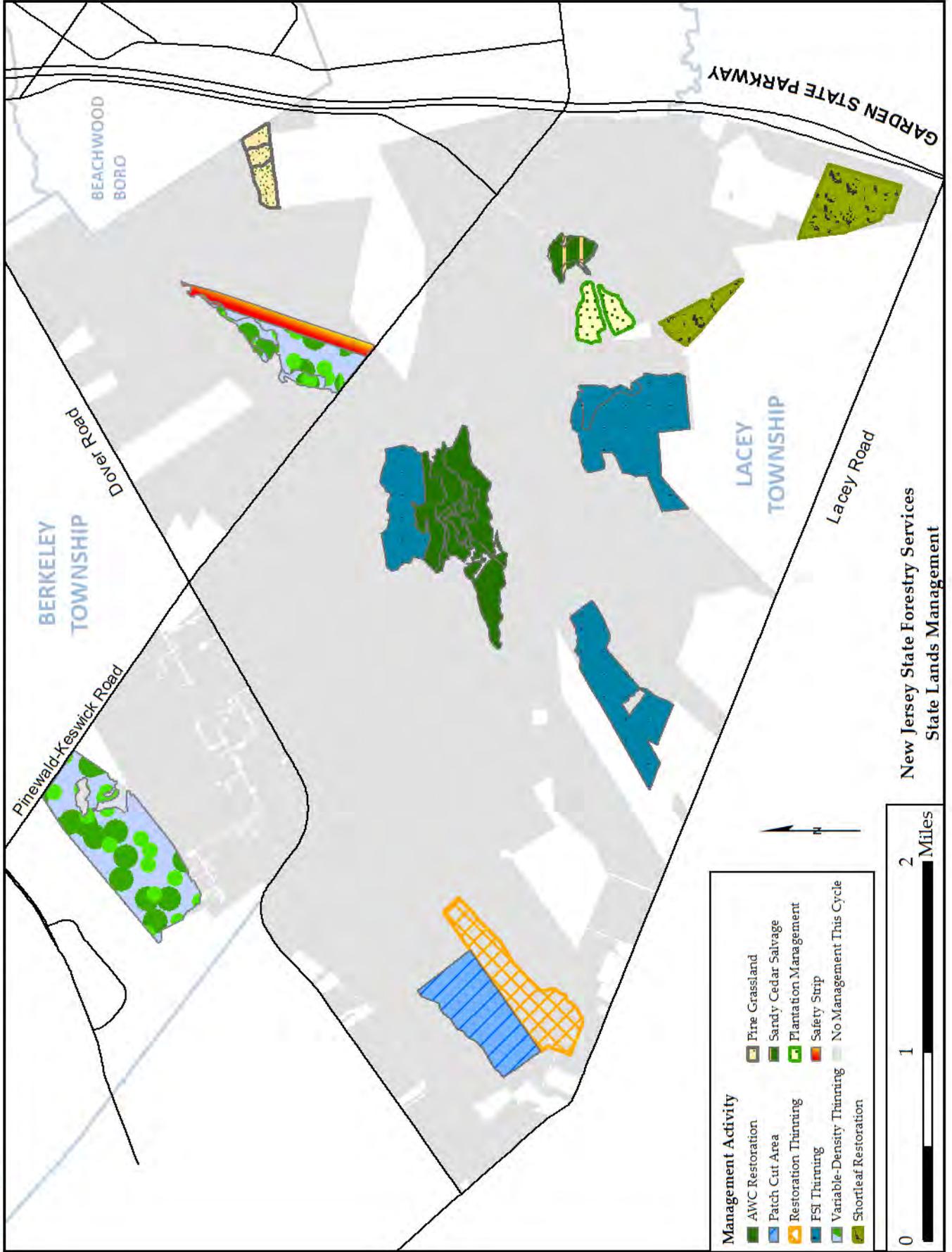


Appendix J: Representative Sample Area Map



Double Trouble State Park- Management Activities

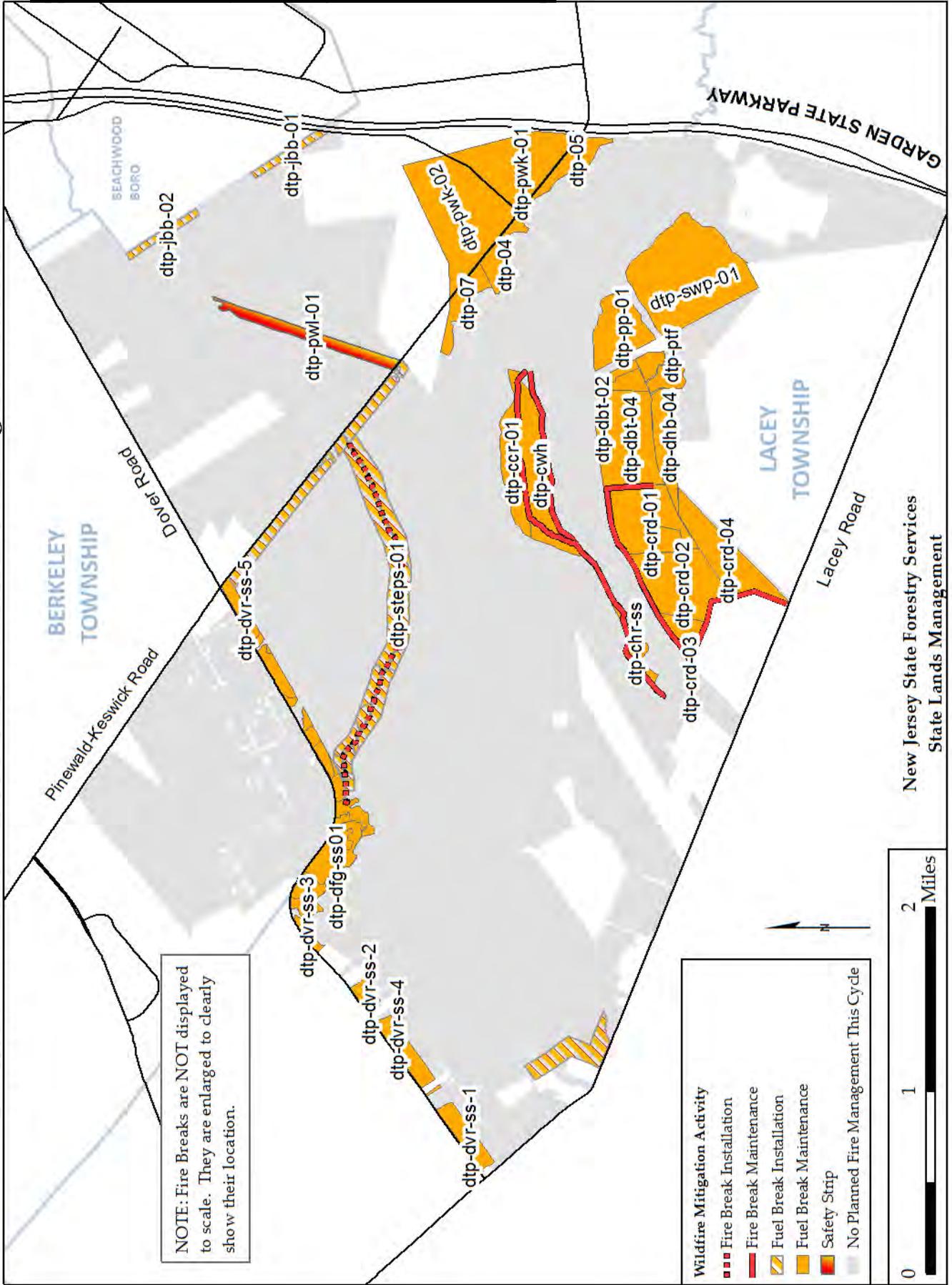
Appendix L: Treatment Type Map





Double Trouble State Park - Wildfire Mitigation Activities

Appendix M: Wildfire Mitigation Activities Map



NOTE: Fire Breaks are NOT displayed to scale. They are enlarged to clearly show their location.

Wildfire Mitigation Activity

- Fire Break Installation
- Fire Break Maintenance
- ▨ Fuel Break Installation
- ▨ Fuel Break Maintenance
- ▨ Safety Strip
- No Planned Fire Management This Cycle



New Jersey State Forestry Services
State Lands Management

Appendix N: Geology

DTSP lies in the Outer Coastal Plain geologic formation, formed as a result of deposition and erosion over the last 170 to 200 million years. It is characterized by gently rolling terrain, sandy and droughty soils lacking rock outcrops, and steep slopes or mountain peaks. In general, it is comprised of a wedge shaped series of unconsolidated layers of sands, clays, and marls on gently sloped southeastward dipping bedrock 1,300 to 6,000 feet below the ground surface. These layers extend seaward into the submerged Continental Shelf. The lowest geologic beds originate from continental deposits (Lower Cretaceous Age). These are overlain by deposits of both continental and marine origin (Upper Cretaceous Age) dating from 136 to 65 million years before present time. Specific formations within this group are (oldest to youngest): the Potomac, Raritan-Magothy, Merchantville, Woodbury, Englishtown, Wenonah, Mount Laurel Sand, and the Red Bank Sand. During the next period of the Tertiary Age (65 to 1.8 million years before present time), the sea covered the Outer Coastal Plain several times. After depositing the Cohansey Sand, the sea retreated for the last time and the present day topography began to form (about 5 million years before present time). The Beacon Hill Gravel was deposited over the Cohansey Sand in the northern and central portions of the Coastal Plain. Composed of quartzose as well as cherty sand and gravel, the Beacon Hill Gravel resulted from extensive stream channel development. The geologic strata of the Tertiary Age are (oldest to youngest): the Hornerstown Sand, Vincentown and Manasquan Formations, Kirkwood Formation, Cohansey Sand, and Beacon Hill Gravel. The Bridgetown and Pennsauken Formations in the southwest portion of the Pinelands are also thought to be Tertiary deposits, as they appear fluvial in origin. Overlying the Tertiary deposits are those laid down during the Pleistocene glaciation (1.8 million years before present time) and the Holocene period (10,000 years before present time). The Cape May Formation deposited during this time extends from sea level to approximately 30 to 50 feet above sea level, and is considered to be of marine origin. The Holocene deposits, alluvial and eolian in origin, are a redeposition of the older material. The Tertiary and Quaternary periods remain ecologically vital to the Pinelands region and serve as potable water sources.

The Potomac and Raritan-Magothy Formations are the oldest, thickest, and most extensive units known to occur throughout the entire Pinelands portion of the Outer Coastal Plain. These interrelated units consist of alternating layers of clay, silt, sand, and gravel. They range in combined thickness from a feather edge to over 3000 feet. These beds are overlain by the Merchantville Clay and Woodbury Formations which together form a thick and extensive confining unit throughout much of the Pinelands region. The Potomac and Raritan Formations are believed to be continental in origin. The Magothy is believed to be both marine and non-marine in origin.

The Englishtown Formation overlies the Merchantville Clay and Woodbury Formations which is then overlain by a thin confining layer called the Marshalltown Formation. The outcrop of the Englishtown Formation ranges in thickness from 50 to 140 feet. This formation uniformly dips to the southeast at a rate of 40 feet per mile and is 1000 feet below sea level in southern Burlington County. The Englishtown Formation is believed to be both marine and non-marine in origin. In the northern half of Ocean County and the northeast corner of Burlington County, the aquifer ranges from 40 to 140 feet thick. In the southern third of Ocean and Burlington Counties the sand component is minimal and the unit is comprised primarily of silt and clay.

The Wenonah and Mount Laurel Sand Formations function hydraulically as one, with the latter predominating. The unit outcrops from Raritan Bay Southwestward to Delaware Bay, and reaches a thickness of over 200 feet in the subsurface. The upper layer of the Mount Laurel Sand Formation dips at a rate of about 40 feet per mile to the southeast. It ranges in elevation from over 100 feet above sea level at its outcrop in the northern end of the Coastal Plain to over 1200 feet below sea level near the barrier beach in northeast Ocean County. This formation is believed to underlie the entire Pinelands area.

The Kirkwood Formation overlaps several other formations including Piney Point, Marshalltown, Hornerstown, and Navesink. It is also overlain by the Cohansey Sand Formation. The top of the Kirkwood Formation ranges in elevation from over 100 feet above sea level at its outcrop area to over 300 feet below sea level along the eastern edge of the Cape May Peninsula. It has an irregular surface and ranges in thickness from 50 to 100 feet at its outcrop to over 800 feet thick in the Atlantic City area.

The Cohansey Sand Formation outcrops at the surface, or is overlain by a thin veneer of Pleistocene deposits. The aerial extent of the Cohansey outcrop is 2,350 square miles, and southeast of the Kirkwood outcrop. The combined thickness, of the Cohansey and overlying Pleistocene deposits, range from less than 20 feet to more than 300 feet thick. The Cohansey Sand Formation typically consists of fine to coarse grained quartzose sand with lenses of gravel one foot or less thick. Lenses of white, yellow, red, and light gray clay generally occur in the upper part of the formation and may be as much as 25 feet thick. The sand component is mostly yellow, but also exhibits shades of white, red, brown and gray. The Cohansey Formation is considered a mixed or transitional deposit partly dissected ancient subdelta plain. This is exhibited through deposits identified as stream, fluvial, deltaic, estuarine, lagoonal, beach, and nearshore marine in origin.

Quaternary Deposits form a discontinuous veneer above the Cohansey Formation throughout much of the Pinelands region. These deposits, from oldest to youngest are: the Bridgeton, Pennsauken and Cape May Formations. The Bridgeton and Pennsauken deposits are generally derived from erosion and redeposition of Cohansey Sand and Beacon Hill Gravel. They cap the tops and mantle the upper slopes of most of the pronounced hills and narrow ridges, and can be as much as 20 feet thick. The most important hydrological function of these deposits is the ability to absorb precipitation and transmit water to underlying aquifers. The hydraulic continuity with the underlying Cohansey Formation is excellent therefore it is considered a part of the Cohansey Sand-upper Kirkwood aquifer system (US EPA 2010).

Appendix O: Hydrogeology

The special characteristics of the Pinelands geology—low relief with sandy, droughty soils, underlain by a number of water bearing sand layers, alternating with confining clay layers give rise to a unique and fragile surface and ground water system. Precipitation is rapidly absorbed and infiltrated through by the droughty sand, percolates to the relatively shallow water table, and ultimately supports the region's stream flow as groundwater seepage.

The most important abiotic element of the Pinelands ecosystem is water, considering its availability and characteristic chemistry. Water is stored in the extensive sand aquifers below the surface. This groundwater supports 89% of the flow in the Pinelands streams which discharges primarily through swamps and marshes. It is replenished by precipitation, of which, 44 % of the annual total is percolated through the sandy soil surface. Although highly permeable, the uppermost soil tends to be chemically inert with a low adsorptive capacity. It is therefore incapable of filtering out wastes. In addition, the waters are susceptible to various forms of pollution because they are weakly buffered against chemical change. As a result, groundwater contamination in the Pinelands is a significant threat.

Numerous aquifer systems, aquifers, and sub-aquifers occur throughout the New Jersey Coastal Plain. However, only five can be considered regional in nature and capable of producing substantial quantities of water. These aquifers, from oldest to youngest are: the Potomac-Raritan-Magothy Aquifer System, Englishtown, Wenonah-Mount Laurel, Kirkwood and Cohansey. The sand strata within the Potomac-Raritan-Magothy Aquifer System are believed to be hydraulically connected, making them function as an aquifer system. At present, this system is not an important water supply for the Pinelands area. In most of the Pinelands region the Englishtown Formation is considered a confining bed rather than an aquifer. This formation is not expected to produce additional water supply for the Pinelands. The Wenonah-Mount Laurel is a minor aquifer system in the Pinelands region. The aquifer has generally low values of transmissivity, with an average permeability value of 97 gallons per day per square foot (gpd/ft²), low for the Pinelands. Water supply in the Pinelands should not be developed from this aquifer. The Kirkwood is the most highly developed aquifer along the shore and barrier beaches. In the central Pinelands, the Kirkwood contains fewer and less permeable water-bearing sands compared to the coast. Recharge in the Kirkwood aquifer is from precipitation, vertical leakage from the overlying Cohansey, and release of water stored in the clay layers above, beneath, and within the formation. The quantity of available water and the permeability of the formation make it a vital aquifer for the coastal area. The Cohansey is the most important fresh water aquifer in the New Jersey Coastal Plain. This is based on its extensive storage capacity estimated to be about 17 trillion gallons, its high permeability (660 to 1,885 gpd/ft²), and availability of direct recharge (2,350 square mile outcrop). The water table in the Cohansey Formation is typically shallow and generally less than 10 feet below the surface over much of the area. The fluctuations in response to discharge and recharge rarely exceed 7 feet. Although the Cohansey stores a large volume of water developing it for water supply without adequate recharge would significantly lower the water table. Since much of the Pinelands unique flora and fauna are adapted to wetland environments, lowering the water table could disrupt entire ecosystems. The cranberry industry which relies heavily on large volumes of water would also be placed in jeopardy, furthermore possibly increasing the frequency and/or risk of wildfire.

Precipitation that recharges the Pinelands groundwater supply percolates through the forest litter and enters a porous groundwater reservoir that is chemically inert. The underground water is generally low in dissolved solids and is weakly buffered against chemical change. Hardness and nitrate concentrations are low. Dissolved iron content is often higher than drinking water standards. As the rainwater percolates through the forest litter dissolved carbon dioxide is picked up from biological decomposition. Reacting with the water the carbon dioxide is converted to carbonic acid which gives the ground water its typical acidic character and common pH values ranging from 4.5 to 5.0. Acidic groundwater with low dissolved solids becomes corrosive and readily dissolves iron from decaying vegetation, soil, and sediment minerals. Bog iron, common in the Pinelands, is a result of oxidation and precipitation of the dissolved iron when water is exposed to air through seepage.

The ground surface of the Pinelands, consisting primarily of unconsolidated sands, holds a vast quantity of clean filtered water. However, based on other areas with similar hydrogeologic characteristics, the Cohansey and Kirkwood aquifers can be highly susceptible to pollution. Actual and potential pollution and contamination sources include septic tanks, landfills, chemical spills and dumping, chemical storage leaks, industrial waste lagoons, highway de-icing, underground oil and gas storage tanks, and agricultural chemicals. These sources may have immediate local impacts and could also pose long-term cumulative threats (US EPA 2010).

Appendix P: Hydrology

DTSP is located within the Barnegat Bay Watershed also known as the Toms River Watershed. The NJ DEP labels this as Watershed Management Area 13, the smallest of the state's watersheds. Totalling about 660 square miles, this watershed management area encompasses all of the land and water in Ocean County in addition to portions of Monmouth County. Also associated with the Toms River Watershed are the following subwatersheds located in:

- A portion of Jackson Township
- A portion of Manchester Township
- A portion of Berkeley Township
- A small portion of Lakewood Township (the south west corner)
- Most of Toms River Township
- Lakehurst Borough
- South Toms River Borough
- Pine Beach Borough
- Beachwood Borough
- Island Heights Borough
- Roughly half of Ocean Gate Borough (northern portion)

The largest river system in the watershed is Toms River which and drains 124 square miles. It flows from western Ocean and Monmouth Counties southeast to Barnegat Bay and the town of Toms River, 11 miles north of Barnegat Inlet. This is an area of low relief with dozens of small tributaries feeding into the Toms River. The larger tributaries include Davenports Branch, Union Branch, Ridgeway Branch, and Wrangle Brook. The watershed also drains a large area of the Pinelands. Population centers include Toms River, Lakehurst, Dover, and Manchester. There are four other smaller drainage systems including the Westecunk Creek, Cedar Creek, Mill Creek, and Wrangle Brook. All of these streams and rivers drain into Barnegat Bay before discharging to the ocean. The Toms River flows past the "river towns" of Toms River, South Toms River, Pine Beach, Beachwood, Island Heights, and Ocean Gate on its way to the Barnegat Bay. Major impoundments of the Toms River are Lake Success in Jackson Township, Pine Lake in Manchester Township (where the Union and Ridgeway Branches meet), and Horicon Lake in the Borough of Lakehurst.

Wetland forests cover approximately 25% of the total watershed. In the Barnegat Bay watershed salt marshes, freshwater marshes, and forested wetlands create natural buffers minimizing the impacts of coastal storms and wind on coastal and inland habitats. Coastal wetlands are able to withstand major storms without suffering lasting damage while at the same time protecting inland communities. In addition, freshwater wetlands have the capacity of temporarily storing large quantities of floodwaters, releasing water over an extended period of time into groundwater and adjacent water bodies. The wetlands also effectively filter sediments and reduce erosion affects.

Appendix Q: Climate

Southern New Jersey has a humid subtropical climate and can be vastly affected by its proximity to the Atlantic Ocean. **Winter** is typically cold. The lows usually hover in the 20s °F (down to -10 °C) and can frequently dip below 0 °F (-18 °C) in the northwestern sections of the state. New Jersey winters often feature snowstorms known as Nor'easters that can paralyze the area with over a foot of snow. However, a variation in the climate also occasionally renders winter mild and almost snowless in sections of South Jersey near the Atlantic coastline. In the Coastal and southern portions of the state, frequently precipitation falls as rain in the winter despite it snowing in the northwestern portion. **Springs** are mild, averaging in the 50s °F (10 to 15 °C) in late March to the lower 80s °F (25-30 °C) in early June. The weather is unpredictable and brings relatively cool summers as an occasional surprise, and huge snowstorms arriving as late as the second week in April (significant snow after mid-March is fairly rare though). Thunderstorms are common in spring. **Summers** in New Jersey tend to be hot and humid with temperatures often exceeding 90 °F (32 °C), although high temperatures above 100 °F (38 °C) are uncommon. Humidity levels are usually quite high in July and August. Thunderstorms are common in summer. Hurricanes are considered to be a major threat to the area (and especially the Jersey Shoreline communities in Monmouth, Ocean, Atlantic, and Cape May counties). While relatively infrequent compared to areas south and east, a direct hit could cause large loss of life and billions of dollars in damage due to the high population in coastal areas. **Autumns** are comfortable in New Jersey and similar to spring in temperature. However, the weather is notably unpredictable and temperatures do fluctuate quickly at these times of year (Office of the New Jersey State Climatologist 2013).

The temperatures vary greatly from the northernmost part of New Jersey to the southernmost part of New Jersey. For example, these are the average high and low temperatures for Cape May, near the state's southernmost ocean-facing point; Sussex, in the mountainous northwest; and Trenton, the state capital located roughly midway between the two (Office of the New Jersey State Climatologist 2013):

Month	Sussex		Trenton		Cape May	
	High	Low	High	Low	High	Low
January	34	14	38	24	42	27
February	38	16	41	26	43	28
March	47	25	51	33	51	35
April	59	35	61	42	60	43
May	70	45	71	52	69	53
June	78	54	80	61	78	62
July	83	59	85	67	84	67
August	82	57	83	65	83	66
September	74	49	75	57	77	60
October	63	37	64	45	66	49
November	51	30	54	37	56	40
December	39	21	43	28	47	31
All Temperatures are in Fahrenheit						

Some climatic facts are as follows.

<u>Temperature:</u>	Mean Annual Temperature	Max. 65 degrees; Min. 43 degrees
	Extreme temperature	Below zero to a high of 100+ degrees
	Mean date of first frost	October 8 th
	Mean date of last frost	May 1 st
	Mean length of growing season	178 days
<u>Precipitation:</u>	Mean Annual Precipitation	44 inches
	High Month	August (4.9 inches)
	Low Month	February (2.9 inches)
<u>Sunlight:</u>	Mean number of days:	
		Clear 100
		Partly Cloudy 111
		Cloudy 154