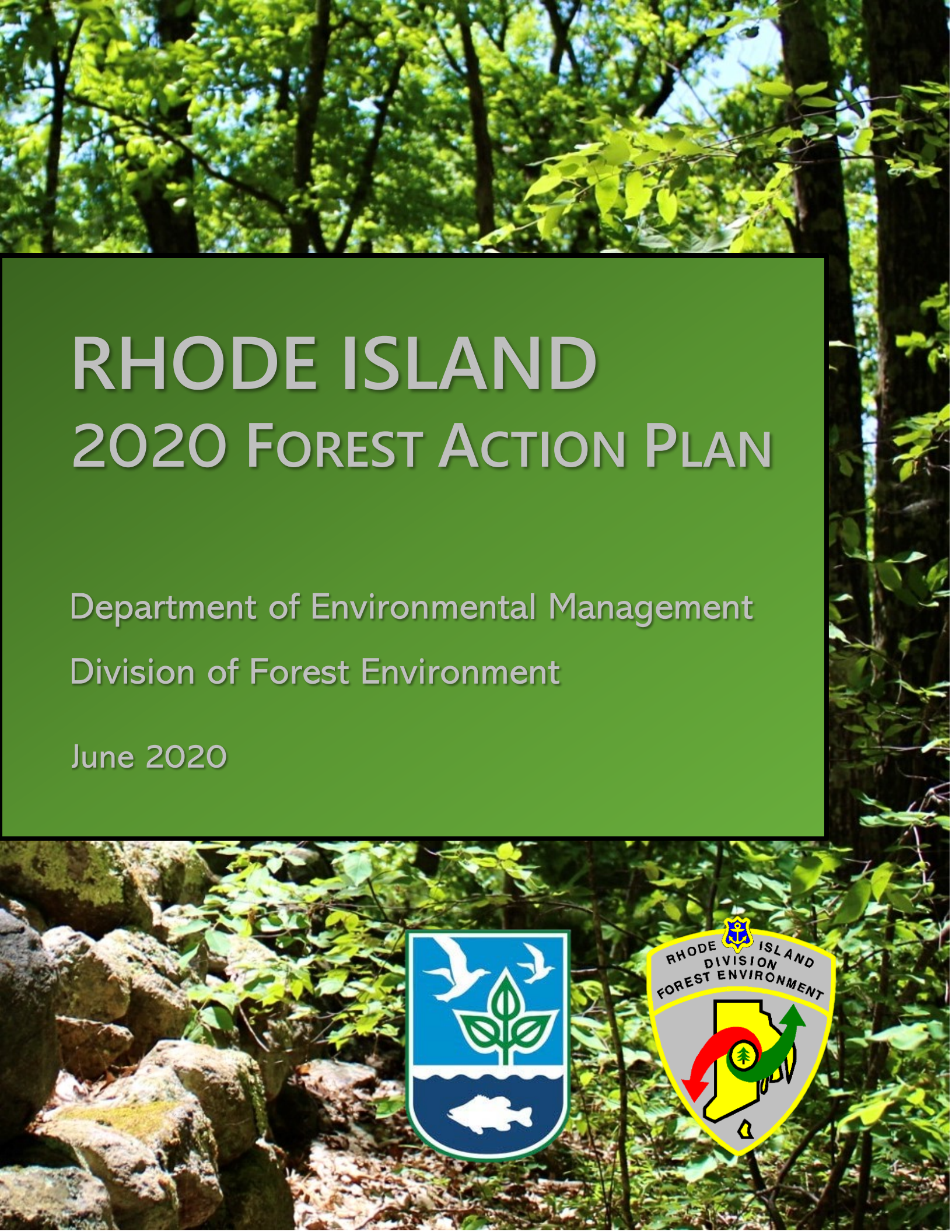

RHODE ISLAND
2020 Forest Action Plan

Department of Environmental Management

Division of Forest Environment

June 2020

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- Forest Fire Advisory Committee
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- RI Tree Council

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Executive Summary

Rhode Island's forests blanket over more than 50% of the state. This forest cover, both private and public, offers a myriad of benefits to all Rhode Island citizens. While forested lands play and important role in providing materials for building homes and other wood products, forests also protect vital soils, preserve and improve air and water quality, and capture carbon emissions. Trees contribute to the quality of life in urban settings, play and important role in outdoor recreations and aesthetics, and are essential tools for storm water management and reducing temperatures. The relationship between forests, biological diversity, and habitat for wildlife is as equally important.

Forests provide these commodities and all their conservation roles, functions, and outputs without the care and management required by traditional infrastructure.

RIDEM's Division of Forest Environment (DFE) currently receives approximately 23% of its funding through the Cooperative Forestry Assistance Act (CFAA) through the State and Private Forestry programs (S&PF), leveraging the federal resources and partnerships in collaboration with private and public stakeholders. These programs are important components of DFE's mission and help protect public resources, support forest landowners and managers, and help to prevent the spread of wildfires:

- Cooperative Fire Program (State Fire Assistance (SFA) and Volunteer Fire Assistance (VFA))
- Cooperative Forest Health Program
- Forest Stewardship Program
- Urban and Community Forestry Program
- Forest Legacy Program

These programs contribute to the Rhode Island's Department of Environmental Management strategic goals, as well as the national priorities:

1. **Conserve** and Manage Working Forest Landscapes for Multiple Values and Uses
   Forest landscapes, whether under public or private management must be conserved to protect landscape functionality, habitat and environmental benefits.
2. **Protect** Forests from Threats
   Rhode Island's forests face threats on multiple fronts: development leading to the loss and fragmentation, ease of spread of invasive plants and pests/diseases, loss of habitat, loss of economic and environmental benefits, and wildfire risk.
3. **Enhance** Public Benefits from Trees and Forests
   Support and promote the management and retention of forest lands for multiple benefits, including water and air quality, carbon sinks and sequestration, temperature moderation, forest products, wildlife habitat, outdoor recreation, and human health.

The Rhode Island 2020 Forest Action Plan discusses facts, trends, benefits and issues of concern, as well as priorities, goals, and strategies for the management of forest land. Five issues of concern are identified as having significant impact on the extent of forest land and its resilience:

- **Forest Loss, Fragmentation, and Parcelization** – wildlife habitat, landscape functionality and sustainability, interface and intermix, and invasive species
- **Forest Health** – invasive plants, wildlife habitat, diversity and resiliency, pests and diseases
- **Water** – stormwater, riverine/wetlands, water quality
- **Fire** – increasing intermix and expanding interface combined with increasing fuel loading
- **Climate Change** – increasing disturbances, alterations in species distributions and relationships, and compounding forest health threats

For four CFAA programs, the priority service areas are within the Wildland-Urban Interface/Intermix although their target audiences may differ somewhat:

- Stewardship works with landowners to manage their forests, and keep their property as working lands;
- Forest Health focuses on introduced and invasive pests/diseases/plants, since the interface is often where they appear and are more easily spread via human transport and developed corridors;
- Fire targets wildfire risk planning since most fires in Rhode Island are ignited by humans in the interface and intermix;
- Urban & Community Forestry conveys the importance of maintaining and planning for green space to limit the negative effects of landscape use change.

The Forest Legacy Program's priority parameters are not the same as the other four programs, but the general area is quite similar, mainly the forests within the western and eastern areas of Rhode Island and has not changed from the boundaries initially established in 1993.

Highlights from the Rhode Island 2020 Forest Action Plan include:

- Rhode Island's forest land began to increase in the late 1800s until the mid-1900s as livelihoods shifted from farming to industry and manufacturing. A slow decrease in forest land acres has occurred since the 1970s due to permanent land-use conversions for development and infrastructure.
- 75% of Rhode Island's trees range from 40-80 years old with only 2% between 0-20 years. This disparity affects wildlife needing early successional habitat, and also indicates fewer landowners are harvesting for timber production.
- An average acre of Rhode Island forest land absorbs 1.3 metric tons of atmospheric carbon.
- Rhode Island's forest land is predominantly held in private ownership. An estimated 38,000 families and individuals own 68% of Rhode Island's forest land.
- 70% of Rhode Islanders get their drinking water from reservoirs protected by forests.
- RIDEM's Divisions of Forest Environment (DFE) and Fish and Wildlife (DFW) manage more than 57,000 acres of state-owned forests.
- DFE provides services to private landowners with a field staff of 11:
    - 1 State Lands Forester in DFE
    - 1 Stewardship Forester working with private landowners
    - 1 Forest Health Program Coordinator
    - 1 Urban and Community Forestry Program Coordinator
    - 3 staff to maintain of DFE-managed Management Area trails, roads and campgrounds
    - 4 Forest Fire staff delivering training, outreach, plans and prescribed fire, and assisting DFW with prescribed fire
- Invasive pests continue to challenge forest management, whether gypsy moth outbreaks, new arrivals like emerald ash borer in 2018, or looming pests like spotted lanternfly presently spreading aggressively through PA and recently confirmed in NY.
- Of the many benefits provided by green space and natural areas is the human health effects (air quality and urban heat islands) which is important considering that Rhode Island is 11th nationally in ADHD/ADD, and 9th in asthma conditions per capita. (Covid-19 has recently emphasized the impact of impaired lung capacity and has highlighted economic disparities in community impact.)

There are many challenges facing Rhode Island, and the Division of Forest Environment, to meet the goals set out in this Forest Action Plan; most significantly, the lack of adequate funding and sufficient staffing levels. But the magnitude of the challenges to the State are beyond the actions on any one Division or Department, requiring collective commitment and action.

Rhode Island's Challenge

Concerted action is needed to keep one of the state's signature resources – its forests – intact, financially viable, and contributing the many values and public goods they provide. In the face of anticipated changes in the global climate and economy, each extant acre of forest is important, having intrinsic value, and contributing to the sustained health and well-being of the state's citizens, communities, forest products industry and forest-based tourism, and ecosystems.

Healthy forests are inextricably linked to healthy urban and rural communities and an intact natural landscape offers the best opportunity for both mitigating and adapting to climate change. A top priority for all Rhode Islanders must be to ensure that this regionally important forest resource will remain intact, healthy, productive, profitably and sustainably managed, and accessible to all segments of society.

Resources are needed to ensure that forest land is sustainably managed and maintained for the benefits to all residents. This is not something that can be accomplished by the Division of Forest Environment alone, nor even Rhode Island's Department of Environmental Management. This action requires the continuing financial commitment of federal, state, local, private, and philanthropic partners, all having a substantial stake in the outcomes, as noted in the Blue Ribbon Commission on Land Conservation: 2010 Report to the Governors and adapted below.

PRIMARY PRIORITY: Keeping forests as forests

FUND & SUPPORT

1. Promote and fund state-wide forest planning with emphasis on sustainable private forest conservation and management.
2. Make the working lands of Rhode Island more profitable and financially viable by growing more wood, cultivating new businesses, and creating and strengthening markets for their products.
3. Mindful of global economic and climate change: enhance economic, environmental, and social resilience across the state, to create more prosperous and sustainable industries and communities throughout Rhode Island.
4. Serve the interests of environmental justice, making the landscape and all its benefits more accessible to underserved populations; and our settled places, more livable and healthier, to discourage sprawling development patterns.
5. Provide technical assistance to the DEM Land Acquisition Committee, supporting protection of critical forest habitat, particularly larger intact blocks of high value forests for multiple benefits including connectivity and protection of wildlife habitat, and reduction in forest fragmentation.

EDUCATE & PARTNER

6. Strengthen the connections in the daily lives of the people of Rhode Island, whether residents, landowners, farms or businesses, and the land that supports them, to the mutual benefit of each.
7. Encourage the public to see themselves as part of, and not apart from, Rhode Island's natural heritage; educate them to its many values and public benefits and wise uses; and cultivate a conservation ethic as an active duty of citizenship.
8. Recognize the values and contributions of our urban forests and assure coordination and collaboration with this community to realize their full complement of benefits.

Rhode Island has a wealth of engaged and passionate natural resource professionals, non-profits, landowners, and residents involved in private forest land conservation and management. It is hoped that the 2020 Forest Action Plan will serve as a platform to build support, action and funding for state-wide forest planning and management beyond RIDEM's Division of Forest Environment.

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Rhode Island 2020 State Forest Action Plan

INTRODUCTION

The Rhode Island 2020 Forest Action Plan is part of a nationwide strategy that codifies the national priorities of federal and state private forestry programs. The Cooperative Forestry Assistance Act (CFAA) was amended by the Food, Conservation, and Energy Act of 2008, commonly referred to as the 2008 Farm Bill, to require that states and territories assess all forest land within their boundaries, and develop strategies to improve the health, resiliency, and productivity of their forests, starting in 2010.

These statewide forest assessments, or forest action plans (SFAP), are required for maintaining eligibility to receive funds under the authorities of the Act, through the USDA Forest Service State and Private Forestry (S&PF), and must be updated every 10 years. The SFAPs provide an analysis of forest conditions and trends, identify issues and priorities, and outline strategies to ensure healthy trees and forests into the future. The SFAP must also address the three national S&PF priorities included in the 2008 Farm Bill:

- **Conserve** and Manage Working Forest Landscapes for Multiple Values and Uses
- **Protect** Forests from Threats
- **Enhance** Public Benefits from Trees and Forests

The Rhode Island 2020 State Forest Action Plan is comprised of two distinct sections:

1. **ASSESSMENT**
   The Assessment section provides a discussion of Rhode Island's forest-related conditions, trends, and opportunities and is aimed at ensuring that federal and state resources are being focused on high priority areas with the greatest opportunity to achieve meaningful outcomes.
   a. **Forests, Conditions & Trends** contains current information and data, discusses current forest conditions, ownership and use trends, and the benefits derived from healthy forests.
   b. **Issues, Threats & Opportunities** discusses the priority issues impacting the health and management of forests and forest land.
   c. **Priority Landscape Areas in Rhode Island** identifies the target areas for the programmatic cooperative forestry activities.
   d. **Multi-State Priorities** lists Rhode Island's regional and national engagement efforts.
   e. **Stakeholder Engagement** describes the input into the SFAP priorities and stakeholder process.
2. **STRATEGIES**
   The Strategies section provides short- and long-term plans for investing state, federal, and other resources to where it can most effectively stimulate or leverage desired action and engage multiple partners. The strategies are built on the understanding that forests are long-term investments that need near term actions to contribute to progress over decades with which a comprehensive and coordinated approach will improve effective progress.
   a. Goals and Objectives, addressing the three national priorities, have been developed for each of the cooperative programs of Fire, Forest Health, Stewardship, and Urban Forestry. Each program has identified strategies within its capacity and its priority areas.
      i. A summary matrix is provided in this section.
      ii. A matrix of the correlation of the Goals and Objectives with the Department of Environmental Management's *Strategic Plan 2019-2022* is in Appendix D.
   b. The Forest Legacy Program's *Assessment of Need* is attached as Appendix F.

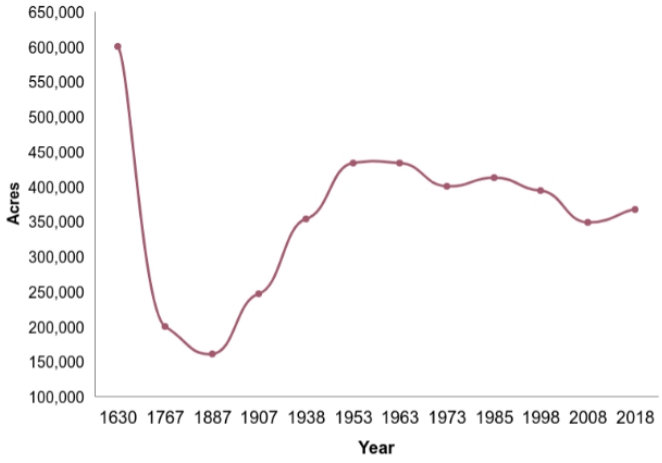
Taken together, Rhode Island will use the State Forest Resource Assessments and Strategies to target program delivery and develop competitive proposals for addressing priority landscape areas and issues.

Rhode Island
2020 State Forest Action Plan: Assessment

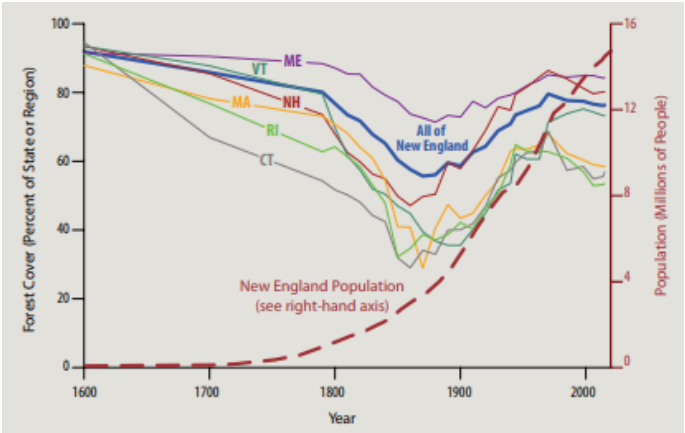
FOREST CONDITIONS & TRENDS

Forest management planning is not a static process; it is a dynamic one, responding to changes wrought by:

- events that transcend local forest systems, like hurricanes, droughts, and other natural disasters;
- pests or diseases, such as gypsy moth or emerald ash borer, that impact trees directly, threatening the forest health or productivity; and
- invasive plants, changes in weather and precipitation patterns, or wildlife browse, that impact the growing conditions and success of tree establishment and growth.



Approximate Forest Area in Rhode Island 1630-2018
Sources: RI Wildlife Action Plan; Forests of Rhode Island, 2018



New England Forest Cover and Human Population
Source: Wildlands and Woodlands, Farmlands and Communities: Broadening the Vision for New England

Some of these events are abrupt, showing consequences in hours or days, while others progress for years with increasing impact and management implications.

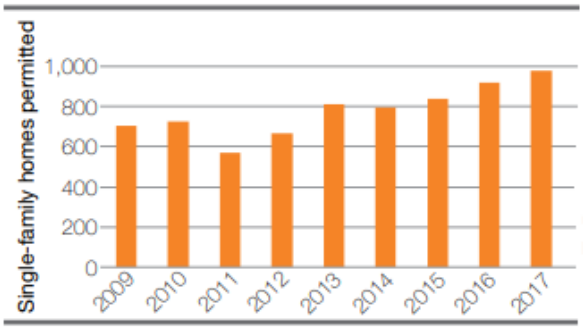
Historically, Rhode Island was mostly forested by deciduous trees, primarily oaks, hickories, and red maple, with ~15% being coniferous forests comprised of white pine, pitch pine, and hemlock. This forest acreage has waxed and waned over the history of human residence. Native American forest activities on and within the forests impacted land cover significantly less than natural events like wildfire. By comparison, colonization in the early 1600s resulted in nearly 100% of forest land being cleared over the next ~125 years, reaching its lowest point in the late 1800s.

Not solely confined to Rhode Island, this pattern of land clearing occurred throughout New England: a decrease in forest land associated with population growth, followed by a rebound in forest land as farmland was abandoned, populations migrated, and social shifts like wars, the Great Depression, and industrialization occurred. By the mid-20th century, the reforestation of 67% of Rhode Island had occurred, as small-scale farming as a livelihood did not recover in the post-war, post-industrial years.

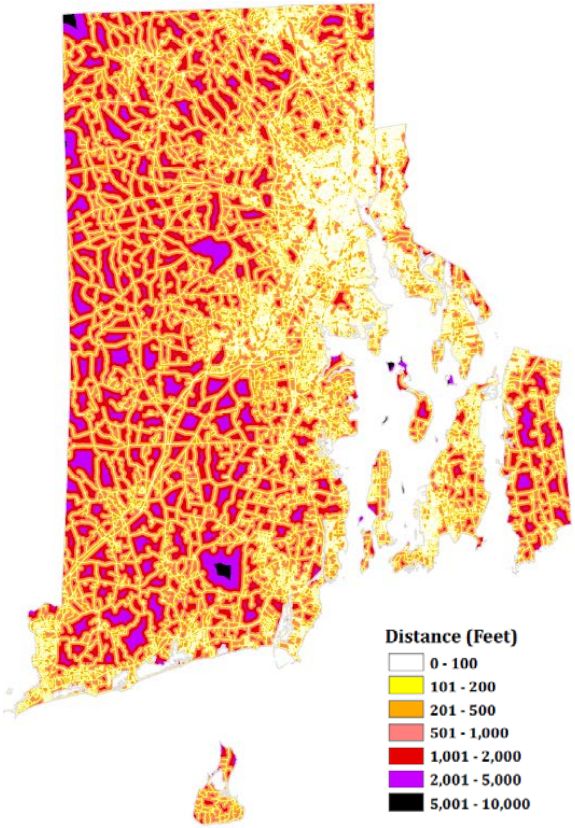
However, forest land acreage began to shrink again in the 1970s, which the Department of Administration Division of Statewide Planning attributes to changing development patterns:

- smaller households but larger houses, consuming more land per house;
- population movement from urban to rural areas, expanding the impacts of development into rural and forested areas; and
- commercial land use, which has almost doubled, extending into less developed parts of the state and concentrated along heavily traveled roadways.

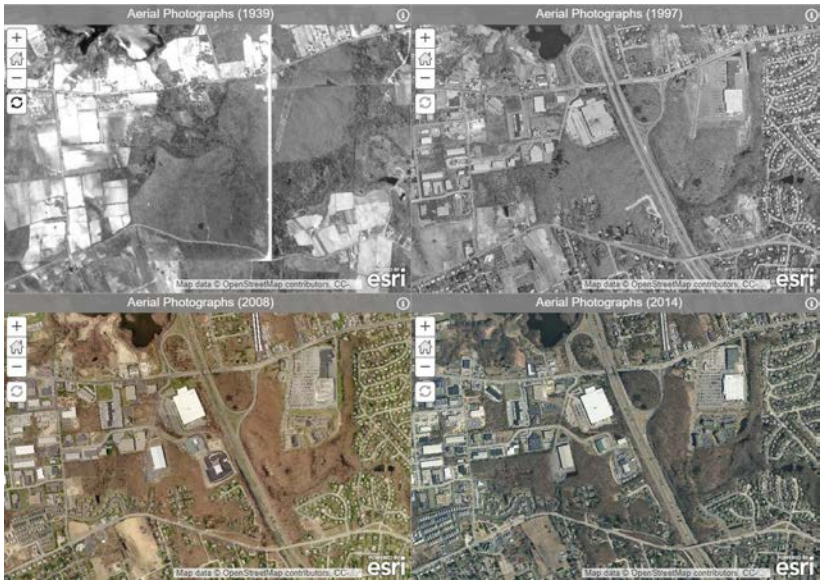
Historical information and aerial photography shows that the rate of permanent land conversion in Rhode Island has been increasing since the 1960s with more development of residential, commercial, and industrial land between 1970 and 1995 than in the previous 325 years. Even as recovery from the Great Recession has been slow, single home construction has increased by 9% yearly since 2011. Rhode Island already has 6,027 miles of permanent roads, as communities expand and increase, the supporting gray infrastructure must also increase to support the population (schools, roads, businesses, etc.), which comes at an environmental cost.



On average, single-family home construction in Rhode Island has increased since 2012.
Source: HUD PD&R Housing Market Profiles: RI



Distance to Nearest Road
Source: Peter August, Department of Natural Resources Science, University of Rhode Island



The photo series on the left depicting land use change along Interstate I295 at Plainfield Pike (Route 14) (years: 1939, 1997, 2008, 2014), clearly shows the increase in gray infrastructure needed to support increasing populations and residents, services and transportation.

Rhode Island Forests

The *Rhode Island 2020 Forest Action Plan: Assessment* utilizes historical USDA Forest Service (USFS) Forest Inventory Analysis (FIA) data to maintain a consistent description and to directly compare historical acreage estimates to the present. The Rhode Island Department of Environmental Management is moving towards land-use estimates, assumptions, and definitions based on the DOA/DEM/RIGIS 2011 Landuse/Landcover (LULC) data and DEM land records, as used in the 2015 Division of Fish & Wildlife's Wildlife Action Plan (RI WAP), for future statewide forest management estimations, as new mapping methods and technology become available to the Department. Appendix A describes these methodology differences.

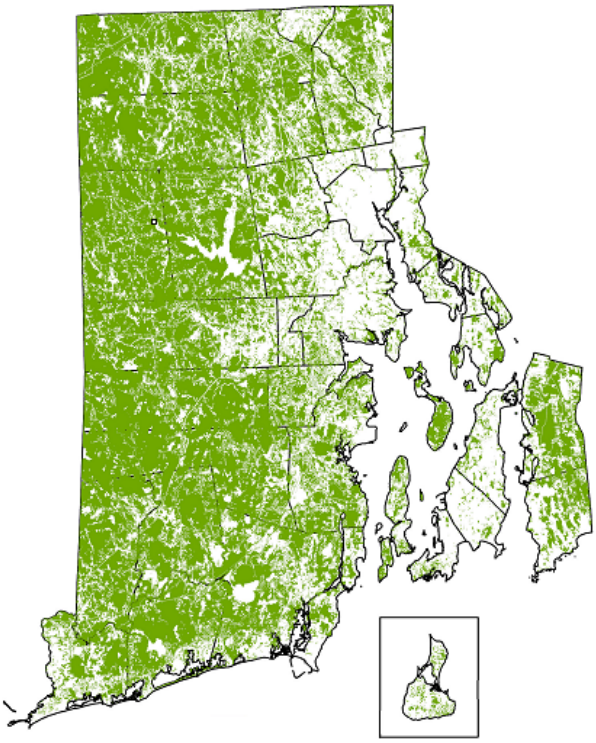
The first USFS FIA survey in Rhode Island was completed in the 1950s. Since 2003, annual FIA sampling updates and reports have included data on the status and trends in forest area and location, estimation of species, tree size, and health of trees; total tree growth, mortality, and removals by harvest; wood production and utilization rates by various products; and forest land ownership.

The status of Rhode Island's forests is based on FIA estimates, where 1/7th of the permanent plots are assessed each year. This annualized forest census, carried out nationally, projects how forests are likely to appear 10 to 50 years from now and enables evaluation of the sustainability of current forest management practices.

According to the most recent FIA report, Forests of Rhode Island, 2018, Rhode Island contains an estimated 366,958 acres of forest land – 53% of the total land area of the state. Rhode Island's forests are considered second growth and approximately 96% is classified as timberland, forest land that exceeds the minimum level of productivity and is available to harvest.

Since FIA collects data on a rolling average the data may be affected by denial of access to properties, the spreading out of mortality and recovery updates, or changes to data collection protocols as technology and applications advance. Rhode Island, a small state, is subject to a higher sampling error (3.5 - 4.0% typically for forest land estimates) than larger states. These factors must be kept in mind when viewing the change in the acres of forest land in the state. The estimated 356,000 acres of forest land discussed in the 2010 State Forest Action Plan is now estimated to be ~367,000 acres in the Forests of Rhode Island, 2018 report.

While the 2018 FIA forest land estimate of 367,000 acres shows an increase from 356,000 acres in 2007, this may be partly accounted for by the explanation of changes in FIA protocols. This estimated increase in acres should not be assumed to indicate that forest land and habitat have increased (or are increasing) and are not at risk.



Extent of Forests in Rhode Island

FOREST TYPES & SPECIES COMPOSITION

Undisturbed forest composition tends to change slowly, with forest succession as the main agent of change, barring large-scale tree loss events, such as wildfires or storms. Rhode Island forests have not been

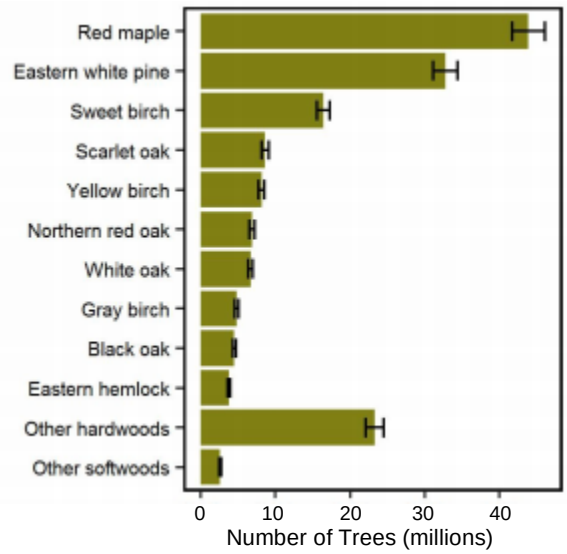
substantially affected by such catastrophic events since the 1960s. However, forest composition has been affected by widespread pests and diseases, including chestnut blight (*Cryphonectria parasitica*) and Dutch elm disease (*Ophiostoma ulmi*). More recently, the gypsy moth infestations from 1980-86 impacted ~3/4s of Rhode Island's canopy, contributing to a subsequent documented increase in the number of red maples reported in USFS FIA data. The recent gypsy moth outbreaks (2015-2018) and the occurrence of emerald ash borer (confirmed 2018) is anticipated to affect forest species composition, resulting in a decrease in the overall presence of oak species and of all ash species being extirpated. The impact on future forest composition is expected to increase in the proportion of pioneer species such as red maple, black cherry and black birch in the future forests of Rhode Island.

The significance of the most recent mortality events on forest species composition many not be completely apparent until a full 7-year panel of FIA data has been collected, post gypsy moth outbreak. As EAB spreads throughout the state and mortality is documented, the full impact of the loss of multiple species of ash in natural and urban areas will take time to be fully realized and assessed.

These mortality events will also impact sawtimber volume and numbers, with additional impact from the expected heavy deer browse on future forests. USFS FIA surveys have noted a lack of understory seedlings in the permanent sample plots revisited, which suggests that there may be an effect on the establishment of tree species regeneration.

Rhode Island's forests contain a wide variety of tree species with over 46 species sampled in 2017. Red maple is the dominant tree species by number, comprising 27% of the tree stems in the state. Other common species include eastern white pine, black birch, scarlet oak, and yellow birch, accounting for 67% of the trees by number. The most commercially valuable species are Eastern white pine and red oak, making up 56% of the wood volume.

With respect to forest type, oak-hickory forest (dominated by red, black, scarlet, and white oak) comprises 61% of the forest, decreasing from earlier FIA data (66 % in 1972). Red pine/white pine forests have also decreased (from 12 % to 9 %) in that same timeframe. This decrease coincides with increased harvesting activity shown in DFE *Intent to Cut* records as red pine plantations were salvaged, due to the effect of the red pine scale. By 2010, the "other softwoods" category had almost disappeared from harvesting reports. Other forest types, like pitch pine and Atlantic white cedar, make up a small percentage (~3+%) of Rhode Island's forest but have high importance due to their value as wildlife habitat.



Number of Trees ≥ 1-inch DBH by Species
Source: Forests of Rhode Island, 2017

Forest-type group	All size classes of forestland (% of land cover?)
White / red / jack pine	8.8%
pitch pine	3.2%
Oak / pine	5.3%
Oak / hickory	61.0%
Oak / gum / cypress	6.3%
Elm / ash / cottonwood	4.7%
Maple / beech / birch	6.4%
Aspen / birch	1.9%
Other hardwoods	1.5%
Nonstocked*	0.9%
Total	100.0%

*** Nonstocked Areas: Timberland Less Than 10% Stocked with All Live Trees**
Source: Forests of Rhode Island, 2017

USFS FIA FOREST TYPE DESCRIPTIONS

White-red-jack pine: Forests in which eastern white pine, red pine, or jack pine, singly or in combination, comprise a plurality of the stocking. Common associates include hemlock, aspen, birch, and maple.

Pitch pine: not an FIA forest-type group, but pitch pine falls under the loblolly/shortleaf pine group and it would be misleading to use that name when neither of those species are present in Rhode Island.

Oak-pine: Forests in which hardwoods (usually upland oaks) comprise a plurality of the stocking, but in which pine or eastern redcedar comprises 25-50 percent of the stocking. Common associates include gum, hickory, and yellow-poplar.

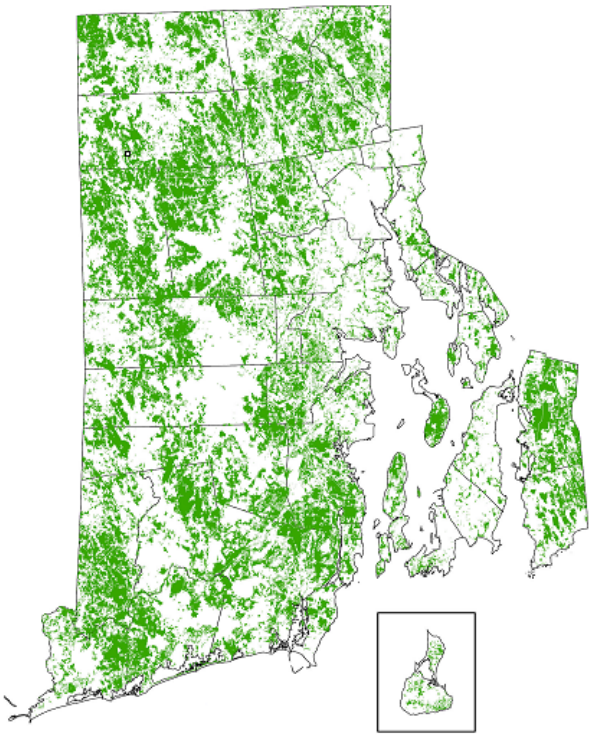
Oak-hickory: Forests in which upland oaks or hickory, singly or in combination, comprise a plurality of the stocking except where pines comprise 25-50 percent, in which case the stand is classified as oak-pine. Common associates include yellow-poplar, elm, maple, and black walnut.

Elm-ash-cottonwood: Forests in which elm, ash, or cottonwood, singly or in combination, comprise a plurality of the stocking. Common associates include willow, sycamore, beech, and maple.

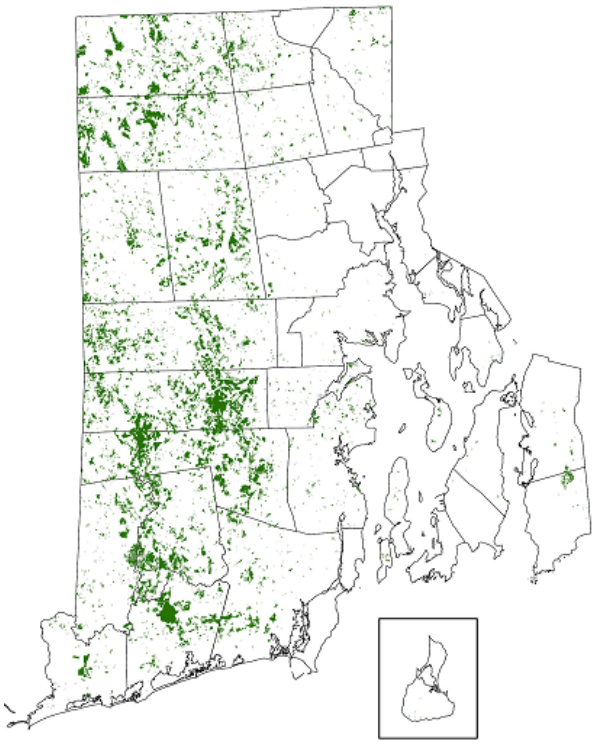
Oak-gum-cypress: Bottomland forests in which tupelo, blackgum, sweetgum, oaks, or southern cypress, singly or in combination, comprise a plurality of the stocking except where pines comprise 25-50 percent, in which case the stand is classified as oak-pine. Common associates include cottonwood, willow, ash, elm, hackberry, and maple.

Maple-beech-birch: Forests in which maple, beech, or yellow birch, singly or in combination, comprise a plurality of the stocking. Common associates include hemlock, elm, basswood, and white pine.

Aspen-birch: Forests in which aspen, balsam poplar, paper birch, or gray birch, singly or in combination, comprise a plurality of the stocking. Common associates include maple and balsam fir.



Distribution of Deciduous Forests

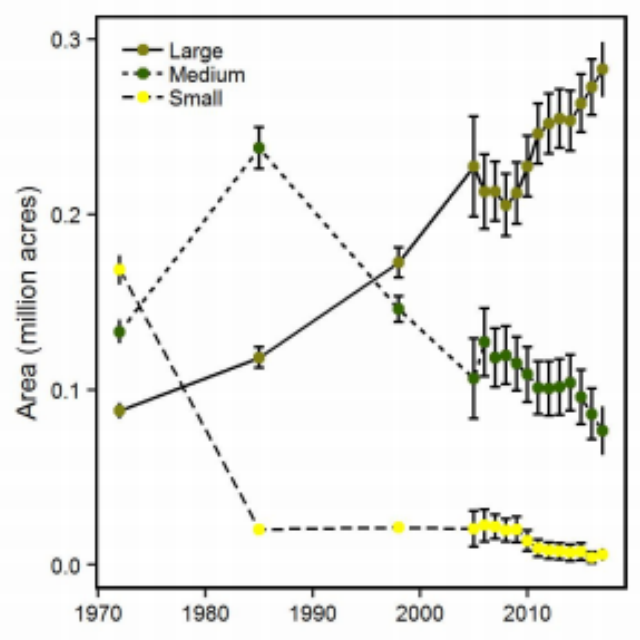


Distribution of Coniferous Forests

FOREST AGE/MATURITY

The Forest Futures Dashboard, using 2007 FIA data, estimates that northern forests, as a whole, lacks age-class diversity. In Rhode Island over 75% of its trees are 40-80 years old. Only 1% of RI's trees are estimated to be older than 100 years which, given the potential longevity of most tree species, is still comparatively young. Of greater concern is the extremely low 2% of trees in the 0 to 20-year range – the future forest. In fact, Rhode Island has the lowest proportion of old and young trees of any of the 20 northern states included in the assessment. Depending on the level of regeneration success, over time we expect to see an increase in acres of early successional habitat due to mortality and crown opening caused by the 2015-18 gypsy moth outbreak.

Age of Timberland	
More than 100 yrs	1 %
81-100 years old	11 %
61-80 years old	54 %
41-60 years old	23 %
21-40 years old	9 %
1-20 years old	2 %



Area of Timberland by Stand-Size Class
Source: *Forests of Rhode Island, 2017*

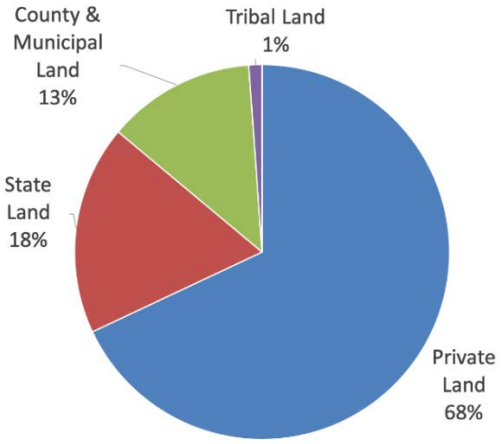
Ten years later, the Forests of Rhode Island, 2017 report indicates that the trend continues with 77% of the timberland large or sawtimber size (over 9 inches in diameter at breast height for softwoods and 11 inches for hardwoods), 21% medium or pole size (5 to 10.9 inches) and 2% small, or young, regenerating trees (less than 0.5 inches).

Rhode Island has had relatively few stand replacing events over the past few decades contributing to the overall maturing of Rhode Island's forests; a large percentage of the forest land is in the largest stand size class and steadily increasing. This has significant implications for forest resilience (i.e., the ability of the forests to withstand severe weather events or insect infestations), wildlife habitat/diversity, and other ecological functions.

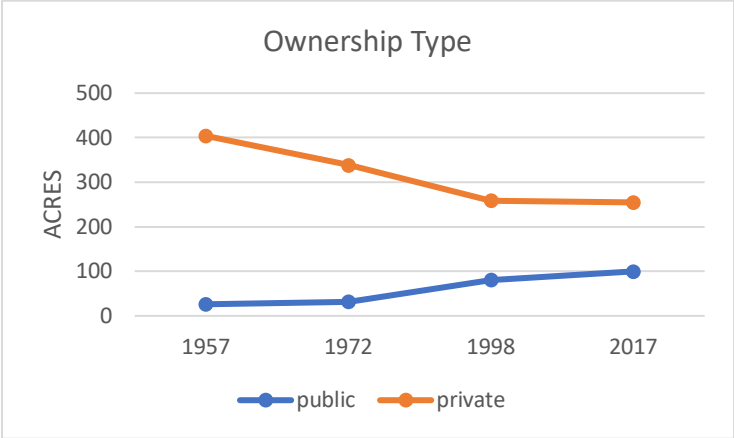
Forest Ownership

Rhode Island's forests are owned and managed by a combination of federal agencies and programs, state agencies and programs, national and local land trusts and other conservation organizations, and private landowners.

A USDA Forest Service Report from 1957 estimated that 94% of Rhode Island's forests were privately owned. By the late 1980s private ownership had decreased to 85% and continues to decrease. The 2020 State and Private Forestry Fact Sheet for Rhode Island states that approximately 68% of forest land is privately owned and managed by an estimated 38,000 landowners, including conservation organizations and nonprofits.



Forest Ownership in Rhode Island
Sources: Forests of Rhode Island, 2017 and USFS FIA Estimate Tables



Total Public and Private Ownership
Source: Forests of Southern New England, 2012

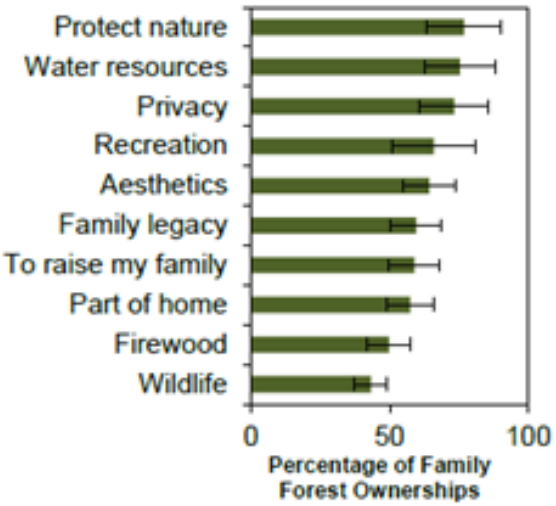
This decrease in privately owned forest can be attributed to both conservation efforts by public agencies, and the pattern of land ownership shifting from subdivisions of large ownerships (with an average parcel size of 26 acres in 1973 to 17 acres in 2012). The 2012 Forests of Southern New England report estimates that evaluating only privately-owned parcels greater than 10 acres in Rhode Island, parcel size is about 27 acres, lower than in the past, and lower than the average size in southern New England of 34 acres.

The 2003 Statewide Planning Analysis of land use found 15 communities in Rhode Island with less than 25% developed land area, classifying them as rural. The analysis included a survey of landowners owning more than 10 acres:

- 37% owned less than 20 acres
- 22% owned less than 30 acres.

The 2003 survey found most Rhode Island forest owners live on their land and 90% of respondents agreed that a place of residence was the most important reason for owning forest land. Other popular reasons for owning forest included investment (42%), recreational use (41%), forest products (33%), and hunting/fishing (19%).

Ten years later, a comparison to the USFS 2013 National Woodland Owner Survey shows that the reasons for owning and retaining forest land has not changed, with owners still primarily concerned with beauty, nature, legacy, privacy, and investment:



Reasons for Owning Forest Land, Family Forest Ownerships 10+ Acres, 2011-2013
Source: Forests of Rhode Island, 2013

- Most respondents lived on their land (64%) and owned it for the lifestyle it provided (enjoying beauty and scenery)
- Harvesting wood products were not as important as the other amenities (36%)
- Using it for timber products was even less important (18%)
- Other reasons for owning were to protect water (73%), protect nature and biologic diversity (73%), and protect wildlife (55%)

Additional research by the American Forest Foundation suggests that landowners who are actively involved with their land are less likely to engage in activities that often have negative conservation impacts (such as selling, subdividing, or developing land).

FOREST OWNERSHIP & PARTNERSHIPS: FEDERAL, STATE, LOCAL AND OTHER ORGANIZATIONS

Federal Agencies

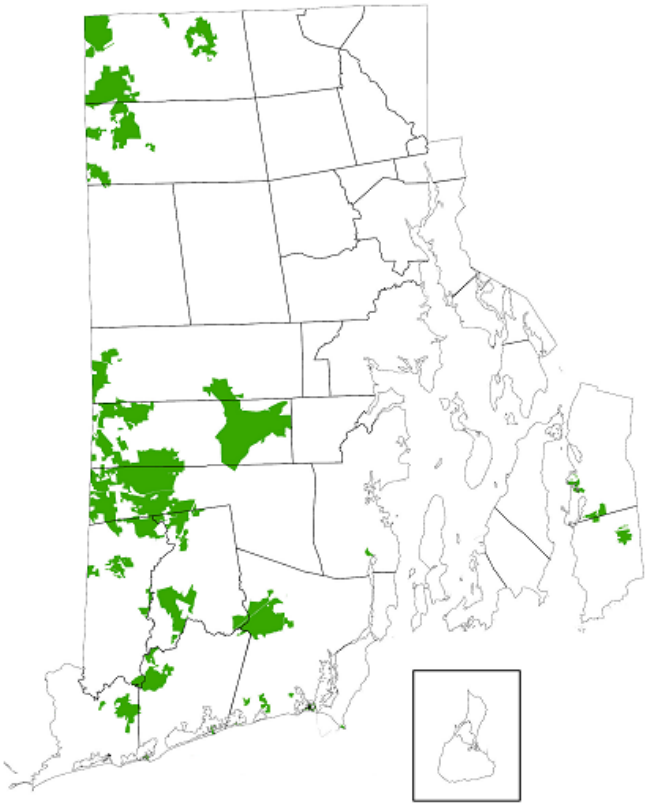
The USDA Forest Service (USFS) and the USDA Natural Resources Conservation Service (NRCS) are the main federal agencies responsible for providing or administering funding, research, educational and technical assistance to the state and private citizens for the management of rural and urban forests, as authorized by the Farm Bill (Agricultural Act of 2014 (P.L. 113-79)). The Rhode Island Department of Environmental Management (RIDEM) delivers programs related to Forest Health, Fire, Forest Stewardship, Urban Forestry, and Forest Legacy supported by USFS grant funding. The USFS Northern Research Station is responsible for the FIA program in Rhode Island. NRCS works directly with private landowners providing funding and technical support.

State Agencies

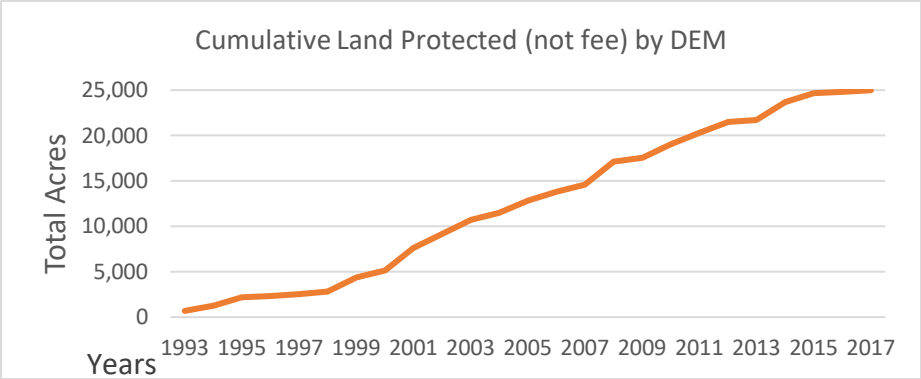
RIDEM permanently protects 73,324 acres of forest land, owning 47,384 acres of forest land in fee, and holding additional interests on 25,940 acres through conservation easements, deeds to development rights, and recreation easements. This protection includes 22 parcels, encompassing 3,583 acres, protected through conservation easement or fee purchase by the Forest Legacy Program, overseen by the Division of Planning and Development. DFE is represented on the DEM Land Acquisition Committee and advocates for the acquisition of large forested parcels, as prioritized in the DEM Land Conservation Plan.

The Division of Forest Environment (DFE) is the main agency charged with overseeing the state's forest resources, managing 40,000 acres of state-owned forests. Through DFE, federal funds and state match are used to administer the Farm, Forest and Open Space (FFOS) Program to meet national priorities for the management of private forest land; for fire protection-related planning and activities; for forest health monitoring and response to insects and disease; and for delivery of an Urban & Community Forestry Program.

The graph on the right shows trends in land acquisition by DEM although most of the acquired land DEM is farmland or open space with recreational potential.



RI DEM Management Areas



Total Acres Owned by DEM from 1993 to 2017

Municipal and Local Governments

Based on 2010 census data, Rhode Island is ranked the second-most densely populated state after New Jersey. Forest land owned by local government is important when considering the full picture of forest cover in Rhode Island as it includes urban forests as well. In 2006, the Statewide Planning Program developed the Urban Services Boundary as a GIS overlay, defined as the general extent of the area where public services supporting urban development presently exist, or are likely to be provided, through 2025. Comprising 13% of land ownership in Rhode Island, natural areas owned by local governments may be held for expansion or buffering of existing natural resources, or set aside for future parks, cemeteries, hospital grounds, schoolyards. Urban forests are not defined as an ecological community, overlooked as a natural resource, but are increasingly identified as contributing to the well-being and environmental goals of residents.

Land Conservation Organizations and Other Public Institutions

Land conservation organizations and agencies – including The Nature Conservancy (TNC), Audubon Society of RI (ASRI), municipal and private land trusts, municipal governments, private homeowner associations, Providence Water, and the University of Rhode Island W. Alton Jones Campus – hold varying degrees of protection on 51,616 acres. Most of this land is permanently protected in fee or through easements, but some land held by land conservation organizations or other institutions has no legal mechanism in place for permanent protection.

Rhode Island has over 45 active land trusts (community-based organizations which protect farms, forest land and open spaces by purchasing easements and/or acquiring land). Supported by the Rhode Island Land Trust Council, a statewide coalition, land trusts monitor their properties and easements to ensure that the lands are being properly conserved and managed.

Non-Profit Organizations and Other Assistance

Private landowners work with several organizations and programs that provide financial and technical assistance to help with the management and stewardship of their forests including:

Rhode Island Forest Conservators Organization (RIFCO) – RIFCO is dedicated to the protection and wise use of Rhode Island's woodland resources, promoting stewardship of Rhode Island's wooded lands and watersheds and better awareness of the role of a healthy forest and provides information and education to the public on issues affecting forest land. RIFCO members include natural resource professionals, land trust and forest product industry representatives, and citizens concerned with forest conservation issues.

Rhode Island Association of Conservation Districts (RIACD) – RIACD supports the three conservation districts in the state (Northern, Southern and Eastern).

The Rhode Island Tree Council (RITC) – RITC cooperates closely with USFS and DFE, supporting the Urban and Community Forestry program through partnership and collaboration. RITC also works with businesses and municipalities to implement tree planting and stewardship programs across the state.

Rhode Island Resource Conservation & Development Area Council (RIRC&D) – Among the many efforts of RIRC&D supporting state landowner programs, includes education to benefit forest landowners such as the RI Coverts Project, Small-scale Forestry Project, Forestry for the Birds, and Women Owning Woodland.

The Rhode Island Woodland Partnership (RIWP) – RIWP is becoming an integral part of DFE's delivery and engagement. The goal of the Partnership is to collaborate, sharing support and expertise to advance the stewardship and long-term protection of Rhode Island's woodlands for the benefit of the local economy, ecological values, and community enjoyment and health. RIWP is comprised of foresters, landowners, non-profit organizations, small businesses, conservationists, and professionals who represent public agencies. The nature of the RIWP membership, and the small size of the state, allows RIWP to act as both the Stewardship Advisory Council and the Forest Ecosystem Monitoring Cooperative's (FEMC) State Partnership Committee. RIWP is also actively involved with the Regional Conservation Partnership network.

American Tree Farm System – The ATF Program certifies private landowners actively managing their forests and promoting sustainable stewardship on their lands. In Rhode Island, this is currently a recognition-only program, without certification. The RI Tree Farm Database currently lists 250 Tree Farms in Rhode Island with a total of 18,112 acres certified. 140 of the 250 Tree Farms are listed under FFOS, with 9,595 acres managed under both programs.

The Sustainable Forestry Initiative (SFI) and the Forest Stewardship Council (FSC) – SFI and FSC provide certification programs intended to ensure that forest products come from responsibly managed forests using sustainable methods. Both organizations provide standards and certification for forest management and chain of custody, tracing the path of forest products through the supply chain. In Rhode Island, 1,783 acres of forest land are managed sustainably under FSC certification. Four Rhode Island-based companies are certified under SFI for sourcing and Chain of Custody.

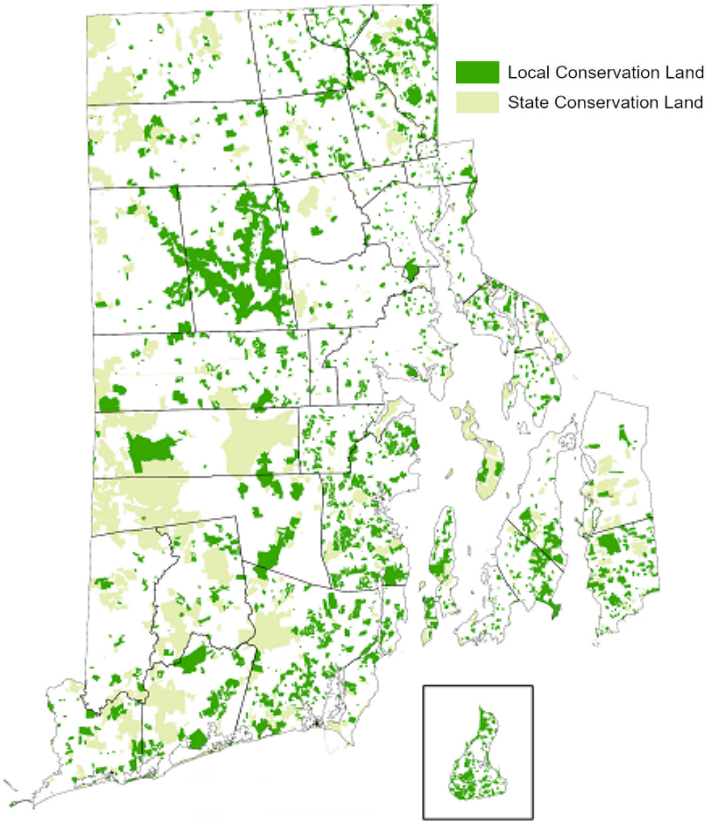
Photo credit: Megan Ruggieri

Forest Resource Management

Given that much of Rhode Island's exurban and rural forests are still privately owned, they provide the greatest land area opportunity for active management. As noted previously, landowner surveys indicate that family landowners care about the value of their land for wildlife habitat, as compared to traditional uses such as hunting and cutting firewood. However, timber harvesting and other products can earn landowners' income to offset property taxes and land management costs. A lack of awareness and education may serve as an initial barrier to engaging in active management. Access to technical expertise and financial resources can also be challenges for private landowners pursuing active stewardship of their land.

Professionals or specialists are more commonly involved with managing public and institutional lands than for smaller private properties though budget levels and funding constraints can similarly limit active forest management on these larger properties as on privately owned ones. While the management of public forests typically depend on staffing and budget levels, some public and institutional owners do not actively manage their forest lands simply because there are other pressing priorities. Municipalities typically lack professional natural resources managers, resulting in forest management being a lower priority compared to other public services. This leaves management projects dependent on grants or periodic funding, and available staff to administer.

Conservation land in Rhode Island includes both small tracts and larger properties. A few large conservation organizations such as TNC and ASRI own reserves in Rhode Island, but the majority of private conservation land is held by small land trusts, many of which do not have paid staff. Therefore, conservation landowners can have much in common with smaller private landowners when it comes to land stewardship.



State and Local Conservation Land

RIDEM's Divisions of Forest Environment (DFE) and Fish and Wildlife (DFW) manage more than 40,000 acres of state-owned forests, and the DFE is further taxed with providing services to private landowners with a field staff of 11, reduced significantly in recent years through attrition:

- 1 State Lands Forester in DFE who also works with DFW with forest management and harvesting
- 1 Stewardship Forester working with private landowners and FFOS
- 1 Forest Health Program Coordinator
- 1 U&CF Program Coordinator
- 3 staff to maintain of DFE-managed Management Area trails, roads and campgrounds
- 4 Forest Fire staff delivering training, outreach, plans and prescribed fire, and assisting DFW with prescribed fire

FOREST RESOURCES ECONOMIC IMPACT

The wood products sector and the forest-based recreation sector both derive economic benefits from forest land. Rhode Island's forest and wood products sector include commercial loggers, arborists, foresters and forestry consultants, sawmills, wood products manufacturers, wood workers, and tree farms.

One measure of active forest management is the amount of timber harvesting on forest land. Net growth in Rhode Island's forests exceeds removals from timber harvests, according to Forests of Rhode Island, 2017:

Annual net growth of live trees ≥5 in d.b.h. (thousand ft3/yr)	14,811
Annual mortality of live trees ≥5 in d.b.h. (thousand ft3/yr)	6,419
Annual removals of live trees ≥5 in d.b.h. (thousand ft3/yr)	2,939

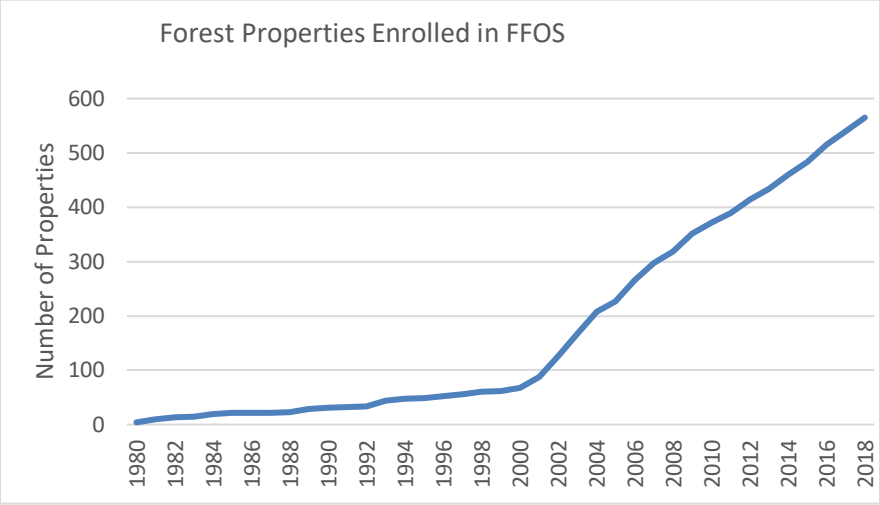
RIDEM has collected data on commercial timber harvests since 1997 through its *Intent to Cut* notification process. Over the 21-year period from 1997-2017, an average year reported harvesting on 2,068 acres, removing 3 million board feet of sawtimber and 3,824 cords of low-grade wood per year. The average harvest occurred on 33 acres and yielded 56,000 board feet and 71 cords. The *Intent to Cut* data indicates low levels of active forest management on private lands, suggesting several possible issues:

- lack of financial and technical knowledge barriers
- lack of markets
- lack of interest or awareness of the potential benefits.

Rhode Island's forest-based economy does not receive the same support or attention that other agricultural-based businesses do, even though the forest industry and forest products are considered an agricultural commodity. For example, the Local Agricultural Seafood Act (LASA) funded through a public/private partnership between the state and three private foundations, created a small grant program to support the growth, development, and marketing of local food and seafood in Rhode Island by providing farmers with funding for equipment, organizational capacity-building, and marketing of their operations. Absent from the LASA is support for Rhode Island's local forest-based products industry.

The Farm, Forest, and Open Space (FFOS) Program, which offers lower tax assessment based on current land use, is the main support for forest landowners. Managed through the Forest Stewardship Program, the forest land component of the FFOS allows local governments to reduce property taxes for forest landowners who implement an approved Forest Stewardship or Forest Management Plan. Interest in this program has increased as property tax assessments increase.

Of the 2,500 eligible landowners (with forest land of 10 acres or more) who can enroll in the FFOS current use tax program under Forest Land Classification, 571 are currently enrolled. As of 2019, over 45,549 acres are managed by private landowners through this program. This does not include adjacent forest land on properties classified under the Farm or Open Space components of the program.



Cumulative Number of Properties Enrolled in FFOS as Forests

More information about the FFOS program can be found in Appendix B.

National, and local efforts, through NRCS and RIDEM also promote forest management on private lands. In addition, the Forestry Best Management Practices for Water Quality Protection are required to limit non-point source (NPS) pollution from forestry activities but still allow low impact timber harvesting operations on forested wetlands, riverbank wetlands, and perimeter wetlands.

Wood Products

Lumber production in Rhode Island peaked at the turn of the century with 33 sawmills in operation. As late as 1988 there were 16 local sawmills producing 6.6 million board feet of lumber, which decreased to six by 2003. Presently, Rhode Island has three active sawmills and eight portable sawmill operators working around the state. Although the number of local sawmills has decreased, sawmills in neighboring states, and shipment to northern New England and Canada, provide additional markets for Rhode Island forest products. An average of 3.0 million board feet of sawtimber was harvested state-wide per year from 1997 through 2017.

The principal use of harvested trees is for sawtimber, primarily industrial pallets, with the highest quality wood exported for other uses. Softwood logs are processed in state or exported while firewood production provides a market for low quality hardwood trees, harvesting over 3,800 cords per year. The sole pulp mill in Rhode Island closed in 1980 and the distance to out of state mills makes harvesting pulpwood uneconomical. Based on analysis of DFE *Intent to Cut* data (1997-2017), the average commercial harvest in Rhode Island during the last 20 years involved about 56,000 board feet of sawtimber and 71 cords of wood on 33 acres.

The 2019 Economic Impact of Rhode Island's Forestry and Wood Products Sector reported that the annual gross output of Rhode Island's forestry and wood products sector totals over $7.2 million and employs 4,844, workers including the spillover effects across all sectors of the state economy. Employment in the forestry and logging sectors is estimated at 90 jobs with gross annual sales of 11.6 million.

Fuelwood

As discussed in the 2015 Rhode Island Forest Based Economy report, the value to the forest landowner from harvesting trees for fuelwood is very low relative to other products, such as sawlogs. Harvesting and processing firewood can be time consuming and does not yield a substantial return in the market, with firewood averaging around $200/cord to consumers. With that being said, a 2014 report compiled from census data by the US Energy Information Administration showed a 160% increase in wood used for heating in Rhode Island from 2005 to 2012. The increase may be attributed to the rise in the cost of propane and home heating oil, and the financial crisis of 2008. 2017 Census data estimates 7,145 households (1.7%) in Rhode Island using wood or pellets to heat or augment home heating (*browser search for 2017 link: House Heating Fuel Universe: Occupied housing units 2013-2017 American Community Survey 5-year Estimates*).

Specialty Products

Specialty wood products include trees, or parts of trees, that are not usually considered valuable due to the tree species or low volume. These materials can be turned into valuable products by skilled artisans using materials unutilized by traditional forestry operations. The eight portable sawmills in Rhode Island and additional sawmills in nearby states service a niche market to process trees unmarketable through traditional means into specialty forest products.

While suburbanization and the small size of most parcels make management for traditional wood products difficult for the typical Rhode Island forest owner, a 2003 landowner survey reported that 1% to 5% of landowners have commercially harvested an alternative product such as maple syrup, mushrooms, floral greens, or witch hazel. Witch hazel, a shrub with astringent properties and used in the cosmetics industry, is cut and chipped, and the chips transported to the American Distilling facility in East Hampton, Connecticut for processing. The shrub regenerates readily and can been sustainability harvested for decades generating at least enough revenue to partially offset property ownership expenses.

Sugar maple, the primary tree species used to produce maple products, is not as common in Rhode Island, usually only found along roads and in association with old farmsteads. Still, there are 19 operations that process and sell maple syrup. Red maple, the Rhode Island state tree, is most commonly tapped to produce maple syrup locally, but it has a much lower sugar content and requires more processing. Norway maple, native to Europe, has been widely planted in Rhode Island as an ornamental and street tree and is commonly tapped in Rhode Island because it grows to a large size.

FOREST RESOURCES & RECREATION

Forests play an important role in outdoor recreation throughout the state, supporting both physical exercise and mental health. State Management Areas also provide numerous recreational opportunities such as hiking, hunting, fishing, camping, bird watching, horseback riding trails, etc.

Arcadia Management Area walk-in backpack campsite. *Photo credit: Megan Ruggieri*

A 2018 Parks Study reported that Rhode Island Parks and Management Areas receive over 9 million visitors each year, contributing an estimated $312 million of economic output and support for over 3,700 jobs. In a survey for the 2019 Ocean State Outdoors State Guide Plan, Rhode Islanders expressed a preference for a wide range of outdoor recreation resources. When asked to indicate how important it is to provide various types of park and recreation facilities, Rhode Islanders showed the greatest preference for:

- Wilderness: very important 64%
- Environmental and outdoor education: very important 58%
- Recreation at lakes and ponds: very important 51%
- Trails for nonmotorized activities: very important 50%
- Boat launches: very important 45%

State-owned Management Areas, land trusts, federal wildlife refuges, hunting clubs, and private and non-profit preserves all provide year-round access to forest-based recreational opportunities. The 2015 report assessing the economic importance Rhode Island's forests estimated that wildlife-based recreational activities contribute an estimated $375 million dollars in sales annually to the Rhode Island economy and 1,500 jobs with an estimated $37 million payroll annually. Fall foliage viewing is the largest contributor with 25% of the total sales, followed by: camping, hiking, wildlife viewing, snowmobiling, and downhill skiing.

According to the 2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, approximately 402,000 residents/non-residents participated in wildlife-related recreation (hunting, fishing, and wildlife-watching) in Rhode Island during 2011, spending an estimated $360 million, with approximately 308,000 residents/non-residents spending $200 million on wildlife-watching alone. The study also revealed that approximately 36% of Rhode Islanders participated in some form of wildlife-related recreation in that same year. But, as noted in the RI WAP, efforts to estimate the true value of wildlife in monetary terms (not solely by income generated), as with most natural resources, have been met with limited success and significant information gaps, and research needs remain.

Revenue generated from license and permit sales for hunting and fishing, and excise taxes from sporting goods is the easiest to track. These sales support state fish and wildlife conservation programs and are leveraged to match federal Wildlife and Sport Fish Restoration Program dollars, which in turn support outdoor recreational opportunities for hunting, fishing, and boating in Rhode Island. According to DEM Fish & Wildlife, fishers and hunters purchase around 70,000 licenses, permits, stamps, and tags each year, contributing more than $235 million to the Rhode Island economy.

Interestingly, DFE does not charge fees for the 2 campsites it manages (Backpack and Frosty Hollow). Meanwhile demand is increasing while staff availability to manage, monitor, and maintain sites is severely restricted due to staffing limitations.

Campgrounds	Larger events requiring special permits:
2017 - 326 users	
2018 - 486 users	2018 - 155 permits for 75 groups serving 5,963 participants
2019 - 678 users	2019 - 175 permits for 77 groups serving 7,384 participants

Picnic shelter constructed by DFE and the Appalachian Mountain Club at the backpack campsite. *Photo credit: Megan Ruggieri*

ECONOMIC IMPACT OF LAND CONSERVATION

It is a common argument, in Rhode Island and beyond, that conserving open spaces and forest land decreases revenue to cities and towns by taking those properties off the tax rolls and reducing land available for development in cities and towns. The American Farmland Trust identified the three common misconceptions regarding working lands within municipal boundaries:

1. Working lands—including productive farms and forests— are an interim land use, not the "highest and best use."
2. Property tax at the current use value (such as Rhode Island's FFOS) gives agricultural land an unfair tax break, as opposed to its potential use value for residential or commercial development.
3. Residential development will lower property taxes by increasing the tax base.

However, numerous studies suggest that protecting forest land, farmland and open spaces can generate economic tax benefits that improve the local tax base by bringing in more revenue than is used to provide services to those properties. A compilation of data from across the US shows that community revenues benefit by having working lands, such as farms and forests, because they require less in service expenditures than residential. While Rhode Island's data is about 25 years old, recent data compiled from MA and CT show that those trends have continued.

REVENUE-TO-EXPENDITURE RATIOS IN DOLLARS

Community	Residential including farm houses	Commercial & Industrial	Working & Open Land	Source
Rhode Island				
Hopkinton	1 : 1.08	1 : 0.31	1 : 0.31	Southern New England Forest Consortium, 1995
Little Compton	1 : 1.05	1 : 0.56	1 : 0.37	Southern New England Forest consortium, 1995
West Greenwich	1 : 1.46	1 : 0.40	1 : 0.46	Southern New England Forest Consortium, 1995

Although there may be short-term impacts through a tax shift for permanently protected or conserved lands, the long-term benefits have been shown to outweigh any short-term losses. Supporting working lands, and conserving greenspace has been shown to actually generate revenue benefits, through avoided service costs and by increasing value and revenue of developed property.

The idea that traditional residential or commercial development yields the highest and best use for increasing municipal revenues by growing the tax base and lowering individual property taxes is contradicted by evidence from local communities. Property taxes generally increase because the cost of providing services increases for the municipality. Even new commercial development, which can bring economic growth without significantly increasing the cost of services to the municipality, tends to bring new jobs and new residents who rely on those same municipal services. Managing that growth requires a thoughtful, proactive planning approach to maximize the benefits of development for all residents. When communities are highly reliant on property taxes to fund local government and lack comprehensive planning guidelines, it is often difficult to incorporate land conservation as part of the larger development picture and managing the future character of the community.

The economic benefits of planned development that takes advantage of the benefits of conserved land and well-placed development and service corridors include:

- Open spaces are not anti-development: with planning, conserving open spaces doesn't reduce housing development, but redirects the density or the location;
- Studies have shown that open spaces enhance community property values, leading to increased property tax revenue: properties located near parks and open spaces are assessed at higher rates and sell for more than comparable properties located elsewhere in the community;
- Open spaces in cities and towns contribute to the quality of life and health of residents: both an affordable tool in addressing environmental health and justice outcomes, and aiding in the achievement of meeting federal and state environmental standards; and
- As land protection and conservation increase, studies have also shown that employment rates tend to increase over the next five-year period, with jobs focused mainly in tourism and recreation sectors, with amenity-related growth likely the factor driving positive long-term impacts.

Benefits

Benefits can be described as being environmental, economic or social, but the reality is that the benefits provided often address the three types of benefits simultaneously. The exhaustive list of benefits provided by traditional and urban forests and green spaces can simultaneously calm traffic, reduce peak stormwater flows, capture particulate pollution, provide mental relief, reduce UV exposure, protect drinking water, and improve air quality, all for pennies a day.

The benefits provided by traditional and urban forests are significant for all aspects of habitat for humans and wildlife. The comprehensive benefits are summarized well in BANKING ON GREEN: A Look at How Green Infrastructure Can Save Municipalities Money and Provide Economic Benefits Community-wide, which compiled the economic arguments for retaining and managing green infrastructure. But the benefits to human health are becoming another compelling argument for recognizing the significance of that same green infrastructure.

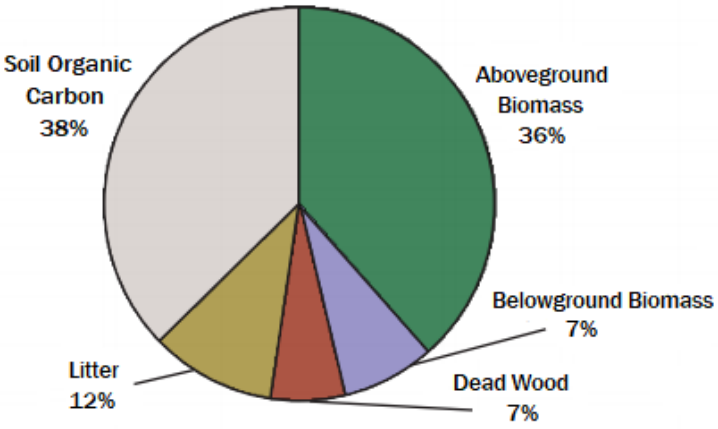
CLIMATE CHANGE MITIGATION

Rhode Island is already experiencing the impacts of climate change in the form of increasing temperatures, rising sea levels, and more intense rain and flood events. These and other climate changes are having and will continue to have profound effects on natural ecosystems as well as human ecosystems. Forest management practices are increasingly being designed in response to these pressures to help ecosystems adapt (see Issue: Climate Change, page 49). Further, the role of forests and other green spaces— whether managed, unmanaged, or built—are gaining greater acknowledgement for their essential role in the mitigation of climate change through the sequestration and storage of carbon dioxide. A 2017 study by The Nature Conservancy, Natural Climate Solutions, found that natural and working lands have the capacity to provide 37% of the mitigation needed between 2017 and 2030 to keep global temperature rise below 2° Celsius. The researchers examined strategies that are available now, scalable, cost-effective, and provide other benefits to communities. Recent analyses point to several cost-effective pathways for using trees and forests to reduce atmospheric greenhouse gases, including avoided deforestation (i.e. land use change and fragmentation), urban reforestation, and improved forest management.

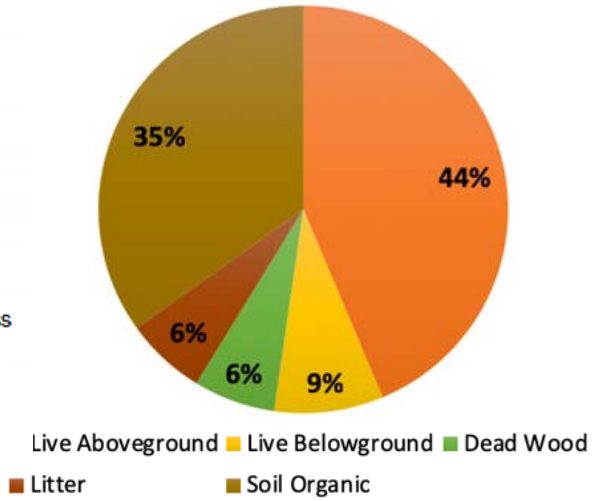
Rhode Island loses 838 acres per year of forest from conversion of forest to other land uses, which also results in carbon losses since natural ecosystems store more carbon than developed lands (See Issue: Forest Loss and Fragmentation, page 28). In 2016, the Rhode Island Greenhouse Gas Emissions Reduction Plan, prepared by the Executive Climate Change Coordinating Council, advised that meeting the state's emissions goals could be compromised by continued loss of forested land and recommended exploring a "no net-loss of forests" policy, from the 2 acres per day average experienced in Rhode Island from 1990-2010. The 2018 Statewide Climate Resilience Action Strategy (Resilient Rhody) identifies forests as a natural system that provides crucial services to communities and recommends that Rhode Island protect remaining forest cover, particularly large, unbroken tracts of forested land, and support the development of Forest Management Plans to guide landowners in healthy forest management practices.

There are two aspects of forest carbon: how much carbon is contained within forest ecosystems (storage) and how much forest carbon is changing over time (sequestration). Both carbon storage and sequestration are influenced by numerous local conditions, including the age and species of the forest, soil characteristics, past land-use, and natural and human disturbances. Discussions about forest carbon storage typically considers the above ground component of carbon. However, forest soils are also any important carbon pool, and minimizing heavy soil disturbance and conversion to other land uses is key to maintaining carbon storage in forest soils.

The 2019 report on Forest Carbon by UMass Amherst and the University of Vermont reported that an average acre of Northeastern forest holds 77 metric tons/acre (t/ac), as shown in the chart on the left below. Similarly, carbon storage in Rhode Island's forests averages 76 metric tons per acre (and 26.7 million metric tons statewide), shown on the right.

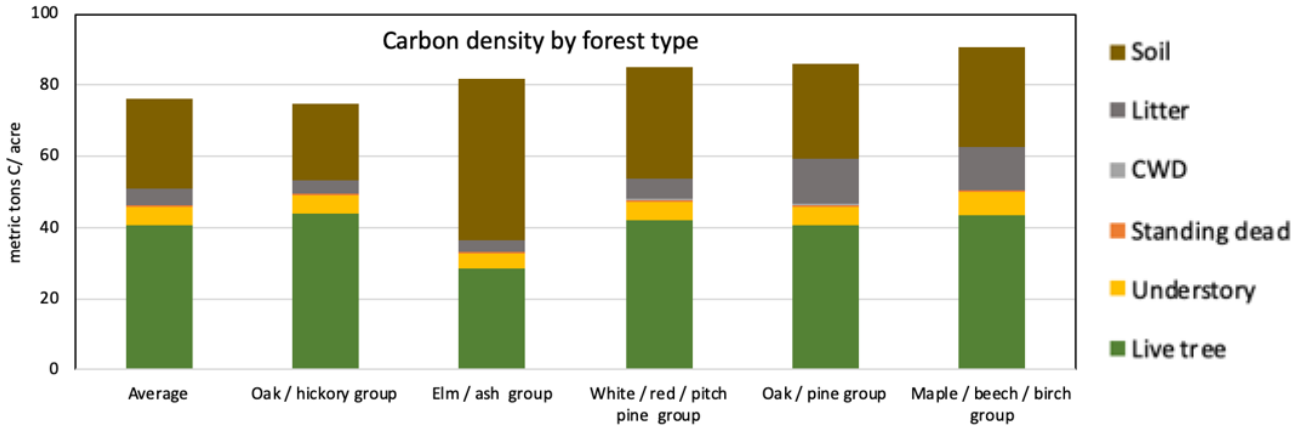


Northeast Forest Carbon Stocks Averaged
Source: Forest Carbon: An essential natural solution for climate change



Rhode Island Forest Carbon Storage
Source: FIA Data

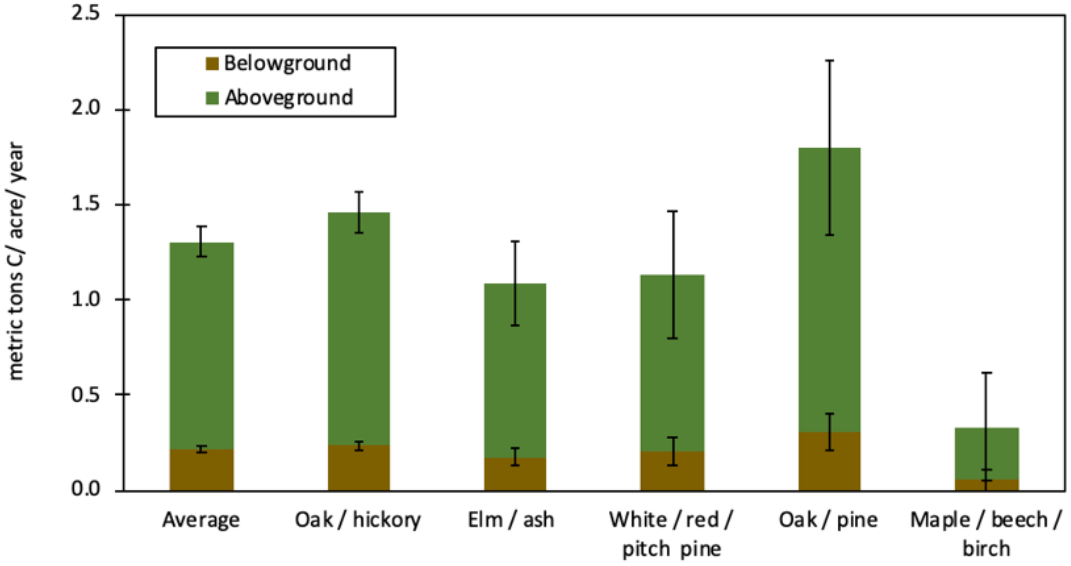
Carbon storage varies not only by species, size, maturity, and growth rate, but can is also related to soil type and depth. The different forest types in Rhode Island range in average carbon storage from 75 to 91 metric tons per acre. It's important to note that the small size of Rhode Island provides some limitations to the use of national data from the US Forest Service Forest Inventory and Analysis program, particularly for less common forest communities. But more recent data for Rhode Island show that the Northeastern percentages are relatively consistent with RI's state-specific data, calculated using the using the Forest Inventory and Analysis Program, Forest Inventory EVALIDator, as shown below:



Statistics for Forest Carbon Density (Storage) Among Different Forest Types
Source: The Value of Rhode Island Forests

The average acre of Rhode Island forest absorbs 1.3 metric tons of carbon per year from the atmosphere. The roughly 367,000 acres of forest land in Rhode Island sequester nearly 500,0000 metric ton of carbon dioxide each year. Collectively, Rhode Island's forests offset the annual emissions of more than 100,000 passenger vehicles each year (EPA Greenhouse Gas Emissions from a Typical Passenger Vehicle), equivalent to a significant percentage of Rhode Island passenger vehicle emissions. Available transportation statistics

indicate that nearly 429,000 automobiles (not including buses, trucks, etc.) were registered in Rhode Island in 2016. This suggests that the state's forests are capable of offsetting roughly one quarter of the annual emissions of the state's registered passenger vehicles.



Annual Carbon Sequestration by Forest Type
Source: The Value of Rhode Island Forests

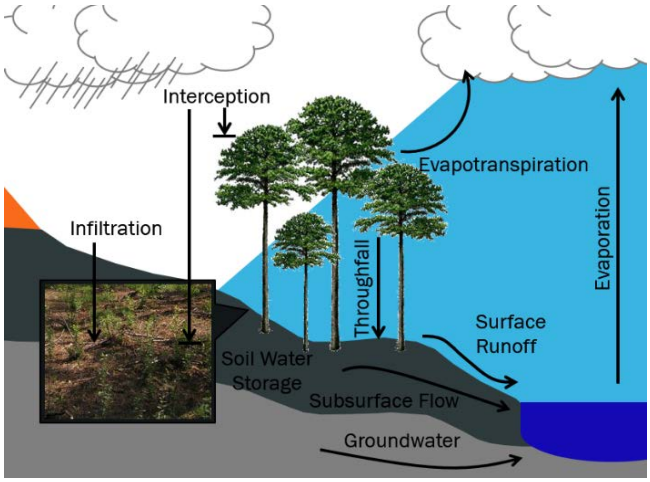
Additional information on the carbon sequestration using the Forest Inventory EVALIDator web-application Version 1.8.0.00 is in Appendix C.

STORMWATER MITIGATION

Rhode Island relies on surface reservoirs and groundwater for potable water supplies; land use influences water quality for both sources. Forests serve as natural filters and are the most effective land cover for maintenance of water quality and quantity, providing a quantifiable economic benefit by filtering sediments and other pollutants from the water in the soil before it reaches a water source, thereby reducing treatment costs. These forests also mitigate impacts from severe storms and flooding by slowing water flow and buffering waterbodies. Maintaining forest cover and practicing forest stewardship help ensure cleaner water is available from water supply sources.

The impact of forest loss and, most notably, permanent land conversion from green infrastructure to grey infrastructure or developed uses, is particularly dramatic for stormwater flow. The loss of soil permeability due to the installation of hardscape and changes in site gradient requires costly stormwater management systems that need long-term maintenance and are not built to withstand increasingly frequent extreme rainfall events.

Impeding the infiltration of water into the soil and subsurface flows keeps stormwater on the surface where peak flows and flow rates are increased, leading to more frequent and more damaging flood



Precipitation Movement in the Landscape
Source: How Trees & Forests Really Affect Stormwater

events. Stormwater management planning to include the retention of natural areas and trees in the built landscape provide mitigation of storm flow. Even seemingly positive efforts to encourage alternative energy sources can have a negative impact on water movement in the landscape, when trees are cut, topsoil is removed, land is graded and compacted, and equipment is installed.

While much of the western part of Rhode Island is forested, the higher population and densely urbanized areas of the state are in close proximity to water, whether Narragansett Bay or the many rivers that flow through the state.

Providence, shown on the right, is a local example of the high percentage of hardscape and impervious surfaces typical of the dense urban development in the eastern area of the state. The area in pink shows the extent of impervious surfaces. Here water is unable to infiltrate into the soil and precipitation washes pollutants, oils, and trash into storm drains and waterways.

The effects of impervious surfaces were evident in Rhode Island in 2010 when heavy rains impacted the lower Woonasquatucket River, where the river corridor flows through a densely developed landscape. The lower river valley experienced dramatic flooding that led to evacuations, property damage, and loss of business. A major component of the Woonasquatucket Vision Plan, a recent project of the City of Providence and the Woonasquatucket River Watershed Council, is to restore green infrastructure along the river, including trees and vegetation, to improve the natural capacity to absorb the impact of future storms.

HUMAN HEALTH

Research has continued to advance, refining and quantifying our understanding of the contribution of green spaces, and trees in particular, to human health:

- Urban Nature for Human Health and Well-Being: a research summary for communicating the health benefits of urban trees and green space
- The Human Health and Social Benefits of Urban Forests
- Human Dimensions of Urban Forestry and Urban Greening

Mental health support as an ecosystem service is critically needed in Rhode Island. According to the 2015 RI Behavioral Health Project: Final Report, mental health statistics show that there are unmet needs for mental health support in the state, including:

- Higher state spending than the national average for behavioral health services as a percentage of state GDP, but adults reporting unmet behavioral health needs at a higher rate than adults in other New England states; and
- Children in Rhode Island are at a greater risk for developing mental health and substance use disorders than children in other New England states.

CDC resources (High School Youth Risk Behavior Surveillance and ADHD Prevalence respectively) show that 29% of Rhode Island high school students (grades 9-12) have experienced depression symptoms and 16% have seriously considering attempting suicide in the past year. Rhode Island ranks 11th among U.S. States for Attention-deficit disorder (ADD) or attention-deficit/hyperactivity disorder (ADHD) in children, with parent reports showing that 11.1% of children in Rhode Island currently have the disorder.

Utilization of Rhode Island's natural areas is highly valued. Increasing access and exposure to green space in urbanized areas is a priority and is supported by recommendations in the RI Behavioral Health Project: Final Report to shift mental health treatment away from costly, reactive services and towards evidence-based, community-centered strategies for promoting and managing mental health care. Given the many values that forests, and other green spaces, provide to Rhode Island communities, maintaining forests to support mental well-being should be part of a community-centered health care strategy.

The benefits of forests and green spaces extend beyond mental well-being to physical health. The Rhode Island Land Trust Council has adopted a program that encourages people to take walks and spend time outdoors in nature for their health. The Council is partnering with the healthcare community to "prescribe" walks through Park Rx and RI Walks program and to raise awareness about the connection between forests and other natural areas and human health.

DFE is a partner in the American Forests project, Urban Forests for Climate and Health Initiative, to develop tools that assist communities to address the issues of climate and public health. The project, funded by the Doris Duke Charitable Foundation, is developing a Tree Equity Score and a GIS-based decision-support tool that uses urban forestry to reduce the impacts of climate change and to improve public health outcomes. Rhode Island's Department of Health and the Health Equity Zones (HEZ) are also involved in this effort, as is the USFS Northern Institute of Applied Climate Science (NIACS).

AIR QUALITY

Air quality also plays a significant role in health outcomes. National air quality standards were established by the US Environmental Protection Agency (US EPA) under the federal Clean Air Act in order to maintain safe levels of "criteria pollutants" that include ozone, particulate matter, nitrogen dioxide, sulfur dioxide, carbon monoxide, and lead.

RIDEM's Division of Air Resources monitors air quality in Rhode Island via a network of monitoring stations and submits an annual air quality report to the US EPA. Most criteria pollutants have remained within the safe levels, but the 2018 RI Annual Monitoring Network Plan reported that measured ozone levels have exceeded safe standards in Rhode Island in recent years. According to the 2019 State of the Air report by the American Lung Association, all three reporting counties in Rhode Island (Kent, Washington, and Providence Counties) received failing grades for air quality based on high ozone days.

Research shows that air pollutants have been shown to have a range of negative, and compounding, impacts:

- A Framework for Examining Social Stress and Susceptibility to Air Pollution in Respiratory Health: The impact of air pollutants is exacerbated in low-income communities, where its impacts are often concentrated and combined with other social stressors.
- Outdoor Air Pollution and Asthma: Poor air quality has been linked to asthma exacerbation and onset.
- The medications that change who we are: Medications used to treat asthma are sometimes associated with behavioral changes, e.g. an increase in hyperactivity and the development of ADHD.

According to RIDOH data, Rhode Island has the ninth-highest prevalence of children with asthma, 10.9%. According to self- reported data collected by the Henry J Kaiser Family Foundation, more than 1 in 10 adults (12%) in Rhode Island had asthma in 2018. Black and Hispanic children are more likely to visit the emergency room or to be hospitalized due to asthma. Medical conditions caused by air pollution, like asthma, come with significant costs to quality of life and economic costs to afflicted individuals and the local medical system. A 2017 study published in the Annals of the American Thoracic Society reported that the economic cost of asthma is $3,266 per asthmatic person per year.

Trees contribute to cleaner air by absorbing gaseous pollutants through leaf stomata and intercepting particulate matter on tree surfaces, including carbon monoxide, nitrogen dioxide, ozone, lead, sulfur dioxide, and particulate matter. Even with the variability in absorption among species, the emission of volatile organic compounds (VOCs), and pollen production, trees have an overall positive impact on human health. Recent research is showing that trees planted in urban areas, even when still relatively small, have an impact on air pollution.

A 2014 i-Tree Canopy assessment of all 39 municipalities in Rhode Island estimated that Rhode Island's entire population of trees (natural areas, green spaces and urban trees) provide more than $30 million annually in pollution removal benefits. Trees in Rhode Island remove an estimated 13,800 tons of dangerous air pollutants from the atmosphere each year. The value of pollution-removal provided is greater than $38 million annually when considering the removal of carbon monoxide, nitrogen dioxide, ozone, and small and large particulate matter (not including the benefits of carbon dioxide removal). While a large portion of Rhode Island is considered rural and may not actually see $38 million in pollution removal, the benefit to the region as a whole is significant. It is where dense and healthy tree cover is located closer to pollution sources and to population centers that trees can provide the most pollution-removal benefits to the most people.

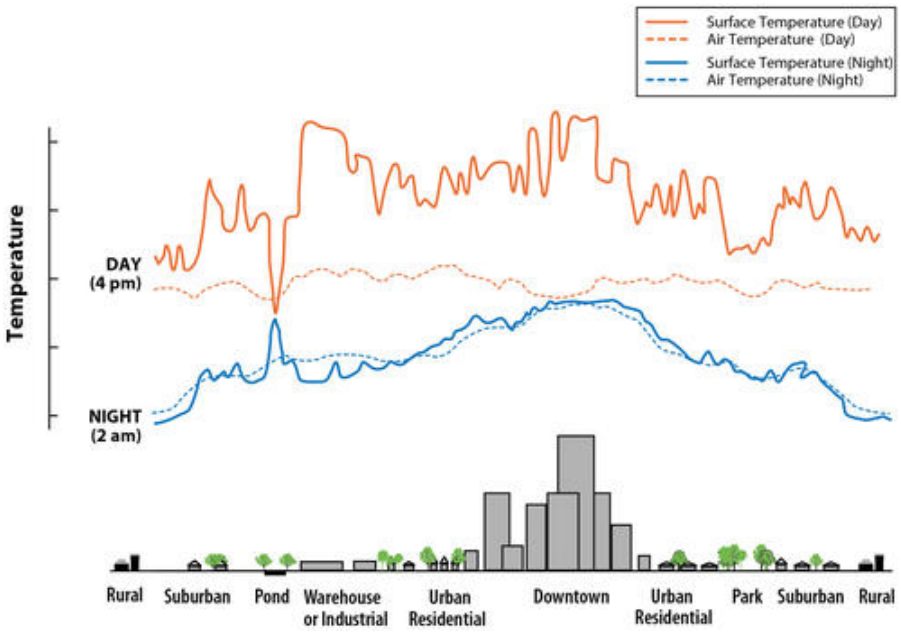
Published in 2013, Tree and forest effects on air quality and human health in the United States assessed 2010 data for air pollutants, not including large particulate matter (between 2.5 and 10 microns and calculated that Rhode Island trees removed 10,500 tons of air pollutants, to a value of $33.6 million in avoided human health costs. This includes 2,900 tons of pollution removed by trees on urban land ($27.9 million value) and 7,600 tons of pollution removed by trees in the state's rural land ($5.7 million value).

TEMPERATURE MODERATION & URBAN HEAT ISLAND MITIGATION

Forest cover plays a significant role in moderating local temperatures; the combination of shade and transpiration cooling the air can reduce temperature extremes. Development and refinement of modeling tools are valuable to effectively assess and communicate the impact of trees: a large tree can transpire as much as 100 gallons per day in a hot, dry climate, providing the cooling equivalent of five air conditioners running for 20 hours.

Urban areas, with their dense development and grey infrastructure, are warmer than greener areas both in the daytime under direct sun, and at night when the stored heat is released. This urban heat island effect increases energy use and associated greenhouse gas emissions, mainly through air conditioning cooling, as well as affecting air quality.

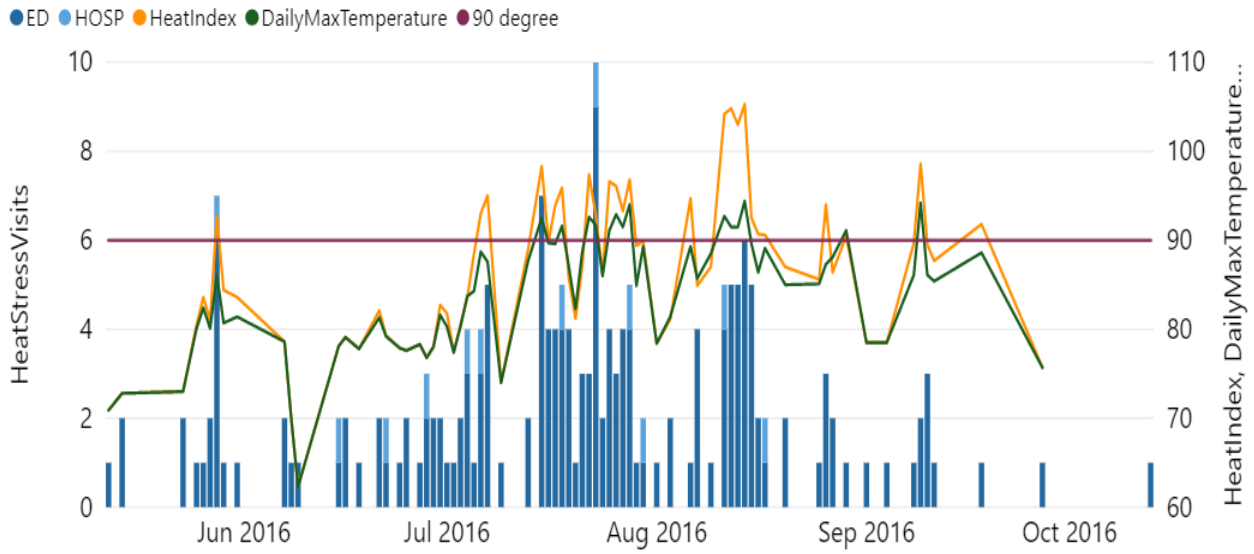
Research shows that electricity demand for cooling increases 1.5–2.0% for every 1°F (0.6°C) increase in air temperatures, starting from 68 to 77°F (20 to 25°C), suggesting that 5–10% of community-wide demand for



Heat Island Impacts
Source: USGS.gov

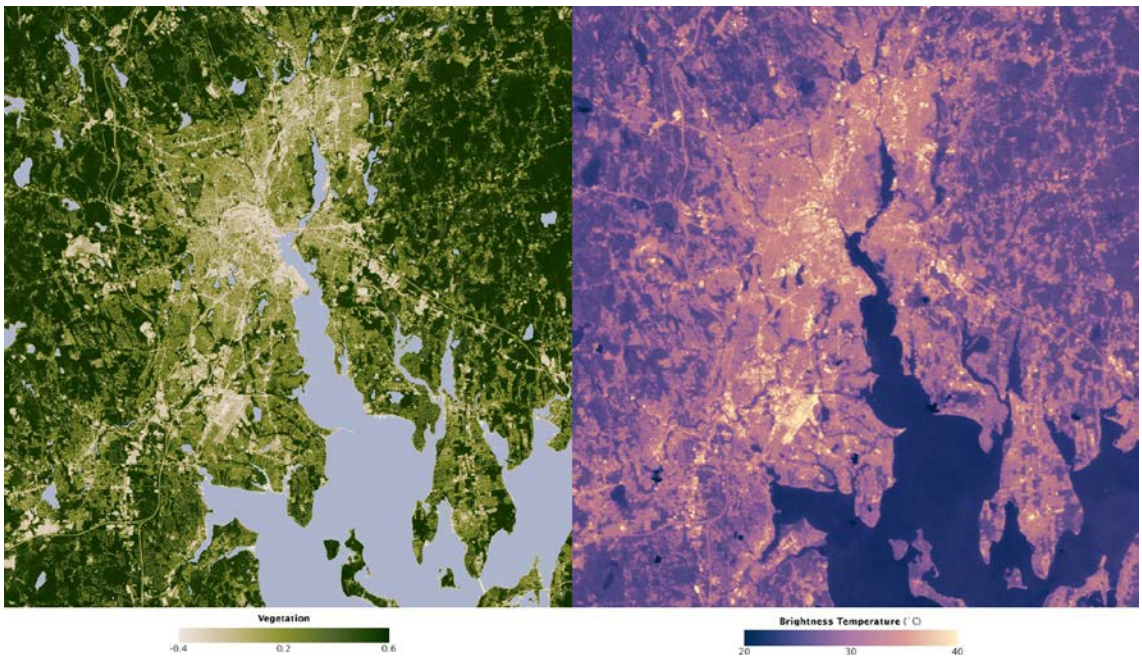
electricity is used to compensate for the heat island effect. Meanwhile, a 2010 study on urban greening to cool towns and cities estimated a 2°F reduction in ambient air temperature for every 10% increase in urban tree canopy.

High temperatures are associated with negative health impacts, including heat cramps, exhaustion and stroke, and even heat-related death. Data from the Rhode Island Department of Health (DOH) shows that this relationship between extreme heat and negative health outcomes is borne out at the state level – emergency department and hospital visits spike as temperatures increase.



Rhode Island Heat Index Compared to Emergency Room and Hospital Visits. *Source: RIDOH*

A 2002 NASA report on Drivers of Urban Heat Islands used satellite imagery to demonstrate the relationship between acute heat island effects and vegetation. The results for Providence, shown below, displayed the expected inverse relationship between temperature, shown on the right, and vegetation, on the left.



Satellite Images of Vegetation and Temperature in Providence, Rhode Island. *Source: NASA*

Low-income communities are those often most acutely impacted by the urban heat island effect. The DOH Climate Change Program partnered with Rhode Island's Health Equity Zones (HEZ) in 2019 to identify places in the state's HEZ with an above average risk for heat-related illness during extreme heat events. This understanding of where increased temperatures will most impact human health can direct resources and outreach to these communities. Increasing and maintaining green space and access to green space is a logical part of any solution to address the dangerous effects of extreme heat.

Since 2015, DFE and the Arbor Day Foundation have partnered to deliver the state's Energy-Saving Trees program. This popular program funds the annual distribution of 2,000 tree saplings to homeowners to help them conserve energy, reduce utility costs, and mitigate stormwater runoff while beautifying their neighborhoods.

WILDLIFE HABITAT

The state's varied soil, vegetation and hydrology support almost 100 natural vegetative communities that support a wide range of wildlife. According to the 2015 RI WAP, Rhode Island supports 92 species of mammals, 431 species of birds, 306 species of fish (freshwater and saltwater), and 36 species of amphibians and reptiles; 236 are considered are considered to be Species of Greatest Conservation Need (SGCN) in Rhode Island.

For many of these species, forests provide the necessary habitat required for robust and resilient populations. Of the 84 key habitat profiles identified, 21 are forest types, from pitch pine barrens and maritime forest, to forests representative of the Appalachians in the south or the Laurentians in the north, and the familiar oak forests of the northeast. Not only is this range of forest types needed to support the multitude of wildlife species, but age class diversity is also necessary. As noted earlier in this report, the percentage of young (0-20 years) and old (>100 years) forests is very low in Rhode Island. So, while there may be an increase in the upper age classes if harvesting levels remain low, the lack of early successional stands requires management intervention by DFW and DFE working together, and the development of tools such as the silvicultural recommendations for supporting bird habitat that target landowners and consulting foresters are needed.

The distribution and abundance of Rhode Island's forest dwelling wildlife is affected by the characteristics of the forest cover and their specific requirements. Some of Rhode Island's forest dwelling creatures are generalists and can be found in a variety of habitats, including human habitats periodically or seasonally, while others are specialists requiring a single habitat type or a much-reduced variability, and thus are far more susceptible to changes in forest cover. And, while some species can get by with fragmented patches interspersed with development, area-sensitive species need large, unfragmented forest blocks to thrive.

Examples of species that have grown accustomed to human proximity and proven more adaptable in fragmented landscapes include white-tailed deer treating the suburbs as a buffet, rose-breasted grosbeak using suburban feeders during migration, and red foxes and coyotes using local green spaces and taking advantage of intentional and unintentional human subsidies.

Examples of species needing large patches of intact forest to thrive include northern goshawk, scarlet tanager, red-spotted newt, marbled salamander and, because they depend upon increasingly rare cold-water streams for survival, brook trout.

Some species require young forests, or a matrix of older forest and more open habitats (which may or may not include young forest), but landscape fragmentation by roads and other development can be highly detrimental to such species as New England cottontail, Eastern box turtle, woodcock, and numerous songbirds.

Still other species are even more specific, relying on only one or a few host plants to complete their life cycle, such as the state-threatened frosted elfin butterfly, which relies on wild indigo or wild lupine, and the state-concern sleepy duskywing, whose host plant is scrub oak. Given that these plant hosts are found in the pitch pine woodlands and barrens, the decrease of that forest type to about 1/5th of their original range through land conversion means that any further loss of that forest type is a significant concern.

Rhode Island's wildlife needs forests of all stages, and the state's human residents benefit from robust and healthy wildlife living in those habitats. Wildlife resources play a direct and critical role in how the ecosystem functions through the complex services that they provide to humans and the landscape. Pollinators (not only bees but birds, moths, butterflies, wasps, flies) are critical in the reproduction process of countless plants including those important to human food systems. According to the Food and Agriculture Organization of the United Nations, three out of four crops across the globe producing fruits or seeds for human use as food depend, at least in part, on pollinators. As noted in The Value of Rhode Island Forests, other beneficial wildlife species include birds, mammals and insects dispersing seeds through their movements and droppings; and squirrels inadvertently planting trees by forgetting where they buried their acorns. Even the less charismatic species have a role to play: all resident bat species are insectivores; scavengers, like the turkey vulture, clean up roadsides by consuming road killed animals; and the opossum's diverse diet includes insects, beetles, ticks, and roadkill.

Photo credit: Megan Ruggieri

ISSUES, THREATS & OPPORTUNITIES

The *Rhode Island 2020 State Forest Action Plan: Assessment* has identified five *issues of concern*. These priority issues also present challenges to existing DFE capacity, but all five Cooperative Forestry Programs recognize their significance to a viable and resilient forest and address these issues within their strategies and program delivery.

The priority issues, or issues of concern, are:

1. **Forest loss, fragmentation and parcelization** – wildlife habitat, landscape functionality and sustainability, interface and intermix, and invasive species
2. **Forest health** – invasive plants, wildlife habitat, diversity and resiliency, pests and diseases
3. **Water** – stormwater, riverine/wetlands, water quality
4. **Fire** – increasing intermix and expanding interface combined with increasing fuel loading
5. **Climate change** – increasing disturbances, alterations in species distributions and relationships, and compounding forest health threats

It should be noted that fragmentation exacerbates the issues that threaten Rhode Island's forests or impact its management and response for the priority issues two through five. Fragmentation is an underlying issue that contributes to, speeds, and intensifies the rate of change, the severity of conditions, and the exposure of forest types and habitats to these threats. Therefore, although fragmentation is addressed as the first priority issue, it will also be referenced as a factor in the discussion of Forest Health, Water, and Fire as priority issues. Climate change is also a driver impacting forest resiliency and the rate of change, further complicating forest management and planning.

RELATIONSHIP TO NATIONAL PRIORITIES

The Priority Issues for Rhode Island incorporate the National Priorities and are addressed in the *Rhode Island 2020 Forest Action Plan: Strategies* section.

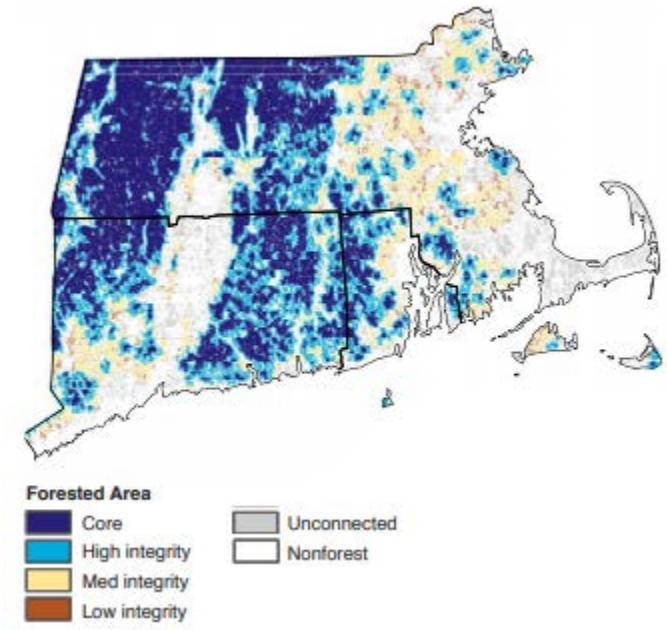
1. **Conserve** and Manage Working Forest Landscapes for Multiple Values and Uses
   Forest landscapes, whether under public or private management, must be conserved to protect landscape functionality, habitat, and environmental benefits.
2. **Protect** Forests from Threats
   Rhode Island's forests face threats on multiple fronts: development leading to the loss and fragmentation, ease of spread of invasive plants and pests/diseases, loss of habitat, loss of economic and environmental benefits, and wildfire risk.
3. **Enhance** Public Benefits from Trees and Forests
   Support and promote the management and retention of forest lands for multiple benefits: water and air quality, carbon sinks and sequestration, temperature moderation, forest products, wildlife habitat, outdoor recreation and human health.

RI SFAP Priority Issues	Conserve	Protect	Enhance
Fragmentation	✓	✓	✓
Water			✓
Fire	✓	✓	✓
Forest health	✓	✓	✓
Climate Change		✓	

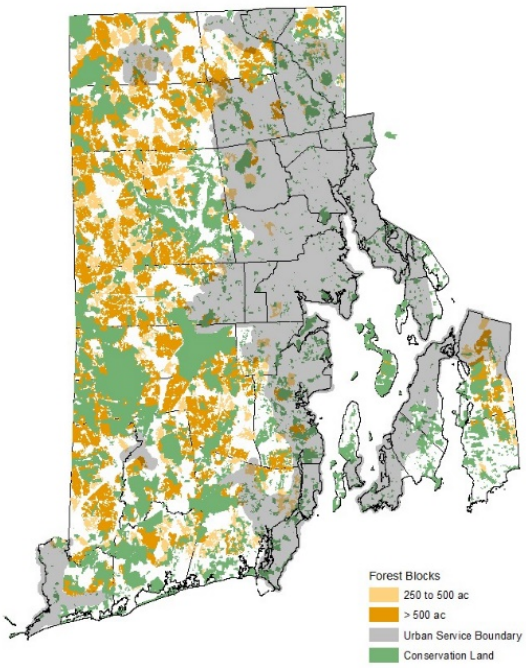
Issue: Forest Loss & Fragmentation

According to a 2015 study, 70% of the world's trees are within 1 km (0.62 miles) of the forest edge. The study authors concluded that "Fragmentation experiments—some of the largest and longest-running experiments in ecology—provide clear evidence of strong and typically degrading impacts of habitat fragmentation on biodiversity and ecological processes." Established well beyond anecdotal observations, "habitat fragmentation reduces biodiversity by 13 to 75% and impairs key ecosystem functions by decreasing biomass and altering nutrient cycles." The impacts of fragmentation are a major threat to the species of greatest conservation need (SGCN) identified and addressed in the RI WAP, and are a consequence of human habitation and infrastructural needs. As populations grow and demand continues to increase, the resulting subdivisions, roads, utility corridors, and transmission installations result in smaller and smaller parcels with less and less connectivity, impacting the movement and subsequent genetic diversity of plants and animals, and removing necessary habitat for species with specific interior forest requirements.

Fragmentation is not only impacting Rhodes Island it is a national and regional issue as well. However, the compact size of the state means that there is less area available that could be retained as core forest (i.e. blocks of unfragmented forest 250 acres or larger), as population density increases:

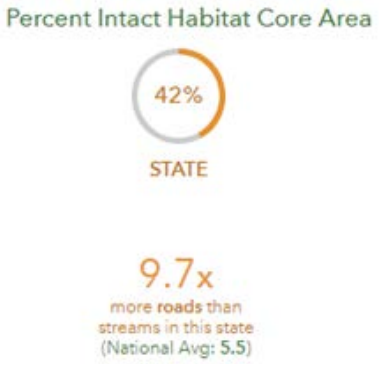


Forest Land Integrity in Rhode Island, Massachusetts, and Connecticut. *Source: The Forests of Southern New England, 2012*



Forest Blocks by Area

The impacts of fragmentation are a major contributor to the number SGCN in Rhode Island. Fragmentation of forests into smaller patches reduces the value of these habitats for forest interior species, which is reflected in the 236 SGCN. The map and text on the right shows the distribution of blocks greater than 500 acres in size and illustrates the degree to which forests have been fragmented in Rhode Island. Not only are the biological process altered, but the economics of forest management, and increase in decision makers, make it more difficult to educate landowners and coordinate management on the landscape.



Source: ESRI Green Infrastructure Strategy

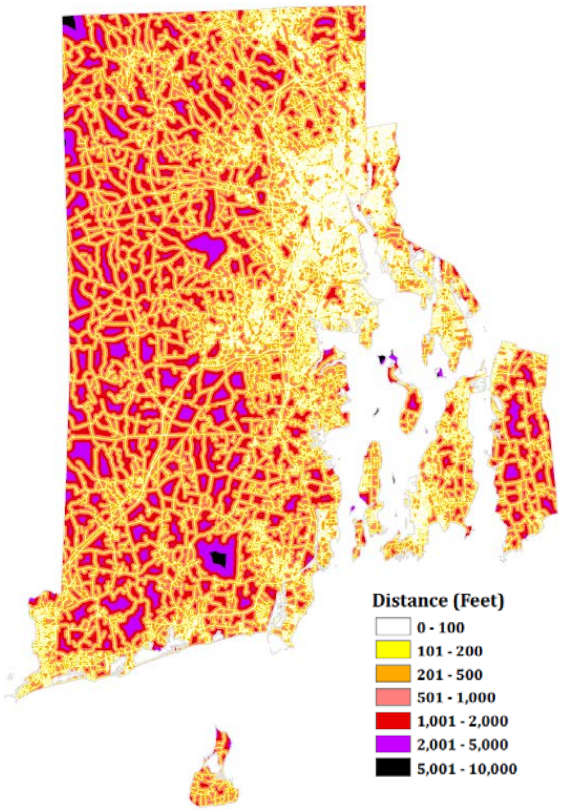
This can cause numerous issues:

- Opening intact natural habitats to invasive species
- Increased wind & erosion potential
- Windthrow on the newly exposed edges of forest stands
- Loss of interior forest species
- Loss of diversity, and
- Economically, can result in forested areas too small to manage for harvest

A 2019 GIS research brief by the University of Rhode Island, Loss of forest in large unfragmented blocks of forest in Rhode Island, identified significant loss of forest within large, previously unfragmented blocks of forest greater than 250 acres. These blocks of remaining core forest were mapped by RIDEM during the preparation of the RI WAP. The URI analysis compared statewide aerial imagery of forest cover in 2011 and 2018. Over the seven-year period, 1,914 acres classified as large, unfragmented forest in 2011 were converted to non-forest use, with most of the forest conversion occurring as small, scattered patches. Moreover, 66% of the forest loss (1,267 acres) occurred within blocks larger than 500 acres, which are particularly valuable for wildlife habitat.

Another way to estimate forest fragmentation is the distance to the nearest road from a given point. URI researchers performed a statewide analysis with RIGIS land use classification data (based on a 30m x 30m pixel) and found that the mean distance to a road in Rhode Island in 2019 is only 613 feet (0.12 mile), with a standard deviation of 702 feet.

Even with a more generous interpretation of a core forest, by including locations more than 2,000 feet from a road, URI researchers found that the only mainland locations where forest blocks are large enough to be more than a mile from a road are found in DEM's Buck Hill and Great Swamp Management Areas as well as land along the Connecticut border.



Distance to Nearest Road
Source: Peter August, Department of Natural Resources Science, University of Rhode Island

PRESSURES CONTRIBUTING TO THE BURGEONING LOSS & FRAGMENTATION OF RHODE ISLAND'S FORESTS:

State Development Trends

As reported by RI Statewide Planning, the conversion of forest land to developed uses in the late 20th century was higher than historic trends, increasing by 43% from 1970 to 1995: developing more residential, commercial, and industrial land during that time than in the previous 325 years. While forest loss generally occurs near urban areas and roads, the trend is changing as pressure to convert forest to residential use continues, and as pressure for the development of renewable energy threatens large forest parcels, even in more rural areas.

Building permits and aerial photography confirm that Rhode Island's recent development continues to follow sprawling land use patterns, and forest acreage continues to decline as land is developed. A USFS

report on forest statistics (1985 and 1998) noted a decrease in timberland area of 9% from 1985 to 1998. A similar decrease between 1998 and 2007 means that Rhode Island had the greatest forest loss in southern New England in that timeframe.

Renewable Energy Demands

The desire for energy independence has also fueled forest conversion. Rhode Island's Clean Energy Goal, calling for 1,000 megawatts of solar energy by 2020, has created a demand for large parcels of land to site ground-mounted solar installations. The 2020 State of the State speech presented a new target: all electric energy from renewables by 2030. The opportunity for forest landowners to derive income from their property is naturally tempting and has broad implications for state forest land.

As of 2019, 150 "solar farm" projects are generating 58 megawatts on 262 acres, a mere 6% of the projected goal. As each megawatt has required an average of 4.5 acres of land, mostly forested, meeting that goal through solar farm installations alone would require an additional 4,239 acres. This would require a significant increase, from historical average rate of land conversion of 838 acres per year. Solar farms are becoming a source of forest loss to achieve Rhode Island's clean energy goals.

Cities/Towns	Solar Farm Projects	Megawatts generated	Total Acres Used
Bristol	6	0.3	1.35
Burrillville	1	0	0
Charlestown	1	0	0
Coventry	1	0.1	0.45
Cranston	9	6.4	28.8
Cumberland	4	1.8	8.1
East Greenwich	1	0.1	0.45
East Providence	8	3.8	17.1
Exeter	2	1.8	8.1
Foster	1	2	9
Glocester	6	0.9	4.05
Hopkinton	3	0.7	3.15
Jamestown	2	0.2	0.9
Johnston	4	1.6	7.2
Little Compton	1	0.2	0.9
Lincoln	4	1.4	6.3
Middletown	12	1.9	8.55
Narragansett	1	0	0
Newport	1	0.3	1.35

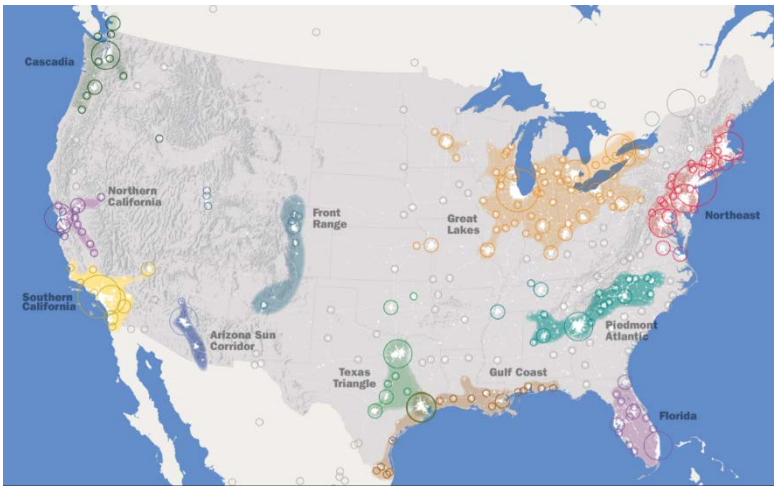
Cities/Towns	Solar Farm Projects	Megawatts generated	Total Acres Used
North Kingstown	8	6.9	31.05
North Scituate	2	1.4	6.3
North Smithfield	6	3.2	14.4
Pawtucket	1	0.2	0.9
Portsmouth	1	0.5	2.25
Providence	25	4.4	19.8
Richmond	4	7	31.5
Scituate	1	5	22.5
Smithfield	3	0.3	1.35
South Kingstown	7	1.4	6.3
Tiverton	2	0.2	0.9
Warren	1	0.1	0.45
Warwick	5	0.4	1.8
West Greenwich	1	2	9
West Warwick	6	1.1	4.95
Westerly	7	0.4	1.8
Woonsocket	2	0.3	1.35
Total	150	58.3	262.35

The Total Number of Solar Projects in Rhode Island by Town, Acres Used, and Megawatts Generated by Project by 2019.

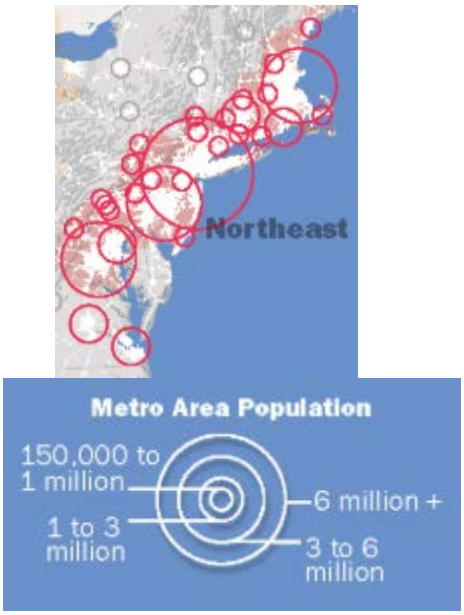
Regional Development Trends

While Rhode Island has not experienced the rapid population growth similar to other areas in the US, according to America 2050, Rhode Island is a part of the Northeast megaregion, stretching from Washington D.C. to Boston, which produces 20% of the nation's GDP with 17% of the population on 2% of the nation's land area. It is predicted that by 2050 that the Northeast will add 17 million new residents over the 2010 census (from 52 million to 71).

The impact in Rhode Island is predicted as being an outward expansion from the edges of existing urban areas, infill of green spaces within urban areas, and continued dispersal of humans and their related development into the smaller communities and forested areas of the state.

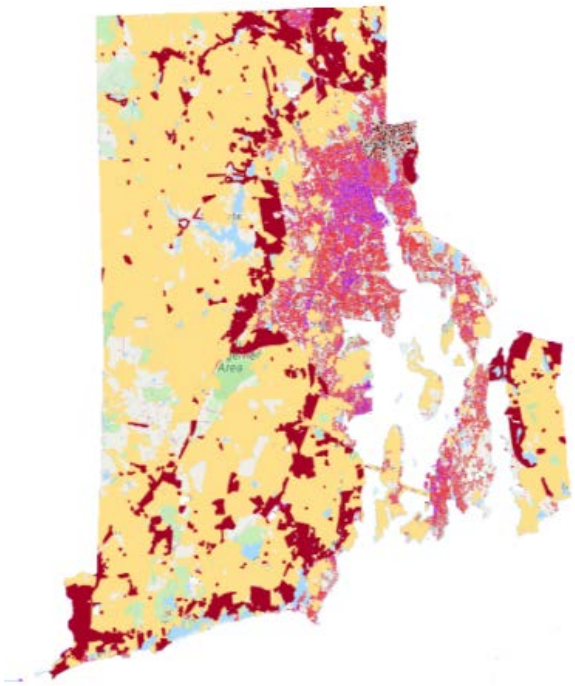


US Megaregions
Source: America 2050



Expansion of Wildland-Urban Interface & Increasing Intermix

The impact on core forest is not the only consequence of fragmentation. While Rhode Island is the 2nd-most densely populated state per capita, the western part of the state is still largely forested. Although parcel size is typically small, and tracts of forest land are surrounded by non-forest uses, the continued encroachment into the forested areas also expands the Wildland-Urban Interface (WUI).



This map, derived from the i-Tree Landscape Tool, shows the Wildland-Urban Interface (WUI) in red and Wildland-Urban intermix in yellow.

Wildland-Urban Interface refers to a distinct area of wildland fuel adjacent to a developed area.

Wildland-Urban Intermix refers to a specific type of wildland-urban interface in which the homes or other structures are intermixed with wildland fuels, scattered or in small groupings.

A comparison of WUI in Rhode Island in 1990, 2000 and 2010, completed by the Silvis Lab in 2013 shows an increase in the area of forest land acres designated as WUI, with an increase in housing units and population. The maps provided under Priority Landscapes (page 53 of this plan) show the change in designation of land between 1990 and 2010.

The number of housing units within the WUI increased by 20% between 1990 and 2010 (below).

HOUSING UNITS		1990	2000	2010	1990%	2000%	2010%
Rhode Island	WUI	114,310	128,646	142,751	27.6	29.2	30.8
	-Intermix	*49,555*	*57,005*	*63,127*	*12.0*	*13.0*	*13.6*
	-Interface	*64755*	*71641*	*79624*	*15.6*	*16.3*	*17.2*
	Non-WUI	300,262	311,191	320,637	72.4	70.8	69.2
	TOTAL	414,572	439,837	463,388			

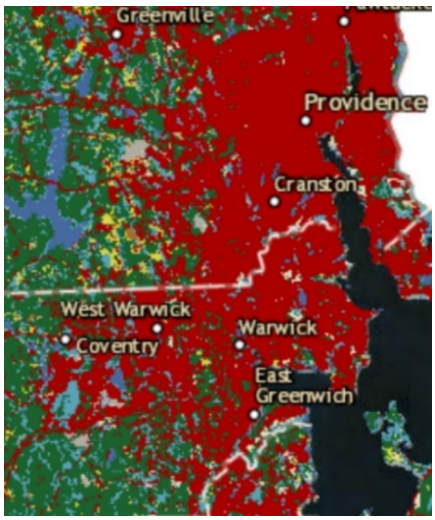
Meanwhile, in that same period, while the overall state population increased by only 5%, the population within the area designated as WUI increased by 12% (below).

POPULATION		1990	2000	2010	1990%	2000%	2010%
Rhode Island	WUI	289,689	316,066	327,152	28.9	30.1	31.1
	-Intermix	*130,658*	*147,034*	*151,766*	*13.0*	*14.0*	*14.4*
	-Interface	*159031*	*169032*	*175386*	*15.8*	*16.1*	*16.7*
	Non-WUI	713,775	732,253	725,415	71.1	69.9	68.9
	TOTAL	1,003,464	1,048,319	1,052,567			

As the table below further shows, the area assessed as WUI also increased during that time, meaning not only were more people moving into forested areas, but development was occurring in new areas of forest land. This trend has continued past 2010, and is a likely contributor to the fragmentation of the largest blocks of contiguous forest (>500 acres) reported in the RI WAP.

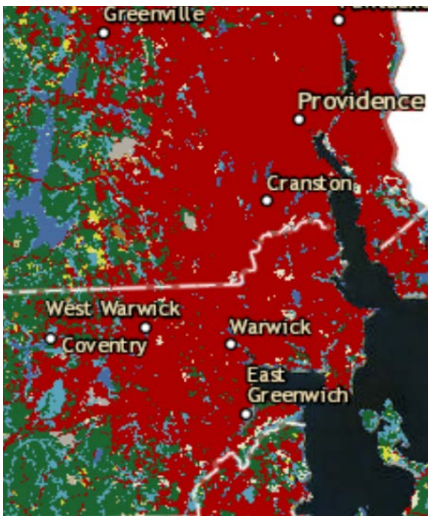
AREA (square km)		1990	2000	2010	1990%	2000%	2010%
Rhode Island	WUI	1,514	1,580	1,634	37.8	39.5	40.8
	-Intermix	*1,299*	*1,343*	*1,376*	*32.5*	*33.6*	*34.4*
	-Interface	*215*	*237*	*258*	*5.4*	*5.9*	*6.4*
	Non-WUI	2,487	2,421	2,368	62.2	60.5	59.2
	TOTAL	4,001	4,001	4,001			

Predictive models of future development, such as the ESRI Green Infrastructure Strategy, use imagery that is rather coarse (30m pixels) to communicate change in Rhode Island. These models do not show change within the Wildland-Urban Intermix well, but they can show the expected development in the Wildland-Urban Interface. The ESRI predictor compares changes between aggregated 2011 National Land Cover Database land cover categories with similarly aggregated land cover categories from The Clark Labs 2050 Conterminous US Land Cover Prediction.



2011

These models for future development predict the continued loss of forest, showing continued expansion from existing high-density areas in the eastern part of the state, and infill of many remaining green spaces in urban Rhode Island. Unfortunately, the 30m scale is too coarse to realistically capture/predict change in the western part of the state.



2050

Source: ESRI Green Infrastructure Strategy

Issue: Forest Health

Forest health is a broad term that can refer individually or comprehensively to the health and condition of forest types, forest succession, wildlife habitat, invasive plants, pest and disease concerns, fire fuel conditions, and future state. Forest health, through the lens of forest management, can be considered a condition where forest ecosystems sustain their complexity while, at the same time, provide for human needs.

By their very nature forest ecosystems are in a constant state of change. Even healthy forests are continually disrupted:

- Ice and snow break tree branches, destabilizing structure or opening trees to decay.
- Strong winds topple trees providing new material to decay into the soil, opening the understory to increased sunlight, releasing suppressed trees, and allowing dormant seeds to germinate.
- Native and non-native insects and diseases stress trees, resulting in decline and, often, mortality.
- Invasive plants often outcompete native species for growing space, soil nutrients and water, affecting wildlife habitat and food sources.
- Fires can disrupt forest successional stages, resetting the forest to earlier stages; or fire can revitalize ground cover and understory, enhancing habitat and plant biodiversity.

As the forest flora changes, fauna respond to the new conditions and either adapt in place or migrate in response to altered conditions. Some wildlife populations thrive, others decline or perish. Human activity is an additional complication to the ebb and flow of forest conditions and "health": plats are plotted and developed, resulting in fragmentation of continuous forest land; passive to intensive recreation, while encouraging an appreciation of a forest's values, leave a distinct, and sometimes, damaging footprint on the land. Forest ecosystems are resilient and able to withstand or recover from such disruptive events provided they don't threaten the sustainability of the ecosystem itself.

Pests and diseases, invasive plants, and wildlife habitat are not only elements reflective of forest health, but they are further impacted by fragmentation. In fact, humans are the leading contributor to the spread of forest pests and diseases, exotic invasive plant species, and degradation or destruction of wildlife habitat:

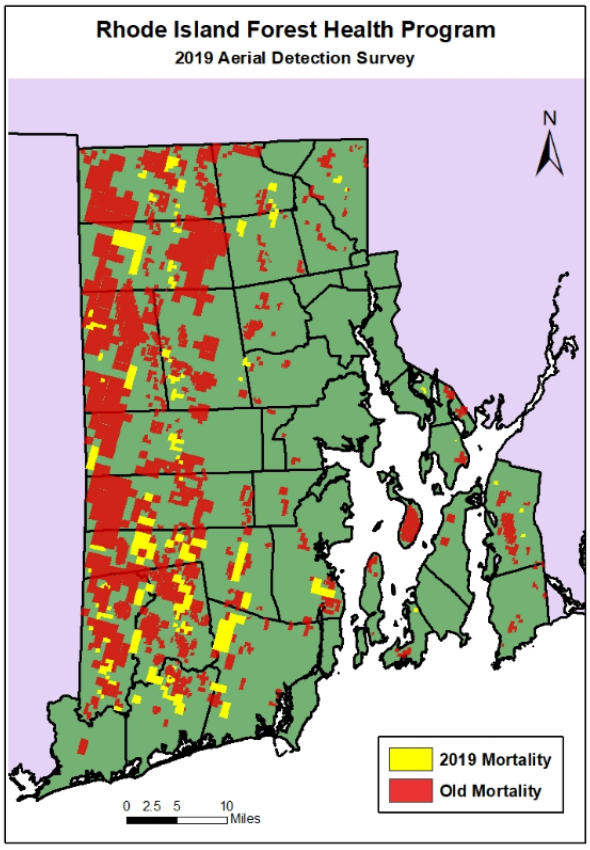
- movement of commercial goods
- transportation of firewood
- movement of plant material
- transportation corridors
- development

These are only a few of the mechanisms that contribute to often catastrophic impacts on forest health, forest structure, and stability. Eons of localized stand equilibrium, forest succession, structure and habitat can be undone with a single shipment of infested packing materials, infested plant material, soil, or seeds, which may ultimately disrupt entire ecosystems. Movement along transportation corridors increases ease of movement and migration of invasive species, while development and construction interfere with native plant and wildlife movement, gene flow, and resiliency.

INVASIVE INSECTS & DISEASES

Native insects and diseases are a normal part of healthy forests, but the introduction of non-native insects and diseases (even earthworms) can have devastating effects on forests. During the past 100 years, the forests of Rhode Island have been impacted by gypsy moth, chestnut blight, Dutch elm disease, hemlock woolly adelgid, and now emerald ash borer. Other non-native invasive insects, currently not present in Rhode Island, are being monitored for their spread and inevitable arrival.

Given the size of DFE with a field staff level of 11, and only one staff person within Forest Health, the capacity of the state to respond/react/treat pest and disease issues is limited. In addition, even if staffing and funding levels were suitable for the forest management needs of DFE, some actions would still not be considered appropriate, such as widescale insecticide treatment for gypsy moth. The programmatic capacity to address Forest Health is focused on meeting the requirements of the USDA Cooperative Grants Program and relies on in-state partners to assist with delivery, mainly RIDEM Division of Agriculture and the University of Rhode Island.



Aerial detection surveys are flown yearly, as needed and where budget exists. Surveys in 2019 showed mortality expanding the over 45,000 - 50,000 acres impacted by gypsy moth (2014-2018), nearly 14% of Rhode Island's forest land. Contributing factors to that continued mortality include two-lined chestnut borer, forest tent caterpillar, and residual pockets of gypsy moth. Ash mortality due to emerald ash borer is expected in future years but, due to its distribution in natural areas in Rhode Island, is not expected to have the obvious mortality margins of gypsy moth outbreaks.

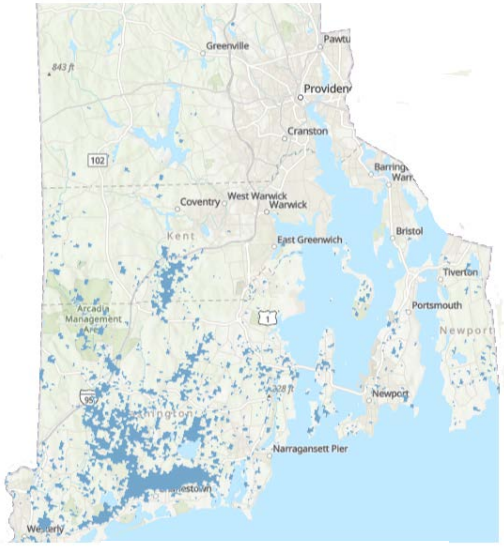
Insect Pests of Continuing Concern

Gypsy Moth *Lymantria dispar*

Gypsy moths remain as permanent residents within eastern forests and will continue to reach outbreak status periodically. Changes in seasonal weather patterns and precipitation amounts will have the greatest impact on the periodicity of outbreak occurrence. Cool April temperatures and sufficient precipitation to support the life cycle of *Entomophaga maimaiga,* a fungus that kills gypsy moth caterpillars, are necessary to maintain gypsy moth at low population levels. However, additional stressors to trees, particularly chronic ones such as drought, will continue to increase tree mortality where repeated defoliation occurs.

Southern Pine Beetle *Dendroctonus frontalis*

Trapping for the SPB continues with variability in collection numbers observed from year to year. In 2019 there was a significant reduction (92 beetles in 2018, 1 in 2019) but concern remains that an endemic population exists and has the potential to reach outbreak status. Not only will warming temperatures provide conditions conducive for SPB outbreak, but they may also contribute to chronic stress factors to Rhode Island's pitch pine (*Pinus rigida*). URI continues to collect other species of concern, as well as predators of SPB.

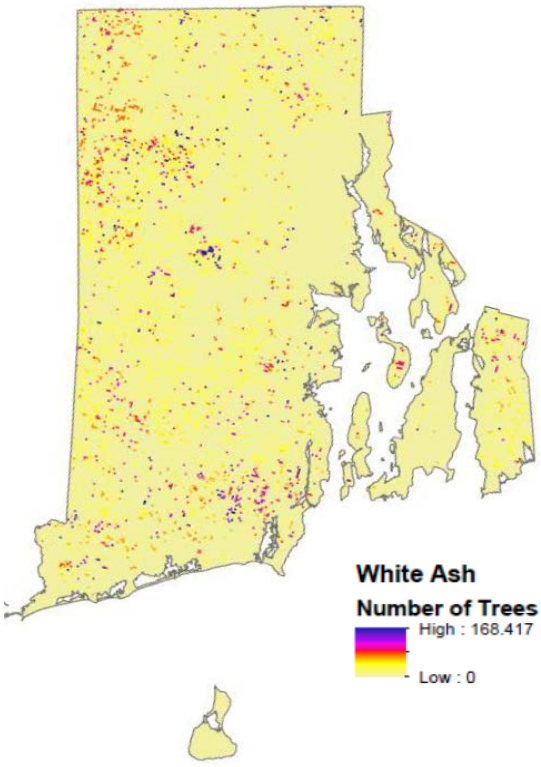


Pitch Pine Distribution
Source: Lisa Tewksbury, URI

Emerald Ash Borer *Agrilus planipennis*

Adults were found in Rhode Island in 2018 and larvae in 2019. Given the prognosis for the spread of this pest, treatment is not a feasible option for forest trees. Individual landscape trees and trees deemed significant by the owner/manager may be suitable for prophylactic treatment for long term management. DFE provides information regarding the options on the Forest Health webpage. Workshops and educational sessions for the public, communities, and green industry professionals are ongoing. Surveying and monitoring activities, mainly trapping with baited and unbaited traps, and *Cerceris fumipennis* (no common name) biosurveillance, also occur as appropriate to help determine the location and extent of the EAB population and direction of spread.

2018 FIA data indicates that there are nearly 1.4 million ash in Rhode Island, mainly comprised of white ash (1.3 million), plus green and black ash. Over 600K of those trees are less than 3" dbh. Information on ash trees in urban areas is limited to anecdotal observations of tree species planting selection. (Urban FIA data collected over 200 plots (1/2 a full cycle, 2015-2018) in Providence tallied 2 white and 2 green ash, which may not indicate municipal and private exposure to EAB at the time of this report).

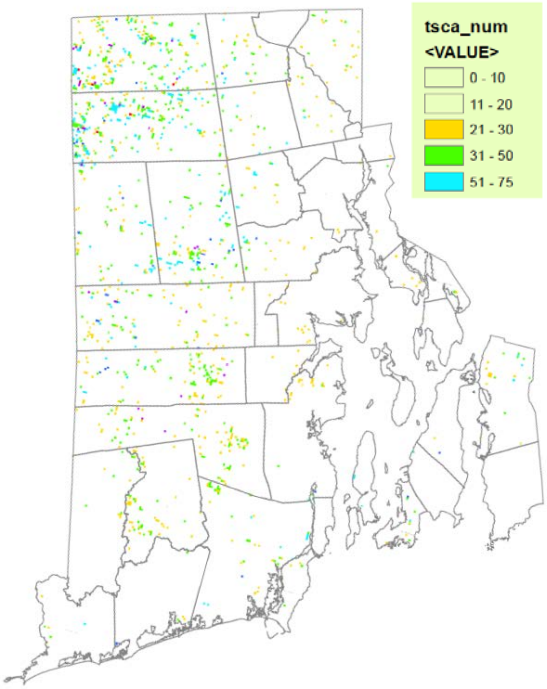


Ash Species Distribution
Source: FIA data

Hemlock woolly adelgid *Adelges tsugae*

First confirmed in Providence and Washington Counties in 1986 and Newport County in 1993, HWA is established through the southern and eastern range of Eastern hemlock and has made its way to southern ME, NH and VT. In Rhode Island, little has been done since initial insect predator research releases in the early 2000s. The hemlock population is scattered, with the largest population in the northwest of the state, including state lands at George Washington State Management Area and Campground.

Continued predatory insect research, and release and recapture of west coast native lady beetle, *Laricobius nigrinus*, from GA to MA suggests that there may be opportunities to revisit this issue. Since HWA thrives on stressed urban trees, a predator population would have a beneficial impact, reducing HWA population levels on individual, as well as forest, hemlocks.



Eastern Hemlock Distribution
Source: FIA data

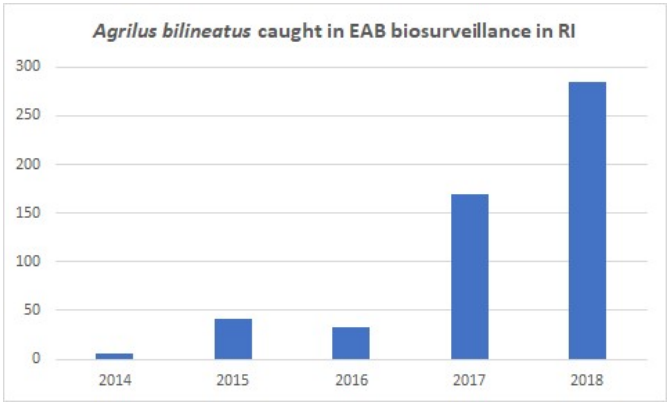
Winter Moth *Operophtera brumata*

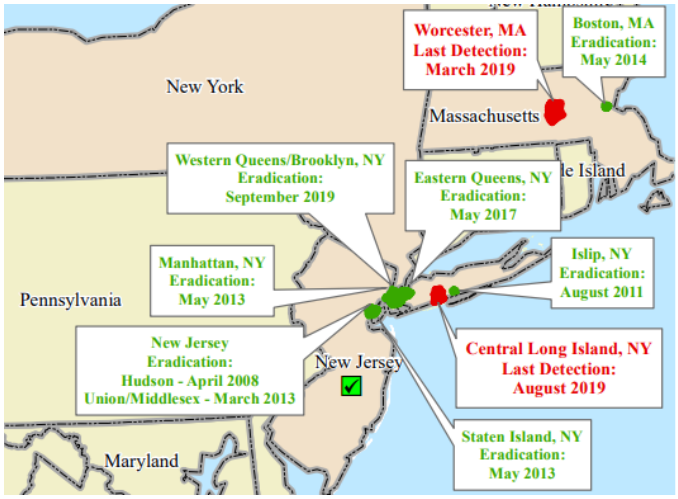
Recent years have seen a reduction in the occurrence of Winter Moth with much of the credit going to the release of a parasitic fly, *Cyzenis albicans*, 2011-2017, and as an increase of native predators and parasitic insects. Recently, URI's monitoring program is been finding it difficult to find areas with sufficient winter moths to trap and monitor. While this pest remains on the list of pest concerns in Rhode Island, the hope is that outbreaks will be localized and of short duration due to a rapid buildup of established predatory insects.

Source: Heather Faubert, URI

Monitored Insects of Concern

- Two-lined chestnut borer (*Agrilus bilineatus*) –
  may be contributing to post-gypsy moth outbreak mortality, specimens collected from EAB biosurveillance program increased during the 2017-2019 seasons.
- Forest Tent caterpillar (*Malacosoma disstria*) –
  populations rise and fall as does public concern; identifiable mortality during aerial detection surveys is periodically reported.
- Orange-striped oakworm (*Anisota senatoria*) –
  skeletonized leaves on host species in Providence & Kent counties occurred in 2019, but no mappable areas of defoliation/mortality were observed.
- White pine weevil (*Pissodes strobi*) –
  is not specifically tracked, however monitoring bycatch data suggest that populations of *Pissodes spp.* are robust; understory white pine recently released due to oak mortality may see impact in future years.
- Monitoring continues for: Cynipid gall wasp (*Bassettia ceropteroides*), Black Turpentine Beetle (*Dendroctonus terebrans*) and the exotic invasive Asian longhorned beetle (ALB) (*Anoplophora glabripennis*)





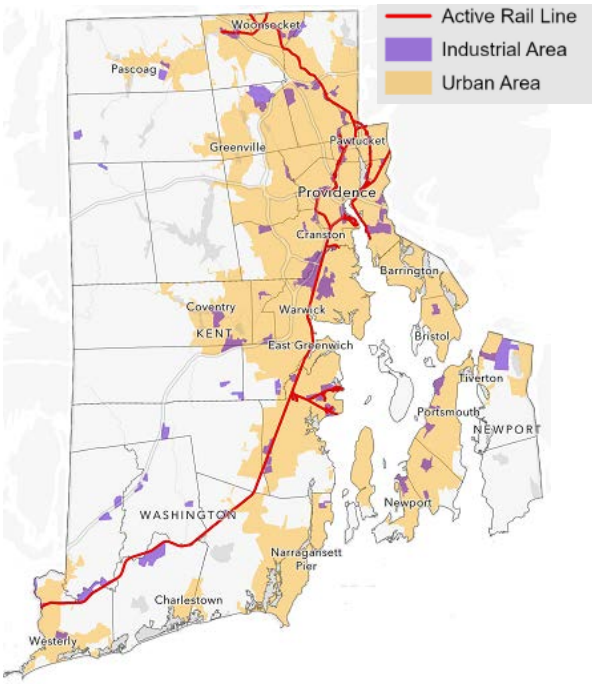
Status of Asian Longhorn Beetle Spread and Control

Source: 2019 National ALB Program Overview

Anticipated Pests

Spotted lanternfly (SLF) (*Lycorma delicatula*)
While still only documented in mid-Atlantic states, DFE, in partnership with the Division of Agriculture has begun educating itself about SLF. SLF's impact on agricultural plants (hops, grapes and fruit trees) is a concern, but the degree of impact on forests and forest species is less clear at this time. There is a high likelihood that SLF will create a nuisance factor in residential and urban areas, requiring DFE engagement/education of the Forest Health, Stewardship, and Urban Forestry Programs.

The preponderance of the preferred host, *Ailanthus altissima*, particularly along railway lines (and former railway lines) provides a corridor for population expansion through the eastern/central portion of the state.



Transportation corridors and industrial areas conducive to transportation and introduction of invasive pests, plants and diseases, particularly spotted lantern fly.

Monitored Diseases of Concern

Monitoring/awareness continues for:

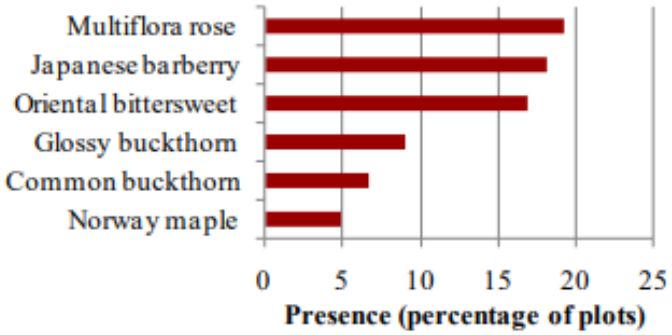
- Rhizosphaera Needle Cast (*Rhizosphaera kalkhoffii*) – a disease of spruce, commonly seen on stressed landscape trees.
- Oak anthracnose (*Apiognomonia errabunda*) – periodic; associated with wet springs that promote *Entomophaga maimaiga.*
- Beech bark disease (*Nectria coccinea* var. *faginata* or *Nectria galligena* vectored by *Cryptococcus fagisuga*) – present throughout the state but limited in number of trees affected and observed mortality at this time.
- White pine blister rust (*Cronartium ribicola*) – considered nearly eradicated in the eastern US, has seen a resurgence and is a rising concern; understory white pine recently released due to oak mortality may see impact in future years.

INVASIVE PLANT SPECIES

Invasive pests and diseases can thrive because of either: 1) a lack of genetic resistance or evolved response tactics by native local species to attack and infestation; or 2) a lack of predators or organisms that can attack and overcome introduced pests. Invasive plant species, on the other hand, typically outcompete native species through processes that include high seed yield and seed movement, seed banking, allelopathy, clonal growth, and aggressive rooting. These processes give invasive plant species a competitive advantage in the fight for colonization, growth, and dispersal. Invasive plants can overwhelm native plant communities and reduce biodiversity of the native plants and the wildlife that relies on them – especially when an area is disturbed, cleared, or developed – and can have significant ecological and economic impacts. Land development, urbanization, and fragmentation exacerbate the introduction and spread of invasive plants.

In 2015, almost half (48%) of all invasive species identified in the RI WAP were associated with forest edge habitat and were listed as threatening Rhode Island's key habitats. Included was information from the report Identifying relationships between invasive species and species of greatest conservation need, which identified 238 non-native species with the potential to adversely impact species of greatest conservation

need (SGCN) in the Northeast, and 68% of these were invasive. According to the Forests of Southern New England, 2012, the most common invasive plants in the southeastern New England region are multiflora rose, Japanese barberry, and Oriental bittersweet. Between the 2007 and 2012 FIA reports, 19% of regional monitoring plots noted an increase in occurrence: multiflora rose and Oriental bittersweet each increased by 8%, and Japanese barberry, 5%.



Presence of the six most common invasive plant species found on invasive monitoring plots, Southern New England, 2007-2009. *Source: Rhode Island's Forest Resources, 2010*

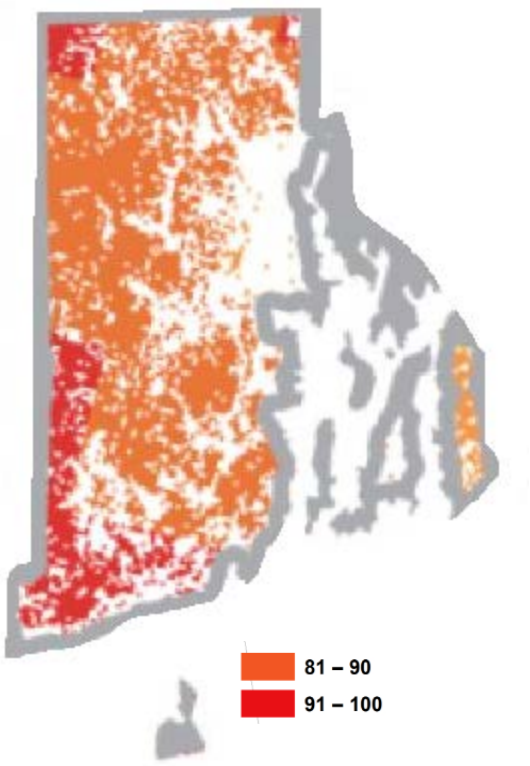
WILDLIFE HABITAT

Healthy forests are not solely determined by tree or stand heath. As previously mentioned from the RI WAP, the state's varied soil, vegetation, and hydrology support plant communities that support a wide range of wildlife, many of which utilize forest habitat for at least some portion of their life cycle. Whether generalists or specialists, the largest forested tracks, or core forests, support the greatest biodiversity of species throughout the forested landscape. Even with increasing fragmentation, retaining green corridors connecting these core sites can play a crucial role for the sustainability of wildlife populations.

The lack of age class diversity also affects wildlife, particularly those species dependent on early successional habitat, such as the New England Cottontail. The RI WAP estimates less than 4% of forest land is in the early successional stage (the RI WAP included shrubland in that calculation, in addition to young stands 0-20 years). Natural disturbances, like severe storms, do not create early successional habitat on a regular basis to support SGCN wildlife species, like New England Cottontail. Birds associated with early successional communities, including grasslands, scrub-shrub habitats, and young forests, have also declined. Several bird species, including: northern bobwhite, American woodcock, prairie warbler, and field sparrow, are listed in the 2019 Partners in Flight (PIF) assessment as being on the Continental watch-list for concern or decline due to a lack of early successional habitat. In contrast, according to the Guidelines for Managing Wood Thrush and Scarlet Tanager Habitat in the Northeast and Mid-Atlantic Regions, wood thrushes and scarlet tanagers do best in forested blocks of over 250 acres and "consistently reach their highest breeding densities in mature to old forests that are dominated by hardwoods and contain a mix of large and small trees."

Fragmentation is the main reason for habitat degradation, dividing large contiguous areas of forest into smaller patches, increasing edge habitat and reducing interior habitat. This loss of ecological integrity not only has a negative impact on certain species, but also subjects the core area to deeper penetration of predatory and/or parasitic species (e.g. blue jays, brown-headed cowbirds, cuckoos). Few areas in Rhode Island contain core habitats large enough to support the full complement of expected species and natural ecosystem processes, which is reflected in the decline of forest interior species. The increasing number of landowners and collective small parcel size makes management for species that require large tracts of forested habitat difficult. RIDEM has prioritized the acquisition of large tracts of forest land as well as parcels adjacent to existing State-owned Wildlife Management Areas to address this concern.

Landowners who actively manage their forest land can be benefit wildlife by creating a range of forest types and age classes distributed across the landscape. A partnership of organizations including the Natural Resources Conservation Service (NRCS), RIDEM, RIFCO, and RI Tree Farm Committee provide financial and technical assistance to create and manage forest habitat for the needs of a variety of species, committed to increasing the abundance of young forests and early successional forests across the forested landscape in Rhode Island.



Probability of Occurrence (%) for Moderate or High Ungulate Browse Impacts on Forest Land, Midwest and Northeast, 2017
Source: Subcontinental-Scale Patterns of Large-Ungulate Herbivory and Synoptic Review of Restoration Management Implications for Midwestern and Northeastern Forests

WHITE-TAILED DEER

One particular concern for overall forest health and future forest cover composition is herbivory. White-tailed deer (*Odocoileus virginianus*) are highly adaptive to fragmentation, thriving in the wildland-urban interface. The spreading of suburban landscapes and increasing fragmentation of forests combined with the long-ago extirpation of most natural predators and a decrease in hunting has caused an increase in white-tailed deer populations. In western Rhode Island, deer densities of 15-20 per square mile are common, although higher densities may occur in some areas where hunting access is limited. An overabundance of deer can have a negative impact on forest vegetation since an individual deer can browse between 5-9 pounds of food a day, including tender shoots, buds, twigs, and leaves of trees and shrubs.

A 2017 USFS study looking at ungulates and forest management implications noted that Rhode Island forests have a high probability of forestland with moderate or high deer browse impacts. The study indicated that forest type most subject to high deer browse was oak-hickory of which 61% of Rhode Island forest is composed. Deer browsing preferences have been studied for many years and is well-documented. An increase in tree species unpalatable or of low-preference to deer would have a significant impact on forest composition and habitat characteristics.

Addressing the impact of browse on regeneration may require silvicultural practices that are not commonly used in Rhode Island, as forest management typically practices clearcutting and rely on natural regeneration. In addition, evidence indicates that there are other factors which may be as significant in species composition, such as fire suppression and the resulting forest densification, as noted in the 2019 study, Does white-tailed deer density affect tree stocking in forests of the Eastern United States?. Once again, reminding forest managers of the complexity of interactions, causes and effects, and the implications of decisions that play out to unexpected consequences over time.

A 2019 Landscape Scale Restoration grant was awarded for a multi-state, multi-partner effort (MA, RI and CT): *Increasing Resiliency in Southern New England Oak Forests*. This project will address deer browse while looking at the various aspects of forest health and managing for resilience. The project is discussed in the Multi-State Priorities further in this document.

Issue: Water

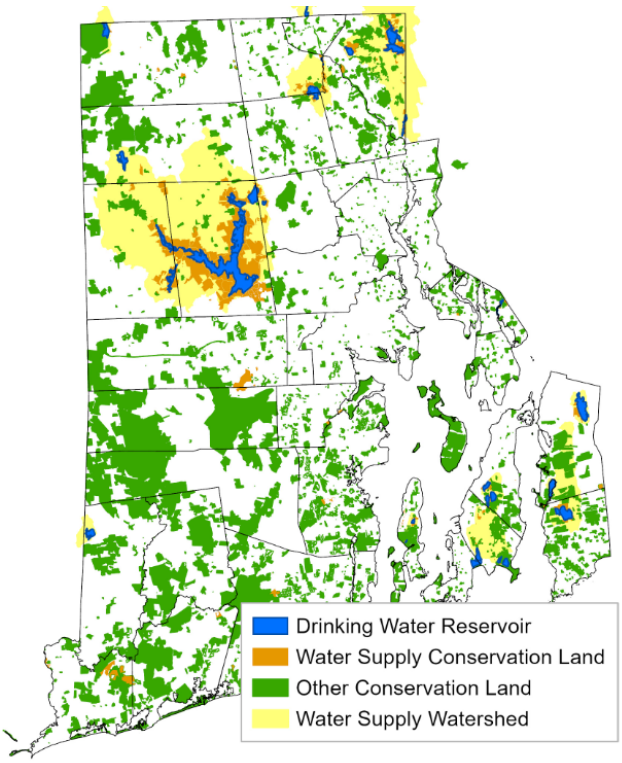
Water is of particular interest and concern in Rhode Island, whether large (or small) inland waterbodies, waterways and wetlands, or Narragansett Bay and salt marshes. Water quality and stormwater management affect all residents and habitats, human and wild. A USFS 2009 analysis of 540 large watersheds ranked several of Rhode Island's watersheds as having some of the greatest development pressure on private forests important for drinking water supply in the east: Blackstone, Pawtucket-Wood, Narragansett, and Quinebaug.

In addition to providing a safe drinking water supply, protecting clean water is critical to maintaining Rhode Island's aquatic ecosystems, fish and shellfish populations for safe consumption, and safe water recreation opportunities. The federal Clean Water Act requires states to create water quality standards and monitor and report on water quality conditions in the state. The RIDEM's Office of Water Resources (OWR) monitors and reports on:

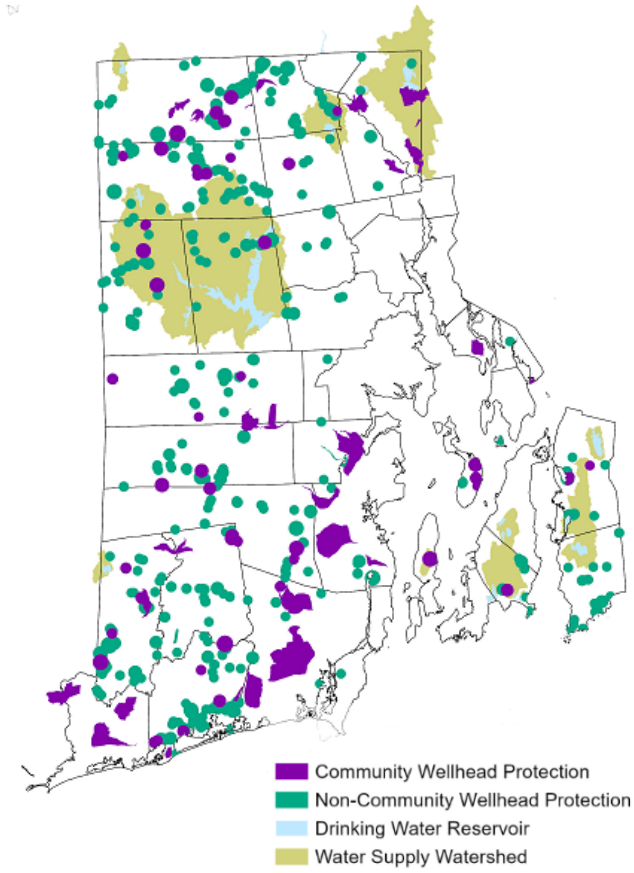
- 1,420 miles of rivers
- 20,749 acres of lakes and ponds
- More than 15,000 acres of freshwater swamps, marshes, bogs and fens
- 72,000 acres of forested wetlands, and
- 159 square miles of coastal waters like Narragansett Bay estuary and coastal ponds.

Rhode Island is home to some of the US's first public water systems. These systems were expanded in size and scope of their operations as the populations in the area they served grew – this is no longer feasible due to increased private land development. Other large public water suppliers now rely on the Providence Water Supply Board (PWSB) as a water source due to contamination from intensive land use activities. Although it was never intended to be the single source supply for the state, the Scituate Reservoir of the Providence Water Supply Board (PWSB) water system now provides water to the metropolitan areas of the State (600,000 persons or about 60% of State's residents) either directly or through other utilities purchasing water from the PWSB.

The Scituate Reservoir watershed's drainage area is about 60,000 acres. The PWSB controls 28% of the watershed (including 12,000 acres of managed forestland), the rest is privately owned. The watershed is subject to development pressure due to its proximity to Providence. The PWSB works to acquire critical parcels of land within the watershed to ensure important watershed resources are protected. Since less than a third of the land in the watershed is protected, stewardship of the remaining land by private landowners is identified as critical by the Forest Legacy Program. In 2019, the state received a grant through the Forest Legacy Program to focus on easements on the Scituate Reservoir Watershed. The grant application identified 716 acres on 14 targeted properties.



The Scituate Reservoir was never designed to be serve as the main source of supply for over 50% of Rhode Island's residents, but there is no large-scale alternative since the EPA prohibited construction of the Big River Reservoir in 1989. Initial efforts to



develop an alternative water supply by constructing a reservoir was determined by the EPA to likely cause serious environmental damage. The Big River Reservoir land (about 8,000 acres) was designated as open space by the Rhode Island Legislature. This land is protected and cannot be sold or developed except for the development of wells and well sites for the distribution of drinking water.

According to the EPA's Safe Drinking Water Information System (SDWIS), as of 2017 more than 80% of the 1.06 million people living in Rhode Island rely on surface reservoirs for clean drinking water. With few exceptions, the rest of the population relies on groundwater. Most of the State's groundwater is considered suitable for drinking water use. Four groundwater aquifer systems of the State have been classified as Sole Source Aquifers by the EPA, since they serve as the principal source of drinking water for an area and no other water supplies are available. About 26% of the state's population depend on other public water sources for their water supply and there is a total of 490 public water supply systems ranging in size from small rural residences to 28 major suppliers.

WATER QUALITY

Forests act as a water filter as surface and subsurface water flow moves over and through soil into wetlands, creeks, and ponds, rather than across asphalt and concrete where the water picks up oils and pollutants before flowing into Rhode Island's waterways. This does not only affect those waterways: a 2002 study by the Trust for Public Land and the American Water Works Association found that for every 10% increase in forest cover in the source watershed, treatment and chemical costs decreased by about 20%. Similarly, a study of the High Rock Lake watershed in North Carolina showed water treatment costs trending lower in watersheds at least 70% covered in forest. A 2014 article in the Journal of the American Water Works Association discusses how protecting and sustainably managing forested watersheds makes economic sense as a strategy for water that complements traditional infrastructures by reducing costs and, in some cases, even opening new funding streams.

Currently, OWR has enough data to assess water quality in 65% of the river miles, 77% of the lake acres and nearly 100% of the estuarine waters. OWR's 2018 Impaired Waters Report identified 96 named water bodies as "impaired". For example, multiple junctures of the Blackstone River where it flows through Pawtucket, Central Falls, Woonsocket, North Smithfield, Cumberland, and Lincoln have been designated "impaired" due to the presence of lead, mercury in fish tissue, and fecal coliform (among other pollutants), rendering it unsafe for drinking, fishing, wildlife habitat, and recreation.

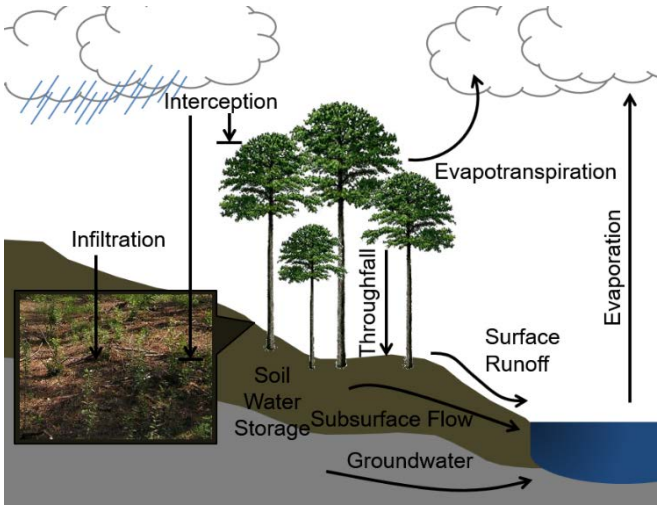
Forests play a monumental role in both water quality and stormwater management, filtering and protecting the water supply, and all other waters, for all residents in Rhode Island. Forest fragmentation and loss to development and other land uses is a major contributor to water availability and quality concerns. The impact of water quality and availability on wildlife habitat and species diversity, whether salt or fresh water,

is a significant management issue discussed throughout the RI WAP. Whether the concern is a physical loss of pools, streams, wetlands, or a degradation of the quality of those waters, the impacts on wildlife and plants is of importance to maintaining a healthy and resilient landscape.

STORMWATER

Forests and other natural and well-managed working lands also play a significant role in stormwater management, slowing the rate of water flow into waterways and into built stormwater management infrastructure by intercepting rainfall, reducing rainfall intensity, and increasing storage capacity of soil. Trees and vegetation slow and redirect waterflow through multiple mechanisms, reducing peak flows by:

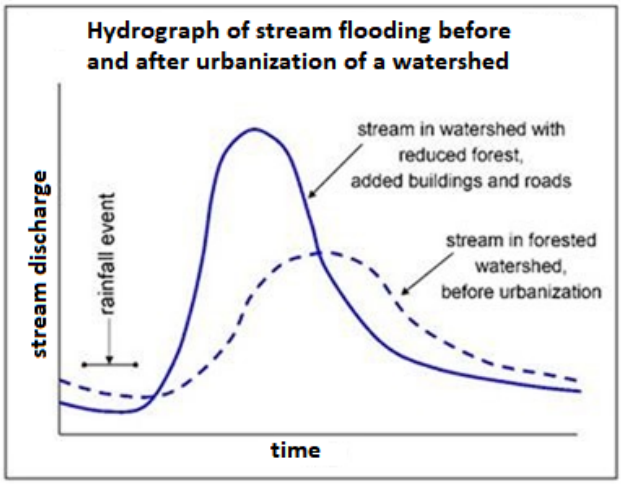
- Interception by the crown, branches and trunk reduces amount of precipitation reaching the ground
- Throughfall is slowed so it impacts the ground with less speed and more opportunity to infiltrate
- Pervious soils allow infiltration and subsurface flow into waterways



Precipitation Movement in the Landscape
Source: How Trees & Forests Really Affect Stormwater

In fact, a one-acre parking lot releases 36 times more water than one acre of forest (Changing Landscapes, USDA NA–TP–01–14 A3, page 6). According to the USFS, 100 mature trees can intercept and filter over 100,000 gallons of rainfall per year in their crowns, reducing the need for expensive stormwater controls and

Simply by slowing the rate of flow, forests protect water. As we see changes in amounts and seasons of precipitation, forests mitigate those impacts. Increased volumes of water, either in single events or multiple events occurring within narrow timeframes, can result in:



Source: Lehman College

- Increased flooding, making 50- and 100-year floods more common
- Increased velocity of water flow, eroding soils and streambanks
- Decreased water quality from surface flows carrying pollutants and high amounts of soil particles.

Trees and green spaces in urban areas can also make significant contributions to stormwater management where planning and management maximize impact.

As summarized Oct 2016 in Stormwater (Journal for Surface Water Quality Professionals):

- "Open-grown trees, as found predominantly in municipalities, generally have greater leaf area than comparable sized trees grown in forested stands. Because of this, municipal trees have been shown to retain greater rainfall volume than trees in forests."
- "Coniferous trees (i.e., pine) tend to retain greater volumes than deciduous trees."

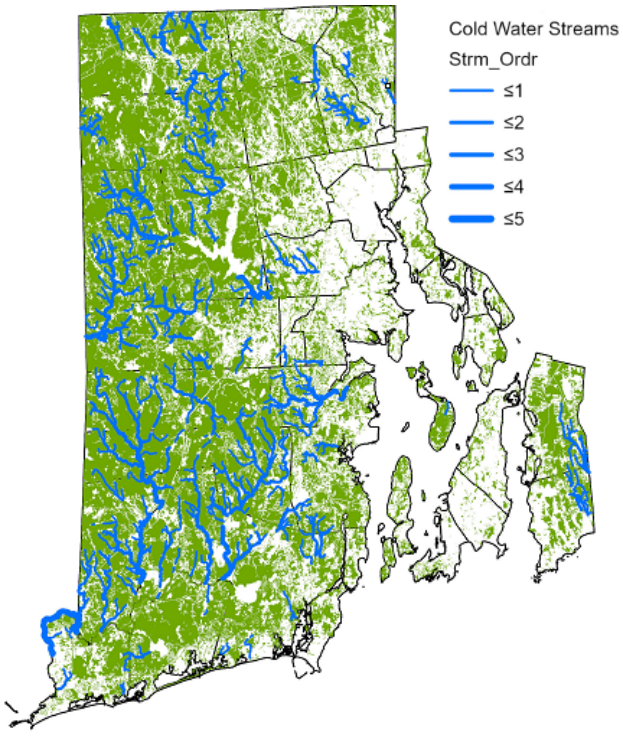
- "Urban trees have been shown to retain from 20% of the annual rainfall where rainfall volume and intensity can be great, such as in the southeastern United States, to as much as 80% in regions with relatively light rainfall intensity and volume, such as in the Pacific Northwest."

WATERWAYS

The RI WAP identifies the conditions of, and threats to, waterways in Rhode Island and their value and use for wildlife. Waterways of all sizes and characteristics are necessary to provide the aquatic habitat needed for resilient and diverse populations of plants and animals. Besides the benefits that forests provide by filtering and slowing water entering these waterways, the forests also contribute other essential qualities.

1. Shade – the cooling effect provided by canopy cover along and over streams is very important to regulate water temperatures needed for habitat and life-cycle completion needs, as well as basic survival by maintaining oxygen levels. In Rhode Island, obligate cold-water stream species (like the native brook trout) are threatened by warming waters.
2. Food – leaves, flowers, seeds, droppings from tree canopies, and insects, can enrich the water and provide suitable nutrients for decomposers at the base of the food chain
3. Cover – branches, leaves and even the occasional limb or trunk contribute to a varied environment that can support a variety of organisms, insects, fish and other wildlife.

The majority of cold-water streams in Rhode Island are located in traditionally forested landscapes where obligate cold-water stream species, like native brook trout, are threatened by warming waters. Maintaining tracts of forest land protects the values and conditions needed to maintain living and vital waterways.



Distribution of Cold Water Streams Within the Protected Surroundings of Rhode Island Forests.

SOIL

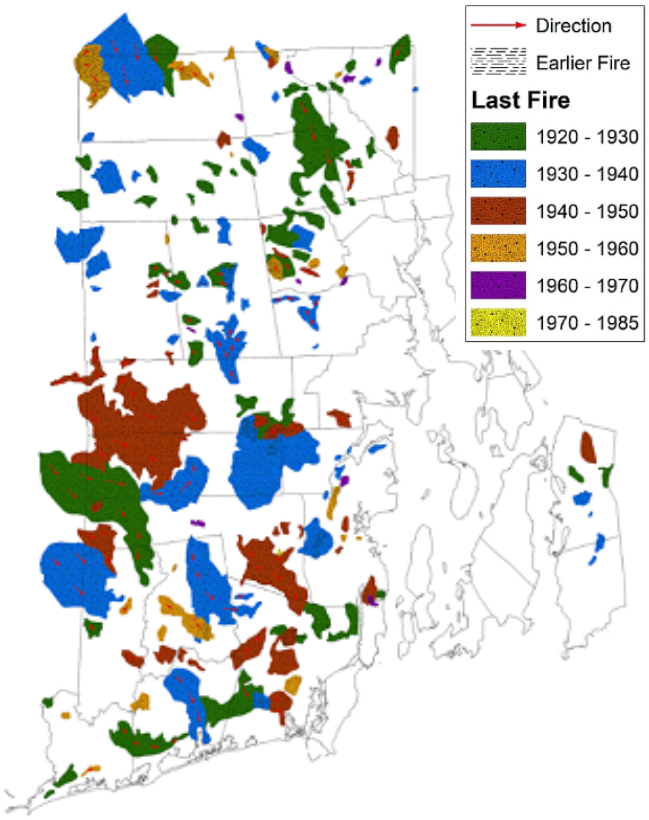
While the impact of fragmentation on Rhode Island's forests and habitats has been discussed previously, the source of that fragmentation has deeper implications for water quality, stormwater management, waterway health, and for forest health itself.

The replacement of these soils with impervious surfaces and the redirection of water movement, whether to built stormwater management or by changes due to grading, fill, or other reasons, affect the forests themselves, not just the waterways. Removal of topsoil, compaction of soil surfaces, changing the flow of surface and subsurface water flows also affect the forest functionality and benefits:

- Forest soils hold microorganisms, fungi, nutrients and moisture that is lost with their removal.
- Compaction of soils for infrastructure installations, and access to those structures, limits water infiltration, root penetration, and microorganisms.
- Grading changes can redirect water: reducing availability to trees adapted to historical water levels and/or increasing availability to trees in excess of what they are adapted to.
- Loss of soil carbon storage and decrease in site capacity to sequester soil carbon in the future.

Issue: Fire

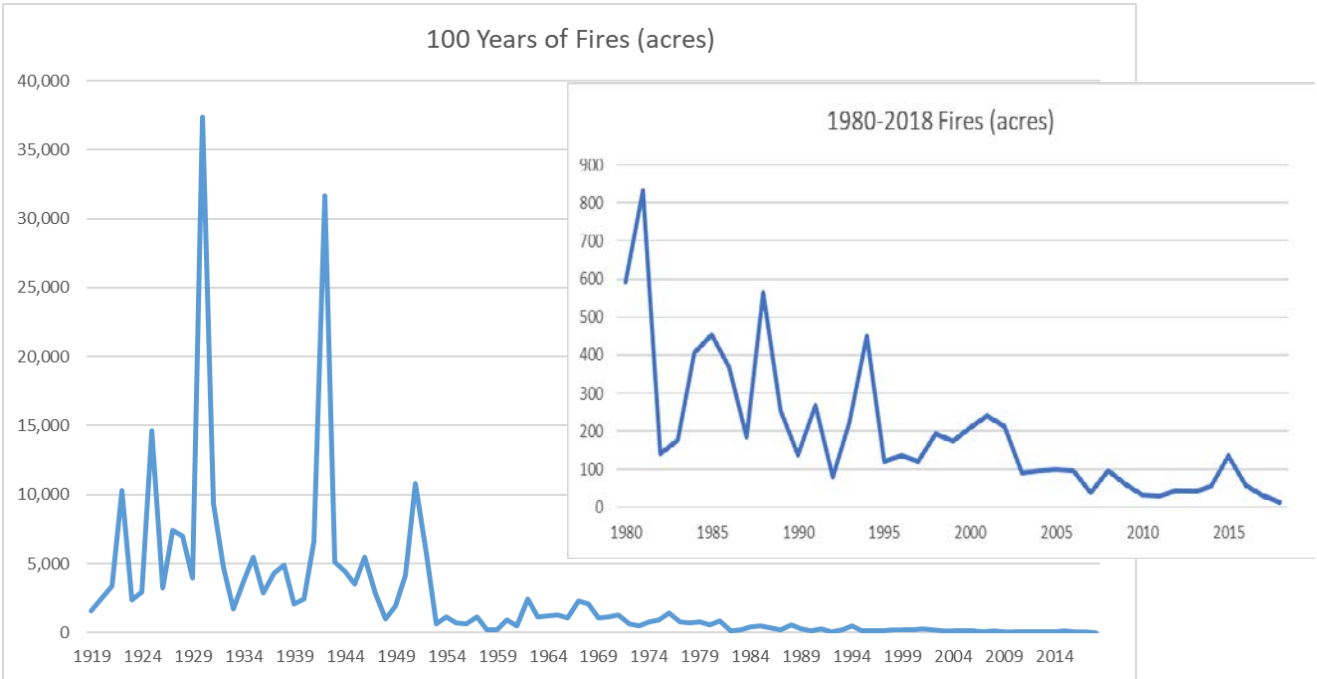
DFE's Forest Fire Program has existed since 1906 with the establishment of the Rhode Island Forest Commission, followed almost immediately by chestnut blight. During its 114 years, the Division of Forest Environment has seen various departmental names, and numerous large-scale event fires and large-scale disturbances leading to event fires or hazardous fuel conditions. The dynamic nature of the environment seems to be the constant.



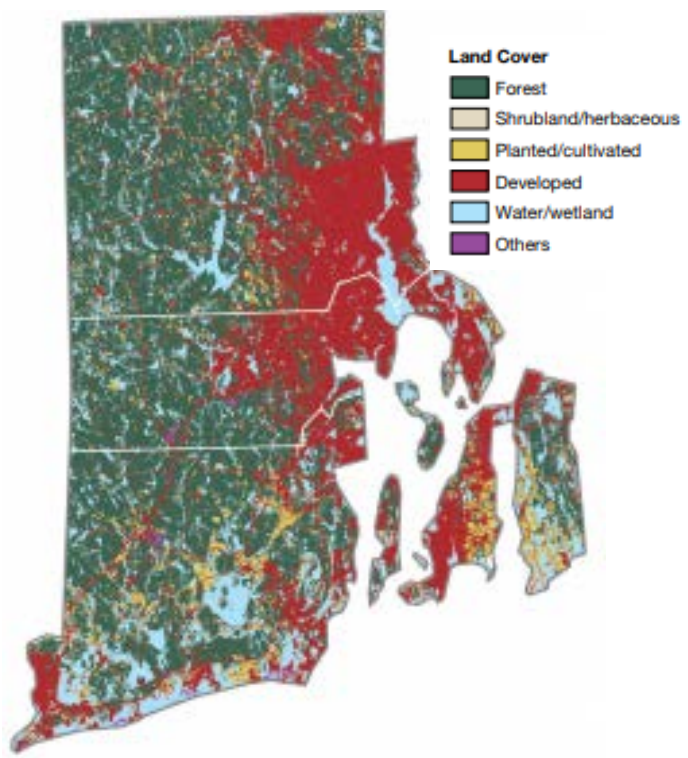
Rhode Island's fire occurrence from the 1920's to 1970 shows the size of fires in areas, many of which are still predominantly forest today, but now with more population and infrastructure than in the 20th century.

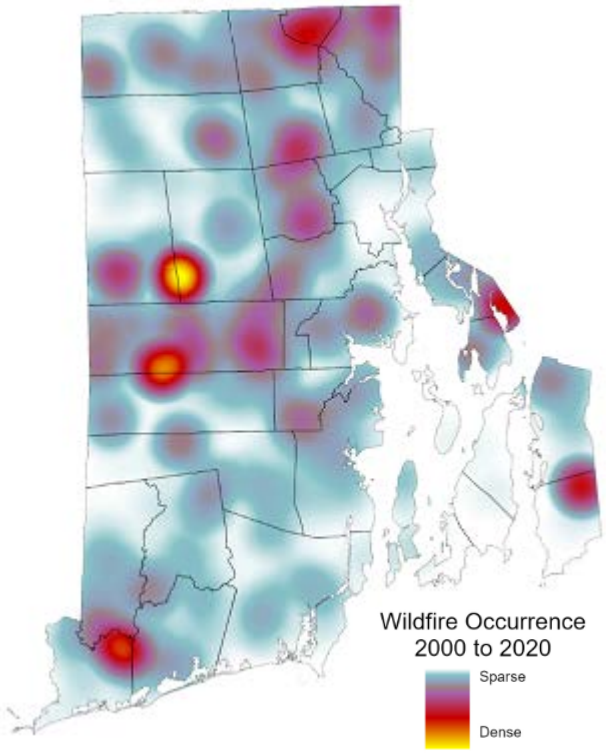
As the western part of the state has experienced an increase in development, the values at risk have increased significantly. However, this increase in wildfire risk is partnered with:

- decreases in resident awareness, concern, and preparedness for wildfire;
- communities and fire departments focused on increasing demands for EMS and HAZMAT services;
- reduced fire department reporting of small fires to DFE, affecting fire statistics; and
- decreases in DFE staffing capacity for wildfire response, mitigation, and preparedness.



The expansion of the wildland-urban intermix/interface, with the associated increase in monetary, infrastructure and human values, combined with an unmanaged accumulation of dry fuels, and a lack of local and state preparedness and capacity, is of concern to DFE.





Source: ESRI Green Infrastructure Strategy

Fire location occurrence 2000 - 2020

Data from 2000 - present shows hot spots where human-caused fires commonly occur. When considered with respect to fire-adapted ecosystem information, historical fire occurrence, and population centers, escaped fires have the potential for rapid spread and impact to values at risk.

COMPOUNDING FACTORS

More recently, changes in seasonal weather patterns and precipitation have decreased moisture availability in the summer months, increasing tree mortality. Severe pest and disease mortality have also increased. All these factors combined have led to increased fuel loading and drier fuels across the state.

Oak mortality, due to gypsy moth defoliation, 2017.

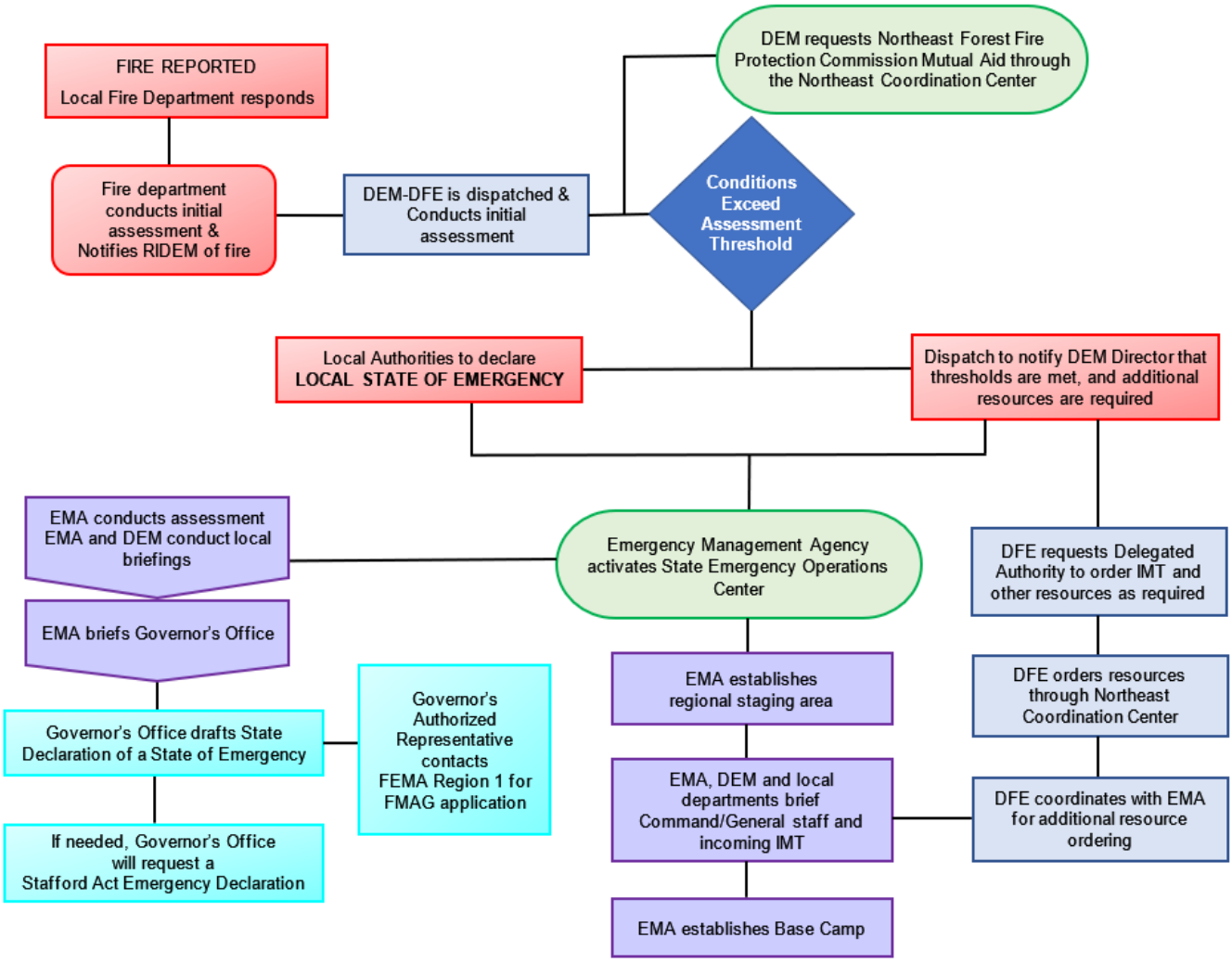
After 3 years of intensive defoliation by gypsy moth, and droughty summers, many oak trees failed to recover, resulting in an estimated 45-50,000 acres of forest loss. Mortality in 2019 was attributed to the lingering effects of the chronic stress and other factors, such as continued drought during the growing season and other pests.

An increase in the population of two-lined chestnut borer (*Agrilus bilineatus*) developed as oak trees were increasingly stressed by gypsy moth defoliation. This borer contributed to late-season oak mortality in 2018 and is expected to be a significant contributing factor to oak mortality in the future, until the population levels naturally subside. Additionally, ash species mortality is anticipated over the next several years as emerald ash borer spreads through the state.

FOREST FIRE PROGRAM STATUS

Although prevention and enforcement efforts have been successful in reducing the incidence and size of fires in recent years, DFE has been unable to sustain response capacity and leadership to support local wildfire suppression efforts, primarily due to past substantial funding cuts. As the development continues to expand into rural and forested western Rhode Island, fuels continue to build due to declining management and forest health issues as weather and precipitation patterns become more extreme. This combination of elements indicates the potential for significant wildfire events in the future.

Over the past 20 years DFE has seen a shift in responsibilities and staffing levels, from 80 staff handling forestry, recreation (3 campgrounds, 4 beaches), law enforcement responsibilities, maintenance, etc., to an 80% reduction to 15 employees (of which 11 are field staff), with significant carry-over of non-forestry/fire responsibilities. With respect to fire suppression, presently there are 5 allocated Fire staff (Fire Science Officer vacant since early 2018) resulting in an extremely limited response capacity as a suppression force. This, combined with a lack of surge capacity/emergency firefighters, means that once local fire department capacity is exceeded, so too is state capacity, thus requiring external assistance. As a result, small scale incidents with a higher complexity due to urban interface would require a declaration of a state of emergency and mobilization of resources.

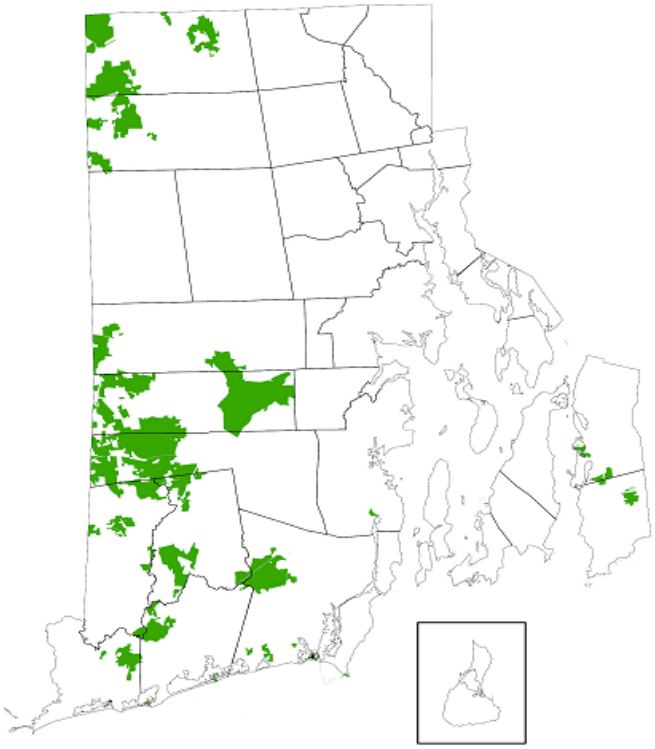


The pending state legal review of the Stafford Act further compounds the lack of suppression capacity. This has resulted in a cap on operational qualifications DFE that can be developed and utilize. The 2020 Fire Plan seeks to address these shortfalls by providing detailed information and guidance on the policies and procedures associated with fire suppression and an emergency declaration. Further effort is required to develop in-state capacity to limit the potential for small incidents to require a declaration in order to meet response objectives.

In addition to a lack of staff capacity, and a lack of agency level and public awareness, there is a lack of equipment and technology to allow the Forest Fire Program to communicate and deliver fire information, awareness and management:

- *Fire danger prediction* using a standardized prediction system, National Fire Danger Rating System (NFDRS), requires weather station measurements for: wind speed and direction, air temperature and relative humidity, precipitation, barometric pressure, and solar radiation. The Forest Fire program cannot meet the NFDRS standards with the current weather stations which, while comparatively new, lack the ability to integrate data with the GOES16 satellite system, and do not collect solar radiation data. *Presently, Rhode Island's danger rating is calculated manually using 1967 indices which do not correlate well to more recent iterations, and will be completely obsolete when a new, updated danger rating system is released in 2020*. Due to the differences between the 1967 FDRS and the 2016 NFDRS indices, DFE is unable to communicate effectively to federal partners the actual fire danger.
- *Fire risk assessment* based on fuels, flame heights, and terrain at a scale appropriate to Rhode Island, requires data and mapping capabilities beyond existing budget and capacity.
    - Scale: 30m resolution results in many of Rhode Island's wildland-urban interface communities being labeled as developed land and, thus, classified as non-burnable and are reported as such in the federal budget allocation. However, these areas contain the same highly flammable fuels with a significantly high concentration of values at risk.
    - Ease of use: data is not easily available to municipalities, land managers, and fire departments, requiring a high degree of experience with, and access to, ESRI software.

Multiple efforts to access competitive federal funding have not been successful to date, that would allow DFE to develop the maps and strategies to effectively engage with local governments, residents and fire departments.



RI DEM Management Areas

FOREST FIRE PROGRAM EFFORTS

- The Forest Fire Program has been working to develop program delivery through its 2020 State Fire Plan and increased engagement with RIEMA to increase awareness of fire risk and incorporate fire into hazard response planning.
- A WRR grant in 2019, Increasing Fire Awareness & Management in Rhode Island, is focused on utilizing Firewise® messaging to educate and empower communities, homeowners, and fire departments to understand and mitigate wildfire hazards by modifying their landscaping and land use to be fire adaptive.

- The general goal is to institute a culture of preparedness and establishing defined actions at the time of an emergency (e.g. clearing brush around buildings, orderly evacuation, etc.)
- A specific target is to provide communities assistance with risk assessment, plan development, and implementation.

- Continued engagement with the Division of Fish and Wildlife to assist with prescribed burns for wildlife habitat and management; assistance with federal Fish & Wildlife prescribed burns; and to increase Incident Management Team (IMT) qualifications within DFE and other state agencies.
- A Wildfire Risk Reduction (WRR) grant in 2015 funded Rhode Island's first Community Wildfire Protection Plan (CWPP) for Prudence Island.
  - Prudence Island has 88 year-round residents and is 3,565 acres, of which 85% is protected from development, and addressed within the plan. Further prescribed burning is planned for the spring of 2020.
  - Future efforts will be made to procure funding for development of CWPPs for Management Areas. The WUI intermix/interface would be served by such plans, and they would provide an example to Rhode Island communities.

Pitch pine barrens are a fire-adapted ecosystem, requiring periodic ground fire to maintain plant species and support pitch pine regeneration. Light-intensity fires help limit ground and ladder fuel accumulation and reduce the incursion of competitive species, which shade and out-compete pitch pine and its associated species.

Not only do prescribed fires reduce fuel accumulation and reduce competition for nutrients and light, as shown three years post-treatment at Nicholas Farm; they also reduce the intensity of wildfires, protecting habitat for wildlife and humans alike.

Issue: Climate Change

As discussed within the Benefits section (page 18), forests simultaneously provide a myriad of benefits to the natural and built habitats of creatures and humans. The complex interactions within, and by, the forest is still barely understood but has withstood millennia of disruption and change. Given enough time, forests and the species that rely on and support forests can adapt. But today, the combined onslaught of climate change, fragmentation and parcelization, interference with migration, loss of biodiversity, invasive plant and insect species, overuse and overgrazing, and more extreme weather events occurring more frequently – all contribute to forest lands with less biological resilience to change and less time to adapt to those changes.

Climate change is affecting natural ecosystems and human communities in Rhode Island. As reported in Resilient Rhody, temperatures in Rhode Island have increased more than 3 degrees since the beginning of the 20th century, and sea level has risen 10 inches since 1930. The joint NOAA and RIDEM publication, Overview of a Changing Climate in Rhode Island, reports that over the past 80 years, Rhode Island and southern New England have experienced a significant increase in both flood frequency and severity, including a doubling of the frequency of flooding and an increase in the magnitude of flood events. Other research shows that spring is arriving sooner in southern New England, with leaf-out for trees and woody plants occurring more than two weeks earlier than in the 1850s.

Temperatures are projected to continue increasing, leading to longer growing seasons and more extreme hot days. Climate models predict additional changes in the future. Climate change is increasing stress on the state's forests and playing a role in more complex, compounding factors, as Resilient Rhody noted:

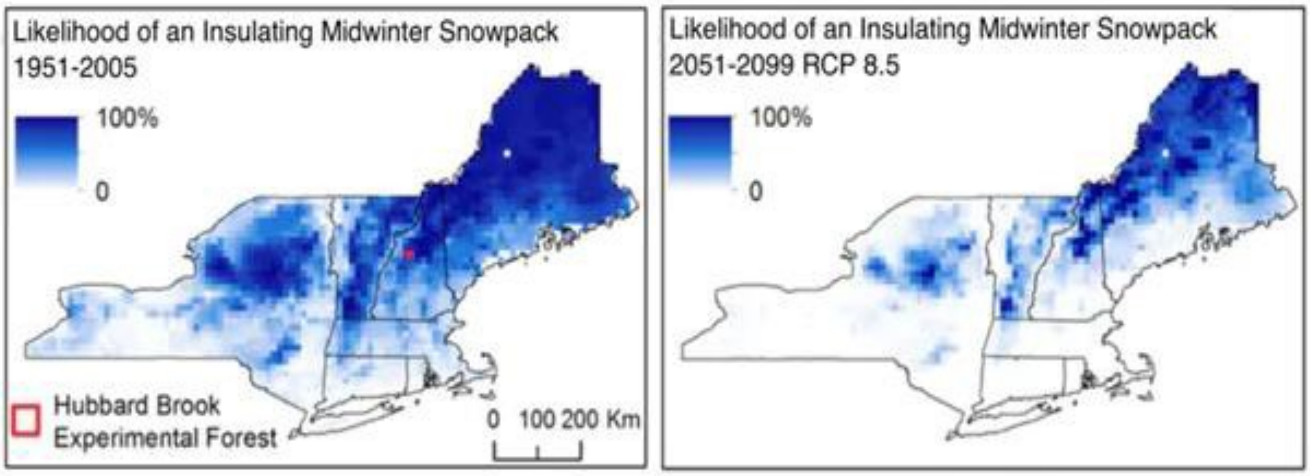
- Annual precipitation is expected to continue increasing, particularly during the spring and fall, and heavy precipitation events will occur more often. Warmer temperatures will result in more rain than snow. More rainfall during concentrated periods will significantly affect hydrological patterns, including more flooding events;
- A longer growing season, warmer temperatures, and more variable summer rain are likely to increase summer moisture stress on plants and could lead to harmful droughts;
- As the climate changes, forest composition will change, becoming less favorable to species that are adapted to cold climates, promoting typically southern species at the northern edge of their range;
- Warmer winters with fewer periods of sustained cold weather may lead to increased activity of forest insects and pests that have the potential to cause greater impacts to forests, as well as migration of more southerly pests as conditions become more favorable; and
- Changes in the timing of leaf-out, flowering, and fruiting in plants can be very disruptive to plant pollinators, seed dispersers, and migratory wildlife.

Similarly, the New England and Northern New York Forest Ecosystem Vulnerability Assessment and Synthesis: A Report from the New England Climate Change Response Framework Project assessed the impacts of climate change on tree species and forest ecosystems across the region. These impacts were summarized in the online resource Climate Change and Adaptation: New England and Northern New York Forests and include:

CLIMATIC IMPACTS	**FOREST IMPACTS**
Warmer temperatures	More variable soil moisture
Longer growing seasons	Increased risk of drought
Shorter, warmer winters	Stress from forest pests and diseases
Rising sea levels	Competition from invasive plants
Changing precipitation	Changes in suitable habitat
More extreme precipitation	Changes in tree establishment
Changes to the water cycle	Changes in tree growth
	Changes in forest composition

Overall, the complexity of ecosystems makes accurate predictions challenging, longer growing seasons can mean desynchronized pollinators and food sources, bird nesting, and migration, etc., which may have unforeseen impacts. These increasing threats and rapid rate of change have the potential to exceed an ecosystem's resilience or capacity to adapt.

New information regarding climate change impacts on forest ecosystems continues to emerge. For example, recent research suggests that a decline in snow pack will have a detrimental effect on northern forest growth – even where temperatures remain cold. The amount of snowpack may not be a significant factor in many forests in Rhode Island, but it shows the overall climatic impacts that will affect forest establish and health, as well as forest management decisions.



Source: Climate Change is Shrinking Winter Snowpack

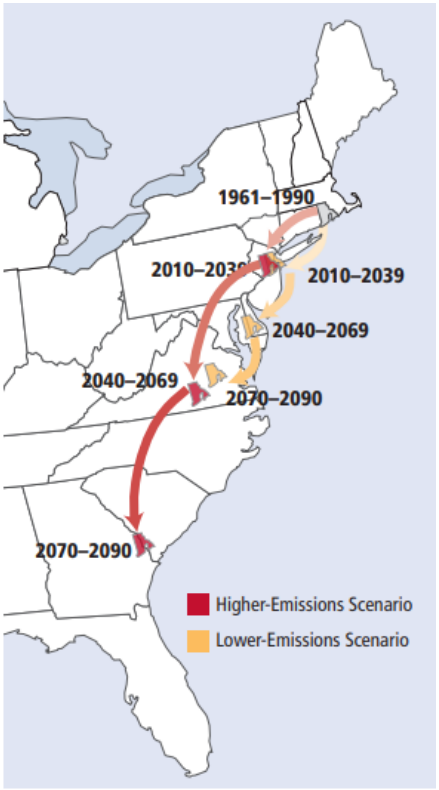
Increasing winter temperatures also increase the threat from many invasive plants and insect pests (native and exotic) because these species may no longer have to withstand or recover from extremely cold winter conditions. A warmer climate may facilitate the establishment or increase the competitiveness of these threats, and compound damage within ecosystems.

It isn't only forests in the traditional sense that are affected by climate change. Climate change will also have direct and indirect consequences for urban forests, already under stress from localized temperatures and moisture regimes due to the urban environment, as well as atmospheric pollution, salt damage, and exposure to novel pests and diseases. Urban forests are distinct from natural or managed forest ecosystems, not only because of their structure and composition, but also the many specialized benefits they provide for residents of cities and towns. But climate change is expected to amplify existing stressors in a similar way to forests in natural environments. Expected consequences include increased activity of insect pests and diseases and higher infestation levels; more extreme exposure to heat waves and drought; and phenological mismatches with pollinators and dispersal agents. Well-managed urban forests, like well-managed forest land, can yield additional climate benefits with management and maintenance.

SPECIES COMPOSITION

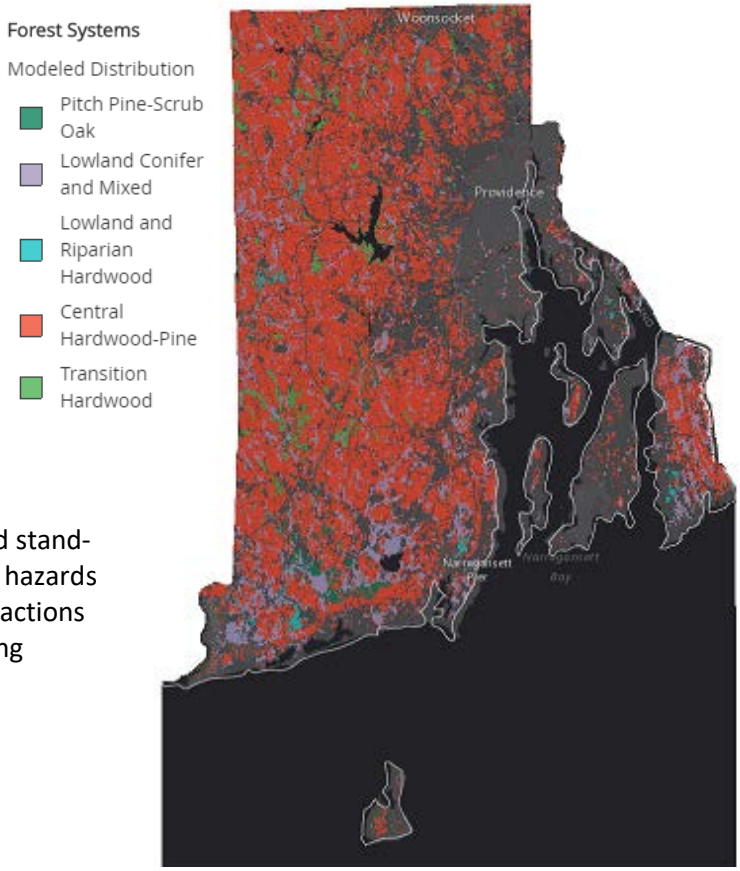
Increased temperatures and altered climate conditions are also expected to shift suitable growing conditions for individual species of trees, shrubs, and plants. This means that many species growing at their more southerly extent in Rhode Island may be unable to withstand the changes in growing conditions and become locally less common or disappear entirely. Meanwhile, species growing at their more northerly extent may find growing conditions conducive to expanding their range northward. The natural shift in growing range and dispersal is a slow process but, in the 21st century, it is complicated by grey infrastructure, permanent land conversion, and other impacts of fragmentation and forest loss which impede species migration.

Predictive models for anticipated climate change look at the effects of various emission rate scenarios. An example on the left, from the 2006 Northeast Climate Impacts Assessment, shows the effects of two emission scenarios on the heat indices for Rhode Island over the next 80 years and the impact on summer temperatures. While these changes are speculative estimates, and modeling has advanced considerably since 2006, this visually captures changes in local temperatures that would affect habitat and species composition.



The impact of climate change will not only impact individual species but also the composition of entire plant communities. Such communities, as expressed as forest types or systems for example, may be more vulnerable to climate changes, which can also affect wildlife habitat availability and quality. As one example, the Lowland Conifer and Mixed type relies on a relatively narrow range of soil and moisture conditions, making it vulnerable to impacts from droughts and extreme weather events. By comparison, the Central Hardwood-Pine type occurs naturally across a wide range of habitats and, at the northern extent of its range, is expected to persist.

Such shifts are expected to ultimately impact forest management decisions. The New England and Northern New York Forest Ecosystem Vulnerability Assessment and Synthesis presents an assessment of vulnerability for forest ecosystems for the end of the 21st century, shown in the table below. The assessment includes the level of evidence and degree of confidence in the vulnerability of forest types (which is not summarized here) and provides context for the ratings.



Forest Systems in Rhode Island. *Source: Climate Change and Adaptation: New England and Northern New York Forests*

Although many of the common forest types across Rhode Island are generally expected to have some capacity to adapt to changing conditions, the likely effects of climate change also need to be considered at the property- and stand-levels where local site conditions and potential hazards can be evaluated. This allows for management actions to be focused on reducing stressors and enabling ecosystems to adapt to changing conditions.

Forest System	Vulnerability
Pitch Pine – Scrub Oak	low
Lowland Conifer & Mixed	moderate-high
Lowland & Riparian Hardwood	moderate
Central Hdwd - Pine	low
Transition Hardwood	low-moderate

RESPONDING TO CHANGE

These complex interactions can seem beyond the individual, or even the state, to manage. However, there are forest management practices that support healthy forests and also incorporate climate change considerations. Meanwhile, DFE and its partners work to educate landowners and professionals of ways to keep their forests healthy through the years. One method is to encourage the planting of a variety of forest tree species that will be suited to the changing climate patterns. This can assist the migration of such species, avoiding interruptions caused by fragmentation and development, and speeding up the very slow movement of trees beyond their existing ranges.

The main challenge for post-harvest tree planting in Rhode Island is two-fold:

1. tree planting after harvesting is not a typical practice in the state, as regeneration is typically left to understory release and natural regeneration; and
2. the impacts on planted growing stock from overbrowsing by deer would be as severe and more expensive than presently occurring on natural regeneration.

These are two significant challenges that do not have a quick solution, and will require working with stakeholders and partners, as well as identifying possible funding sources to develop and support a programmatic effort.

The issue of climate change ultimately influences planning and management actions within DFE also, affecting commonly understood forest processes and progressions. Not only does forest change compound existing agency management challenges, but political or legislative responses to climate change, whether at the local and national level, adds additional complexity that may either enhance or impair the functioning landscape.

DFE's role in the midst of this uncertainty is education and technical support to encourage the retention and management of forest lands, as ever. It is necessary for DFE to advocate and support adaptive forest management practices that maintain a resilient forest able to withstand the effects of stress related to changing climate zones and pests and diseases (whether native or exotic). Communicating research and information for changes to management methods and resources requires adaptiveness and leadership. DFE will also need to explore funding and partnerships to initiate efforts that will benefit Rhode Island, based on good science, such as planting and protection of seedlings, assisted migration, demonstration sites, and financial assistance.

PRIORITY LANDSCAPE AREAS IN RHODE ISLAND

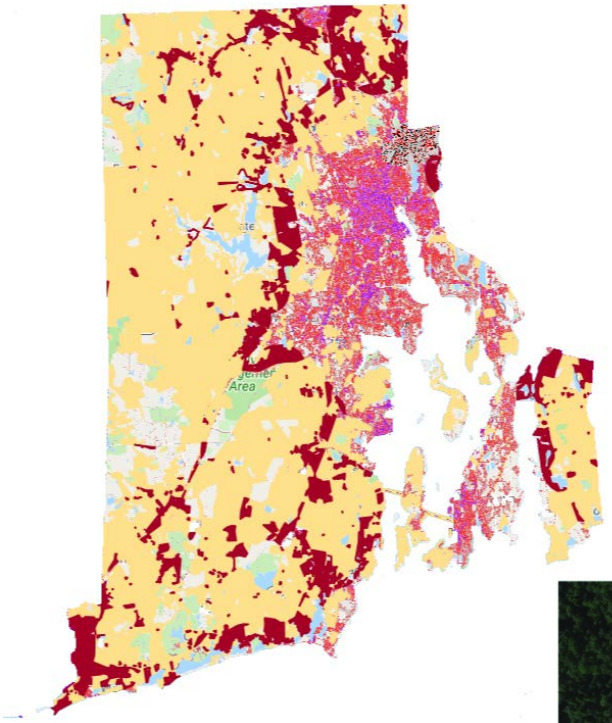
The determination of Rhode Island's priority areas for the Stewardship, Forest Health, Fire, and Urban Forestry programs is relatively straightforward in such a compact state. The priority areas for these four cooperative programs is where expansion of urban areas and ingress into forested areas is occurring: the wildland-urban interface and intermix – with each program focused on their audience and providing cross-messaging with the other programs.

Stewardship – landowners in the interface – managing their forests, and keeping their property as working lands; engaging and educating rural municipalities remains a significant challenge

Forest Health – introduced and invasive pests/diseases/plants – the interface is often where they appear and are more easily spread via human transport and developed corridors; educating professionals and homeowners to promote awareness and initiate management practices

Fire – wildfire risk – most fires are ignited by humans in the WUI – new outreach to municipalities with the Firewise message and assisting communities to develop plans and implement them for wildfire risk reduction

Urban & Community Forestry – expansion of urban areas and the loss of interior greenspace – an important part of the urban message is maintaining and planning for green space to limit the impact of landscape change.



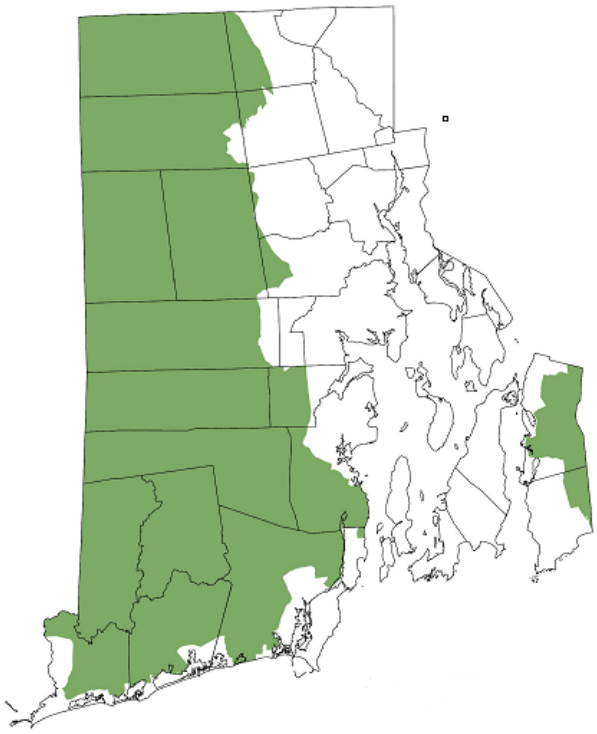
This map, derived from the i-Tree Landscape Tool, shows the Wildland-Urban Interface (WUI) in red and Wildland - Urban intermix in yellow.

Wildland-Urban Interface refers to a distinct area of wildland fuel adjacent to a developed area.

Wildland-Urban Intermix refers to a specific type of wildland-urban interface in which the homes or other structures are intermixed with wildland fuels, scattered or in small groupings.

Intermix **Interface**

Source: Researchgate.net

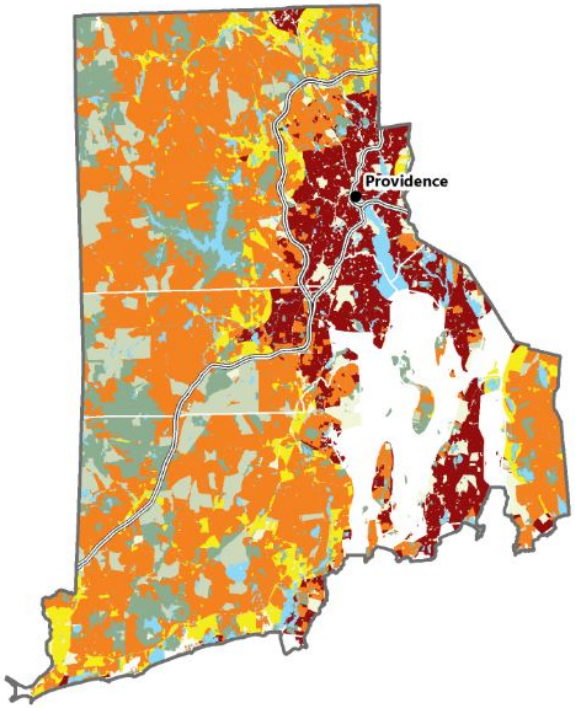


Forest Legacy Priority Areas

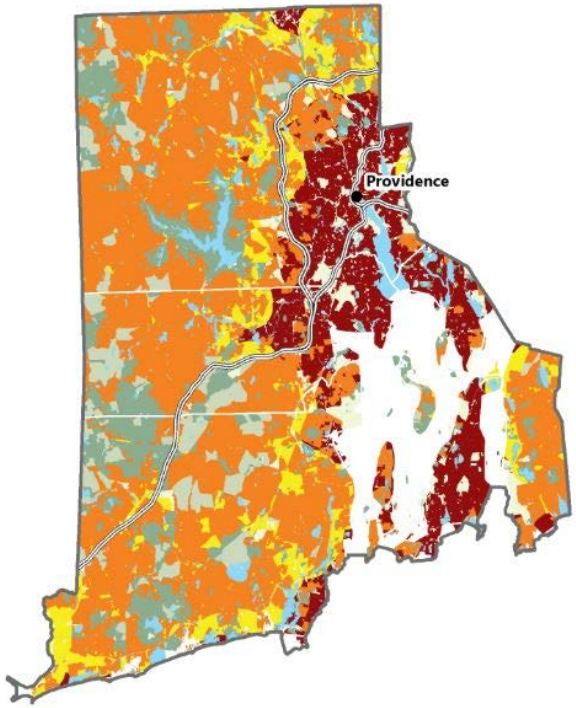
The *Forest Legacy Program* can be considered as the primary "land acquisition" element of the five Cooperative Forestry programs in Rhode Island and is a potential source of funding considered by the DEM Land Acquisition Committee. The program prioritizes significant forest tracts, watersheds for public drinking water, public open-space tracts and recreational areas, location of rare, threatened and endangered species and/or their habitats, and significant mineral resources. Forest Legacy also considers population growth statistics and communities identified as experiencing significant population increases. The Forest Legacy Program identified its two distinct priority areas in its 2020 document (see Appendix F):

1. Mainland – comprised of the forested and intermix areas on the west side of the state, and
2. East Bay – where some of the last forested tracts remain in eastern Rhode Island.

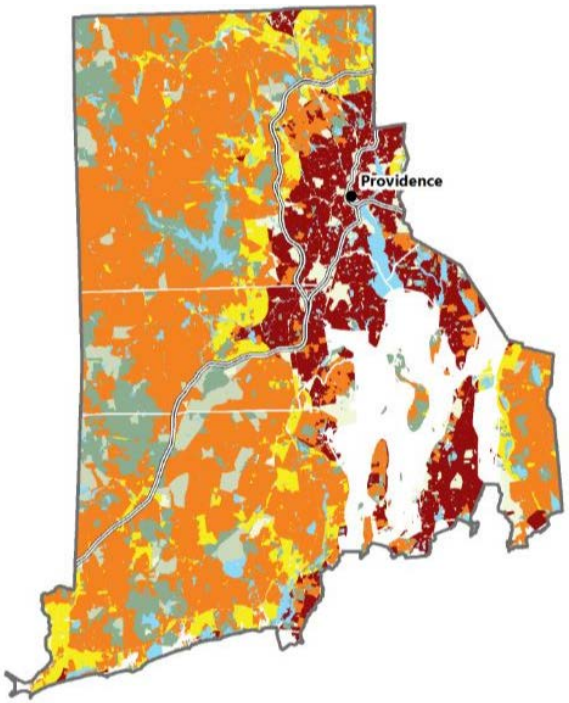
The basis for the four other cooperative program priority areas can be further described using data from Silvis Labs, University of Wisconsin-Madison. The maps on the following page show Wildland-Urban Interface (WUI) Change from 1990-2010. It is clear, even with the relatively coarse resolution, that while increasing interface (yellow) has been occurring in the more urbanized and highly populated areas of the state, the decrease of yellow in areas with no housing or very low housing (greens) is a result of conversion to intermix (orange). Besides protected, conserved, and state lands, Rhode Island has little land remaining that is unaffected by, or at risk from, human habitation or infrastructure in Rhode Island; there are few landowners, communities, and other stakeholders who are outside the priority target audience. Similar to the priority areas determined in 1993 for the Forest Legacy program, the forested areas of the state and their owners, comprising over 50% of Rhode Island, are significant for all DFE Programs. Landowner education, technical support for forest land management, management of state lands, and land acquisition comprise the outcomes of the Cooperative Forestry Programs delivered in Rhode Island.



1990



2000



2010

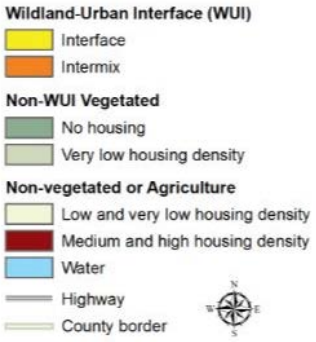
DATA SOURCES

United States Census Bureau
2010 TIGER blocks

Multi-Resoluton Land Characteristics Consortium
2011 National Land Cover Dataset (NLCD)

Conservation Biology Institute
Protected Areas Database (PAD) version 2

Source: Silvis Labs, University of Wisconsin-Madison



MULTI-STATE PRIORITIES

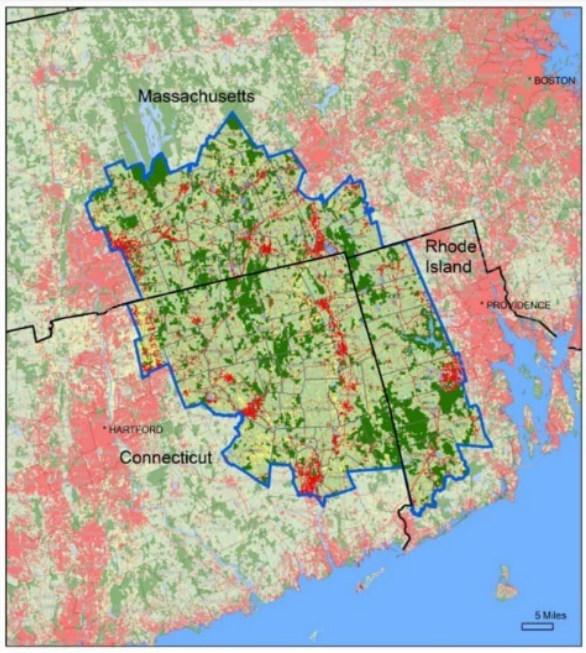
Rhode Island contributes to several multistate or joint efforts that involve RIDEM-DFE or its partners, whether federal, regional, or local. Some of these efforts are programmatic in nature, related to the cooperative forestry programs where shared efforts and grant proposals occur:

- Northeastern Forest Fire Protection Compact
- Eastern White Pine Multi-state LSR grant FFY2016
- Urban Forest Inventory Analysis

Other multi-state efforts involve multi-tasking stakeholders and partners who ably represent Rhode Island and ensure its regional representation and contribution:

THE SOUTHERN NEW ENGLAND HERITAGE FOREST REGIONAL CONSERVATION PARTNERSHIP PROGRAM (RCPP)

This Program is a partnership between the Natural Resources Conservation Service, The Last Green Valley, MassConn Sustainable Forest Partnership, and the Northern Rhode Island Conservation District (NRICD). The program's target area includes the Southern New England Heritage Forest (SNEHF) a 11.4 million-acre corridor where 76% remains forested. An analysis by Harvard Forest shows that by 2030, as much as 20-40% of this forest will be lost or fragmented to development.



Source: The Southern New England Heritage Forest

SNEHF's over-arching goal is to keep forests as forests, maintaining as much unfragmented, core forest as possible; a goal that supports both federal and state concerns.

Goals include: improve forest habitat for fish, wildlife, and invertebrate species of concern; support the recovery of endangered or threatened species and improve biodiversity; protect water quality and quantity; foster forest resiliency and stand diversity; and enhance air quality and carbon sequestration.

Funded through the USDA NRCS Regional Conservation Partnership Program, the program has funding for five years for work within Rhode Island:

- Identifying easement opportunities in perpetuity (13 applications, resulting in 3 projects), with restoration plans that incorporate threatened and endangered interior bird species.
- Incorporating Audubon bird surveys and habitat plans into forest management plans within the SNEHF, either new plans or incorporating the bird plans into existing plans.
- Implementing forest management plans (3rd phase of project not yet active).

INCREASING RESILIENCY IN SOUTHERN NEW ENGLAND OAK FORESTS

This program is a multi-state Landscape Scale Restoration grant awarded by the USFS to the Forest Stewards Guild in 2019. The RI Woodland Partnership (RIWP) was instrumental in developing the project and connecting with partners in neighboring states (MA and CT). Through education and outreach the project aims to:

- Increase forest stewardship activities that increase oak resilience;
- Empower natural resource professionals with tools for assessing oak forest health;
- Increase landowner awareness of regeneration challenges and solutions; and
- Foster communication between states and agencies about strategies for addressing oak forest resilience and regeneration challenges.

Besides the Forest Stewards Guild (FSG), partners include:

- CT Agricultural Experiment Station (CAES)
- CT Forest & Park Association (CFPA)
- University of Connecticut Cooperative Extension Service (UConn)
- CT Dep't of Energy & Environmental Protection (CT DEEP)
- MassConn Sustainable Forest Partnership
- MA Dep't of Conservation and Recreation Bureau of Forestry and Forest Fire Control Service Forestry Program (MA Forestry)
- MA Dep't of Conservation and Recreation Division of Water Supply Protection (Quabbin)
- RI Dep't of Environmental Management Division of Forest Environment (RIDEM DFE) and Division of Fish and Wildlife (RIDEM DFW)
- Providence Water Supply Board (Providence Water)
- RI Woodland Partnership (RIWP)

FOREST ECOSYSTEM MONITORING COOPERATIVE (FEMC)

FEMC is a multi-state cooperative effort to gather and synthesize trends in forest ecosystem health across the Northeast. The USFS funded program is housed at the University of Vermont where it provides resources to states, and supports ongoing research, monitoring, outreach and data synthesis. Rhode Island has recently joined FEMC and is required to maintain a state partnership committee to identify FEMC priorities and state needs. RIWP acts as the State Partnership Committee for Rhode Island, with its broad representation across the state, and with DFE represented on the FEMC steering committee.

STAKEHOLDER ENGAGEMENT

Stakeholder engagement in the development of this action plan included public input, partner review and stakeholder committees.

- Public input was solicited through a survey on the DEM Facebook page in 2019. Results are summarized in 2019 Public Survey & Responses.
- Preliminary reviews of the Assessment and Strategies sections by cooperative program partners: URI, DFW, RIWP, RITC, occurred in 2019 and 2020.
- Meetings with stakeholder committees in early-mid 2020, including State Technical Committee, Stewardship Committee, Fire Advisory Committee, DFW and RIWP. In many cases, people representing different groups were on multiple committees, and all partner groups were given the opportunity to provide input and feedback into the draft.

Public Input Summary

An electronic survey, adapted from the New Hampshire SFAP survey, requested input from the public and stakeholder groups made available for 6 weeks in summer of 2019. The survey was created on the www.wwufoo.com website and shared directly with groups and posted multiple times on DEM's Facebook page. DEM utilized Twitter and sent out a press release towards the end of the time frame to garner further participation.

Responses exceeded expectations with a response rate of 0.13% from an estimated 2019 state population of 1.06 million. 67% (863) of the respondents expressed one or more written concerns, ranging from tree removal for ground-mounted solar installations to climate change, water, deer browse, and garbage in state parks, in nearly 2,000 comments, whether a single word or a lengthy statement.

The comments could be organized into several main themes corresponding to DFE priority issues:

- Fragmentation
- Water Quality
- Forest Health (including deer and wildlife)
- Fire
- Climate Change

In addition, other themes of concern included:

- Private Land Management
- Actions, Policy & Legislation
- DEM & DFE Capacity & Funding
- Urban Forestry
- Education/Knowledge
- Solar
- Recreation

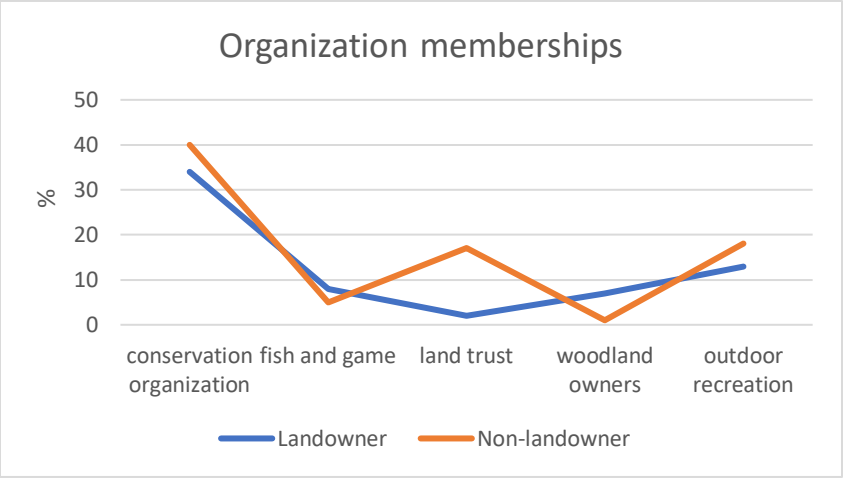
Many of these concerns are addressed within the DFE strategies and are part of the larger picture of holistic program delivery, where sufficient capacity exists. Other concerns expressed can only be acknowledged due to the existing DFE capacity, such as larger scale actions, policy and legislation, Department/Division funding, or solar issues. Some, like recreation, fall under the purview of multiple programs.

The following word cloud was created using the 100 most commonly occurring relevant words in the 1930 comments, after the most common words of forest(s) and tree(s) were removed.

Overall, responses between landowners and non-landowners were quite similar; however, there was no statistical analysis done on any of the results. Several identifying questions were asked, including land ownership and organizational memberships.

	Non-Landowners		Landowners	
# of Respondents	910	70%	383	30%
Club membership - 0	405	45%	178	46%
Club membership - 1	325	35%	124	32%
Club membership – 2 to 4	180	20%	84	22%

Level of organization memberships were similar between the two groups, although the breakdown of the groups varied somewhat. The most common combination of multiple memberships for both groups was conservation, land trust, and recreation.

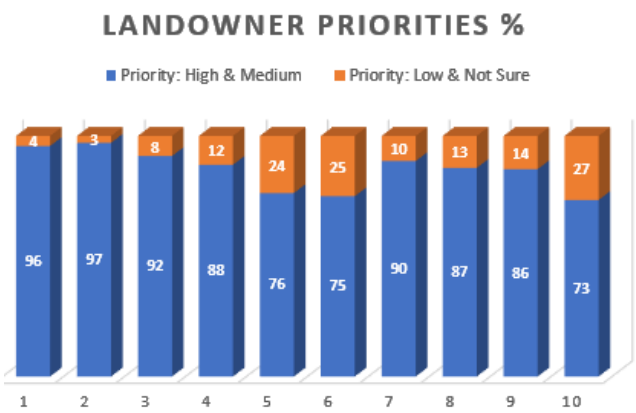


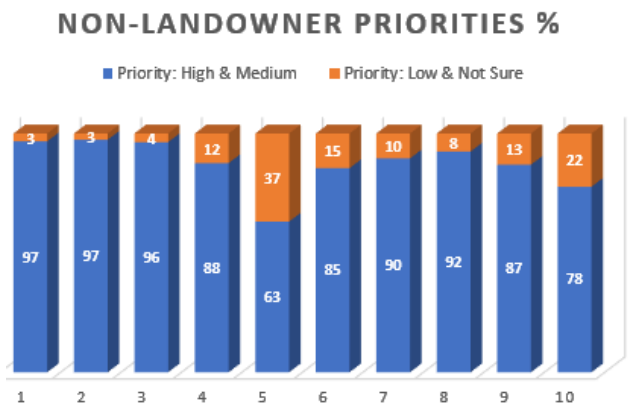
More non-landowners were members of land trusts. The other memberships were quite similar between the two groups, with even a few non-landowners being part of woodland owner groups.

The rest of the survey was comprised of 2 questions that required the respondents to prioritize the 10 listed challenges and 10 desired outcomes.

CHALLENGES TO ADDRESS IN RHODE ISLAND IN THE NEXT 10 YEARS:

1. Forest ecosystem health and biodiversity issues: e.g. invasive species, deer browse, species and age diversity, threatened and endangered species, natural disturbance, extreme weather.
2. Loss of forest land and increasing forest fragmentation.
3. Public values provided by forests: e.g. water, climate, carbon storage, forest products, recreation, education, culture.
4. Public land management challenges: e.g. staffing and funding for planning, maintenance, etc.
5. Challenges and opportunities facing private forest landowners.
6. Climate change.
7. Public awareness and support for funding for management of state forests and assistance to landowners and communities.
8. Funding for effective forest planning and policy (e.g. land use planning, use of open space lands, regulations).
9. Land use conversion pressures on public and private forests.
10. Urban forestry management capabilities in Rhode Island's communities.



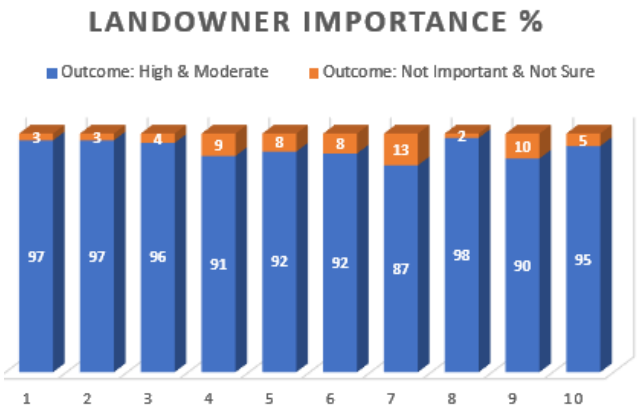


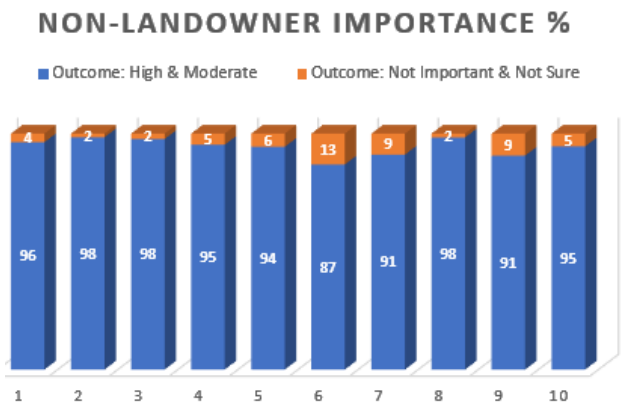
Forest health and diversity and *fragmentation* (# 1 and 2) were not only the two issues with the greatest support in both groups, but also garnered a substantial number of comments. People are concerned about where Rhode Island is headed and the lack of resources to address these issues.

The biggested difference between the two groups was that fewer non-landowners (63%) considered *challenges facing private landowners* (#5) to be a priority issue; although only 76% of landowners considered it a concern, which suggests a question to be explored. Non-landowners considered *climate change* (#6) to be more of a priority issue than did landowners (85% vs 75%). Overall, issues 5, 6 and 10 (*urban forestry capabilities*) garnered the most "low" or "not sure" votes. The differences in priorities between the two groups for the other priorities, were minimal. The results suggest that some demographically targeted messaging might be appropriate to increase understanding of the three lowest priority issues.

IMPORTANCE OF OUTCOMES TO THE FUTURE OF RHODE ISLAND'S FORESTS:

1. Businesses, public decision makers, the forestry community, and the public have the information they need to make informed decisions about the ecological integrity and sustainability of the resource.
2. Contiguous blocks of forest and working lands remain intact to provide environmental benefits and ecosystem services.
3. Landowners, resource professionals, and the public understand that forest lands contribute to the protection, availability, and sustainability of high quality, cost-effective drinking water.
4. Healthy and sustainable urban & community forests support livable, desirable, and ecologically healthy communities.
5. Residents and visitors support and understand the value of Rhode Island's forests: the benefits they receive from the forest and the relationship between a healthy environment and a healthy, vibrant forest-based and tourism economy.
6. Privately owned forest lands are supported to remain working lands for landowner, community, and state benefits.
7. Rhode Island forests contribute to mitigation of global climate change, managed for resiliency to climate change with minimal adverse environmental and economic impacts.
8. Rhode Island's forests are able to support healthy and sustainable populations of native plants and animals.
9. Residents and local fire departments are prepared for wildfires through planning, implementation, and response, reducing risks to people and structures; and protecting Rhode Island's forests and natural communities.
10. Rhode Island citizens and professionals are well prepared to respond to threats from invasive species; supporting adequate monitoring, response plans, and suppression programs to minimize the impact of invasive plants, insects, and diseases.





The ratings for the outcomes were even more similar and consistent between the two groups than the priorities, with 7 of the 10 outcomes within 0-2%. The outcomes with the greatest support were *healthy and sustainable plants/animals* (#8) and *contiguous blocks of working lands* (#2). These were narrowly followed by *resources needed to make decisions* (#2) and *importance of forests to drinking water* (#3) pointing to the concerns of residents and the need for decisive action and implementation of planning standards.

The outcome with the greatest number of "not important" or "not sure" reponses was *mitigating climate change* (#7), followed by *wildfire preparedness* (#9). Again, the results suggest that some targeted messaging might be appropriate to increase understanding of these issues. While large wildfires have not occurred with any severity for many years, smaller fires are frequent during the fire season and the possibility for larger wildfires has not decreased.

The intent of this survey was to narrow down or refine the priorities and concerns of residents, in order to identify the priority issues for DFE's next 10 years. It is apparent that the agency and the residents are in sync in what they see as threats to their state, communities, and ways of life. Clearly, many Rhode Island residents are not unaware of the interconnectedness of many of the issues and see effective leadership and action, and even funding, as necessary to protect the natural inland environment.

Stakeholder/Partner/Agency Input

RIDEM-DFE solicited input and feedback from various partner individuals and committees. Program partners provided input on the plan's accuracy, clarity, and perspective, prior to sharing with the larger committees.

- The DFE U&CF contracted report, The Value of RI Forests, which was written by the Rhode Island Forest Conservation Advisory Committee and RITC (also members of the RIWP), provided significant information regarding Rhode Island-specific resources and practices, context and insight, and are identified as contributing to this report.
- RI DEM's DFW and the Division of Planning & Development, which houses the Forest Legacy Program, provided initial feedback and input in the early drafts, as well as opportunity for input in later drafts, and are acknowledged for their contributions.

Due to COVID-19, stakeholder meetings were held virtually in the spring of 2020.

- A draft was shared with the Forest Fire Advisory Committee, and the Forest Stewardship Advisory Council was convened for feedback and comments:
    - RIWP, RITC, RIFCO, DFW, NRICD, URI, DFE
- The State Technical Committee and Division of Fish & Wildlife attended a shared meeting organized by RI NRCS.
    - NRCS, DFW, RI Land Trust Council, NRICD, RIRC&D

Federal Lands management agencies in Rhode Island include Naval Station Newport, which was not affected by this plan, and five coastal wildlife refuges. The person associated with the National Wildlife Refuges was given the opportunity to provide input on the plan.

Input from USDA Forest Service Region 9 federal program managers was provided in a preliminary review early February 2020, and a virtual introduction to the plan and further program manager feedback and initial requirements review in May.

Rhode Island 2020 State Forest Action Plan: Strategies

The Cooperative Forestry Assistance Act (CFAA) of 1978 (Public Law 95-313), as amended through Agricultural Act of 2014 (P.L. 113-79), gives the United States Forest Service (USFS) the authority to provide financial and technical assistance to states, and others, on a variety of forestry issues. These issues include forest management and stewardship, fire protection, insect and disease control, reforestation and stand improvement, and urban forestry. As amended by the 2008 (and 2014) Farm Bill, the CFAA also requires each State forestry agency to maintain a "Statewide Assessment and Strategies for Forest Resources," or State Forest Action Plan (SFAP), to be eligible to receive funds under the authorities of the Act.

The programs which comprise Cooperative Forestry for Rhode Island include:

- State Fire Assistance & Volunteer Fire Assistance (SFA & VFA)
- Forest Health Management (FHM)
- Forest Stewardship (FSP)
- Urban & Community Forestry (U&CF)
- Forest Legacy (FL) – see Appendix F

The Cooperative Forestry Programs promote the health and productivity of forests, emphasizing timber and other forest products, wildlife, water resources, rural economies, and conservation practices. The programs' overall goal is to maintain and improve the environmental, economic, and social benefits provided by the state's urban and rural forests. These programs:

- Improve cost effectiveness by using partnerships to deliver programs
- Increase forest-related values by sustaining forest productivity
- Use voluntary, non-regulatory approaches.

The financial assistance provided to each state must be equally matched by that state and each individual program must meet their national eligibility requirements, including the statewide strategy (revised every 10 years). The strategy must include strategies for addressing threats to forest resources in the state, a description of the resources necessary for the State Forester to address the statewide strategy, and must address the three national State & Private Forestry (S&PF) priorities:

1. **Conserve** and Manage Working Forest Landscapes for Multiple Values and Uses
   - 1.1 Identify and conserve high priority forest ecosystems and landscapes
   - 1.2 Actively and sustainably manage forests
2. **Protect** Forests from Threats
   - 2.1 Restore fire-adapted lands and/or reduce risk of wildfire impacts
   - 2.2 Identify, manage, and reduce threats to forest and ecosystem health
3. **Enhance** Public Benefits from Trees and Forests
   - 3.1 Protect and enhance water quality and quantity
   - 3.2 Improve air quality and conserve energy
   - 3.3 Assist communities in planning for and reducing forest health risks
   - 3.4 Maintain and enhance the economic benefits and values of trees and forests
   - 3.5 Protect, conserve, and enhance wildlife and fish habitat
   - 3.6 Connect people to trees and forests, and engage them in environmental stewardship activities
   - 3.7 Manage trees and forests to mitigate and adapt to global climate change

The Cooperative Forestry Programs have identified their respective goals, objectives and strategies to successfully deliver programs that address the issues and priorities in Rhode Island, which also correlate to the DEM Strategic Plan 2019-22 (see correlation matrix in Appendix D).

Additionally, the state land managed by DFE, while not a part of the Cooperative Forestry Programs, is an important partner in the conservation and management of forest land in Rhode Island and provides recreation access and educational opportunities – which contributes to the achievement of some of the goals of the Cooperative Programs. As such, State Lands Management is included in the Strategies Section to fully communicate the extent and direction of RIDEM Division of Forest Environment.

State Priority Issues

Forest lands in the rural, urban, and interface/intermix are significant resources benefitting all residents. Suburban and urban "forests" are increasingly recognized (and researched) as contributors to the economic, ecological, aesthetic, and human health values associated with traditional forest land, and to the well-being and quality of life for those who live, work, and play there.

Rhode Island faces many of the same issues and concerns as almost all states, but at a smaller scale that reduces its resiliency and increases the impact and visibility of even comparatively small disturbances, land-use changes, or pest/disease infestations. Meanwhile, Rhode Island's suburban sprawl continues to blur the boundary between forested and non-forested lands and creates opportunities for the introduction and spread of native, invasive, and naturalized insect pests, plants, and pathogens, potentially increasing risk to Rhode Island's forest health. Not only do rural forest health issues overlap with urban and suburban issues, but insects and pathogens harmful to trees do not differentiate between the two, so actionable items in Rhode Island typically include and affect both communities.

The main threat to Rhode Island's forests, whether rural, suburban, or interface/intermix, is disturbance. Throughout history, disturbance from one source or another has impacted forest land. However, the scale of that disturbance, its frequency, degree of degradation, and permanence, when placed in context of human population and demands, challenges the equilibrium of natural processes and environmental services.

The threats and issues and concerns discussed in the Assessment section of this document are all sources of disturbance, and are mainly driven by human activity or interference:

- Fragmentation
- Water
- Forest Health
- Fire
- Climate Change

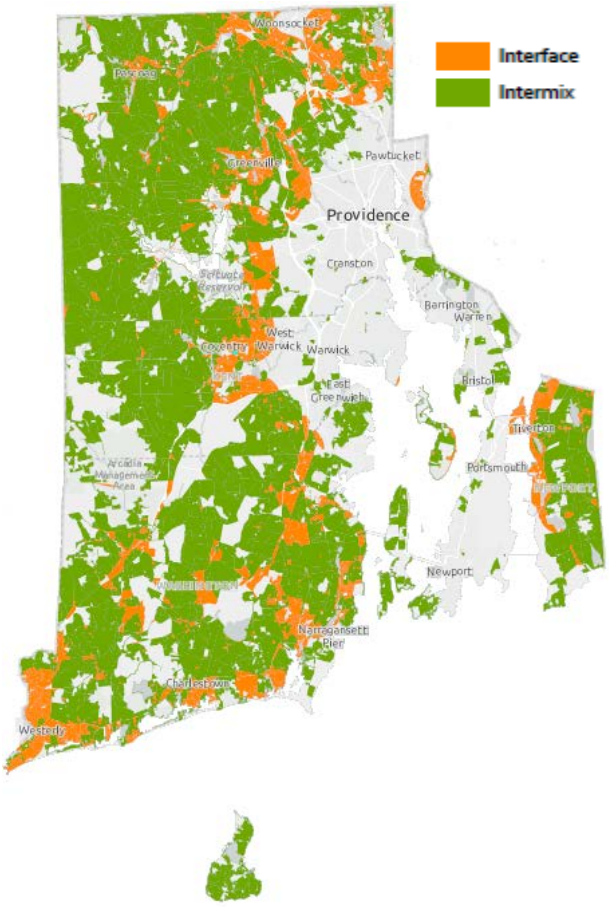
Climate change further complicates and compounds these disturbance issues on an international scale by increasing pressures and stress on forest landscapes and individual trees and reducing resources and resiliency in those same landscapes. The impacts of these observable and measurable changes to planet-wide climatic processes influence forest processes, from the micro- to the macroscopic. These climate changes alter the equilibrium of our natural environment and its ability to recover, respond, or adapt to those changes. Humans may be the source of much of the pressures on forest lands, but they will also be one of the victims with the loss of large- and small-scale landscape functionality.

State Priority Landscapes

As discussed in the Assessment section on page 53, each cooperative program has its own goals and objectives, but the impacts of disturbance and land change are priority concerns. With Rhode Island's small size, disturbance in any area, whether rural, urban, or in-between, has direct repercussions in the adjacent areas. *This means that the entirety of Rhode Island remains important.*

Within Rhode Island, there are specific areas expected to face the most immediate disturbance pressures. Based on past development trends, those projected areas are in the Wildland-Urban Interface (WUI) adjacent to larger urban areas. While the entirety of the state is a priority, the WUI areas have been identified as specific areas of interest for all cooperative programs to deliver messages and technical support to **conserve**, **protect,** and **enhance** functional working lands in these urban-adjacent areas. Within the national priorities, the program's goals are to work within the state's priority areas to:

1. **Conserve** and Manage Working Forest Landscapes for Multiple Values and Uses
    - SFA: Conserve forest resources and ecosystems by supporting resiliency-focused management.
    - FHM: Promote the conservation and management of Rhode Island's forests through practices that address forest health and resiliency.
    - FSP: Promote conservation of non-industrial private forest land (NIPF).
    - U&CF: Promote active and sustainable management to conserve trees and forests where people live, work and play.
2. **Protect** Forests from Threats
    - SFA: Protect communities and their ecosystems from negative impacts of wildfire.
    - FHM: Protect Rhode Island's forests by monitoring and evaluating forest health conditions and threats.
    - FSP: Protect private forest land from development and degradation.
    - U&CF: Protect trees and forests from threats (invasive, catastrophic, climate, etc.) through planning and response.
3. **Enhance** Public Benefits from Trees and Forests
    - SFA: Enhance public benefits from trees and forests to Rhode Island communities and residents by developing increased resiliency to wildfire.
    - FHM: Enhance public benefits from trees and forests through promotion of practices and programs that address threats to forest health.
    - FSP: Enhance forest resources and ecosystem services of private forest lands.
    - U&CF: Enhance the public benefits of trees and forests through improved management practices.



Priority Landscapes: Wildland-Urban Interface/Intermix

Resources for Success

Accomplishing the goals identified in this SFAP requires three primary elements:

1. Continued federal funding for Cooperative Forestry Programs at current or increased levels.
2. Retention of professional staff committed to building internal capacity and delivering the best program possible within the limiting factors of stringent budget and staffing levels.
3. Positive and fruitful working relationships with Rhode Island forestry-focused and other allied non-profits.

Rhode Island receives the base USFS federal funding. Although DFE cannot be assured of future sustained federal support, the US Forest Service funding is crucial to the delivery of the DFE Cooperative Forestry Programs. The Program coordinators positions are contingent on that funding, which contributes to salary and programmatic travel needs.

While DFE has invested in acquiring dedicated and enthusiastic staff to deliver and advance state forestry programs, it struggles to work beyond the limitations of a minimal State budget (essentially supporting staff only). DFE staffing is minimal and staff experience an increasing workload and multitude of responsibilities. This results in DFE staff often lacking the time and the resources to fully engage and contribute to regional and landscape-scale efforts that address issues shared by multiple states.

DFE recognizes the challenges of retaining such staff with limited state and federal funding. Under ideal circumstances, sufficient resources would include increased funding to expand DFE staffing; increasing budget levels affected by years of reductions. The bare-bones budgets, lack of up-to-date resources, and the inability to access necessary resources (planning, mapping, assessment, etc.), keep the programs and the coordinators from accomplishing all that they are capable.

Additional funding would be directed towards:

- capacity building across the S&P programs
- increasing resources to expand education and outreach to all constituents, public and private
- improved data gathering tools and mechanisms

Programmatically, this could translate to:

- Forest Fire – develop wildfire risk maps based on scale suitable for RI; increase access to low/no cost training for VFAs
- Forest health – fund sufficient flights for health monitoring; increase access and tracking for new controls, particularly biological
- Stewardship – direct funding to assist landowners with costs associated with plans; develop and print materials; increase program education and access
- Urban & Community Forestry – increase subgrant program to provide sufficient support for management: inventory, planning and canopy assessments

Increased funding to better plan, manage, diagnose, and disseminate information on the heath, condition, and risks to Rhode Island's forests is essential to increase public support and advocacy for forest protection and enhancement activities.

Partnerships and collaborations are crucial to protect, conserve, and enhance Rhode Island's forest cover. DFE works closely with several non-profit and other state and federal governmental agencies, participating as frequently as possible, to improve forest management and education. These partnerships are integral to Rhode Island's forest management and future conditions, and without these crucial relationships the reach and engagement of all levels of residents and landowners would be drastically reduced.

The collective resources provided by the US Forest Service, providing financial and technical expertise; a qualified and motivated staff; and multiple working partnerships are all key to the DFE's success now and in the future.

Conserve and manage working forest landscapes for multiple values and uses.		
Objectives	**S&PF Programs**	**Partners**
Develop and expand existing planning and hazard monitoring capacity.	**FIRE (SFA)**	Federal & Regional Partners RIEMA
Increase capacity for implementation of management recommendations to achieve resiliency goals.	**FIRE (SFA)**	DEM RIEMA Fire Departments
Develop and deliver information on multiple platforms that addresses the identification and management of forest insect, disease, and non-native invasive threats.	**FHM** Fire (SFA) FSP U&CF	URI RI Division of Agriculture NRCS
Increase collaboration with local partners' management efforts to address forest health.	**FHM** FSP U&CF	URI RI Division of Agriculture NRCS
Keep forests as forests by increasing NIPF certified under the Forest Stewardship Program through targeted outreach to landowners in cooperation with partner groups.	**FSP**	NRCS RIFCO RIWP private
Promote forest management and conservation within spatial communities of small landowners using a landscape-scale approach.	**FSP** Fire (SFA) FHM U&CF	NRCS RIFCO RIWP private
Maintain RI's active involvement in regional and national Cooperative Forest Management (CFM) committee.	**FSP**	
Increase the number of communities with active local urban and community forestry programs.	**U&CF**	RITC Local government
Improve technical and professional capacity of tree-care professionals and the green industry.	**U&CF** FHM	RITC Local government
Advance community urban tree inventory and planning capabilities.	**U&CF** Fire (SFA) FHM	RITC Local government

Protect forests from threats.		
Objectives	**S&PF Programs**	**Partners**
Develop in-state wildfire response (surge) capacity and specialist skills.	**FIRE (SFA)**	DEM RIEMA Fire Departments
Improve communication between in-state partners and responders.	**FIRE (SFA)**	RIEMA Fire Departments
Maintain fire response capacity.	**FIRE (SFA)**	Federal & Regional Partners Fire Departments
Survey for native and non-native forest insect and disease threats and monitor for their outbreak and spread.	**FHM**	URI RI Division of Agriculture
Work with regional and national partners to disseminate current information about the biotic and abiotic threats to RI's forests.	**FHM**	URI RI Division of Agriculture NRCS
Maintain lines of contact and support structures for NIPF owners via onsite visits, meetings, informational exchange, and site inspections.	**FSP**	NRCS RIFCO RIWP private
Provide access to and information on relevant educational opportunities, current events, and funding opportunities.	**FSP**	NRCS RIFCO RIWP private
Promote forestry BMPs, and expand messaging, especially in regard to harvesting operations, which should be inspected prior to harvest and during operations to prevent wetland violations.	**FSP**	NRCS RIFCO RIWP private
Develop disaster preparedness and threat response.	**U&CF**	RITC Local government
Assist communities with establishing tree planting goals and management plans including trees and urban forests as an energy-saving practice.	**U&CF**	RITC Local government

Enhance public benefits from trees and forests.		
Objectives	**S&PF Programs**	**Partners**
Increase public awareness of wildfire and the need for preparedness.	**FIRE (SFA)**	RIEMA Fire Departments Municipalities
Incorporate a Firewise approach to wildland urban interface areas.	**FIRE (SFA)**	RIEMA Fire Departments Municipalities
Expand stakeholder engagement in collecting forest health information and disseminating forest health messaging.	**FHM**	URI RI Division of Agriculture
Maximize messaging effectiveness by increased coordination with partners for responses regarding threats to RI's forests.	**FHM**	URI RI Division of Agriculture NRCS
Promote active, sustainable forest management supporting wildlife habitat diversity, structural diversity, and understory health to landowners.	**FSP**	NRCS RIFCO RIWP private
Promote good silvicultural practices to support forest health, ecosystem resiliency, wetland conservation, wildlife habitat, and carbon storage.	**FSP**	NRCS RIFCO RIWP private
Provide education and outreach on forest management for special areas, highlighting the relationships of private forest land to wetlands and water quality, air quality, climate protection, and urban-rural interface values.	**FSP**	NRCS RIFCO RIWP private
Incorporate green infrastructure into municipal planning.	**U&CF**	RITC Local government
Maximize program delivery and messaging effectiveness through partnerships and coordination with local, regional and federal partners.	**U&CF**	RITC Local government

State Fire Assistance & Volunteer Fire Assistance (SFA & VFA) Programs

Program Description

The Rhode Island Forest Fire Program is comprised of two federally supported programs:

1. State Fire Assistance (SFA), CPG; and
2. Volunteer Fire Assistance (VFA), not CPG

Both support state and local rural fire prevention and control programs by providing financial support for prevention, control, suppression, and prescribed use of fires. This funding is also authorized to help conduct preparedness activities, including training, equipping, and otherwise enabling state and local firefighting agencies to respond to requests for fire suppression assistance and to uphold departments' statutory responsibilities. These funds, distributed through the Division of Forest Environment (DFE), promote mobilization readiness for efficient suppression of wildfires on all state and private lands, which assists in maintaining resilient forests and promotes working relationships and service excellence.

These federal funds are essential for DFE to address its critical fire management needs and to develop capabilities as described within the National Cohesive Wildland Fire Management Strategy. The goals include restoring and maintaining resilient landscapes, fire adapted communities, and safe and effective wildfire response. Within its Forest Fire program, DFE is required to specifically address and report on expenditures and activities that contribute to achieving the goals related to:

- Preparedness
- Suppression and Support
- Equipment
- Training
- Community Mitigation and Hazardous Fuels

Strategic Partnerships

REGIONAL

While the Fire Program engages with its adjacent State counterparts, the main mode of engagement is through the Northeastern Forest Fire Protection Compact (NFFPC), of which Rhode Island is an active member**.** The multi-state, multi-provincial organization provides its member states and provinces with assistance to address fires that might be beyond the capabilities of a single member through information, technology, and resource sharing (mutual aid) activities. One of the primary services the NFFPC provides is facilitation for training and qualification development. The NFFPC makes it possible to access qualified individuals to deliver local training to better meet local and regional obligations. Involvement in NFFPC committees, planning, and meetings involves 100% of the Forest Fire Program staff (4 people) to fulfill the required state commitments.

LOCAL

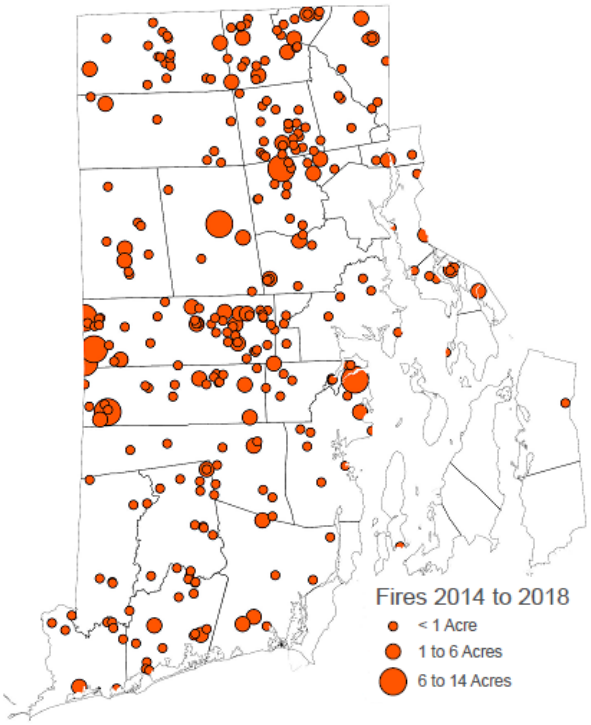
In Rhode Island, authority is delegated from the Director of DEM to the local fire departments to conduct wildfire suppression, prevention and mitigation work. The Forest Fire Program engages with the local fire departments and associations to identify and develop capacity to meet these goals. Partners include the Rhode Island Association of Fire Chiefs, Rhode Island State Firefighters' League, and the regional Fire Leagues: Northern Rhode Island, Central, Southern, and Woonasquatucket Valley Leagues. These partners are engaged in various activities such as training, hazard fuel reduction, prevention and outreach. The Forest Fire Advisory Committee, established by statute following disastrous fires in the 1940s, is an integral group to facilitate collaboration between the fire leagues, departments, and DFE.

STATE

The Forest Fire Program is working hard to develop increased visibility and stronger partnerships with Rhode Island state agencies, with the goal of creating efficiencies and improving interoperability and response. Currently, efforts are directed at increasing engagement with RIDEM Division of Emergency Response, RI Department of Public Safety, RI Fire Marshal's Office, and the RI Emergency Management Agency.

Programmatic Capacity

DFE's reduction in staffing has impacted the ability of the Agency to deliver a cohesive program. The Forest Fire Program has a staff of 4 (with 1 outstanding vacancy), straining its ability to address Preparedness, Suppression and Support, Equipment, Training, and Community Mitigation and Hazardous Fuels programming. It is fortunate that the incidence and size of fires have been diminished since the 1970's, as DFE is no longer able to provide robust response and leadership to support local wildfire suppression efforts. This reduction in large-sized fire occurrence has also resulted in a general lack of awareness on the part of residents and a lack of engagement or sense of urgency on the part of local fire departments.



Program delivery is more than firefighting readiness, and includes:

- Provide training opportunities for fire departments/districts, including chainsaw safety, land navigation, fire behavior, and other department-specific requests;
- Manage Volunteer Fire Assistance (VFA) grant funding. These monies are used to organize, train, and equip fire departments in rural areas and rural communities (having a population of 10,000 or less) to suppress fires;
- Administer the Hose Loan Program to maintain a supply of clean and tested fire hose for fire departments/districts;
- Deliver an equipment-on-loan program for requesting fire departments;
- Assist with community planning to develop fire protection plans and prevention activities for schools, fire departments/districts, and municipalities as time and staffing permits;
- Manage the Federal Excess Personnel Property (FEPP)/ Firefighter Property Program (FPP);
- Hazard Mitigation Planning, and implementation; and
- Fire Danger and Hazard Monitoring

PREPAREDNESS:

DFE Fire staff conduct several activities that facilitate and maintain a state of readiness, including the analysis of current and predicted weather conditions, wildfire occurrence, and the presence and availability of vegetative fuels throughout the year, maintaining a continual assessment of wildfire risk. Utilizing this information, agency staff develop daily forecasts, to assist the state and local government entities in preparing for and responding to periods of elevated fire danger (i.e., fire seasons), as well as administering "Open Air" burn permitting and other restrictions.

Two technology challenges continue to impede the ability of the DFE Forest Fire Program to

fully deliver preparedness planning and messaging:

1. Lack of fire risk mapping at a scale appropriate to Rhode Island's size: Due to the size of Rhode Island and the comparatively small parcel/project sizes, the 30- or 120-meter resolutions of the National and Regional Hazard Assessments are of limited use for management decisions. While these scales lend themselves well to broad landscapes, they are too coarse to capture small-scale forest characteristics or changes in forest cover due to fragmentation and development in Rhode Island, where 5m resolution would be more useful. Tools that can identify stand level data and cover/fuel type changes are a missing foundational component of state hazard assessment and state lands management. Mapping tools or programs are needed in order to effectively develop management plans and implementation strategies. Insufficient staffing levels do not allow for the manual development of stand level data to manage state lands or to communicate and educate landowners, communities and fire departments for wildfire planning and mitigation. Efforts to access other federal funding sources to develop this capacity have been made, and those efforts will continue.
2. Lack of up-to-date weather technology: Existing weather stations (Arcadia and Chepachet), while comparatively recent, lack compatibility with the GOES16 satellite system, and are unable to collect solar radiation data. The Forest Fire program is still using a manually calculated danger rating using **1967 indices,** which do not correlate well to more recent iterations. This system will be completely obsolete when the new, updated danger rating system is released in 2020.

Response planning is also a component of maintaining a state of readiness. This often includes engaging partners to identify and address areas of significant hazard, risk, or challenges. DFE is working to increase the level of engagement with other state partners to ensure resources and information is exchanged freely. It is critical for DFE to be a part of the conversation when plans such as the State Hazard Mitigation Plan and the Comprehensive Emergency Management Plan are revised.

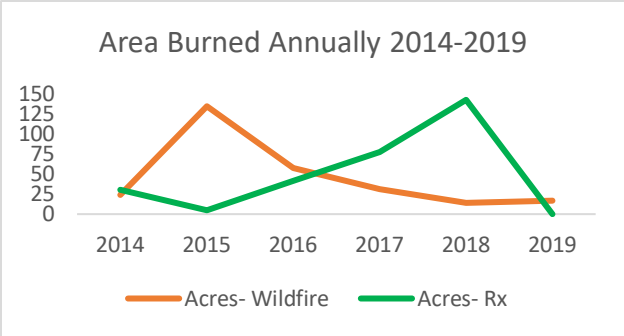
SUPPRESSION / SUPPORT:

Improving efficiency of the protection program including:

- firefighter training and testing to maintain a list of qualified personnel for in-state and out-of-state response;
- maintaining readiness of fire protection resources, available both in-state as well as to other states (outside of Rhode Island's planned fire season).

Currently, due to staffing limitations, the qualified list is only comprised of DFE Fire Program staff. This requires DFE Forest Fire Program to successfully attract DEM and other state agency staff to commit to involvement, training, and maintenance for their readiness. While historically, Rhode Island has not needed to utilize the mutual aid services offered by the NFFPC, the Rhode Island Forest Fire Program is wholly dependent upon the NFFPC and the services provided.

While DFE support capacity and capability is severely limited with existing staffing levels, response to active fires remains a cornerstone of the Forest Fire Program and is critical in meeting the goal of minimizing the impact of event fires and fulfilling the statutory obligations of the Director of DEM. RIDEM is making progress in developing policies and procedures to direct and guide the Forest Fire program including: a State Fire Plan, Standard Operating Procedures, a formal training progression, and a strategies template to develop wildfire response (surge) capacity. Until surge capacity is developed, all forest fires that exceed the volunteer/municipal fire department capacity may require a declaration for a state of emergency. Additional work needs to be initiated for collaboration and information exchange to be institutionalized within DEM.



The acres of wildfires since 2014 and prescribed fire (Rx) by the Forest Fire Program.

TRAINING:

From 2014 to 2018, 589 firefighters attended training either directly taught or facilitated by the DFE Forest Fire Program staff. Delivering training programs is a DFE priority and is critical to address the short- and long-term goals of developing capacity and incident management skills: providing training to volunteer firefighter and Forest Fire Program personnel in wildland fire fighting, firefighter safety and risk analysis, prescribed fire, usage of state forestry hose program, incident preplanning/complexity progression training, ICS, and Wildland-Urban Interface (WUI) Operations.

Besides the training progression, DFE is also increasing partnership efforts with NFFPC and local partners to increase in-state access to non-DFE or DEM staff. In 2019, the program, enabled by NFFPC, hosted an in-state Staging Area Manager course attended by 39 emergency and firefighting staff from across Rhode Island. Future educational courses will be planned and will assist in advancing the training progression efforts.

COMMUNITY MITIGATION AND HAZARDOUS FUELS:

The Forest Fire Program is committed to wildfire mitigation and prevention programs that help reduce hazardous conditions that, in turn, lower the risks from wildfires. The program focuses on outreach, planning, and implementation through public information and messaging from such programs as: Smokey Bear, Firewise, and Ready Set Go.

Existing capacity for fuel reduction efforts rely on DFW and federal partners to implement. On a state-wide basis, capability to implement moderate complexity prescribed burns is insufficient. Developing that capacity is needed to effectively implement prescribed burning as a fire management tool.

Increasing the ability of the Forest Fire Program to support municipal planning efforts in developing priorities and setting objectives was initiated from a 2015 Wildfire Risk Reduction (WRR) grant for a Community Wildfire Protection Plan (CWPP) for Prudence Island. While the project has been successful, additional time and effort will be required to further implement the preparedness messages for this first CWPP and for other communities statewide. The 2019 WRR grant awarded to DFE focuses on delivering the Firewise program and providing active technical support and developing in-state informational materials that will be made available online. This effort will include utilizing existing risk assessment tools, identifying communities at risk, and initiating proactive contact and follow-through with community leaders in these areas.

EQUIPMENT:

The Forest Fire Program currently maintains:

- a “strike team” of six type 6 engines;
- one type 3 engine;
- specialized deployable kits available to fire departments and NFFPC members; and
- a forestry hose loan and maintenance program for 35 miles of forestry firefighting hose for fire department/ district apparatus. The basis for Rhode Island’s initial attack capacity since the 1960s, the program requires a substantial time investment to maintain.

Humans cause most fires in Rhode Island with the potential to spread and impact multiple assets.

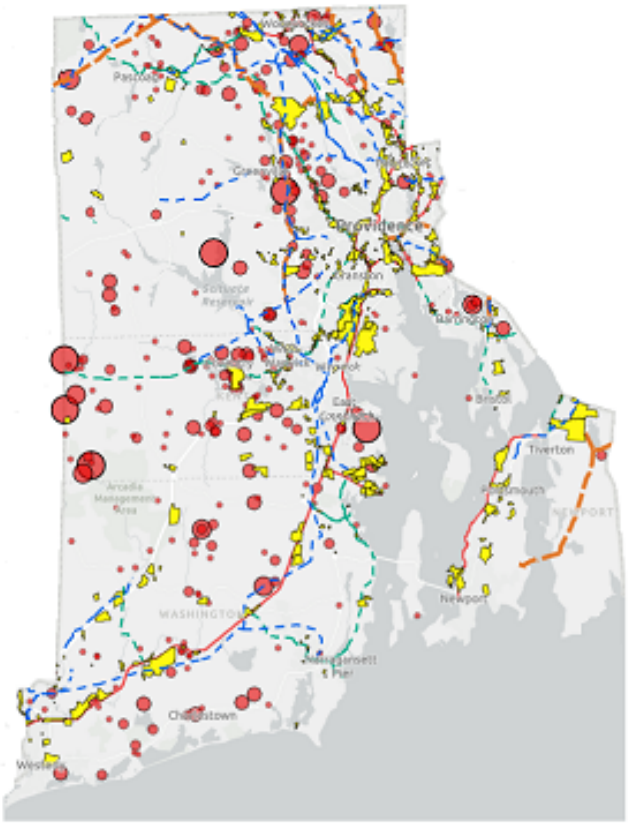
Hose laid out for cleaning; to be rolled and delivered to local fire departments.

Equipment maintenance is a critical component of maintaining a state of readiness. A priority for DFE is the development (and funding) of an equipment replacement plan as the majority of DFE's specialized equipment ages, depreciates, and can no longer be repaired. Due to budgetary constraints, large dollar items (such as vehicles) are currently on a 35-40-year replacement schedule. This is an unfeasible timeframe for second-hand vehicles and engines and requires a significant commitment of staff time to maintain, affecting reliability and the Forest Fire Program's ability to meet its fire responsibilities.

Program Priorities

Forest loss and fragmentation increases as the population continues to migrate from urban centers into adjacent forest land. As a result, fire departments are increasingly fighting fires within the expanding Wildland-Urban Interface (WUI), defined as areas where homes are built near or among lands prone to wildland fire. The increased population results not only in an increased proximity to fire, and more potential sources of ignition, it also exposes more residents, and their material assets (values at risk), to increased risk from wildfire. The vast majority of Rhode Island's fires are a result of human activity or carelessness, and often burn within the home ignition zone. The one benefit of increased population is more eyes reporting smoke or fire. However, the close proximity to values-at-risk reduces the time available to respond, assess, plan, and attack fires. This results in the potential for moderate to high consequence fire environments, characterized by:

1) the relatively high complexity due to the proximity and number of values-at-risk threatened, and
2) the high number of resources required to engage and control the fire.



This map shows a few of the assets at risk, related to recent RI fires: electrical transmission lines, urban industrial areas, natural gas lines, railways and roads. These are only a fraction of the values at risk should a large event wildfire occur. Homes, businesses and communities are scattered throughout Rhode Island amongst forest land.

These trends have been further exacerbated by the oak decline and mortality caused by several years of gypsy moth infestation and by trends of lower summer precipitation. The values at risk and the ecosystems that cohabit those areas are seeing increased fuel loading short-term, and change in fuel types long-term to more



Typical 0.2 acre fires located in populated areas: adjacent to forest fuels and structures, including garden and farm storage.

aggressive shrub fuel models better adapted to drier conditions, and dramatically increasing fire behavior; a dangerous combination.

As a result, the Forest Fire Program's priority is to address these high complexity response challenges appropriately, to the best of its capacity, including accessing additional grant funds like the WRR grants. Expanding public information and outreach and increasing planning and technical support efforts targeting communities and fire departments within the interface and intermix is the long-term and on-going priority of the Forest Fire Program.

Goals, Objectives, Strategies

Besides the S&PF National Priorities of Conserve, Protect and Enhance, the Forest Fire Program must also address the goals of the National Cohesive Wildland Fire Management Strategy (NCS):

1. Restore and Maintain Landscapes: Landscapes across all jurisdictions are resilient to fire-related disturbances in accordance with management objectives.
2. Create Fire Adapted Communities: Human populations and infrastructure can withstand a wildfire without loss of life and property.
3. Improve Wildfire Response: All jurisdictions participate in making and implementing safe, effective, efficient risk-based wildfire management decisions.

GOAL 1: ***Conserve*** forest resources and ecosystems by supporting resiliency-focused management. (NCS: Restore and Maintain Landscapes)

Objective 1.1: Develop and expand existing planning and hazard monitoring capacity.

Strategy 1.1.1: Pursue funding opportunities for fire risk mapping at a scale appropriate to Rhode Island for planning and prioritization.

Strategy 1.1.2: Pursue funding opportunities to purchase NFDRS compatible weather stations to update fire danger tracking and national reporting capability.

Strategy 1.1.3: Use improved planning capacity to establish fire program priorities for land management on state lands.

Strategy 1.1.4: Work with partners to assist landowners, municipalities, and agencies to address fire adapted ecosystem management.

Objective 1.2: Increase capacity for implementation of management recommendations to achieve resiliency goals.

Strategy 1.2.1: Work with partners to develop prescribed fire crew capacity and qualifications.

Strategy 1.2.2: Identify opportunities to employ alternative fuel treatment methods, like herbicide application and mechanical treatment.

Goal 2: ***Protect*** communities and their ecosystems from negative impacts of wildfire. (NCS: Improve Wildfire Response)

Objective 2.1: Develop in-state wildfire response (surge) capacity and specialist skills.

Strategy 2.1.1: Identify and initiate training for DFE, DEM and other state employees to meet Type 3 incident management needs.

Strategy 2.1.2: Increase local fire department's basic proficiency for wildfire suppression and safety.

Strategy 2.1.3: Work with state agencies and lawmakers to develop an updated emergency hire program.

Objective 2.2: Improve communication between in-state partners and responders.

Strategy 2.2.1: Work with RIEMA to improve and increase interaction and partnerships, and implementation of communications interoperability.

Strategy 2.2.2: Continue to host Forest Fire Advisory Committee meetings and improve fire departments' and partners' access to fire hazard, prevention, suppression, training, and preparedness information.

Objective 2.3: Maintain fire response capacity.

Strategy 2.3.1: Leverage Hose program efforts to increase Fire Department engagement in surge capacity development.

Strategy 2.3.2: Maintain agreements with Federal partners and NFFPC for response, and address barriers to resource sharing.

Strategy 2.3.3: Maintain or replace specialized equipment to ensure initial response capacity.

Goal 3: Enhance public benefits from trees and forests to Rhode Island communities and residents by developing increased resiliency to wildfire. (NCS: Create Fire Adapted Communities®)

Objective 3.1: Increase public awareness of wildfire and the need for preparedness.

Strategy 3.1.1: Develop education/awareness outreach, utilizing existing programs like Firewise and Ready- Set-Go

Strategy 3.1.2: Work with state partners to incorporate wildfire into environmental hazards preparedness messaging.

Objective 3.2: Incorporate a Firewise approach to wildland urban interface areas.

Strategy 3.2.1: Identify communities at risk through hazard assessment and developing fuel management strategies.

Strategy 3.2.2: Provide technical assistance for communities to develop fuel management strategies and/or Community Wildfire Protection Plans (CWPP).

Strategy 3.2.3: Pursue funding to assist communities with plan development and implementation costs.

Forest Health Program

Program Description

The goal of Rhode Island's Forest Health Program is to protect, enhance, and conserve the health and sustainability of forest resources and, therefore, the values they provide. Distributed through the Rhode Island Division of Forest Environment (DFE), the program is funded by two federal match programs which support national priorities and state activities:

- The Cooperative Forest Health Protection (CFHP) allocation in the Forest Service directives (FSM 3400, Chapter 3430) is a minimum of $60,000. Activities include ground-based surveying, outreach and education, training and technical assistance. It is required to have a full-time forest entomologist or plant pathologist on staff.
- The Forest Health Monitoring (FHM) component promotes the collection of forest stress and disturbance data on Federal, State, tribal, and private lands using nationally standardized methods and data fields. The data is collected through aerial and ground surveys using Digital Mobile Sketch Mapping (DMSM) codes, standards, and format. Allocation of FHM base funding ($23,000) is based on the number of participating States and acres of forested land in those States.

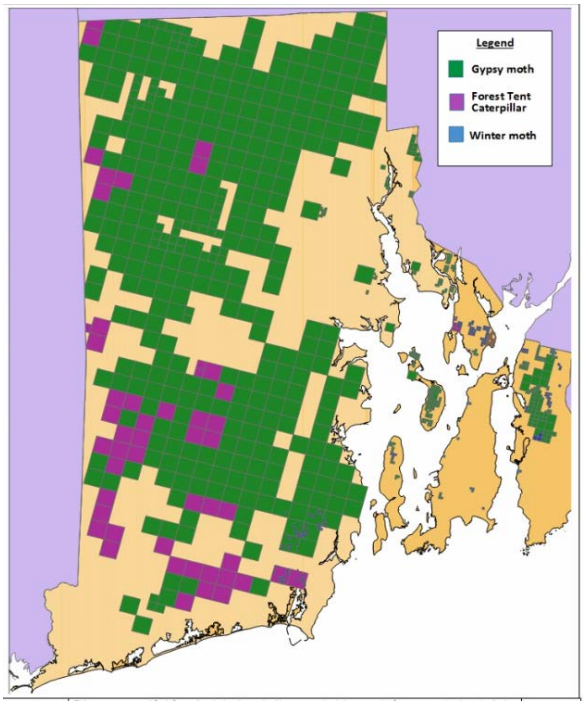
These programs fund activities to detect and monitor threats to Rhode Island forests, to evaluate forest health conditions, and to inform and educate others about the status of known and possible threats, and future conditions of the forest resource.

Surveying is the fundamental tool used in the Forest Health Program, from soliciting/ collecting information from the public via phone calls, mailings, conversations, or social media, to monitoring forest health plots situated around the state. The same platforms and opportunities are used to disseminate information and/or provide technical assistance. CFHP activities are critical in the conservation, protection, and enhancement of the forest and include surveying, monitoring, outreach, trainings, technical assistance, cooperative assistance with partners and cooperators, and evaluation of the collected information.

The CFHP in Rhode Island utilizes the same scientifically recognized and accepted survey protocols as other programs across the country to ensure consistent, valid data is collected. Protocols are in place for trapping (sticky traps, funnel traps), collecting with insect nets, or creating "trap trees" (a tree deadened or felled for the purpose of luring insect pests). For some insects, laboratory rearing from the larval stage to adults is required. Methodology is based on such considerations as the damage causing agent (DCA), tree species, lure availability, site parameters, purpose of the survey, etc.

While the CFHP program relies on ground-based activities, FHM involves aerial detection surveys (ADS) of the state's forested landscape to map canopy damage, defoliation, discoloration and/or tree mortality; to identify the cause of those problems; and to evaluate the risks that those threats pose. Mapped areas are "ground-truthed" to confirm the DCA.

In Rhode Island, common pests include: winter moth (*Operophtera brumata*), forest tent caterpillar (*Malacosoma disstria*), gypsy moth (*Lymantria* spp.), hemlock woolly adelgid (*Adelges tsugae*), orange-striped oakworm (*Anisota senatoria*), and southern pine beetle (*Dendroctonus frontalis*). On occasion, unanticipated DCAs or events (fire, weather events, human activities, etc.) require assessment. For example, in 2018, emerald ash borer (EAB) was confirmed, and spotted lanternfly (SLF) (*Lycorma delicatula*) is aggressively advancing in the northeast.



2017 Defoliations by DCA

FHM also relies on on-line tools, such as the USFS Forest Health Assessment & Applied Sciences Team's (FHAAST) "Forest Disturbance Monitor" (FDM). The FDM tool uses remote sensing to detect incremental changes in the "greenness" (deviation in how green the canopy should be compared to what it had been in the past few years) of small patches (about 16 acres) of the forest canopy. Monitoring and evaluating this data can provide warnings that the identified area may be experiencing a forest health threat and requires further investigation.

Strategic Partnerships

University of Rhode Island: Department of Plant Sciences and Entomology

DFE is a state forest health partner without a permanent entomologist or plant pathologist on staff. To meet the national requirement for funding, DFE annually requests a waiver from this requirement and submits a detailed plan for approval that demonstrates how the CFHP program will be implemented and monitored.

The University of Rhode Island (URI) is an essential partner in program delivery and fulfills the role of entomologist required for the federal funding. A yearly contract with URI allows the Forest Health Program to meet the national requirement and supports a close working partnership.

URI assists in the identification of forest damage-causing agents and, as necessary, propagation of suspect plants, insects, and pathogens for identification. URI also provides technical assistance to landowners and cooperates with the FHP on projects such as the rearing and release of species utilized in an approved integrated pest management program (biocontrol). URI also conducts surveys for forest damage causing agents in furtherance of the stated goals of FHP, and otherwise advises on pest management strategies, including participation at workshops and/or training sessions.

Department of Environmental Management: Division of Agriculture

The Division of Agriculture (DAG) is the State lead agency for the implementation of the Cooperative Agricultural Pest Survey (CAPS) which focuses on agricultural pests, some of which can impact forest resources. Issues that affect forest environments require partnerships for outreach and messaging to all stakeholders. Combined efforts and shared data and analysis are essential elements of this partnership.

Additional partners are also recipients of data collection (compiled and analyzed), such as Conservation Districts, cooperators like Forest Stewardship Program landowners, and non-profits such as RI Forest Conservators Organization (RIFCO). State data, combined with the results of data collected by other states, present a perspective of forest conditions at regional and national scales. Sharing this data enhances the health of forests in each state.

Looking for EAB Larvae: Bark Peeling

Programmatic Capacity

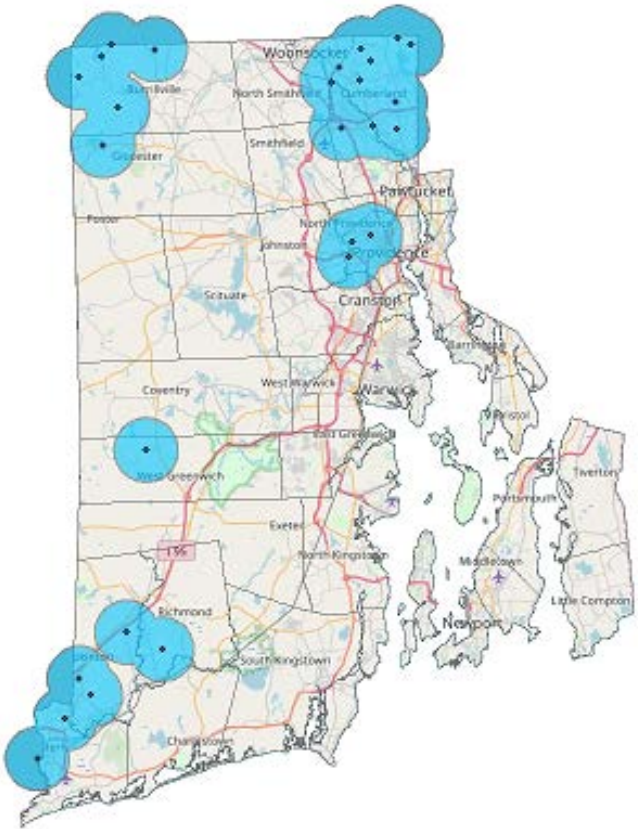
The Forest Health Program is managed by one full time staff person, with one seasonal (6 month) employee (as available). Coordination with program partners is integral to successful program outcomes. For example, some types of surveys or trapping are undertaken with URI on a geographical basis; messaging may be hosted/disseminated by URI, DAG and/or DFE depending on the type of pest or disease and the target audience. The additional threats posed by new pests (e.g. EAB and SLF) increase the need for more surveys, tracking, delimiting, and reporting. These activities all require an overall increase in time and effort from all partners.

Not including aerial detection flights, significant time is spent:

- Undertaking statewide gypsy moth surveys, (counting egg masses was a monumental task during the epidemic outbreaks in 2016 and 2017).
- Monitoring Eastern white pine needle damage (WPND), which has recently been noted, although the pines do not appear to have suffered harmful impacts to date.
    - Long term monitoring plots have been established regionally to monitor changes.
- Surveying for the native southern pine beetle, recently found in Rhode Island, indicates the species continues to thrive regionally, but has yet to cause the type of damage and mortality seen in other parts of its range (predominantly the SE).
    - Monitoring for population changes is continuing.
- Detecting EAB using the *Cerceris* bio-surveillance protocol, now supplemented by ash trap tree establishment and baited lindgren funnel trap installation.
    - Information from these surveys is vital as communities prepare for the impact to ash resources.
- Mapping winter moth damage, which has expanded its range into Rhode Island, periodically causing severe canopy defoliations (especially to red maple), particularly in the coastal zone.
    - As red maple is the state tree of Rhode Island, the threat to this resource is of particular interest.

Additional Issues being monitored include:

- Two-lined chestnut borer (*Agrilus bilineatus*) (identified as a possible source of secondary mortality of Gypsy moth damaged oaks)
- *Cynipid* gall wasps (Oak mortality)
- *Phytophthora ramorum* (various types of damage)
- Oak wilt (*Bretziella fagacearum*) (decreased vigor and/or mortality)
- Beech bark disease (insect/disease complex: *Cryptococcus fagisuga* and *Neonectria* spp) causes Beech mortality)



EAB trapping in 2019 shows locations where adults were caught using lindgren funnel traps. The blue boundary indicates a two-mile radius, the extent the infestation is presumed to have reached. 2020 trapping will start on these boundaries to further delineate the extent of infestation in Rhode Island.

In addition, DFE has adopted The Nature Conservancy's Don't Move Firewood campaign as a proactive protection step to prevent the introduction and slow the spread of invasive species. The FHP disseminates outreach materials to RV parks, campgrounds, and other appropriate facilities, and venues as part of Rhode Island's forest protection outreach. Informing the public at these outlets has a direct impact at a point source for potential infestations that reaches beyond the property boundaries of the facility, since the movement of firewood has been identified as the major vector for introduction of forest pests into un-infested areas.

Program Priorities

Similar to the other Cooperative Programs, land use change and development pressures present the greatest challenge to forest health. Sprawl and transit corridors provide multiple pathways and opportunities for the introduction and spread of native, invasive, and naturalized insect pests, plants, and pathogens, many affecting tree species and habitats. But urban problems don't remain urban and rural forest health is impacted, whether through competition, decline or mortality, or loss of synergistic flora and fauna. The popularity of recreation exposes trails and campsites to hitchhikers in or on vehicles travelling from infested to non-infested areas, and through the movement of infested firewood or wood products. Since forest health issues cross state boundaries, a regional approach to management is often required, necessitating cooperation with partners within the region, as well as continued vigilance within Rhode Island.

Priority areas where educational efforts can be targeted and are prime locations for trapping pests include locations where sprawl and development are occurring (typically immediately adjacent to existing urban areas, and in areas of high human activity, such as campgrounds). However, rural forests remain a priority given that mortality and regeneration, changes in species mix, and chronic stressors can affect habitat and forest characteristics for generations.

Goals, Objectives, Strategies

Goal 1: Promote the ***conservation*** and management of Rhode Island's forests through practices that address forest health and resiliency.

- **Objective 1.1:** Develop and deliver information on multiple platforms that addresses the identification and management of forest insect, disease, and non-native invasive threats.
  - **Strategy 1.1.1:** Develop messaging that emphasizes a landscape approach to tree and forest management and threat response, incorporating shared messaging from other DFE programs: Stewardship, Fire, and Urban Forestry.
  - **Strategy 1.1.2:** Utilize internal and external social media platforms and websites such as DFE's Current Threats to Forest Health, and Don't Move Firewood to inform and prevent the spread of invasive pests.
  - **Strategy: 1.2.3:** Utilize survey and monitoring data to assist management efforts that further Forest Health Program goals.
- **Objective 1.2:** Increase collaboration with local partners' management efforts to address forest health.
  - **Strategy 1.2.1:** Share latest techniques and protocols for identification and management of current forest threats.
  - **Strategy 1.2.2:** Pursue funding opportunities for alternative treatment methods and biocontrol response to damage causing agents (DCAs).

Goal 2: ***Protect*** Rhode Island's forests by monitoring and evaluating forest health conditions and threats.

- **Objective 2.1:** Survey for native and non-native forest insect and disease threats and monitor for their outbreak and spread.
  - **Strategy 2.1.1:** Maintain federal collection protocols for priority species and complexes.

Strategy 2.1.2: Assess effectiveness and adapt methodology of state gypsy moth plots as appropriate.

Objective 2.2: Work with regional and national partners to disseminate current information about the biotic and abiotic threats to Rhode Island's forests.

Strategy 2.2.1: Attend regional and state meetings to share and exchange information and efforts.

Strategy 2.2.2: Establish Rhode Island representation on the Northeastern Forest Fire Protection Compact (NFFPC) *Forest Health Working Group*.

Goal 3: ***Enhance*** public benefits from trees and forests through promotion of practices and programs that address threats to forest health.

Objective 3.1: Expand stakeholder engagement in collecting forest health information and disseminating forest health messaging.

Strategy 3.1.1: Engage local stakeholders with trapping and monitoring efforts by providing materials and training and promoting local efforts on social media and public workshops/presentations.

Strategy 3.1.2: Continue to support local partners (such as RI Conservation Districts, Envirothon, and RI Forest Conservators Organization (RIFCO)) by sharing data and information and participating in outreach efforts to professionals and the general public.

Objective 3.2: Maximize messaging effectiveness by increased coordination with partners for responses regarding threats to Rhode Island's forests.

Strategy 3.2.1: Continue to collaborate with primary in-state partners, URI and RIDEM Department of Agriculture, on developing consistent messaging across programs and platforms.

Strategy 3.2.2: Maintain engagement with Federal and other State Forest Health counterparts for updating, coordinating and assisting with regional forest health efforts and initiatives.

Lindgren funnel trap for SPB

Purple prism trap for EAB

Forest Stewardship Program

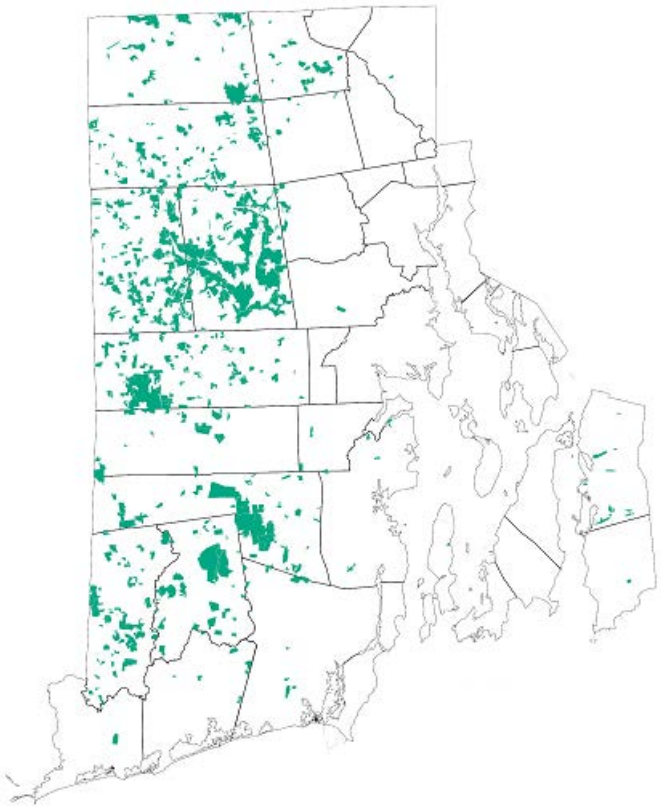
Program Description

The Rhode Island Forest Stewardship Program (FSP), under the US Forest Service, serves to promote and support active forest management on non-industrial private forest lands (NIPF). Through the Rhode Island Division of Forest Environment (DFE), this program provides NIPF owners with access to professional and technical assistance. In Rhode Island, this assistance includes:

- Maintenance and delivery of the Forest land Classification current use taxation program
- Site visits to forest landowners requesting technical assistance
- Education and outreach for both landowners and the general public
- Timber harvesting permitting and BMP education for landowners and loggers
- Dissemination of information on education and funding opportunities

The Rhode Island FSP is also responsible for tracking land-use change and ownership patterns, seeking out new programmatic opportunities, and exploring creative, flexible ways to serve the needs of Rhode Island's people and forests.

Landowner participation in the FSP is driven by the current use program that allows lower land tax valuations for lands under Forest land Classification (FLC). To maintain FLC under the Rhode Island Farm, Forest, and Open Space Act (FFOS), NIPF owners must actively manage their forest land according to federal FSP standards. While FFOS requires a landowner to manage 10 or more acres of forest land to qualify for FLC, all NIPF owners in the state are eligible for assistance from the FSP and can request assistance at any time. Outreach and education are also available to any groups requesting relevant assistance, including presentations, guided walks, or workshops.



Forest land enrolled in the FFOS Program, 2019

Strategic Partnerships

Personnel and resource limitations requires the Stewardship Program to rely on close associations with partner groups. Currently, an MOU is being developed between Natural Resources Conservation Service (NRCS) and DFE that recognizes the importance of Rhode Island forest management and makes provision for close cooperation and collaboration between the programs to provide and deliver technical assistance to NIPF owners.

The Rhode Island Woodland Partnership (RIWP) is a local partner organization drawing from public agencies, small businesses, and non-profit organizations, to meet shared stewardship goals. The broad membership representation allows RIWP to act as the Stewardship Advisory Council for periodic meetings and input.

Other partner groups include:

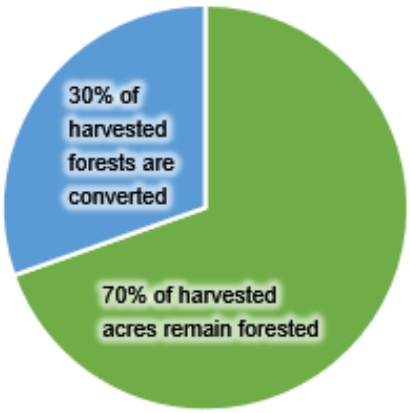
- Rhode Island Forest Conservators Organization (RIFCO)
- Rhode Island Resource Conservation & Development Council (RIRC&D)
- Rhode Island Association of Conservation Districts (RIACD)
- RI DEM Division of Fish and Wildlife (DFW)
- American Tree Farm System, Rhode Island Council (ATFS)
- Forest Stewards Guild

Program Priorities

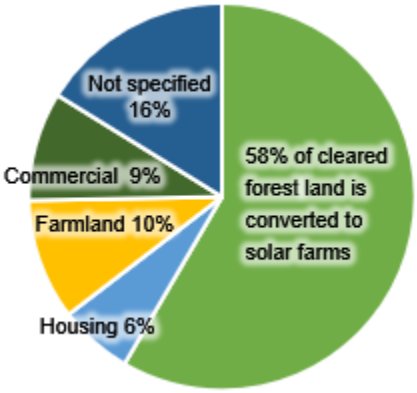
Stewardship Program priorities include mitigating the effects of urbanization by promoting the protection and management of swaths of undeveloped and contiguous forest land in Rhode Island and promoting forest management in the wildland-urban interface (WUI). By percentage of urban land, Rhode Island is the second most developed state in the US, so every acre of remaining forest land is crucial for the health of both the human and wildlife populations of this state.

Currently, the pressures to develop private forest lands remain steady and are increasing as the state recovers from the Great Recession. Trends over the last two years indicate that nearly a third of all timber harvesting in Rhode Island results in permanent land conversion (top graphic on right), the majority of which is due to pressures from alternative energy development (bottom graphic on right). Landowners may not continue to manage and maintain their lands as forest if they perceive a lack of value and support for forest management – to the detriment of all of Rhode Island and its inhabitants. By providing private landowners with technical assistance, education, and outreach, the FSP acts as a support system for forest landowners.

Forested areas under the greatest conversion pressure - those in which the most forested acreage is being permanently converted - are rural areas with cheaper land and higher taxes relative to other towns in Rhode Island (e.g. Hopkinton, Foster). Exurban and wildland-urban interface areas continue to face steady pressures from housing development, resulting in fragmentation from house lots and subdivisions carved from contiguous forest.



Conversion of forest land based on harvesting permit data (2018 – March 2020). Of all harvested forest land acreage, 29% is deforested for permanent conversion to other



Use of converted forest land based on harvesting permit data (2018 – March 2020). Of all deforestation occurring via permitted harvesting, more than half is converted to solar energy farms and 16% to conventional agricultural uses.

This priority focus for the FSP coincides with the modernization efforts underway on national and regional levels and addresses the four critical issues of concern. By targeting remaining contiguous forests in rural western Rhode Island and in the Sakonnet landscape of Tiverton and Little Compton, as well as the interface and exurban areas in Rhode Island, active forest management addresses the issues of concern:

- **Reducing wildfire risk to communities** through active forest management and maintenance of trails within properties.
- **Protecting water resources** by monitoring water quality protection during harvesting, retaining forests adjacent to waterways, and promoting conservation of forests in important watersheds.
- **Enhancing wildlife habitat and promoting forest health and resiliency** through active forest management including successional intervention, invasive species control, and forest health improvement.
- **Supporting jobs in the woods** via retention of working forest lands.

The demand for land for development and other uses resulting in permanent land conversion is increasing, and landowners must be supported and educated on the value and benefits of managing their forests as forests. Without active and consistent efforts, many landowners will succumb to the enticement of selling their land. The FSP acts as a support system for forestland owners by providing private landowners with technical assistance, education, and outreach.

Goals, Objectives, Strategies

Goal 1: Promote ***conservation*** of non-industrial private forest land (NIPF).

Objective 1.1: Keep forests as forests by increasing NIPF certified under the Forest Stewardship Program through targeted outreach to landowners in cooperation with partner groups.

Strategy 1.1.1: Identify key areas of qualifying NIPF and target outreach efforts toward landowners in these key areas to increase awareness about both the Forest Stewardship Program and the importance of sustainable forest management.

Strategy 1.1.2: Continue to promote the current tax provisions of the FFOS Act as a tool to conserve forestland and work with municipal tax assessors to reach eligible landowners.

Objective 1.2: Promote forest management and conservation within spatial communities of small landowners (with less than ten contiguous acres) using a landscape-scale approach.

Strategy 1.2.1: Develop a landscape-scale management framework to benefit small landowners in Rhode Island (<10 acres) who do not qualify for FLC under FFOS.

Strategy 1.2.2: Identify key areas of small landowners with potential for collaborative management and provide outreach to encourage forest management under the landscape-scale management framework.

Objective 1.3: Maintain Rhode Island's active involvement in regional and national Cooperative Forest Management (CFM) committee.

Strategy 1.3.1: Attend annual regional NMSFA CFM committee meetings and biennial national CFM committee meetings.

Strategy 1.3.2: Utilize the Forest Stewardship Committee (RIWP) to advise Stewardship Program activities.

Goal 2: ***Protect*** private forest land from development and degradation.

Objective 2.1: Maintain lines of contact and support structures for NIPF owners, via onsite visits, meetings, informational exchange, and site inspections.

Strategy 2.1.1: Educate NIPF owners on forest fragmentation prevention, sustainable forest management, and conservation-based estate planning.

Strategy 2.1.2: Cooperate with the Rhode Island Forest Fire Program to provide NIPF landowners with wildfire protection and prevention resources.

Objective 2.2: Provide access to and information on relevant current events, partner group initiatives, and funding opportunities.

Strategy 2.2.1: Increase NIPF owner awareness of programs available through collaborative and partner group efforts, such as the "Forestry for Rhode Island's Birds" program.

Strategy 2.2.2: In cooperation with partners, provide outreach and education to tax assessors, realtors, and public officials on the importance of opportunities for landowners to protect NIPF from development and degradation.

Objective 2.3: Promote forestry BMPs, especially in regard to harvesting operations, which should be inspected prior to harvest and during operations.

Goal 3: ***Enhance*** forest resources and ecosystem services of private forest lands.

Objective 3.1: Promote active, sustainable forest management supporting wildlife habitat diversity, structural diversity, and understory health to owners of both managed and unmanaged forest land.

Strategy 3.1.1: Provide education and outreach on: (1) invasive species identification and control, and (2) insect and disease recognition and response.

Strategy 3.1.2: Provide education and outreach on the importance of sustainable forest management in supporting fish & wildlife habitat, improving watershed function, and contributing to air quality.

Strategy 3.1.3: Encourage landowners to seek assistance from qualified natural resource professionals.

Objective 3.2: Promote good silvicultural practices, backed by sound science, to support forest health, ecosystem resiliency, wetland conservation and watershed function, wildlife habitat, and carbon storage.

Strategy 3.2.1: Support best management practices (BMPs) for forest management through education and follow-up.

Strategy 3.2.2: Promote silvicultural practices that support a diversity of forest structures and habitats, especially for threatened & endangered plant and wildlife species and those vulnerable to suburbanization and fragmentation.

Objective 3.3: Provide education and outreach on forest management for important forest ecosystems, highlighting the relationships of private forest land to wetlands and water quality, air quality, climate protection, and urban-rural interface values.

Strategy 3.3.1: Promote "Call Before You Cut" program to educate landowners before timber harvesting.

Strategy 3.3.2: Provide education and outreach to groups outside of NIPF owners, such as community groups, policy makers, and schoolchildren, with specific focus on the universal benefits of private forestland conservation and management.

Strategy 3.3.3: In cooperation with partner groups, inform and educate state and local government officials of the need to provide sound policies for the funding, protection and enhancement of private forest resources.

Urban & Community Forestry Program

Program Description

The goal of the Rhode Island Urban & Community Forestry Program (U&CF) is to support communities in developing sustainable urban forestry programs that enhance the environmental, economic, social, and health benefits that healthy trees and forests provide. U&CF aims to do this by assisting communities with the:

- Development of urban forest resource assessments and management plans
- Development and review of tree ordinances and policies
- Education of citizens, private industry, agencies, and community groups on tree establishment and management
- Establishment or improvement of the effectiveness of advocacy and advisory organizations

To a degree, Rhode Island's forest land has benefited from the industrialization and movement of population from rural to urban areas in the past century, as well as the migration of industry and manufacturing out of the state. Even the slow recovery from the Great Recession has buffered the rate of development and land conversion. But this recovery and reprieve is coming to an end as populations grow and expand both in Rhode Island and in neighboring states.

In Rhode Island, municipalities are facing development pressures that result in forest land conversion, from traditional house lot construction to solar field installations. These municipalities are generally not prepared to address these demands in a way that best represents community identity and character; most communities have no or limited ordinances that address trees and landscape within infill or new development sites. Tree maintenance is typically a reactive event with limited proactive planning.

And, while Rhode Island requires all people working in arboriculture have a state license, to a total of nearly 700 active licenses in 2019, there is no required on-going education requirement.

The opportunity and need for technical support and assistance for communities, professionals and residents in Rhode Island rests on the base funding received for the Urban & Community Forestry Program ($200,000 per year). To be eligible for base funding requires:

- full-time program coordinator
- full-time or equivalent volunteer/ partnership coordination capacity
- active state advisory council, and
- current 5-year plan that may be included in the State Forest Action Plan (as is here)

Unlike most states that receive base funding, Rhode Island utilizes some of that base funding to deliver a small subgrant program (typically $30,000 per year) awarding ~10 small subgrants yearly.

Strategic Partnerships

Rhode Island provides funds to the RI Tree Council (RITC) through a cooperative agreement to fulfill the required volunteer coordinator position necessary to receive federal funding; due to funding limitations, and managing the subgrant program, Rhode Island does not have a volunteer/partnership coordinator employed in State service. RITC manages the champion tree registry, plans and organizes the State Arbor Day, delivers a myriad of public education programs, including the extensive Tree Stewards Program, works with municipalities (e.g., the Set-Back Tree Planting Program with three active municipalities in 2019), and represents the U&CF Program throughout the state, providing education and engagement opportunities in urban and community forestry for Rhode Island citizens.

The U&CF Program provides support or technical assistance to other small or local non-profits and tree boards around the state where support or technical assistance is needed. However, there are multiple opportunities to work with other State Agencies, providing technical support and advocating for trees. In particular, opportunities have been identified to increase engagement with:

- RI Department of Environmental Management State Parks: aging and decaying trees, Emerald Ash Borer, planning and replanting strategies, greenway issues
- RI Department of Environmental Management Division of Agriculture: Invasive pests and diseases affect local agriculture and local forest environments requiring partnerships in outreach and messaging to all stakeholders
- RI Department of Health Health Equity Zones (HEZ) Initiative is a partner for the project funded by American Forests for the RI Urban Forests for Climate and Health initiative
- RI Emergency Management Agency is increasing engagement with the DFE Forest Fire Program, but opportunities for U&CF to promote the inclusion of trees in emergency planning and to support communities through U&CF's involvement with the 2019 NUCFAC: *The Accessible Community Tree Inventory: Expanding State Capacity for Planning and Risk Management*

A final significant partnership, since 2015, is the funding received through the RI Regional Greenhouse Gas Initiative that funds the Energy-Saving Trees Program, described further below. The Arbor Day Foundation is essential in implementing this effort.

Programmatic Capacity

Beyond the technical support and partnerships, the U&CF program delivers or manages several efforts:

U&CF SUBGRANTS

Since 1990, the U&CF program has made a portion of their base funding available for subgrants ranging from $1,000-$4,000, with a 60/40 match requirement. At one time grant monies were as high as $100,000 but, in recent years, funding has held steady at $30,000. Applications from municipalities and varied non-profits and applications are reviewed with the RITC Board. Traditionally, many of the projects are related to tree planting, but the U&CF Program encourages applications for planning and management through its review process where funding priority is given to projects that advance a community's urban forest management program, provide training to public agency staff, educate the public on urban forestry issues, or promote tree planting in low-to-medium income communities with below-average tree canopy cover.

ENERGY-SAVING TREES

A successful grant-funded partnership with The Arbor Day Foundation in 2015 through their Energy-Saving Trees Program (EST) led to an extension of the partnership funded by Rhode Island's Regional Greenhouse Gas Initiative. Two tree giveaways are offered June and September, for 1,000 trees each.

Since the EST program's inception, Rhode Island has planted 11,400 trees around RI residences to reduce heating and cooling costs. An initial survivability study was conducted on the fall 2015 giveaway season one year after their planting and found 78% of trees were planted correctly and still alive; additional survivability studies have not been conducted due to short-staffing and funding. Interest in the program remains high and all trees are typically reserved within a week. Any unclaimed trees are given to RITC, which uses them as part of their outreach and planting efforts.

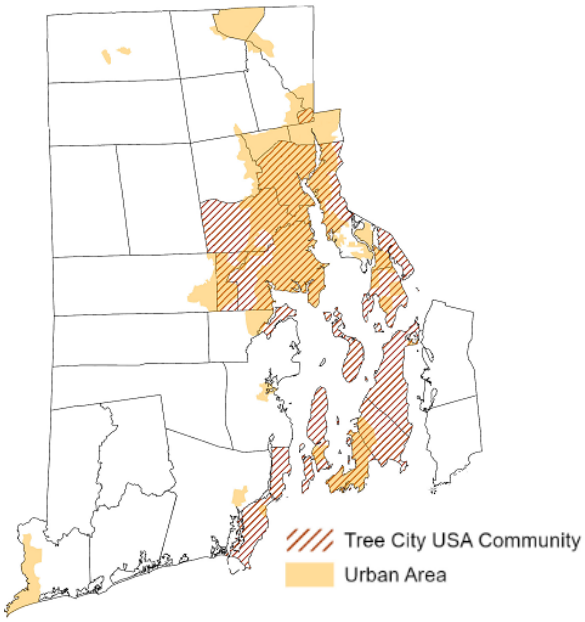
U&CF partners with the RI Nursery and Landscape Association (RINLA) to facilitate the EST program. RINLA is a statewide 501(C)3 that promotes the green industry and supports the marketing of green industry goods and services throughout Rhode Island. Through the partnership with RINLA, trees are stewarded throughout the duration of the season and delivered to each of the 4 giveaways locations.

TREE CITY USA & TREE CAMPUS USA

The U&CF program administers these Arbor Day Foundation programs with 13 municipalities and one university, Salve Regina University, all in the eastern, and highly-populated, side of the state.

There are 39 municipalities in Rhode Island, many which are, or have, highly rural areas associated with them, which will be targeted in future outreach efforts.

National Grid services over 95% of Rhode Island and is recognized as a Tree Line USA utility company in Massachusetts. Obtaining a local designation is a clear target for the program.



STATE ARBORIST LICENSE

Rhode Island State General Law regulation, §2-19-2, requires that "any person, firm or corporation desiring to engage in or practice the art or trade of arborist, …, shall obtain a license to engage or practice from the director of environmental management." The U&CF Program manages the yearly renewal of state licenses, which also administers the qualifying exam four times a year. Nearly 700 licenses were issued in 2019. This contact list provides the basis for offering regular training and workshop opportunities to arborists and allied green industries, to encourage voluntary continuing education.

MUNICIPAL TREE WARDENS

Rhode Island State General Law regulation §2-14-2 establishes the requirement that all Rhode Island municipalities have a Tree Warden, who shall be a licensed RI arborist, appointed each January by the town council or mayor. While some appointments are licensed staff or consultants, other municipal staff, such as planners or public works, may have the responsibility added to existing duties. Providing on-going education to Tree Wardens, as well as technical support, has been enhanced with the start of regular workshops targeting Tree Wardens.

TECHNICAL SUPPORT & EDUCATION

The U&CF Program seeks to leverage its modest resources to serve the greatest number of Rhode Islanders possible. It does this primarily by its programs but also by providing technical urban forestry services to groups, including cities and towns, environmental non-profit organizations, schools, tree care professionals, and others. Increasing access and engagement on-the-ground is a priority. Recent efforts include the purchase of a resistograph which will allow education and direct observations on tree structural integrity, and the start of yearly workshops targeting tree wardens and professionals each spring and fall. These workshops will increase education opportunities, expanding on the existing audience focus by RITC, which mainly targets individuals, and building volunteer capacity.

Program Priorities

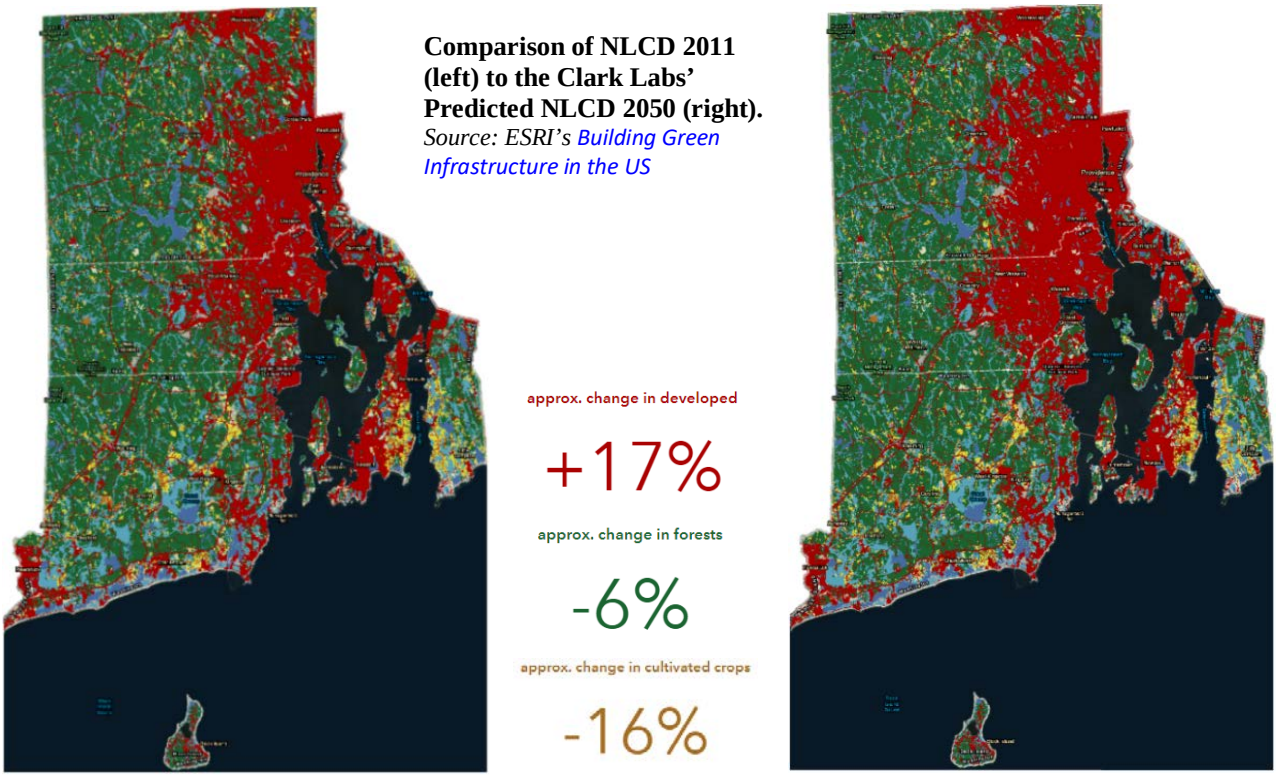
The U&CF Program is multi-faceted and works with groups from large urban centers to small unincorporated communities and all that lies in-

between, including wildland-urban interface and intermix. Ever the advocate for trees and their proper management, the entire environment has come under the purview of U&CF professionals. Trees not only provide multiple and quantifiable economic benefits, but they also play a significant role in the environment and habitat needs of humans and flora/fauna.

Increasing public awareness and expanding education efforts are one element to encourage improved municipal management planning. But, like Rhode Island's own U&CF Program, most communities are operating on a shoestring budget, if they have a budget for urban tree programming at all. These limitations seriously affect the ability of the U&CF Program to lead or support efforts to address the impacts of increasing urbanization, protect community values and culture, maintain landscape functionality, and plan for catastrophic events. Information is only one part of the equation; implementation is the other. Limited funding affects the ability of the U&CF Program and RI's municipalities to carry out substantive efforts.

Rhode Island's small size allows U&CF to make direct and personal connections with municipal staff and identify opportunities to provide support and assistance with additional technical ability and increased contact. These efforts are essential to encourage planning and management to include trees and forests, and to realize their significance as resources that help achieve other municipal goals, including maintaining community character. While core urban centers are limited in their ability to substantially increase their tree cover and the associated benefits, the edges of the communities where development is expanding is a prime opportunity for U&CF to engage communities, and to find the motivating factors and priorities that drives each community, including, among others:

- Connectivity and corridors
- Landscape functionality
- Stormwater management
- Air quality
- Human health
- Culture and character
- Right tree, right place.



Comparison of NLCD 2011 (left) to the Clark Labs' Predicted NLCD 2050 (right).
Source: ESRI's Building Green Infrastructure in the US

Goals, Objectives, Strategies

Goal 1: Promote active and sustainable management to ***conserve*** trees and forests where people live, work and play.

Objective 1.1: Increase the number of communities with active local community forestry programs (managing/developing).

Strategy 1.1.1: Raise awareness levels of elected officials and policymakers on the benefits of urban trees and their management.

Strategy 1.1.2: Improve local governments' capability to write effective tree protection ordinances and policies.

Objective 1.2: Improve technical and professional capacity of tree-care professionals and the green industry.

Strategy 1.2.1: Provide workshops and training opportunities for tree wardens, municipal tree managers and professional arborists to increase their technical knowledge and ability.

Strategy 1.2.2: Support RITC's outreach efforts to promote current tree planting and maintenance best practices

Objective 1.3: Advance community urban tree inventory and planning capabilities.

Strategy 1.3.1: Provide information, training and technical support for community street tree inventories.

Strategy 1.3.2: Promote community-scale canopy studies to assess urban forest populations to determine their conditions, derived benefits, and values, as a basis to improve planning and management of the urban forest.

Goal 2: ***Protect*** trees and forests from threats (invasive, catastrophic, climate, etc.) through planning and response.

Objective 2.1: Develop disaster preparedness and threat response.

Strategy 2.1.1: Assist communities with incorporating trees into their emergency planning processes.

Strategy 2.1.2: Incorporate proactive planning for invasive species into municipal tree inventories and planning/ management practices.

Objective 2.2: Assist communities with establishing tree planting goals and management plans including trees and urban forests as an energy-saving practice.

Strategy 2.2.1: Encourage communities to consider environmental and health equity when prioritizing tree planting projects.

Strategy 2.2.2: Facilitate strategic planting and maintenance of community trees for public benefits.

Goal 3: ***Enhance*** the public benefits of trees and forests through improved management practices.

Objective 3.1: Incorporate green infrastructure into municipal planning.

Strategy 3.1.1: Foster awareness that trees can help municipalities meet federal standards and requirements for air quality, stormwater management and water quality.

Strategy 3.1.2: Promote stormwater management practices using trees, natural systems and other green infrastructure measures.

Objective 3.2: Maximize program delivery and messaging effectiveness through partnerships and coordination with local, regional and federal partners.

Strategy 3.2.1: Provide education and support to RITC, TCUSA tree boards, tree non-profit groups, and other non-traditional partners.

Strategy 3.2.2: Continue to collaborate with regional initiatives and support in-state partners and agencies to develop consistent/shared messaging across programs and platforms.

Strategy 3.2.3: Engage with federal and state U&CF counterparts, attend meetings, share information, skills, and assistance.

State Lands Management

Program Description

RIDEM state land management is not one of the federal cooperative programs, however, the significance of these DEM properties warrants a brief discussion of this program in context with program delivery for the cooperative programs.

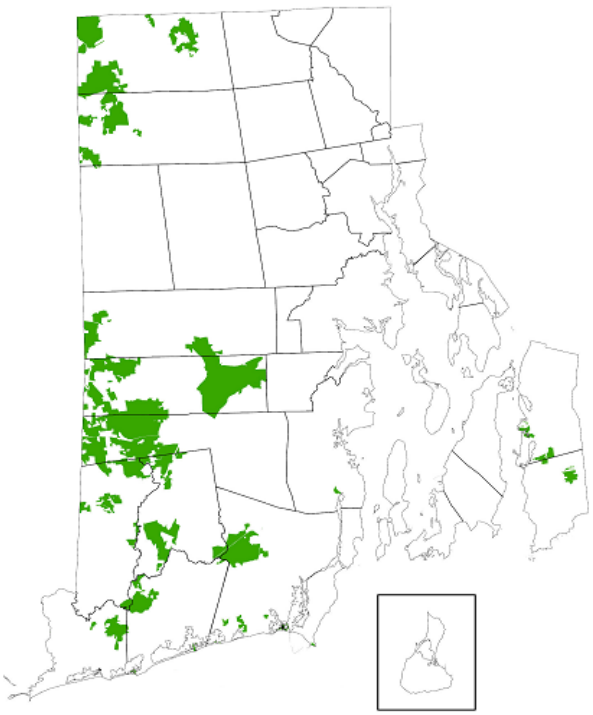
The over 57,000 acres designated as state lands is comprised of 29 management areas. The land is essentially under shared management/ responsibility by the Divisions of Forest Environment (DFE), and Fish and Wildlife (DFW). Forest health silvicultural prescriptions are implemented when the situation warrants. Most of these types of harvests deal with white pine sawtimber and pulp. Harvests targeted to habitat maintenance/creation are conducted jointly with the Division of Fish and Wildlife addressing nesting season and general BMPs for wildlife. DFE also delivers prescribed burning through the Forest Fire Program and DFW assists with those burns.

Responsibilities of the State Lands Forester include a wide range of duties, such as recreational permitting, infrastructure maintenance, timber harvesting, and general patrols of management areas.

Strategic Partnerships

RIDEM DFW is the primary partner with DFE where land management is concerned, but land use by stakeholder groups is overseen by the Management Area Stewardship Committee, which is comprised of representation from five divisions of RI DEM (DFE, DFW, Parks, Legal, and Enforcement).

The committee is tasked with recreational permitting and oversees projects such as timber harvesting, trail work, clean-ups, and a vast array of volunteer events. As forest loss and fragmentation continues, and demand for recreational opportunities increases, the committee's role in permit review is essential to manage access and use.



Land under RI DEM Management

Due to the limited maintenance staffing, stakeholder groups are essential to coordinate events and conduct trail work/projects, some of the most active groups include:

- MOUs with:
  - Appalachian Mountain Club
  - Rhody Rovers
- Partners include:
  - Audubon Society, The Nature Conservancy, University of Rhode Island, RIFCO, American Tree Farm

Programmatic Capacity

With only one State Lands Forester, long-term planning has been regulated to a back burner as history, long-term goals, and strategies are maintained within the heads of active staff. This methodology becomes more untenable in the face of fragmentation, climate change, staffing turnover, and the threats these changes present to high value habitats and forest.

With Rhode Island's small size, its management areas are highly accessible to the public and management actions are highly visible. Prescribed fire and other management actions are publicized (signage and notification to abutting property) but the opportunities for effective public education and showcasing forest management strategies has been under-utilized. The development of demonstration sites for various practices, including management practices for deer browse or assisted species migration, sequential prescribed fire recovery sites, and habitat enhancement would be invaluable when communicating messaging regarding stewardship, forest health, fire management, and even urban forests.

DFE State Lands staff face pressure by numerous stakeholder groups for access, the creation of unofficial trails with the resultant degradation, and a lack of enforcement.

Program Priorities

Oak mortality has become a serious concern throughout Rhode Island as outlined in the forest health section of this Action Plan. Salvage operations have been ongoing within state-owned management areas but future salvages may not be considered merchantable timber harvests as the dead standing oak continues to degrade.

Future conditions of existing oak forests are an important concern as threats and stressors continue to negatively impact these forests. In the years to come it will be critical to understand how Rhode Island's state-owned lands can adapt to these changes while providing safe recreational use areas, and healthy and productive forest habitats.

State-managed forest lands are an important component of program delivery for the cooperative programs. Location of management areas and their ease of access means that efforts undertaken on state land provides visibility and education to residents, including those who might not attend field days. State land priorities support the cooperative programs' priorities and can assist in their education and outreach efforts.

Goals, Objectives, Strategies

Goal 1: Support land conservation partners and DEM Land Acquisition Committee efforts to ***protect***, ***conserve***, and acquire large tracts of contiguous forest by highlighting the multiple public benefits of keeping forests as forest.

Goal 2: ***Protect*** forest land from improper management practices and degradation from increasing recreational use.

Objective 1.1: Develop use and maintenance stewardship standards for harvesting and trail maintenance on state land.

Objective 1.2: Develop forest management plans for priority areas (high value/high use).

Objective 1.3: In partnership with cooperative programs, identify funding sources to aid development of management plans for high value/high use locations and demo sites.

Goal 3: ***Enhance*** and expand the use of state forest land for public education and recreation.

Objective 2.1: Develop demo sites on state land to highlight the benefits of BMPs and forest management (e.g. harvesting, regeneration/restocking, deer browse, prescribed fire, etc.).

Objective 2.2: Deliver outreach and education to the general public, landowners, and wood operators, with partner organizations and cooperative programs.

APPENDIX A

Land Use / Land Cover Mapping in Rhode Island

While moving to DOA/DEM/RIGIS 2011 Landuse/Landcover (LULC) data and DEM land records will make it easier to track change and assess changes in landuse over time as landcover data is updated in future satellite imagery, DFE is not incorporating this approach for the 2020 assessment. Future LULC updates will allow for assessing change but the differences in definitions and mapping between LULC and FIA do not allow this for 2020, as differences in approaches and priorities suggests that FIA, with its forest-centric definitions, incorporating canopy and site productivity, cannot directly correlate with land-use definitions based on apparent use. For example:

1. While the 2017 FIA forest land estimate of 368,000 acres shows an increase from 356,000 acres in 2007, that may be partly accounted for by the explanation of changes to the FIA protocols in the body of the assessment. Meanwhile, the LULC estimates 399,000 acres. The large increase, as identified under the LULC, cannot be assumed to indicate that forest land and habitat has drastically increased and is not at risk.

2. The mapping of ruderal forest as reported in the 2015 WAP by Photoscience using 2011 imagery showed 36.8 thousand acres. Much of this ruderal area would be defined as wildland urban interface (WUI), as seen in the i-Tree Landscape map (pages 31 and 53) and is located in close proximity to highly populated areas or areas of higher demand. It is possible that at least some of this ruderal forest would not have met the stringent FIA definitions to include it in the forest land estimate, although it should now be captured in the Urban FIA protocol initiated in RI in 2015.

The Division of Fish and Wildlife used the LULC data in their 2015 Wildlife Action Plan:

- 687,360 acres of land (not including the bay or coastal salt ponds)‡
- In 2011, 399,000 acres were forested, with an additional ~7,800 acres as brushland, for a combined 407,000 acres considered as open land*
- equaling 56.6% forested land, or 59.2% open land

While the FIA estimates are based on acreages different from the LULC, FIA data provides percentages that have been and continue to be applied to describe and assess forest and timber land in RI. FIA data provides valuable information in:

- status and trends in forest area and location
- species, size, and health of trees
- total tree growth, mortality, and removals by harvest
- wood production and utilization rates by various products, and
- forest land ownership.

A perceived increase in forest land, whether from FIA estimates or LULC mapping, should not be interpreted to suggest that permanent land conversion is not a threat to forest land in RI, as other means of tracking and reporting show that permanent land conversion is continuing to advance.

What is important to remember is that the trends, challenges, and issues facing Rhode Island's forests continue, even if the definitions of the land under threat change.

‡ Source: RIGIS 1997, 1:5000 scale mapping of state boundary and shoreline
*Source: RIGIS Land Use and Land Cover http://www.rigis.org/datasets/land-use-and-land-cover-2011

FIA DEFINITIONS

FIA definitions that are used to determine landuse and acreage are specifically defined with dimensions, canopy cover, and in some cases site productivity potential, related specifically to trees, and are not solely descriptive in nature. Nationally applied in the FIA process, they are the basis for estimating the forest characteristics. The annualized process means that land is assessed and reassessed over time, capturing changes in use and natural progression, and able to be directly compared with other states and locations.

Cropland:
Land under cultivation within the last 24 months, including cropland harvested, crop failures, cultivated summer fallow, idle cropland used only for pasture, orchards, active Christmas tree plantations indicated by annual shearing, nurseries, and land in soil improvement crops, but excluding land cultivated in developing improved pasture.

Forest land:
Land that has at least 10 percent crown cover by live tally trees of any size or has had at least 10 percent canopy cover of live tally species in the past, based on the presence of stumps, snags, or other evidence. To qualify, the area must be at least 1.0 acre in size and 120.0 feet wide. Forest land includes transition zones, such as areas between forest and nonforest lands that meet the minimal tree stocking/cover and forest areas adjacent to urban and built—up lands. Roadside, streamside, and shelterbelt strips of trees must have a width of at least 120 feet and continuous length of at least 363 feet to qualify as forest land. Unimproved roads and trails, streams, and clearings in forest areas are classified as forest if they are less than 120 feet wide or less than an acre in size. Tree-covered areas in agricultural production settings, such as fruit orchards, or tree-covered areas in urban settings, such as city parks, are not considered forest land

Nonforest land:
Land that does not support or has never supported, forests and lands formerly forested where use of timber management is precluded by development for other uses. Includes area used for crops, improved pasture, residential areas, city parks, improved roads of any width and adjoining rights-of-way, powerline clearings of any width, and noncensus water. If intermingled in forest areas, unimproved roads and nonforest strips must be more than 120 feet (36.6m) wide, and clearings, etc., more than one acre (0.4ha) in size, to qualify as nonforest land.

Nonstocked:
Forest land stocked with less than 10 percent of full stocking with all live trees. Examples are recently cutover areas or recently reverted agricultural fields.

Sawtimber:
Forest land stocked with at least 10 percent of full stocking with all live trees with half or more of such stocking in poletimber or sawtimber trees or both, and in which the stocking of sawtimber is at least equal to that of poletimber.

Timberland:
Forest land that is producing or is capable of producing crops of industrial wood and not withdrawn from timber utilization by statute or administrative regulation. (Note: Areas qualifying as timberland are capable of producing in excess of 20 cubic feet per acre per year of industrial wood in natural stands. Currently inaccessible and inoperable areas are included.)

LULC DESCRIPTION

The forest cover data is taken from the 2011 Statewide land use/landcover GIS data layer coded to a slightly modified Andersen Level III schema.

LULC Definitions

The coding schema for Land Cover/Land Use type is derived from the Anderson (modified) coding schema used by RIGIS in previous (1988 and 1995) land cover/land use data sets. It includes level 3 coding for Urbanized Developed areas (100 Codes); level 2 coding for agricultural (200 Codes), Forested lands (400 Codes), and Barren Lands (700 Codes); and level 1 coding for Brushland (300 Code), Open Water (500 Code), and Wetlands (600 Code).

Brushland (shrub and brush areas, reforestation) (#300):
Brushland is characterized by lots of shrubs and very few trees (< 50% canopy). It includes areas that are being reforested but the trees are not large or dense enough to be classified as forests. It also includes areas that are more permanently shrubby, such as heath areas, wild blueberries, or mountain laurel.

Cropland (tillable) (#220):
Cropland is generally tilled land used to grow row crops. There is usually evidence of intense land management. The land is often flat, well drained and the field boundaries are generally very well defined. This category also includes turf farms that grow sod. Associated facilities include barns and other outbuildings.

Forest Lands (#400):
Trees are classified as forests when the tree canopy covers at least 50% of the space when viewed from above on an aerial photograph. The three different categories depend upon the composition of deciduous vs. coniferous trees. On aerial photographs, most coniferous trees have conical shapes (except for pines) with dense needles and tight branching with dark spectral signatures, whereas deciduous trees have a more open or freeform shape with leaves (during the growing season) that give the tree a coarser texture or pattern and a looser or more open branching arrangement. Deciduous spectral signatures are generally lighter than coniferous signatures.

- Deciduous Forest (>80% hardwood) (#410)
- Coniferous Forest (>80% softwood) (#420)
- Mixed Forest (#430)

Idle Agriculture (abandoned fields and orchards) (#250):
When pasture, cropland and other agricultural uses have not been active for a few years, it is classified as idle agriculture. Often, early successional vegetation is seen growing around the edges and there is no evidence of any land or vegetation management. Eventually, it will become brushland.

Orchards, Groves, Nurseries (#230):
This category includes fruit orchards, greenhouses, plant nurseries, Christmas tree farms, vine crops (such as vineyards, strawberry and blueberry patches), and cranberry bogs (including sandy areas adjacent to the bogs that are used in the growing process). The orderly pattern of the vegetation generally indicates that one or more of these land uses is present. Associated facilities include barns, other outbuildings, and parking lots. Orchards and greenhouses are often symbolized on USGS topographic maps. Commercial lawn and garden centers that do not produce or grow the product will be considered Commercial.

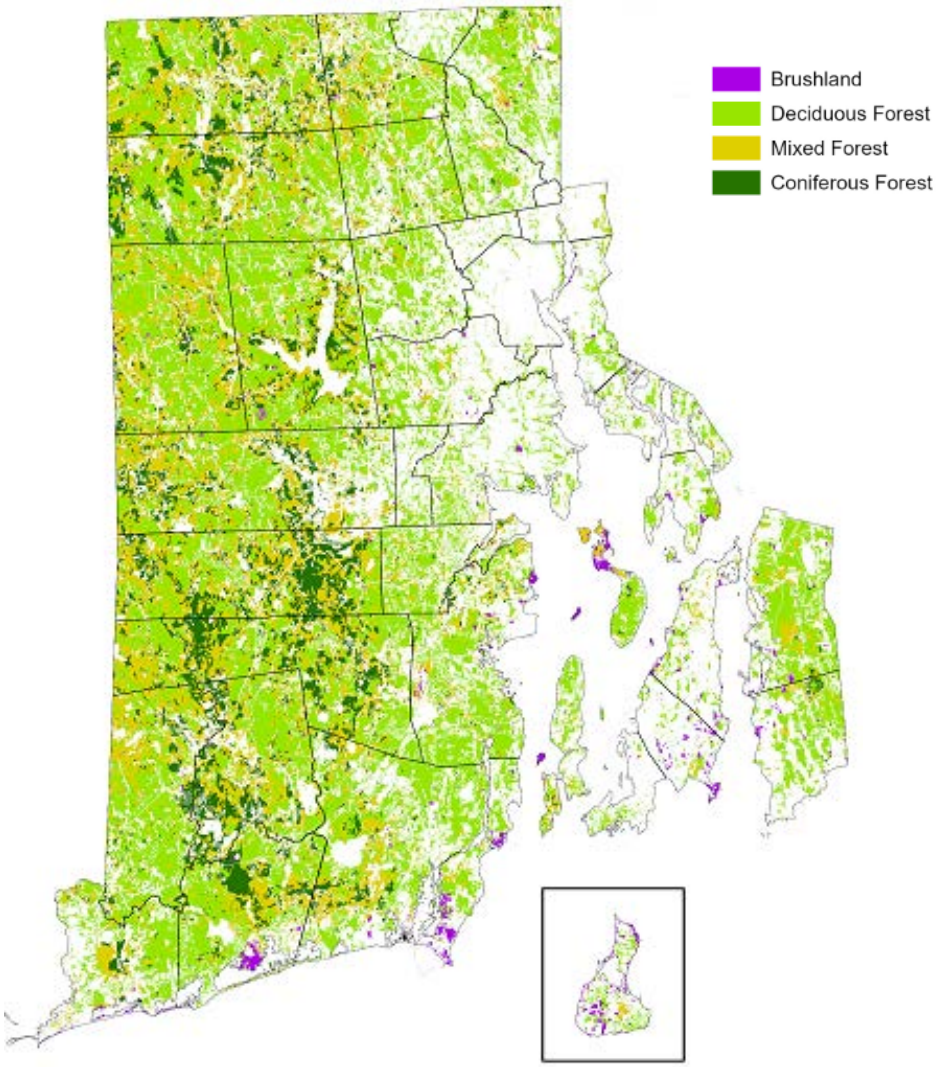
Pasture (agricultural not suitable for tillage) (#210):
Pastureland is generally used for grazing of animals and for the growing of grasses for hay. It is often hilly, may have poor drainage or stoniness, and the field boundaries may be less defined than cropland. There may be scattered trees or shrubs in the field. Associated facilities include barns and other outbuildings.

Vacant Land (#162*):*
Land is classified as vacant if it is abandoned land that isn't being used for any other land use, isn't being prepared for another use (see 750 Transitional Area below), and does not have enough tree growth to be

classified as forest or enough vegetation to be classified as brushland (300). It may include structures and indicates that the land was previously used for one of the urban categories

Type of Forest	**Acres**
DEM-protected forest	73,324
DEM owns by fee	47,384
Other (conservation easement, deed to development rights, recreation easement)	25,940
Other protected forest (by other land conservation entities)*	51,616
Total protected forest	124,940
Privately-owned, unprotected forest	274,060
FFOS forest	45,659
Total statewide forest	399,000

*Includes U.S. Fish & Wildlife Service, The Nature Conservancy, Audubon Society of RI, Municipal and Private Land Trusts, Municipal Governments, Private Homeowner Associations, Providence Water, and the URI W. Alton Jones Campus.



APPENDIX B

Rhode Island's Farm, Forest and Open Space (FFOS) Program

The Farm, Forest and Open Space (RI Gen. Law § 44-27) program allows Rhode Island landowners to have their property assessed at the current use, and not at development values. Properties enrolled in the program are assessed at a lower rate in exchange for ensuring that the property will not be developed for at least 15 years without paying a penalty, or Land Use Change Tax. Established in 1980, the law recognizes that it is, "in the public's interest to prevent the forced conversion of farm, forest, and open space land to more intensive uses as the result of economic pressures caused by assessment for purposes of property taxation at values incompatible for the preservation as farm, forest, and open space land." The FFOS law authorizes the RIDEM as the regulatory body governing both farm and forest land enrolled in the program, while the Open Space is administered by the city or town where the land is located. The FFOS has three classifications:

- **Farmland:** ornamental, vegetable and orchard crops, dairy and livestock (including forage crops) and the forest and wetlands associated with the property of at least 5 acres, actively devoted to agriculture.
    - Landowner must produce at least $2,500/year in farm products (can be for personal consumption)
    - Landowner agrees to have a written Farm Conservation Plan on property, and follow Best Management Practices outlined therein, and will renew the plan every 10 years to stay in the program
- **Forest land:** Forest land of at least 10 acres bearing dense growth of trees including young regenerating forest and including wetlands, exclusive of house site
    - Landowner must have a Forest Stewardship or Management Plan at the time of application, and agrees to implement the plan and renew it every 10 years to stay in the program
- **Open Space:** undeveloped land (including farm or forest land) of at least 10 acres where the land serves to enhance agricultural or forest values, enhances wildlife habitat or protects ecosystem health
    - Classification based on soils; no management plan required

The funding methodology for land values used in the FFOS program was created in 1999 and is modeled on Connecticut and Massachusetts, while taking into consideration the higher cost of values for agricultural land in the state. The recommended value for lands classified as forest is currently $115/acre. There are 571 landowners who participate, and over 45,549 acres enrolled and managed through the program. The Forest program is managed by the Forest Stewardship Coordinator who reviews plans, inspects properties every five years, and monitors compliance.

While the FFOS program works well as a tool to defer the conversion of land by reducing the property tax burden on Rhode Island landowners, it does little in the way of encouraging long-term conservation. The RI Land Use Change Tax only applies to a property classified as forest for the first 15 years in the program and property classified as a farm for the first 10 years in the program. After that timeframe, the statute states "...no tax shall be imposed by the provisions of the law." It is also easy for a landowner to get out of the program. While a lien or legal hold is placed on properties enrolled in the program, sometimes they are overlooked.

APPENDIX C

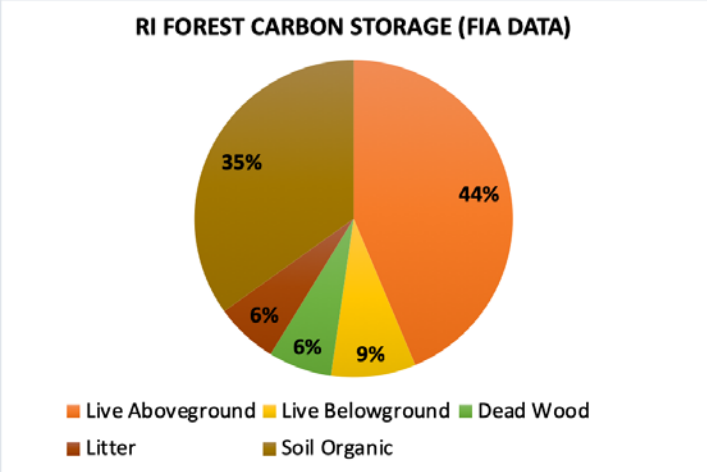
Forest Carbon Data

SOURCE: The Value of RI Forests
by the Rhode Island Forest Conservation Advisory Committee and the Rhode Island Tree Council

The USFS Forest Inventory and Analysis (FIA) program maintains a nationwide network of "continuous forest inventory" or periodic monitoring plots that provide data for an ongoing census of the nation's forests. The forest carbon estimates provided in this section are from FIA data interpreted in consultation with experts from the US Forest Service's Northern Research Station.

The URL data links provided through this summary are from the FIA program's EVALIDator Version 1.8.0.00 database.

RHODE ISLAND FOREST CARBON DENSITY (STORAGE) DATA



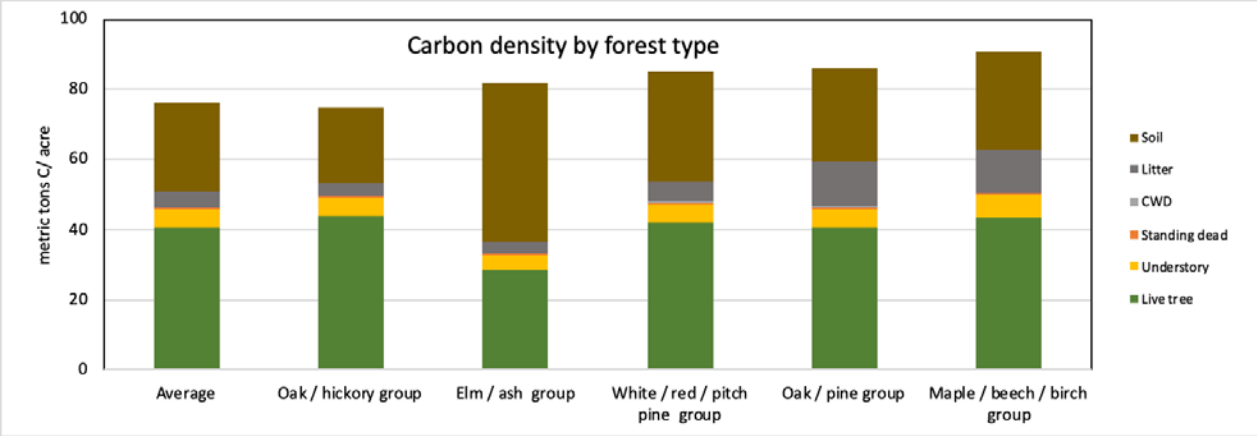
Since 2003, FIA has conducted an annual sampling inventory in Rhode Island and currently measures 14% of the sample plots each year. For the 2017 inventory, estimates of statistics such as volume and biomass were based on 222 plots sampled between 2011 and 2017 and reported in the yearly report: Forests of Rhode Island, 2018.

FIA EVALIDator data links:

Total Acres	https://go.usa.gov/xy73s
All Carbon Pools	https://go.usa.gov/xyfAS
Live Aboveground	https://go.usa.gov/xyfHX
Live Belowground	https://go.usa.gov/xyfHR
Dead Wood	https://go.usa.gov/xyfHm
Leaf Litter	https://go.usa.gov/xyfHV
Soil	https://go.usa.gov/xyfH7

For greater statistical accuracy (lower standard deviation and tighter confidence intervals), estimates of forest carbon density and sequestration for different forest types include both FIA plots in Rhode Island and also plots in similar forest types in Connecticut.

STATISTICS FOR FOREST CARBON DENSITY (STORAGE) AMONG DIFFERENT FOREST TYPES



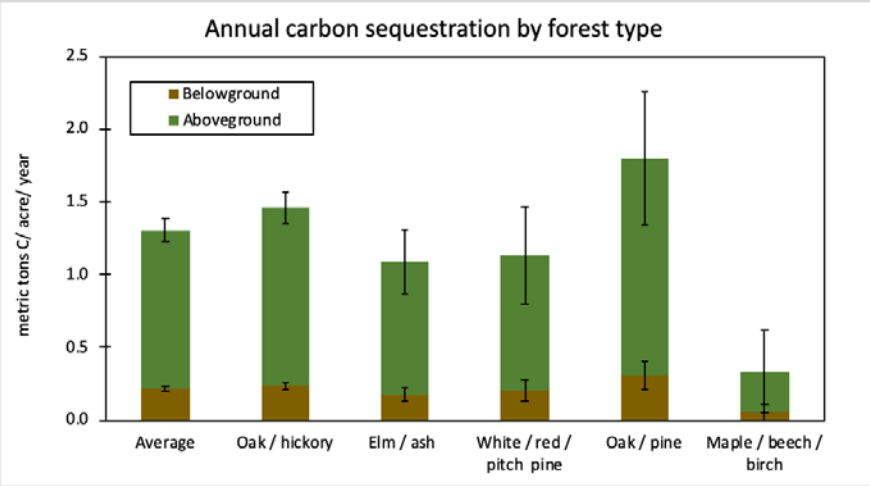
FOREST TYPE	# PLOTS	AVERAGE (mtC/ac)	STANDARD DEVIATION	95% CONFIDENCE INTERVAL (LOW) (mtC/ac)	95% CONFIDENCE INTERVAL (HIGH) (mtC/ac)
Total	**443**	**76.2**	**3.2**	**73.0**	**79.4**
Oak / hickory		74.8	5.7	69.1	80.5
Elm / ash		81.4	29.2	52.2	110.6
White / red / pitch pine		85.2	38.5	46.7	123.7
Oak / pine		85.8	39.7	46.1	125.5
Maple / beech / birch		90.8	38.1	52.7	128.9

mtC/ac = metric tons of carbon per acre

FIA EVALIDator data links

All Carbon Pools	https://go.usa.gov/xyfAc
Live Aboveground	https://go.usa.gov/xyfAa
Live Belowground	https://go.usa.gov/xyfAC
Dead Wood	https://go.usa.gov/xyfAY
Leaf Litter	https://go.usa.gov/xyfAg
Soil	https://go.usa.gov/xyfA4

STATISTICS FOR FOREST CARBON SEQUESTRATION AMONG DIFFERENT FOREST TYPES



FOREST TYPE	# PLOTS	AVERAGE (mtC/ac/yr)	STANDARD DEVIATIO N	95% CONFIDENCE INTERVAL (LOW) (mtC/ac/yr)	95% CONFIDENCE INTERVAL (HIGH) (mtC/ac/yr)
Total	**397**	**1.31**	**0.09**	**1.22**	**1.40**
Oak / hickory	276	1.46	0.13	1.33	1.59
Elm / ash	33	1.09	0.27	0.82	1.35
White / red / pitch pine	21	1.14	0.41	0.73	1.54
Oak / pine	19	1.8	0.55	1.24	2.35
Maple / beech / birch	30	0.33	0.33	0	0.67

mtC/ac/yr = metric tons of carbon per acre per year

FIA EVALIDator data links

Total Acres: https://go.usa.gov/xyEgT

Average Annual Net Growth (Aboveground) https://go.usa.gov/xyEgE

Average Annual Net Growth (Belowground) https://go.usa.gov/xyEgs

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APPENDIX D

Correlation to the DEM Strategic Plan 2019-22

National Priority Issues

1. **Conserve** and Manage Working Forest Landscapes for Multiple Values and Uses
   - 1.1 Identify and conserve high priority forest ecosystems and landscapes
   - 1.2 Actively and sustainably manage forests
2. **Protect** Forests from Threats
   - 2.1 Restore fire-adapted lands and/or reduce risk of wildfire impacts
   - 2.2 Identify, manage, and reduce threats to forest and ecosystem health
3. **Enhance** Public Benefits from Trees and Forests
   - 3.1 Protect and enhance water quality and quantity
   - 3.2 Improve air quality and conserve energy
   - 3.3 Assist communities in planning for and reducing forest health risks
   - 3.4 Maintain and enhance the economic benefits and values of trees and forests
   - 3.5 Protect, conserve, and enhance wildlife and fish habitat
   - 3.6 Connect people to trees and forests, and engage them in environmental stewardship activities
   - 3.7 Manage trees and forests to mitigate and adapt to global climate change

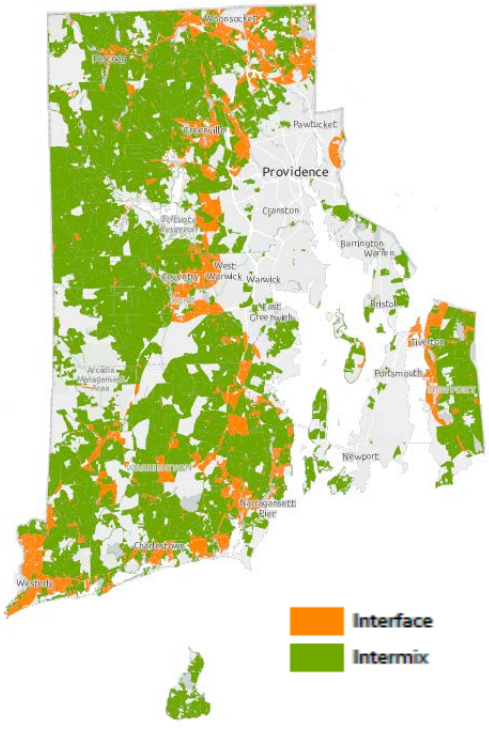
DEM Priority Issues 2019-2022

DEM Strategic Plan 2019-2022

1. Take action to counter climate change and its effects, both locally and regionally.
2. Protect and restore our environment to create greener, healthier communities.
3. Protect and improve water quality.
4. Conserve, promote, and steward our natural resources.
5. Promote and increase outdoor recreation in Rhode Island.
6. Promote and expand local food and agricultural industries.
7. Demonstrate statewide leadership in customer service and continuous improvement.

DFE Priority Issues 2020-2030

- Fragmentation
- Water quality
- Forest health
- Fire
- Climate change



DFE Priority landscapes: Wildland-Urban interface/intermix

DFE contributes to multiple DEM goals, although its impact is limited due to lack of inclusion in both the planning and delivery process, under-staffing, and no state funding for planning or delivery.

1. Take action to counter climate change and its effects, both locally and regionally.
   The existence and function of DFE contributes to **DEM Goal 1**:
   - Promotion and education on the value and contributions of trees and forests in urban and rural areas
   - Promoting good management practices in rural and urban forests

2. Protect and restore our environment to create greener, healthier communities.
   While the examples for **DEM Goal 2** refer to policies and compliance, the existence of a robust DFE, appropriately funded and staffed, would actively help deliver this goal as all cooperative program outcomes focus on greener, healthier communities.
   - The crux of most DFE messaging is the promotion of rural and urban forests for their contributions to green, healthier communities.
   - The American Forests Tree Equity project is engaged in developing partnerships in public health.
   - Strong policy efforts should support the retention of forest lands for clean air, water, stormwater management, wildlife and pollinators, climate change mitigation, etc. DFE should be at the table for these discussions.

3. Protect and improve water quality.
   Healthy forests are a prime contributor to **DEM Goal 3.** Stormwater management is increasingly tied to the mitigating effects of rural and urban forests. Compliance and legislation are only one leg of a stool for addressing water quality which should include funding the management of state forests and supporting the retention of private forests, as working lands protect the source and quality of water. The mere existence of forests helps with water quality, the presence and health of fish, invertebrates, and benthics. Healthy and well-planned management of forests, contiguous forestlands, and upstream prioritization for forestland retention would directly benefit coastal and inland water management and restoration efforts.

4. Conserve, promote, and steward our natural resources.
   DFE efforts are recognized specifically under **DEM Goal 4**, however, state funding to allow DFE help protect forests is not available. Supporting “terrestrial landscapes” requires staffing and financial commitments for necessary data and planning in order to identify, support and deliver meaningful programs and engagement. In addition, state agencies tend to develop and deliver their messaging in a virtual programmatic silo. Increased interaction between DEM divisions and state agencies would benefit all partners through shared external messaging and internal engagement.

5. Promote and increase outdoor recreation in Rhode Island.
   Given the 40,000 acres of land under shared management with DFW, access and recreation are an important but under-funded element for passive and active recreation, resulting in under-managed, under-maintained and under-monitored management areas. DFE is an active partner in addressing **DEM Goal 5**, but lack of funding and staffing has a detrimental effect on a resource that is an important part of the recreational experience in RI.

6. Promote and expand local food and agricultural industries.
   Contribution to **DEM Goal 6** is less apparent, but healthy forests are part of the working landscape. Forests also protect farmland by slowing or limiting the spread of pests or disease as a physical barrier, hosting weed-seed and insect-eating birds, providing habitat for pollinators, and providing a secondary source of income from forest products. Retention of forests as working lands benefits agriculture.

7. Demonstrate statewide leadership in customer service and continuous improvement.
   With respect to **DEM Goal 7**, DFE communicates messaging on multiple aspects of its program delivery,

through the commitment of staff to deliver education and customer service to the landowners, recreational users, foresters and loggers, residents and municipalities, news and professional organizations. However, present staffing and funding levels limit improvement to responsiveness and increased program delivery, even with the committed and professional staff.

Strategies Matrix

Conserve and manage working forest landscapes for multiple values and uses.			
Objectives	**S&PF Program**	**Partners**	**DEM Strategic Plan Goals**
Develop and expand existing planning and hazard monitoring capacity.	**FIRE (SFA)**	RIEMA DEM Fire Departments NFFPC members	2, 3, 4
Increase capacity for implementation of management recommendations to achieve resiliency goals.	**FIRE (SFA)**	RIEMA DEM Fire Departments NFFPC members	1, 2, 3, 4
Develop and deliver information on multiple platforms that addresses the identification and management of forest insect, disease, and non-native invasive threats.	**FHM**	URI RI Division of Agriculture	2, 4, 7
Increase collaboration with local partners' management efforts to address forest health.	**FHM**	URI RI Division of Agriculture	2, 4
Keep forests as forests by increasing NIPF certified under the Forest Stewardship Program through targeted outreach to landowners in cooperation with partner groups.	**FSP**	NRCS RIFCO RIWP private	1, 3, 4
Promote forest management and conservation within spatial communities of small landowners using a landscape-scale approach.	**FSP** Fire (SFA) FHM U&CF	NRCS RIFCO RIWP private	1, 3, 4
Maintain RI's active involvement in regional and national Cooperative Forest Management (CFM) committee.	**FSP**		
Increase the number of communities with active local urban and community forestry programs.	**U&CF**	RITC Local gov't	1, 2, 4
Improve technical and professional capacity of tree-care professionals and the green industry.	**U&CF**	RITC Local gov't	2, 4, 7
Advance community urban tree inventory and planning capabilities.	**U&CF**	RITC Local gov't	2, 4, 7

Protect forests from threats.			
Objectives	**S&PF Programs**	**Partners**	**DEM Strategic Plan Goals**
Develop in-state wildfire response (surge) capacity and specialist skills.	**FIRE (SFA)**	RIEMA DEM Fire Departments NFFPC members	4, 7
Improve communication between in-state partners and responders.	**FIRE (SFA)**	RIEMA DEM Fire Departments NFFPC members	4, 7
Maintain fire response capacity.	**FIRE (SFA)**	RIEMA DEM Fire Departments NFFPC members	4, 7
Survey for native and non-native forest insect and disease threats and monitor for their outbreak and spread.	**FHM**	URI RI Division of Agriculture	2, 4
Work with regional and national partners to disseminate current information about the biotic and abiotic threats to RI's forests.	**FHM**	URI RI Division of Agriculture	2, 4
Maintain lines of contact and support structures for NIPF owners, via onsite visits, meetings, informational exchange, and site inspections.	**FSP**	NRCS RIFCO RIWP private	4, 6
Maintain lines of contact and support structures for NIPF owners via onsite visits, meetings, informational exchange, and site inspections.	**FSP**	NRCS RIFCO RIWP private	4, 6
Provide access to and information on relevant educational opportunities, current events, and funding opportunities.	**FSP**	NRCS RIFCO RIWP private	1, 3, 4, 6, 7
Promote forestry BMPs, and expand messaging, especially in regard to harvesting operations, which should be inspected prior to harvest and during operations to prevent wetland violations.	**FSP**	NRCS RIFCO RIWP private	1, 2, 4
Assist communities with establishing tree planting goals and management plans including trees and urban forests as an energy-saving practice.	**U&CF**	RITC Local government	1, 2, 4

Enhance public benefits from trees and forests.			
Objectives	**S&PF Programs**	**Partners**	**DEM Strategic Plan Goals**
Increase public awareness of wildfire and the need for preparedness.	**FIRE (SFA)**	RIEMA DEM Fire Departments NFFPC members	2, 4, 7
Incorporate a Firewise approach to wildland urban interface areas.	**FIRE (SFA)**	RIEMA DEM Fire Departments NFFPC members	2, 4, 7
Expand stakeholder engagement in collecting forest health information and disseminating forest health messaging.	**FHM**	URI RI Division of Agriculture	4, 7
Maximize messaging effectiveness by increased coordination with partners for responses regarding threats to RI's forests.	**FHM**	URI RI Division of Agriculture	4, 7
Promote active, sustainable forest management supporting wildlife habitat diversity, structural diversity, and understory health to landowners.	**FSP**	NRCS RIFCO RIWP private	2, 3, 4
Promote active, sustainable forest management supporting wildlife habitat diversity, structural diversity, and understory health to landowners.	**FSP**	NRCS RIFCO RIWP private	2, 3, 4
Promote good silvicultural practices to support forest health, ecosystem resiliency, wetland conservation, wildlife habitat, and carbon storage.	**FSP**	NRCS RIFCO RIWP private	1, 2, 3, 4, 6, 7
Provide education and outreach on forest management for special areas, highlighting the relationships of private forest land to wetlands and water quality, air quality, climate protection, and urban-rural interface values.	**FSP**	NRCS RIFCO RIWP private	1, 2, 4
Maximize program delivery and messaging effectiveness through partnerships and coordination with local, regional and federal partners.	**U&CF**	RITC Local government	1, 2, 4

APPENDIX E

URLS for Referenced Links within the Forest Action Plan

URLs associated with graphs and other visuals are bolded; repeated links per page not included

Pages 1-62 ASSESSMENT

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APPENDIX F

Forest Legacy Program Assessment of Need 2020

The Forest Legacy Program (FLP) was established under the authority of the Cooperative Forestry Assistance Act (CFAA) of 1978, as amended in the 1990 Farm Bill (Food, Agriculture Improvement and Reform Act), to identify and protect environmentally important forest areas that are threatened by conversion to non-forest uses. The FLP is a partnership between the State and the United States Department of Agriculture (USDA) Forest Service to protect important forest land through the acquisition of conservation easements or fee title purchases; the Forest Service provides funding and the state acquires and monitors the property.

To establish eligibility for funding, each state is required to complete a state-wide forest Assessment of Need (AON) that analyzes forest conditions and trends, delineates priority forest legacy areas, and outlines the policies and procedures for implementation of the program. The initial Rhode Island AON was completed in 1993 and, since that time, 22 projects, protecting 3583 acres of forest, have been completed.

This document, along with the State Forest Action Plan, are intended to meet the planning requirements of the Forest Legacy Program as outlined in the Forest Legacy Program Implementation Guidelines, May 2017. This document updates the original Forest Legacy Needs Assessment prepared in August 1993 and approved by the USDA Secretary of Agriculture on December 30, 1993 and serves to document the need for the program in Rhode Island as well as to guide the implementation of the program in the State.

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Some of the content in this report was directly excerpted from the original Forest Legacy Assessment of Need, created in 1993.

Maps used in this publication were created by Paul Jordan, Division of Planning and development using data from the Division of Forest Environment as well as RIGIS.

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HISTORICAL PERSPECTIVE

Rhode Island was most likely almost entirely forested when a settlement in Providence was established in 1636, but as the population grew most of the forest was cleared to use the land for agriculture. This trend continued until, by the end of the nineteenth century, almost 80 percent of the land had been cleared and forest was limited to untillable land or wetland. Availability of more productive land in the western United States and improved transportation that brought products to eastern markets led to the abandonment of many farms in Rhode Island and idle land quickly reverted to forest. The trend of increasing forest cover continued until after World War II and the land area covered by "second growth" forest peaked in 1963, at 67 %.[i]

According to the 2010 census, Rhode Island's population density is second- highest in the country yet more than 50 percent of the State is forested. The most recent USDA Forest Service Survey (2018) reports there are 366,958 acres of forestland in Rhode Island; almost 56 percent forest.[ii] This is largely because most of the developed area is concentrated along the coast while the western and southern regions are rural.

Population movement from urban toward rural areas became a dominant land use shift in the latter half of the 20th century and forestland began to be lost to development at a higher rate. RI Department of Administration, Division of Statewide Planning attributes this accelerated loss of forest not only to an increase in population but changing development patterns. Households are smaller and population movement has been to rural areas and single-family houses on larger house lots, consuming more land per house. Employment centers moved from cities as industry relocated from old manufacturing centers to the surrounding countryside. Commercial land use almost doubled, moving into less developed parts of the State concentrated along heavily traveled roadways.

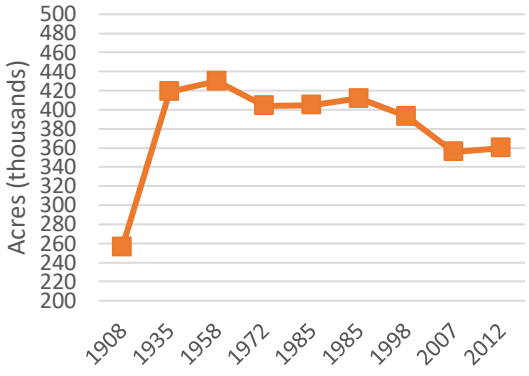
Recent Trends

Land Conversion

The conversion of forest land to developed uses in the late 20th century was higher than historic trends with developed uses increasing by 43 percent from 1970 to 1995.[iii] "Rhode Island developed more residential, commercial, and industrial land between 1970 and 1995 than in the previous 325 years."[iv]

Building permits and aerial photography confirm that development and land use patterns continue to follow sprawl patterns and forest acreage continues to decline as land is developed. The USDA, Forest Service reported a decrease in timberland area of 8.9 percent from 1985 to 1998,[v] and a similar decrease between 1998 and 2007,[vi] Rhode Island had the greatest forest loss of the southern New England States between 1998 and 2007.[vii]

Figure 1. Forestland in Rhode Island

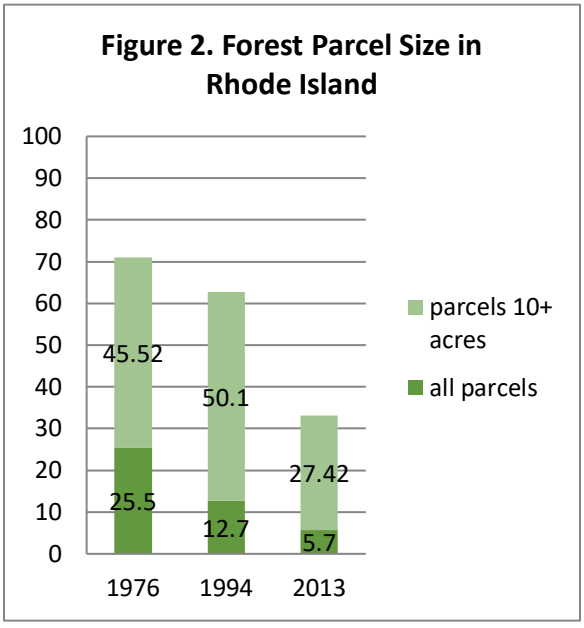


USDA, Forest Service Data from 2017 indicates RI has 354,000 acres of timberland,[viii] but forests

continue to be under pressure from development. In the past, forest loss has generally occurred near urban areas and roads. This trend is changing as pressure to convert forest to residential use continues and threatens large forest parcels, even those in remote areas.

Forest Ownership

A 2017 Forest Service Survey estimates 72% of the forest land in Rhode Island is privately owned. Most of that forest (62%) is owned by families, the remainder by corporations and other private entities.[ix] The recent trend has been acquisition of large parcels of forest by public agencies with a corresponding decrease in the percentage of forestland in Rhode Island in private ownership. A Forest Service Report from 1957 estimated 94% of Rhode Island's forestland was privately owned at that time.[x] By the late 1980's forestland in private ownership had decreased to 85%.[xi] More recent assessments estimate 68% of Rhode Island forestland is privately owned and managed by an 38,000 landowners.



The pattern of land ownership has been one of subdivision of large tracts; average parcel size decreased (from 26 acres in 1973 to 13 acres in 1993).[i] Division of forest tracts into smaller parcels has continued and recent reports estimate that the size of the average tract is now only six acres.[ii] This includes all parcels greater than one acre of forest (many may be large house lots). Figure 2 shows the trend in forest ownership size in Rhode Island based on Forest Service Landowner surveys. If only privately-owned parcels greater than 10 acres are evaluated, parcel size is about 27 acres, about 40% lower than the 1970's. The average land holding in southern New England is 34 acres.[iii]

Characteristics of Forest Ownership

Analysis of land use performed by RI Statewide Planning found 15 communities with less than 25% developed land area and classified them as rural. A 2005 survey of landowners who owned more than 10 acres was conducted as part of the update of the Forest Resource Plan in 2003.[iv] As expected, parcel size was small, with 59% of respondents owning less than 30 acres; 37% less than 20; and 22% owned less than 30 acres.

The survey found most Rhode Island forest owners live on their land, and 90% of respondents gave a place of residence as the most important reason for owning forestland. Investment (42%) and forest products (33%) were the other most important reasons for owning forest. Recreational use (41%) and hunting/fishing (19%) are other common reasons for owning forestland.

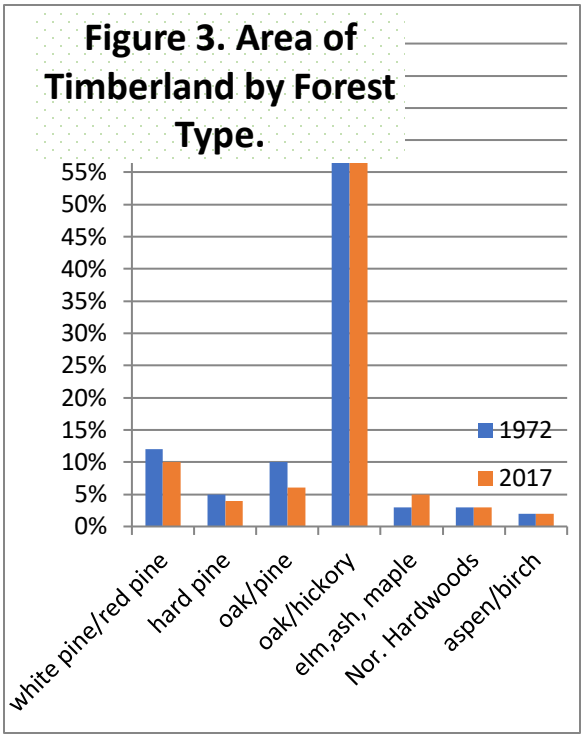
In 2013, the Forest Service surveyed landowners with more than 10 acres of forest. The survey results were similar: most respondents lived on their land (64%) and owned it for the lifestyle it provided (enjoying beauty and scenery). Harvesting wood products was not as important as the other amenities and using it for timber products was even lower (18%). Other top reasons for owning were to

protect water (73%), to protect nature and biologic diversity (73%), and to protect wildlife (55%). [v]

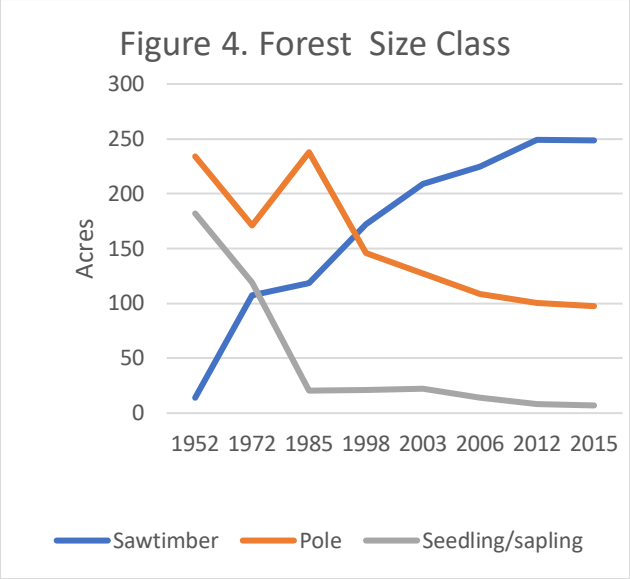
Forest Composition

Oak- hickory forest (dominated by red, black, scarlet, and white oak) is the predominant forest type found in Rhode Island, comprising 61% of the forest according to the 2017 Forest Service Inventory. The area of this forest type has decreased since earlier studies (66% in 1972). Red pine/white pine forests also decreased (from 12% to 9%) of the forest in the period from 1972 to 2017. This coincided with increased harvesting activity shown in Harvesting Records filed with DEM as red pine and hemlock were salvaged due to attack by red pine scale or hemlock wooly adelgid. By 2010, the other softwoods category had almost disappeared from harvesting reports.

Oak/pine is also a common forest type, making up 5 percent of Rhode Island's forest.[vi] Other forest types, like pitch pine and Atlantic white cedar, make up a small percentage (less than 3 percent) of Rhode Island's forest but have high importance due to their value as wildlife habitat.



Most of Rhode Island's forest is on land previously used for agriculture and was established only after active farming ceased. There have been few catastrophic weather events or intensive harvests to stimulate regeneration so the forest has matured. Forest Service studies reported only 3% of the forest was composed of trees larger than 10 inches diameter at breast height (DBH) in 1952, but by 2015 more than 70% of the forest was this size.



RHODE ISLAND'S FOREST RESOURCES

Wood Products

Lumber production in Rhode Island peaked at the turn of the century with 33 sawmills operating.[vii] According to the Forest Service, in 1988 there were 16 local sawmills producing 6.6 million board feet of lumber.[viii] By 2003 this had decreased to six sawmills processing 5.5 million board feet of lumber per year.[ix]

Although the number of sawmills operating in Rhode Island has decreased, sawmills in neighboring states and shipment to northern New England and Canada provide additional markets for Rhode Island forest products.

Analysis of harvesting data filed with Department of Environmental Management (DEM) found an average of 3.0 million board feet of sawtimber harvested per year during the period 1997 through 2017. In context, the peak lumber production in Rhode Island was 33.0 million board feet in 1907 but declined after with annual reports of 2.5 million board feet of sawtimber harvested between 1942 and 1952.

Sawtimber is the principal use of trees harvested, primarily for industrial pallets, with the highest quality trees exported for other uses. Softwood logs are processed in state or exported. Firewood is an important market for low quality hardwood trees, with over 3800 cords harvested in Rhode Island forests each year. The sole pulp mill in Rhode Island closed in 1980 and the distance to out of state mills makes harvesting pulpwood now uneconomical. The average commercial harvest in Rhode Island during the last 20 years involved about 56 thousand board feet (MBF) of sawtimber and 71 cords of firewood on 33 acres.

The annual gross output of Rhode Island's forestry and wood products sector totals over $715 million and employs 4,824 workers. Employment in the forestry and logging sectors of the economy is estimated at 90 jobs with gross annual sales of $11.6 million.[x]

Specialty Products

Suburbanization and the small size of most parcels make management for traditional wood products

difficult for the typical Rhode Island forest owner, so it's no surprise that 1 to 5 percent of landowners have commercially harvested an alternative product such as maple syrup, mushrooms, witch hazel, or floral greens.[xi]

Witch hazel, a shrub with medicinal use, grows in abundance on mesic forest sites throughout Rhode Island. It has astringent properties and is used in the cosmetics industry and the majority of the needs of the industry are met by a facility in nearby Connecticut. The product is cut and chipped in Rhode Island's forest and chips are transported to the American Distilling facility in East Hampton, Connecticut for processing. The shrub regenerates readily and can been sustainability harvested, generating revenue to partially offset property ownership expenses.

Specialty wood products include trees, or parts of trees, that are not usually considered valuable due to the tree species or low volume and are often overlooked in traditional forestry operations. These materials can be turned into valuable products by skilled artisans and a "cottage industry" has developed forest materials. As of August 2019, there were 8 portable sawmills in Rhode Island and additional sawmills in nearby states servicing a niche market to process trees unmarketable through traditional means into specialty forest products.

Sugar maple, the primary tree species used to produce maple products, is uncommon in Rhode Island and is usually found only along roads and in association with old farmsteads. There were 19 operations that process and sell maple syrup in Rhode Island and markets appear good enough to offset the higher production costs associated with producing maple syrup from maple species found in Rhode Island forests. Red maple, which is the Rhode Island state tree, can be tapped to produce maple syrup but it has a much lower sugar content and requires more processing. Norway maple, native to Europe, has been widely planted in Rhode Island as an ornamental and street tree and is commonly tapped in Rhode Island because it grows to large size and other maples are scarce.

Wildlife & Fish Resources

The state's varied soil and hydrology support a range of plant communities which in turn support a wide range of wildlife. Forests in Rhode Island provide habitat for hundreds of species of wildlife. This includes 86 species of mammals, 394 species of birds, 254 species of fish (freshwater and saltwater), 19 amphibians and 26 species of reptiles.[xii]

The distribution and abundance of Rhode Island's forest-dwelling wildlife is governed by the changes in the State's forest cover. Some of Rhode Island's forest-dwelling animals are generalists and can be found in a variety of habitats, while others are specialists. Specialists require one or more specific forest conditions to persist and are more

susceptible to changes in forest cover. Two types of forest habitat found in the State (Pine Barrens and Atlantic White cedar swamp) support globally rare species, such as Hessels hairstreak butterfly.

Forest is the most common habitat type in Rhode Island, and most of it is more than 60 years old. While there is little very old forest, forest maturation, fire suppression, and lack of sound management, has led to a condition where there is also little early successional forest. The predominance of a single age class of forest, combined with the ongoing parcelization and fragmentation of forests, impacts the ability of Rhode Island's forest to support the entire suite of plants, wildlife, and other biota they are capable of supporting.

The extent of early successional habitat in Rhode Island is ephemeral and depends on anthropogenic events; reversion of abandoned farmland to forest in the late 1800's and early 1900's led to an abundance of brush land and young forest. Since that time, there has been a steady decline as old fields succeed to forest and farms are converted to developed uses. Currently less than 4% of the State's forest is early successional habitat and natural disturbances, like severe storms, do not create enough early successional habitat on a regular basis in Rhode Island to support wildlife species of the greatest conservation need (SGCN), like ruffed grouse, blue winged warbler, or eastern woodcock that require it.

In Rhode Island, forest blocks are becoming smaller and more isolated due to fragmentation caused by roads and developed land uses. More than 1,100 acres of forest in large unfragmented blocks identified as important habitat in the RI Wildlife Action Plan were converted to non-forest land use between 2011 and 2018.[xiii] Fragmentation divides large contiguous areas of natural land into smaller patches, resulting in each patch having more edge habitat, degrading its ecological quality and integrity and changing the wildlife species that use it as habitat. Conversion of forestland to other land uses and fragmentation into smaller parcels has a negative impact on some species, such as Wood Thrush, Scarlet Tanager, and Cerulean Warbler, which are dependent on large tracts of unbroken forest for their life cycle.

Core habitat includes large blocks of forest (more than 250 acres) unfragmented by other land uses. Few areas now contain core habitats large enough to support the full complement of expected species and natural ecosystem processes. Key characteristics that determine a forest's value for bird breeding habitat, for example, are its size and shape, proximity to other forest tracts, and surrounding land uses. The increasing number of landowners and small parcel sizes makes management for species that require large tracts of land as habitat more difficult. To address this concern RI DEM has pursued the acquisition of large tracts of forest land as well as parcels adjacent to protected land existing to be incorporated into Conservation Areas.

Active management by landowners can be beneficial to wildlife by creating a range of forest types and age classes distributed across the landscape. A partnership of organizations including Natural Resources Conservation Service (NRCS), DEM, Rhode Island Forest Conservators Organization (RIFCO) and the RI Tree Farm Committee provide financial and technical assistance to create habitat which supports priority upland wildlife habitats that are of conservation concern. This includes early successional forest, shrub-scrub dominated habitats, old fields and grass-herbaceous dominated areas.

Soils & Soil Productivity

Geologically, Rhode Island can be divided into two regions: highlands in the northwestern interior of the state and coastal plain that extends along Narragansett Bay. The western upland area, along the Connecticut border is the state's most rural region with forest, some rural industry, and limited agriculture. The largest water body there is the Scituate Reservoir, an impoundment of the North Branch of the Pawtuxet River created to provide municipal drinking water to the metropolitan Providence area.

The south coast of Rhode Island borders the Atlantic Ocean and the area between the mainland and the sea consists of barrier beaches and coastal ponds. Farther inland, a broad outwash plain of the South County region contains the State's most productive agricultural soil. North of this plain is the Charlestown Moraine, a long ridge formed by soil and rock left by glaciers. The moraine region is drained by the Wood-Pawcatuck River, a river ecosystem that supports the highest biodiversity of any river in New England and is also a focal point for outdoor recreation.

According to *Soils of Rhode Island Landscapes* Approximately 64 % of the soil in the state have developed from glacial till and 21 % from glacial outwash deposits.[xiv] This report groups the 41 soil series found in the State into 13 mapping units based on their properties: this includes glacial till, outwash plains, and areas of Inland depressions or low lying areas where water collects.

Glacial till occurs upland till plains and Narragansett till plains *(immediately* around Narragansett Bay). The RI Soil Survey[xv] reports potential productivity of glacial till varies with site index (height in feet of dominant trees at 50 years) ranging from 49 -70 feet for red oak and 58-80 feet for white pine.

Although characteristics vary, soil in *Narragansett till plains* is generally compacted, with few bedrock outcrops and has been smoothed by glacial action. A large portion of this soil type is cleared and used for agriculture and/or has been developed for low density housing while most of the Upland till Plains is forest.

Outwash consists of particles of gravel, sand, silt, and clay deposited by glacial meltwater. Areas of outwash are located throughout the State with significant deposits along the Wood and Pawcatuck Rivers in West Greenwich as well as deposits in North Kingstown and North Smithfield. Most areas of this soil type have been cleared for crops or pasture with some areas used for low density housing or unmanaged woodland.

Areas of inland depressions and low-lying areas dominated by organic soils make up about 4% of the state. The water table is at or near the surface most of the year and flooding and instability affect the use of these areas. Most of this soil is unmanaged woodland with low potential productivity for growing trees due to poor drainage (site index of 46- 51 feet for red maple).

Mineral Resources

Rhode Island lies at the foothills of the Appalachian mountain range and the geology of Rhode Island is heavily influenced by events that included formation of the Appalachian Mountains. The landform and mineral resources of the State are a result of glaciation 10,000 to 20,000 years ago that shaped the terrain creating narrow valleys. The melting of the ice left sorted surficial deposits, Including two distinct terminal moraines, glacial boulders, and glacial outwash plains.

Limestone is scarce in Rhode Island, and most of the deposits are within the Blackstone Bedrock series in north-eastern Rhode Island. This mineral is still extracted (primarily by one company) on a small scale for lining athletic fields and lawn and garden use.

Westerly Granite is exposed chiefly in south - western Rhode Island is recognized in the stone industry due to its fine grain and uniform composition. It was once used extensively for statuary and monuments. Quarries were common at one time but have declined as the resource has been nearly exhausted. There is one small company in Westerly that uses the granite from their quarry for monuments.

At one time soapstone, coal, and bog iron were also mined in Rhode Island but these industries have ceased operation since it is no longer economical to extract the resource. Currently, Rhode Island's primary mineral production is for construction, sand and gravel, and crushed stone. Some industrial sand is mined and used for beach replacement and other uses. Crushed stone is also used as riprap and jetty stone.

Although it is uncommon in Rhode Island, interests in mineral resources are sometimes owned by someone other than the landowner. A *mineral rights determination*, done during the due diligence phase of a project, is part of the acquisition process for Forest Legacy Tracts.

Water & Water Quality

Surface reservoirs and groundwater are relied on for Rhode Island's potable water supplies, and nearby land uses influence water quality for both sources. Forests serve as natural filters and are the most effective land cover for maintenance of water quality and quantity. Forests therefore provide an economic benefit since they filter sediments and other pollutants from the water in the soil before it reaches a water source, reducing treatment costs. Maintaining forest cover and practicing forest stewardship help ensure cleaner water is available from water supply sources.

Most public water supply systems in Rhode Island originated in the urban areas which needed a source of water because of development and increasing population density. Historically, Rhode Island has some of the first public water systems and they were expanded in size and scope of operations as the populations in the area they served grew. This is no longer feasible.

Although never intended to be the single source supply for the State, the Scituate Reservoir of the

Providence Water Supply Board (PWSB) water system now provides water to the metropolitan areas of the State and about 600,000 persons, about 60% of State's residents. Other large public water suppliers now rely on the Providence Water Supply Board (PWSB) as a supply due to contamination from intensive land use activities.

The drainage area for the Scituate Reservoir watershed is about 60,000 acres. Of that, 28% of the watershed (including 12,000 acres of managed forestland) is controlled by the PWSB, and the rest is privately owned. The watershed is subject to development pressure due to its proximity to Providence. The PWSB works to acquire critical parcels of land within the watershed to ensure important watershed resources are protected. A 2001 USGS study indicated that the quality of water resources in the watershed may be slowly degrading as a result of urban development. Less than a third of the land in the watershed is publicly owned and protected from development, stewardship of the remaining land by private landowners is critical.

The Scituate Reservoir was never designed to be the primary source of drinking water for Rhode Island but the State has no backup supplies. This was one of the factors in the State's purchase of the Big River Management Area in the south- central portion of the Rhode Island as an alternative water supply. Purchase of land for the reservoir began in the late 1960's but the EPA later determined that construction of a reservoir at Big River would cause serious environmental damage so development of the area for water supply was halted. The Big River Reservoir land (about 8,000 acres) was designated as open space by the Rhode Island Legislature. It is protected: the land cannot be sold or developed except for the development of wells and well sites for the distribution of drinking water.

Most of the State's groundwater is considered suitable for drinking water use, and four groundwater aquifer systems of the State have been classified as "Sole Source Aquifers" by the United States Environmental Protection Agency (EPA) since they serve as the principal source of drinking water for an area and no other water supplies are available. About 26 % of the state's population depend on these sole source aquifers for their water supply; there are a total of 490 public water supply systems ranging in size from small rural restaurants to 28 major suppliers.

Aesthetic/Scenic Resources

The value of scenic resources in the Rhode Island landscape is important in measurable ways, such as tourism, recreation, as well as intangible assets that give distinct areas their "sense of place".

The state-wide Comprehensive Outdoor Recreation Plan (SCORP) recommends a policy that recognizes the State's scenic rural landscapes, roads, and vistas are important historic and cultural resources that maintain the quality of life. The Rhode Island Landscape Inventory (DEM 1990) provides a comprehensive evaluation and inventory of the State's significant scenic resources. This report resulted from legislation that directed DEM to

establish and maintain a list of scenic areas in the state. The study evaluated the scenic characteristics of the landscape and identified hundreds of scenic sites throughout Rhode Island. These sites were mapped on United States Geological Survey (USGS) topographic quadrants as well as a comprehensive map of the state. A Geographic Information System (GIS) map layer of the data has subsequently been created.

The Wood/ Pawcatuck River Watershed in south-western Rhode Island provides tremendous scenic, cultural, recreational, and wildlife resources. Although the rivers here provided power for many mills in the 1800's, this area is now largely undeveloped and expanses of forest and unique wetlands interwoven with villages showing the great cultural and historical value these rivers and forest systems provide. There are seven rivers that make up the Wood Pawcatuck River system. In March 219 the Wood-Pawcatuck Watershed Wild and Scenic River Act was passed by Congress protecting the outstanding scenic, cultural, and recreational assets of this river system for the benefit of present and future generations.

Cultural Resources

The context for Rhode Island's cultural resources spans thousands of years from the precolonial period to modern times. Five indigenous tribes inhabited the area and were hunting, fishing, and farming the land. The largest of these tribes, the Narragansetts, are still active in Rhode Island today. It was Narragansett Sachems who, in 1636, granted Roger Williams land use rights to establish a settlement in what is now the City of Providence.

Over 2,500 significant archaeological sites have been identified throughout Rhode Island (including historic shipwrecks beneath the state's waters) and more sites are expected to be present in the areas that have not yet been investigated.[xvi] Historic Resource Surveys have been completed for each town and are available at preservation.ri.gov.

Changing needs and lifestyles over Rhode Island's settlement history have created distinctive places throughout the state. The west side of Narragansett Bay was developed as a series of port villages bounded by agricultural settlements. The western uplands, from the port settlements to the Connecticut border included agricultural use with some rural industry along rivers. The landscape has

been shaped by both natural and cultural forces and arguably nowhere else can such can such a diverse and rich cultural history be found in such a small area. The combination of diverse natural, cultural, and recreational resources gives areas unique "sense of place" characteristics that enhance livability.

The Rhode Island Historical Preservation & Heritage Commission surveyed the cultural heritage in each Rhode Island community to identify land and land-use patterns that characterize each region of the State.[xvii] The publication documents significant historic resources throughout Rhode Island, including historic landscapes, many of which are located with the Forest Legacy area. The Commission has also produced survey publications for each of the state's 39 municipalities highlighting historic, architectural, and archeological resources in each. The survey and report are part of the on-going program set forth in Rhode Island's "Historic Preservation Plan," first edition, issued in 1970.

In recent years, attention and effort has focused on planning at a regional level to protect community character as well as natural resources. One example is the 2003 *South County Greenspace Protection Strategy* that grouped areas with high concentrations of natural and cultural elements into Landscape Preservation Heritage Areas that are priority for conservation.

Recreation & Tourism

Rhode Island's forests provide numerous recreational opportunities such as hiking, hunting, fishing, camping, bird watching, picnicking and more. A study of the economic impact of Rhode Island State Parks found that Rhode Island Parks and Management Areas are host to 6 million visitors each year.[xviii] The study also found that this generates $2.3 billion dollars for the state from both tourism and recreation, making tourism the second-largest and fastest-growing industry in RI. The Outdoor Industry Association estimates that this sector directly supports an estimated 24,000 Rhode Island jobs, which provide $737 million in wages and salaries each year.[xix]

The Wood/Pawcatuck Wild & Scenic Rivers Study showed that the rivers in south-western Rhode

Island are the most heavily used for water-based recreation in the state. The forests in the area provide natural backdrops for other recreation. Cold-water fisheries that support recreational fishing are uncommon in Rhode Island and are predominantly in the south- western part of the State. Brook Trout in Rhode Island remain a threatened species, an indicator of the impact of development.

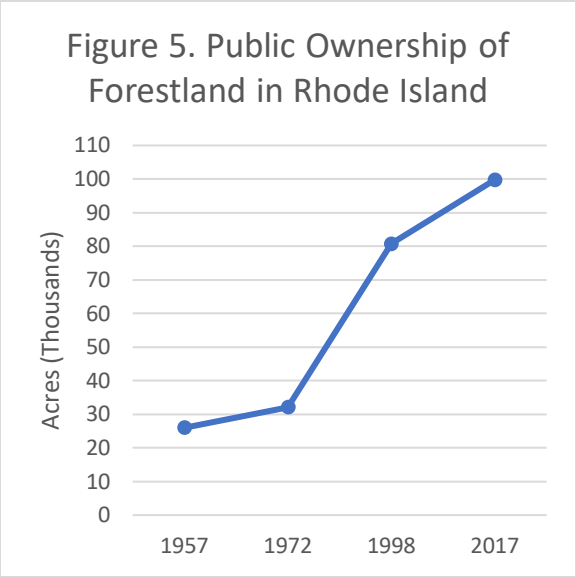
History of Conservation

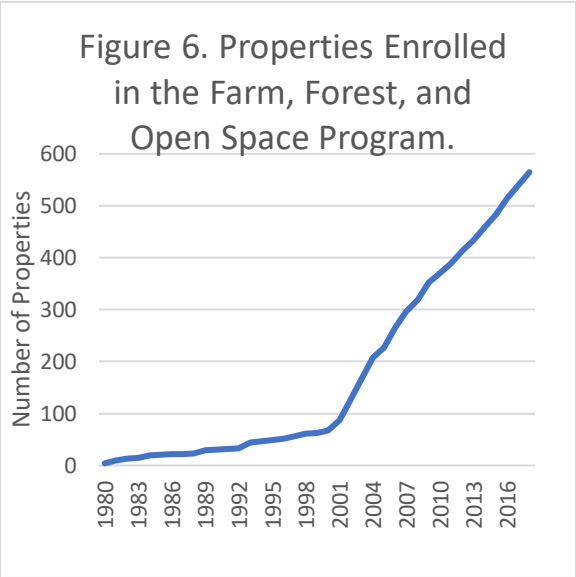
Rhode Island established the Rhode Island Forest Commission in 1906. The first State Forester under this program was Jesse B. Mowry. He believed that the forest sustainability field was not in the hearts of the citizens and that it would have to be the government that led the effort in improving our forests. In 1930, The George Washington Memorial Forest in Glocester became the first state forest. In 1933, The Civilian Conservation Corps was established. Under this Act crews engaged in reforestation, forest management, disease control, etc. throughout the country. The reforestation effort peaked in the 1950's in Rhode Island, when the state was 64% forested. Since that time, the amount of forest land in Rhode Island has declined because of threats from development and fragmentation. However, efforts to maintain the Rhode Island's forest acres have continued. In 1964, the Green Acres Act was established aimed at protecting conservation and recreation land by providing funding for acquisition.

The state sets goals and policies for conservation of open space through a State Guide Plan and indirectly through oversight of local Community Comprehensive Plans for each of its 39 cities and towns. A separate Forest Resources Management plan is an element of the State Guide Plan that provides guidance to enhance the effectiveness of public and private stewardship of the state's tree and forest resources.

Current Measures to Protect Rhode Island's Forest Resources

Although there has been a decrease in privately owned forest in recent years, there has been an increase in conservation efforts by public agencies during the same time period. DEM owns 47,384 acres, has conservation easements on 22,958 acres, and deed to development rights on 2,705 acres, most of it farmland (Paul Jordan, March 28, 2019). This includes 22 parcels encompassing 3,583 acres protected through conservation easement or fee purchase by the Forest Legacy Program. Figure 5 shows trends in land acquisition by DEM from the late 1950's through 2018. Funding for many of these purchases was provided by bond issues approved by voters demonstrating public awareness of the threat of fragmentation and a willingness to protect land by funding acquisition of open space.





Since 2001,There has been a dramatic increase in enrollment in Rhode Island's Farm, Forest, and Open Space (FFOS) Program, a program which offers lower tax assessment (based on the land's use as forest) in return for a conservation restriction that insures the property cannot be developed for 15 years without paying a penalty. Interest in this Program has increased as higher tax assessments have made the cost of maintaining forestland more challenging. Figure 6 shows the number of forest properties enrolled in this Program since 1985. A survey of forest landowners in 2005 found 51 percent of eligible landowners in 13 rural communities participated in the Program at that time. Of properties enrolled in the Program at that time, 58 % were enrolled under the open space classification, 29% as forest, and 12% in the farm classification. This program has been an effective in slowing the change of forestland in both rural and suburban communities to other uses. The Rhode Island State Conservation Committee reports 3,600 properties enrolled in the Program statewide (28,614 acres in farmland and 29,345 acres as forest classification).

ISSUES IMPACTING RHODE ISLAND'S FOREST

The *Initial Forest Legacy Needs Assessment 1993* identified forest fragmentation and conversion as a vital issue facing Rhode Island. A survey of forest landowners done as part of the development of the *State Forest Resource Plan* in 2005 identified development as the most critical issue affecting forests [xx] Recent studies found forest fragmentation, or the breaking of contiguous forested areas into smaller ones, and conversion to other land uses continues to be the greatest threat to forests in Rhode Island.[xxi]

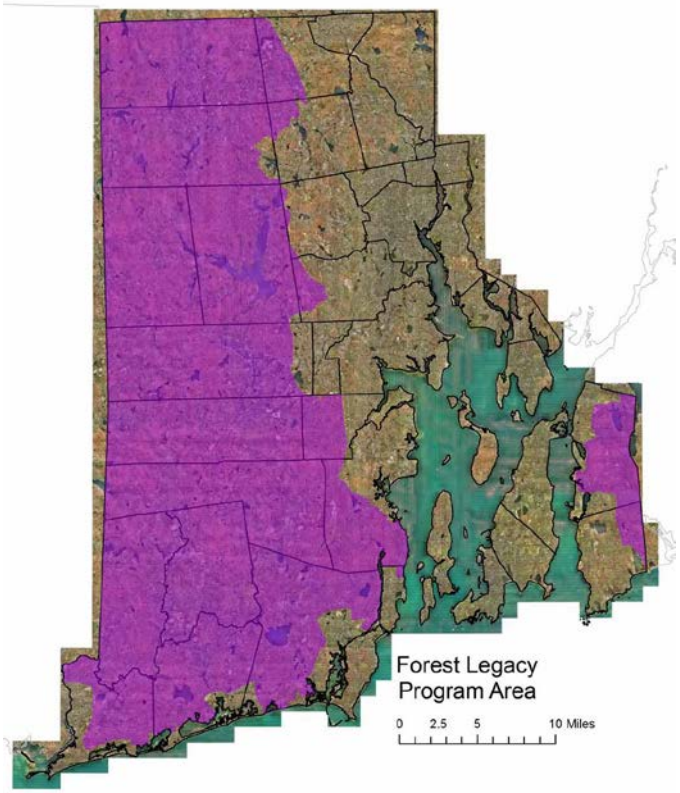
There is a high degree of public awareness about his issue and Rhode Island voters have authorized millions of dollars to protect open space from development through statewide and local referenda. Forest landowners were surveyed about the allocation of funding during the development of the Forest Resource Plan and forest conservation was by far their highest priority for funding. The Forest Legacy Program has been accepted as a tool to conserve Rhode Island's forest resources and has protected over 3,000 acres of important forest from conversion to other uses.

Public comment during the development of the Initial Needs Assessment pointed out that although Forest Legacy is a valuable program there is not enough funding to protect all the important land. The more recent *Value of Rhode Island Forest* report recognized that funding for conservation continues to be a critical issue and reliable sources of financial support are needed. [xxii]

IMPLEMENTING THE FOREST LEGACY PROGRAM

Forest Legacy Area

The Forest Legacy Area in Rhode Island has not changed from that initially established in 1993.



A. Methodology

During the development of the states' first Forest Legacy Assessment of Need (1993) maps of Rhode Island's significant forest tracts, watersheds of public drinking water supplies, public open-space tracts and recreational areas, location of rare, threatened and endangered species and/or their habitats, and significant mineral resources were analyzed (ref. maps *Appendix A*). Then, utilizing population growth statistics, communities experiencing significant population increases were identified and compared with the forest resource data. Once this information was assimilated, the Forest Legacy Subcommittee developed proposed Forest Legacy Area boundaries, keeping in mind the Forest Legacy Program's intent, the need for public involvement, the participation of willing landowners, and utilizing the Committee's expertise and personal knowledge of the state's significant resources. *Appendix B* contains a summary of the important resources to be protected, public benefits to be derived, and entities who may be given monitoring responsibility for an individual parcel.

B. Description of proposed Forest Legacy Areas

The proposed Rhode Island Forest Legacy Areas (FLA) includes two separate pieces and will be referred to in this document as the "Mainland" and "East Bay" areas. Each of these will be discussed separately. See the attached USGS metric topographic maps (1:100,000) which have the proposed Forest Legacy Areas delineated. For a reference map and detailed boundary descriptions of each of the proposed Legacy Areas refer to *Appendix C*.

1. Mainland

The northern and western boundaries of the Mainland Legacy Area are delineated by the state boundaries between Rhode Island and the State of Connecticut and the Commonwealth of Massachusetts. This geopolitical boundary was not selected because it was merely a convenient line. Most of Rhode Island's remaining forested tracts

are located abutting this boundary, as is a significant amount of public open space. The two adjacent States have forested tracts and open space abutting Rhode Island's border as well. Therefore, using these lines as a boundary is consistent with the intent of the Legacy Program to wherever possible recombine significant forest tracts artificially separated by political boundaries.

The southwestern portion of the Mainland Legacy Area includes the watershed of the Wood-Pawcatuck Rivers system, an important public drinking water supply aquifer and recreational and wildlife species resource.

The southern boundary nearly coincides with a drinking water aquifer and includes forested lands located in an area that has seen higher development pressure than any other lands mentioned.

At the south-eastern region of the proposed Mainland Legacy Area lie the towns of South Kingstown and Narragansett. These towns are characterized by clusters of development, particularly near the shoreline and the major roadways, which extend inland towards the University of Rhode Island. The FLA boundary in this area skirts the major developments around the urban centers but is intended to include significant forested tracts which may add to the character of historic villages such as Peacedale and West Kingston. The boundary line actually extends to the forested shoreline of Narragansett Bay and includes the Pettaquamscutt River watershed wherever possible. This area has extremely high wildlife and other forest values and faces a severe threat from development pressure. The U.S. Fish and Wildlife Service maintains a 563-acre wildlife refuge along and including a portion of the river. Also included within this general area are several historic farms.

Moving north, FLA boundary turns inland, skirting major development, and meets and follows the eastern boundary of the Scituate Reservoir Watershed, the State's single most important public water supply watershed. The FLA boundary line continues running in a northerly direction, intersects the watershed boundary of the Slatersville Reservoir watershed and follows this line northerly to the intersection of State Routes 7 and 104. Following Route 104 north to Route 5 north to the beginning, completes the circuit. The above-mentioned roadways are nearly identical to the watershed boundary of the Slatersville Reservoir.

2. East Bay

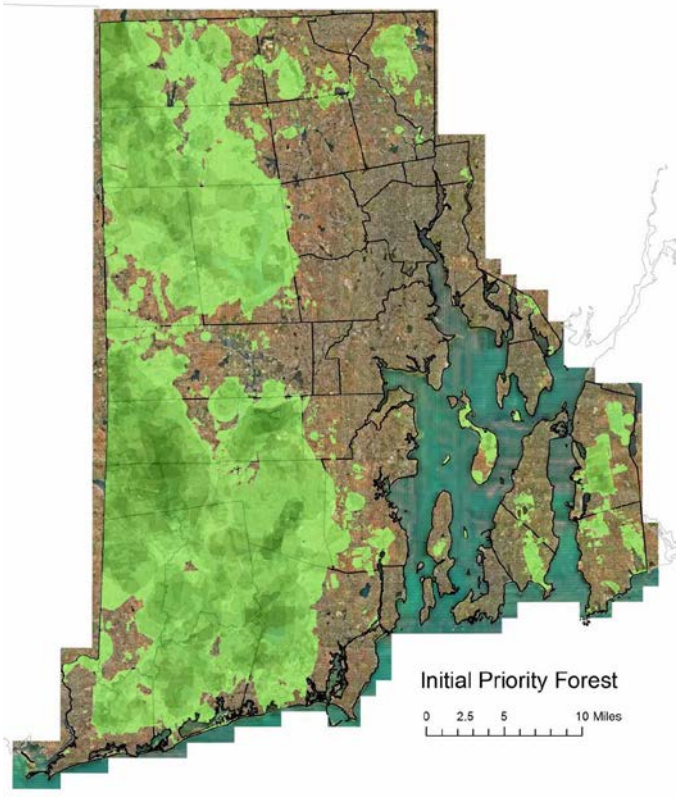
The East Bay Legacy Area is located largely within the Town of Tiverton, and to a lesser extent the Town of Little Compton and includes the last remaining significant forest tracts in this area. This area contains many of the same resources and is experiencing the same types of development pressures as the Mainland area.

The eastern boundary of this tract corresponds with the state line between Rhode Island and southeastern Massachusetts. Once reaching the shoreline, the boundary continues along the north shore of Quicksand Pond to Mullen Hill Road, and continues westward to the intersection of Long Highway where it turns north. The line continues north onto Lake Road and turns westerly onto State Route 179, then continues westerly onto Neck Road and encompasses the Sapowet Management Area. Travelling north from Sapowet Avenue to state Route 77, the FLA boundary turns easterly onto State Route 177, then northerly again on Fish Road to Eagleville Road. Then from Eagleville Road to Stafford Avenue and northerly to the state line and thence to the point of origin. Enclosed within this area are several key open space areas, a state

management area, and several rare, threatened and endangered species habitats.

The initial Forest Legacy Area was refined, but not substantially changed, using GIS technology that wasn't available when the first mapped. This included spatial data for:

- Conservation Lands.
- Core Habitat Water protection area, aquifer or aquifer recharge area
- Pitch pine habitat
- Areas able to produce clean water as identified by the USFS
- Blocks of contiguous forest
- Concentrations of state-listed Natural Heritage species
- State Conservation Priority Areas
- State Forest Legacy Areas



Criteria for Selection as a Forest Legacy Tract

The goal of the Rhode Island Forest Legacy Program is to protect important forest land from fragmentation and/or conversion to non- forest uses. The Forest Legacy Program in Rhode Island is implemented through a State Grant Option, where RIDEM holds title to conservation easements or deeds for tracts of forestland that focus on the sustainable use of forest resources.

Acquisition of conservation easements is preferred to fee simple purchase although the Forest Stewardship Committee will consider recommending full-fee acquisition if it is in the best interest of the resource. Conservation easements (CE) that limits the rights to subdivide the property or convert the forest to other uses and requires it be managed in accordance with a multi resource management plan that has been reviewed and approved by the State Forester. DEM monitors the tracts and enforce the CE if necessary. Following are the criteria for enrollment:

- Property must be more than 25 acres
- Must be in a Forest Legacy Area
- Property must be 75% forested
- Public access is desirable but not required.

The Parcel Acquisition Process

At the state level, the acquisition process begins with an application from a willing landowner. The Application and Project Evaluation Sheet are available for download from the DEM/Division of Forest Environment webpage. *www.dem.ri.gov/programs/forestry/forestlegacy/*

A staff member from DEM may conduct a site visit to evaluate the parcel and ensure it meets minimum criteria for project eligibility. The staff member may be accompanied by one or more

representatives from the Forest Legacy Committee who may have insight into specific resources associated with the parcel.

The review includes both a subjective and objective process to insure the tracts to be included in a project grant proposal fulfill the purpose of the Forest Legacy Program and address the concerns outlined in the Assessment of Need (AON). The Project Evaluation sheet is based on the criteria adopted by the Massachusetts Forest Legacy Committee and modified by incorporating RI DEM Open Space Criteria to evaluate natural resource value and conservation opportunity. In addition, a ranking spreadsheet is used that incorporates the USDA, Forest Service ranking guidance (from the call for projects) to ascertain how the project will be evaluated on National level.

The Rhode Island Forest Legacy Committee endorses parcels for inclusion in a project grant request submitted to the Forest Service for funding based on:

- importance of natural resources on the property
- strategic value (on a landscape scale) conservation of the land would provide
- imminent threat that the parcel will be converted to other uses

If Federal Forest Legacy Project Grant Funding is approved, the application and evaluation will be forwarded to DEM's Land Acquisition Committee (LAC) to confirm state interest in the parcel, authorize appraisals, and determine potential sources of state cost-share funding. The LAC's findings will be reported to the State Forest Legacy Committee.

DEM, cooperatively with the USDA Forest Service, then begins due diligence for the acquisitions which includes:

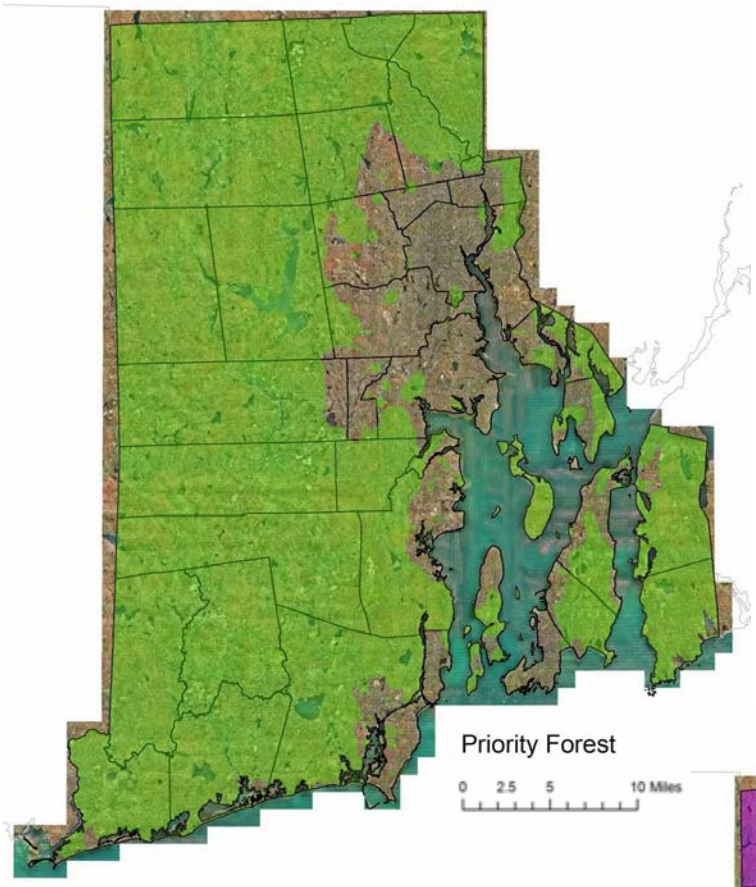
- Conservation easement and deed drafting
- Title Search and Title Insurance
- Legal Description/ Survey
- Minerals Determination

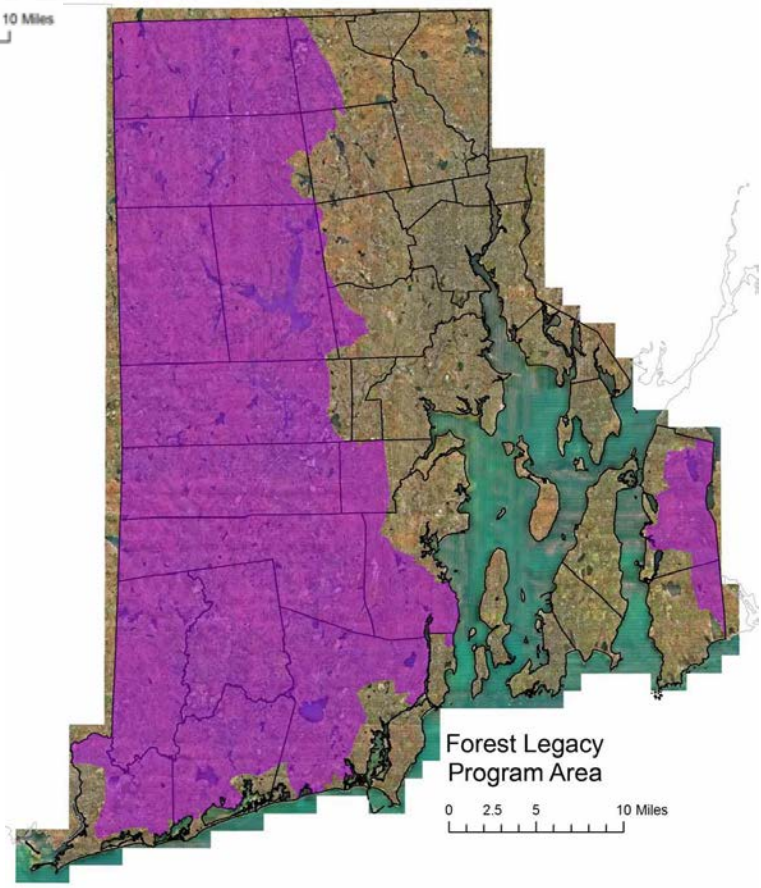
After due diligence is complete, appraisals are initiated in accordance with federal appraisal standards.

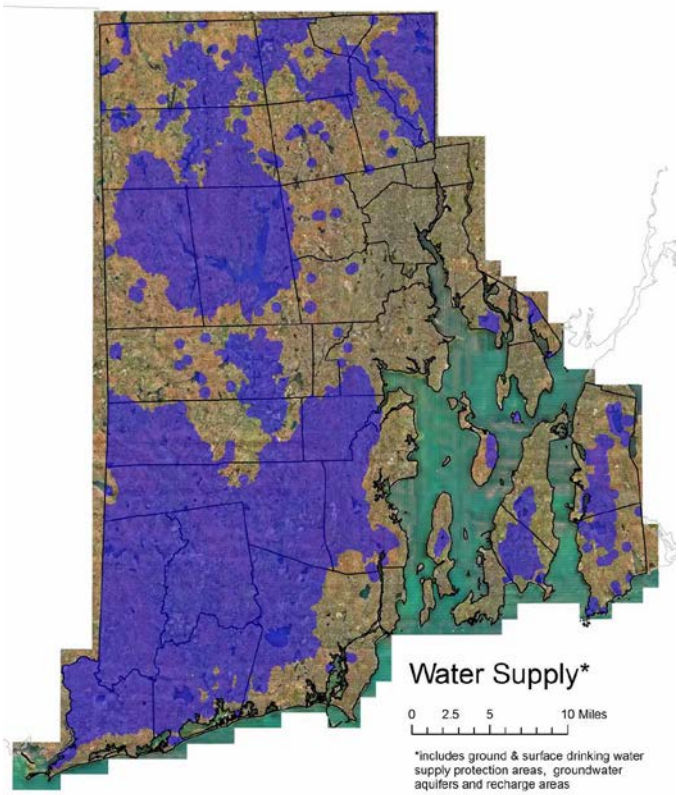
The appraisal must be reviewed and approved by the Forest Service before DEM can proceed to negotiations with the landowner. The LAC then approves negotiations with the landowner to secure a Purchase and Sale Agreement.

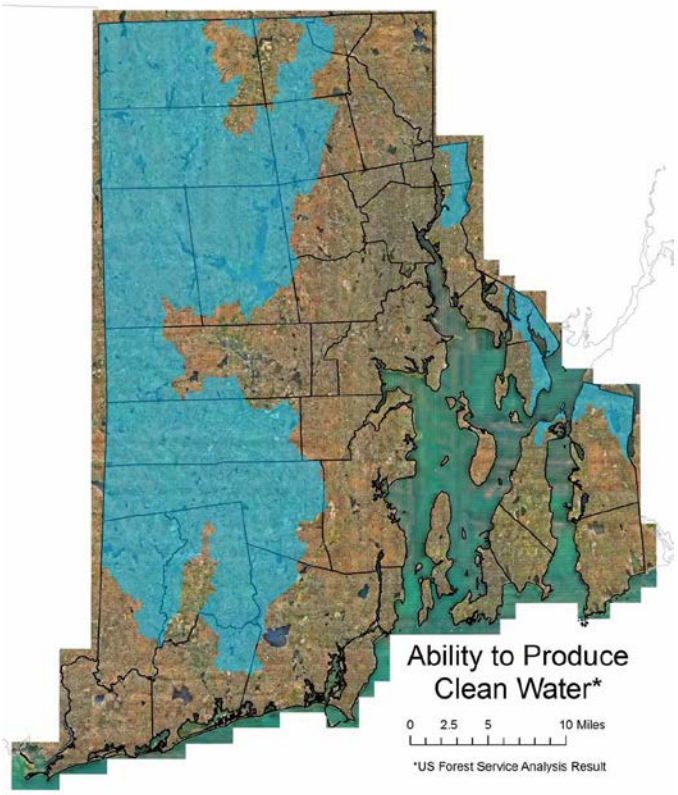
Prior to closing DEM and/or Partners must complete the following tasks.

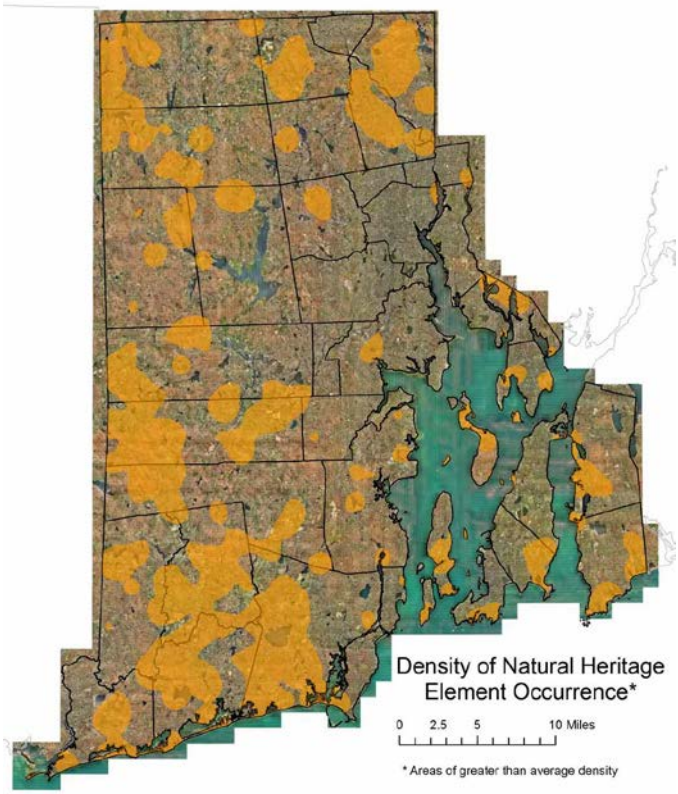
- Environmental Assessment including a preliminary scoping of property conditions and, if warranted, conduct a Phase 1 Environmental Assessment.
- Baseline Documentation Report that details the relevant conditions of the property at the time the conservation easement is granted.
- Multi-resource Forest Management Plan, approved by the State Forester, that addresses the resource elements of the USDA Forest Stewardship Program.
- Appraisal and appraisal review that meets Uniform Appraisal Standards for federal acquisitions.
- Amicable Agreement letter that documents that the sale is strictly voluntary and that the value of property has been determined by an approved appraisal.

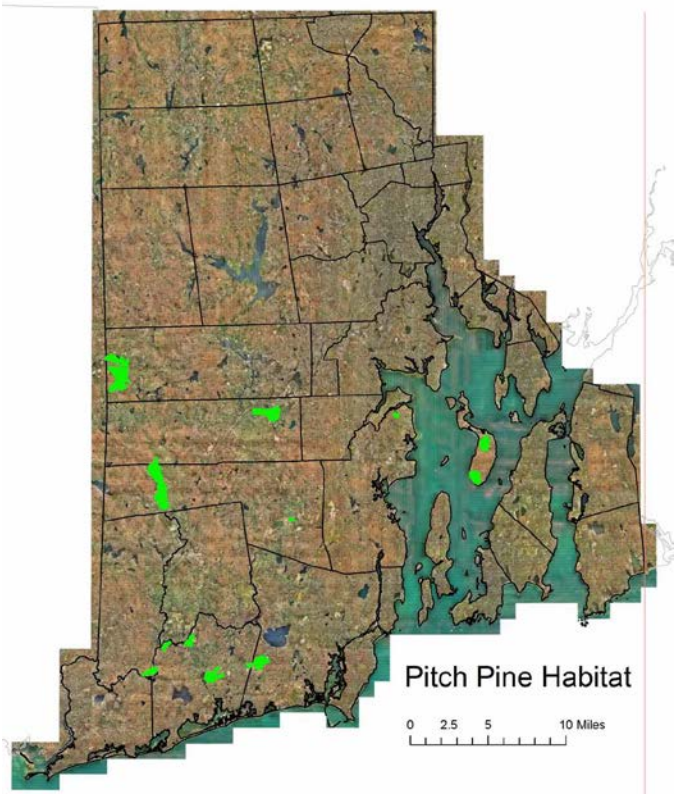

Priority Forest
0 2.5 5 10 Miles

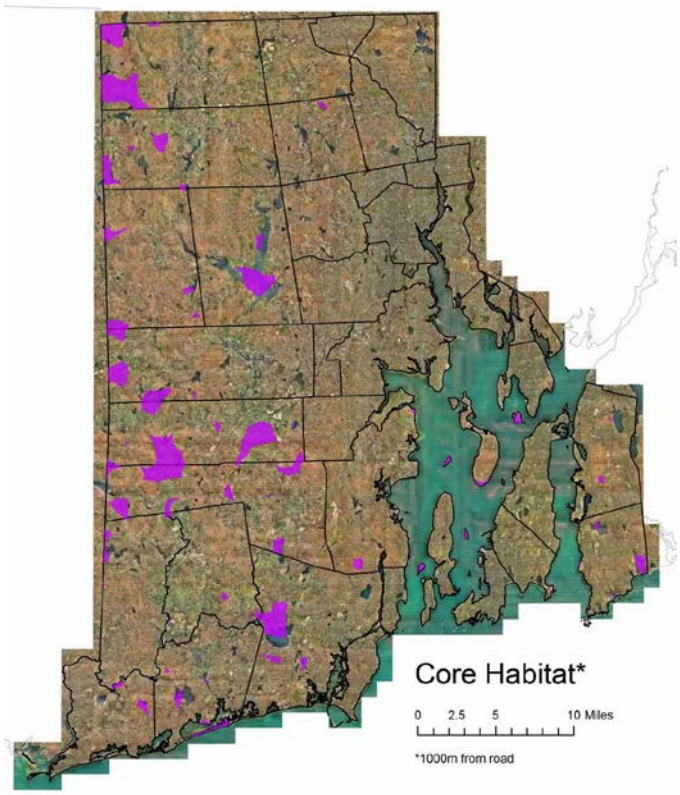

Forest Legacy
Program Area
0 2.5 5 10 Miles

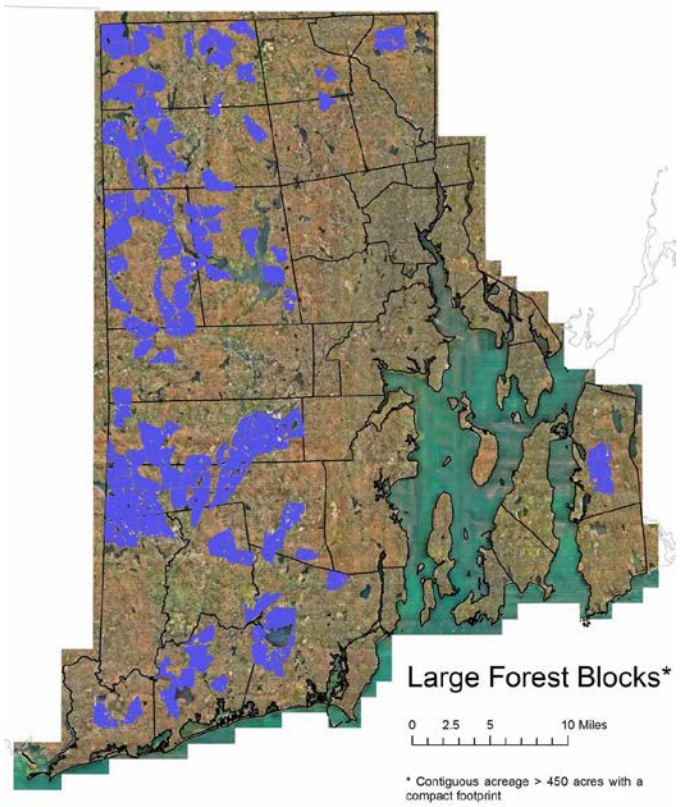

Water Supply*
0 2.5 5 10 Miles
*includes ground & surface drinking water supply protection areas, groundwater aquifers and recharge areas

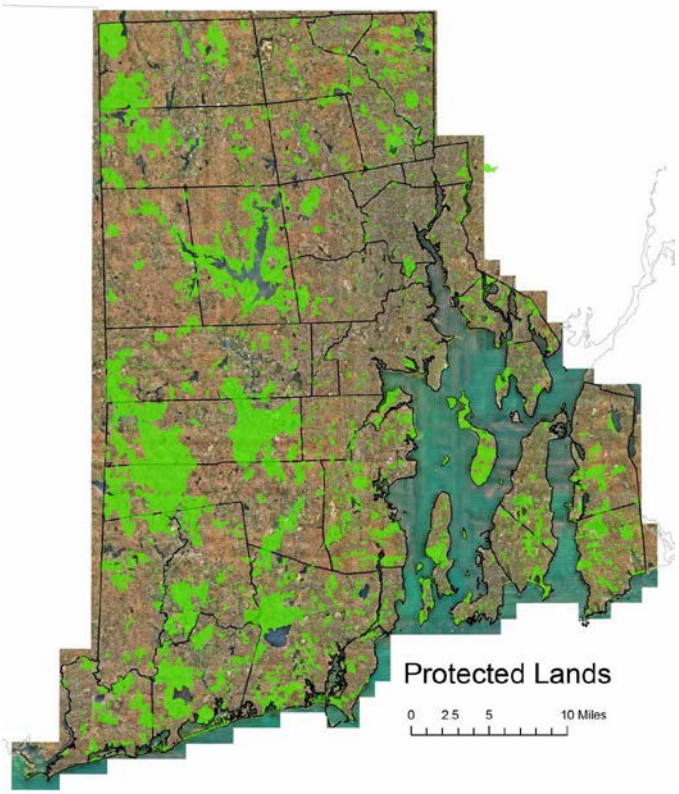

Ability to Produce Clean Water*
0 2.5 5 10 Miles
*US Forest Service Analysis Result

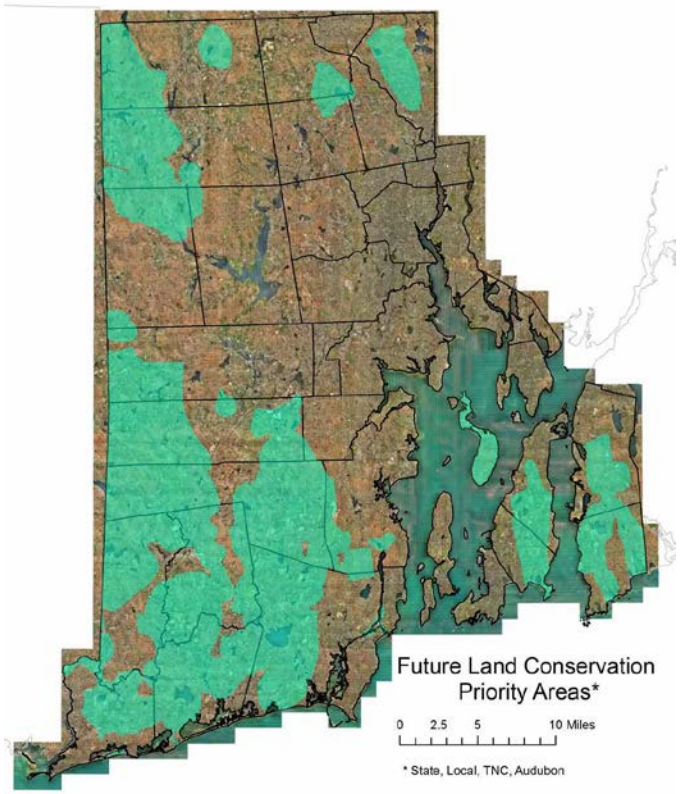

Density of Natural Heritage Element Occurrence*
0 2.5 5 10 Miles
* Areas of greater than average density


Pitch Pine Habitat
0 2.5 5 10 Miles


Core Habitat*
0 2.5 5 10 Miles
*1000m from road


Large Forest Blocks*
0 2.5 5 10 Miles
* Contiguous acreage > 450 acres with a compact footprint


Protected Lands
0 2.5 5 10 Miles


Future Land Conservation Priority Areas*
0 2.5 5 10 Miles
* State, Local, TNC, Audubon

APPENDIX B. Summary of important public resources to be protected in each of the two Forest Legacy Areas

"East Bay – FLA"

1. Description:
   The "East Bay" proposed area is about 20,000 acres and located in the towns of Tiverton and Little Compton in the southeast corner of the State, east of Narragansett Bay. Its eastern boundary follows the State line between Rhode Island and southeastern Massachusetts. The number of ownerships are in the low hundreds with most of the key areas contained in dozens of larger unfragmented forest tracts. See the attached USGS maps which has the proposed Forest Legacy Area boundary delineated.

2. Summary of important environmental values and how they will be protected:
   Enclosed within this area are several key open space areas, a state management area, and several rare, threatened, and endangered species habitats. It includes the last remaining significant forest tracts in this portion of the State. Although there is relatively little development now, pressures are increasing from the Newport, Fall River, and Providence expansions. This area comprises a significant portion of the watershed of the only public drinking water supply available to these two communities. Some of the interests that in these lands that will likely be acquired include, but are not limited to: development rights, public access (ROW's), scenic easements, and occasional fee simple acquisitions for tracts with many key resources.

3. Public benefits to be derived:
   a. Protected habitats for fish and wildlife
   b. Ground water aquifers
   c. Rare and endangered species habitat
   d. Scenic views/aesthetics
   e. Recreation and recreation access
   f. Traditional forest uses including vegetative manipulation
   g. Jobs and economic developments (products and tourism).

4. Potential management responsibility entities:
   Many options exist in the area. Specific assignments will depend on the specific tracts identified when selection criteria are applied to candidates. They may include: U.S. Fish and Wildlife Service, local towns, DEM - Division of Forest Environment, and a host of other federal, state, and public entities.

"Mainland – FLA"

1. Description:
   The "Mainland" proposed area encompasses a large portion of the Western and southern portions of the State and is over 250,000 acres in size. Thousands of ownerships averaging less than 100 acres are contained in this area. Its western boundary borders Connecticut for about 40 miles, while the eastern boundary bisects the State about mid-point north to south. See the attached USGS maps which has the proposed Forest Legacy Area boundary delineated.

2. Summary of important environmental values and how they will be protected:
   Included in this area are most of the State's significant forested land, most of the major State-owned open spaces and other significant inland recreation areas, the watersheds of three (3) public drinking water

supplies which service over half the State's population, many historic villages, a number of threatened and endangered species and/or their habitats. Fragmentation and conversion of the forest resource base continues as population growth and development pressure is felt primarily from portions of the eastern megalopolis. Potable water is an essential resource that needs to be protected. Major groundwater aquifers and surface reservoirs are present, such as the Wood-Pawcatuck Rivers System, the Scituate and Slatersville Reservoirs, and the watershed of the Big River Reservoir. Some of the kinds of interests in land that will likely be acquired after a tract by tract analysis in done include, but are not limited to: development rights, public access (ROW's), mineral rights, timber rights, scenic easements, and occasionally fee simple acquisitions for tracts with many key resource values.

3. Public benefits to be derived -
    a. Potable drinking water
    b. Protected habitats for fish and wildlife
    c. Protected rare and endangered species habitat
    d. Scenic views/aesthetics
    e. Recreation opportunities and recreation access
    f. Traditional forest uses including vegetative manipulation for forest products and other values
    g. Jobs and economic development from forest products and tourism/recreational pursuits

4. Potential management responsibility entities:
   Many options exist in the area. Specific assignments will depend on the specific tracts identified when selection criteria are applied to candidates. They may include: U.S. Fish and Wildlife Service, DEM - Division of Forest Environment, State and local water supply boards, local town governments, and a host of other public and quasi-public conservation land trusts entities.

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