

Virginia Statewide Assessment of Forest Resources

*An Analysis of
Forest Conditions, Trends,
Threats and Priorities*

November 2020





Contents

Section I: Executive Summary	8
From the State Forester	8
Overview	9
Virginia’s Forest Trends, Conditions and Threats Summary	10
Nine Critical Issues Impacting Virginia’s Forests	10
Virginia Department of Forestry Programs	11
Section II: Coordination with Other Plans	13
Community Wildfire Protection Plans	13
Virginia Wildlife Action Plan	14
Stakeholder Groups Coordinated with for the Statewide Assessment and Strategy	15
Section III: Virginia Forest Trends, Conditions, and Threats	17
Forest Trends & Conditions	17
Glossary of Forest Inventory Terms	20
Virginia’s Water Quality	23
<i>Watershed Protection</i>	25
Healthy Watersheds Forest Project	26
Forest Management and Forest Stewardship	27
Urban and Community Forestry	29
Threats to Virginia’s Forestland	30
National Priority: Protect forests from threats	30
<i>Forest Health</i>	30
<i>Wildland Fire</i>	31
<i>Diminished Species</i>	33
National Priority: Enhance public benefits from trees and forests	35
<i>Changing Forest Industry</i>	35
<i>Urban Forest Management</i>	36
<i>Climate Change</i>	37
<i>Conservation Education</i>	37
<i>Tree Improvement</i>	37
National Priority: Conserve and manage working forest landscapes for multiple values and uses	38
<i>Forest Sustainability</i>	38
<i>Loss of Forestland to Other Land-Use Types</i>	38
<i>Forest Composition</i>	40
<i>Reforestation</i>	41



Section IV: Virginia’s Nine Critical Issues 44

Southern Forest Land Assessment45

Issue A1: Protect Forestland and Woodland Home Communities from Wildfire 46

Issue Description 46

Priority Areas 46

Issue A2: Protect Forests from Forest Health Threats and Invasive species 48

Issue Description 48

Priority Areas 48

 Native Pests and Established Invasive Insects and Diseases 48

 Established Non-Native Invasive Plants 50

 Non-established or New Invasive Species Threats 50

Issue A3: Conserve and Restore Diminished Forest Types..... 51

Issue Description 51

Priority Areas 52

Issue B1: Enhance the Role of Forests in Maintaining Water Quantity and Quality 54

Issue Description 54

 Forestry Best Management Practices for Water Quality 55

 Silvicultural Water Quality Law Enforcement Actions..... 55

 Flexible Riparian Buffer Program 55

 Retaining and Creating Forests to Combat the Impacts of Sea Level Rise 56

 Virginia Trees for Clean Water 56

Priority Areas 56

Issue B2: Support the forest economy and diversified markets for forest landowners..... 58

Issue Description 58

 Ecosystem Services..... 58

Opportunities 59

Priority Areas 59

Issue B3: Expand and Improve Urban and Community Forests 60

Issue Description 60

Priority Areas 61

 State and Local Capacity in Urban and Community Forestry 62

 Ecosystem Service Values and Other Public Benefits of Urban and Community Forests 62

 Impacts of Urbanization and Fragmentation 62

 Underserved, Diverse and Non-Traditional Populations..... 63

 Urban Forestry Profession in Virginia..... 63

 Natural Disasters Affecting Urban and Community Forests..... 63

Issue C1: Keep Forests as Forest 63

Issue Description 63

Issue C2: Promote a Larger, Connected Forest Landscape 65

Issue Description 65

Priority Areas: Issues C1 and C2 66

Issue C3: Ensure the Sustainable Use of Forest Resources 67

Issue Description 67

 Forest Sustainability Priority Areas 69

Section V Multi-State Issues and Priority Areas 72

Chesapeake Bay Restoration 73

Forest Health Issues 74

Emerald Ash Borer 74



- Southern Pine Beetle* 74
- Diminished Species Restoration 75
 - American Chestnut*..... 75
 - Longleaf Pine* 75
 - Shortleaf Pine*..... 75
 - Upland Oak Initiative* 75
- Incident Management Team Leadership Development..... 76
- Wildland Fire 76
 - Wildfire Prevention* 76
 - Wildfire Arson* 76
 - Wildland-Urban Interface Hazard Mitigation*..... 76

Section VI: Program Areas within the Virginia Department of Forestry 77

Wildfire Suppression and Public Safety.....77

- Program Overview 77
- Program Focus Areas..... 78
 - Firewise Virginia Program*..... 78
 - Community Wildfire Protection Plans* 79
 - Statewide Wildfire Risk Assessment* 79
 - Dry Hydrant Program*..... 80
 - Volunteer Fire Assistance Program (VFA)* 81
 - Wildfire Prevention* 81
 - Law Enforcement* 81
 - Education* 82

Forest Health.....82

- Program Overview 82
- Program Focus Areas..... 83
 - Prevention*..... 83
 - Partnerships 83
 - Outreach..... 84
 - Early Detection 84
 - Detection and Forest Health Monitoring* 84
 - Trapping 84
 - Surveys 85
 - New Technology 85
 - Reporting..... 86
 - Technical Assistance* 86
 - Treatment 86
 - Biological Control 86
 - Support PRISMs..... 87
 - Training and Diagnoses 87
 - Evaluation* 87

Forest Legacy and Land Conservation88

- Program Overview 88
- Program Focus Areas..... 88
 - Working Forest Conservation Easements* 88
 - Forest Legacy* 89
 - Program Eligibility Criteria..... 89
 - Forest Legacy Priority Areas 89



- Generation NEXT..... 90
- Century Forests 91
- Virginia Sentinel Landscapes Partnerships..... 91
 - Local Government..... 92
- Forest Stewardship and Management92**
 - Program Overview 92
 - State Forest Stewardship Coordinating Committees 93
 - Landowner Eligibility and Requirements..... 93
 - Program Outreach and Education 93
 - Outreach for Traditionally Underserved Landowners 94
 - Accomplishment Reporting..... 94
 - Program Focus Areas..... 94
 - Forest Management of State-Owned Lands 96
- Urban and Community Forestry.....96**
 - Program Overview 96
 - History..... 96
 - Program Description 97
 - Program Focus Areas..... 98
 - State and Local Capacity in Urban and Community Forestry..... 98
 - Ecosystem Service Values and Other Public Benefits of Urban and Community Forests 99
 - Planning for the Impacts of Urbanization, Fragmentation, and Canopy Loss..... 100
 - Underserved, Diverse and Non-Traditional Populations 102
 - Benefits to Human Health and Well-Being of Community Forests 103
 - Urban Forestry Profession in Virginia 103
 - Natural Disasters and Poor Urban Forest Health Affecting Urban and Community Forests..... 104
 - Natural Disasters 104
 - Urban Forest Health 105
 - Urban Wood Utilization 106
- Forest Inventory and Analysis.....107**
 - Program Overview 107
 - Program Focus Areas..... 107
- Water Quality.....108**
 - Program Overview 108
 - Operational Forestry..... 108
 - Harvest Inspection Program..... 108
 - BMP Implementation 109
 - BMP Cost-share program 110
 - Law Enforcement 110
 - Education 110
 - Water Quality Data Management..... 111
 - Watershed Forestry 111
 - Riparian Forest Buffer Establishment Program 111
 - Riparian Forest Buffer Tax Credit Program 113
- Forest Research113**
 - Program Overview 113
 - Program Focus Areas..... 113
 - Loblolly Pine Silviculture..... 113
 - Hardwood Silviculture..... 114



Pine Tree Improvement..... 114
Diminished Species Restoration 114
Growth and Yield 115

Pine Tree Improvement..... **115**
 Program Overview 115
 Program Focus Areas..... 116
 Selection and Breeding Research 116
 Seed Orchard Maintenance 116
 Cone Collection and Seed Processing 116
 Seed Orchard Establishment 116
 Proposed Action Plan 117

Forest Products Marketing and Utilization..... **117**
 Program Overview 117
 Program Focus Areas..... 118
 Technical Assistance 118
 Promotion of Forest Industry and Economic Development..... 118
 Development and Dissemination of Forest Resource and Industry Data 119
 Grant Programs and Special Projects..... 119
 Biomass Energy..... 119
 Forest Certification (legal and sustainable forest products) 119
 Forest Operator and Service Providers for Changing Forests and Markets 120
 Specialty Forest Products 120

Ecosystem Services..... **120**
 Program Overview 120
 Program Focus Areas..... 121
 InFOREST..... 121
 Outreach 121

Conservation Education..... **122**
 Program Overview 122
 Program Focus Areas..... 122
 Project Learning Tree 122
 Forestry Camp..... 123
 State Forest Education 123
 Local Programs for Youth and Adults..... 123
 Virginia Master Naturalist Program 123
 Outreach to Underserved Audiences 123

Virginia’s State Nursery System **124**
 Program Overview 124
 Program Focus Areas..... 125

Virginia’s State Forest System..... **125**
 Program Overview 125
 Program Focus Areas..... 127

Section VII: Linking Issues to Actions **128**

Protect Forests from Threats **129**



A1. Protect forestland and associated woodland home communities from fire 129
A2. Protect forests from forest health threats and invasive species 129
A3. Conserve and restore diminished species..... 129
Enhance public benefits from trees and forests130
B1. Enhance the role of forests in maintaining water quantity and quality..... 130
B2. Support the forest economy and diversified markets for forest landowners..... 130
B3. Expand and improve urban and community forests 130
Conserve and manage working forest landscapes for multiple values and uses.131
C1. Keep forests as forest..... 131
C2. Promote a larger, connected forest landscape 131
C3. Ensure the sustainable use of forest resources 131

Works Cited



Section I:

Executive Summary

From the State Forester

This update of Virginia's State Forest Action Plan could not come at a better time. Trees and forests are gaining recognition for their essential role in the health and resilience of the environment, but also for their influence on our human health. Trees and forests are the answer, and the questions are becoming more urgent every day. Healthy and abundant forests are necessary to provide the raw material for Virginia's third largest industry. Growing trees and utilizing the wood from them provides the most sustainable way to reduce atmospheric carbon. Forests are the best landcover for protecting and restoring our water supplies. Forests provide the habitat to sustain imperiled plant and animal species. In developed areas, trees and urban forests improve our quality of life by reducing the heat island effect, filtering pollutants from the air, and improving mental health.

Our forests, and their ability to provide all these benefits, are increasingly threatened by introduced pests and diseases; climate change and more extreme weather; increasing fragmentation of forest cover and conversion of forests for development. At the same time, the forest industry and global markets are undergoing fundamental shifts that can undermine investment in forest ownership and management.

Virginia's forestland is largely owned by private individuals and entities and while they have many reasons for owning forest, the ability to derive income from the forest is a critical factor when decisions are made about continued forest ownership or investments in forest management. Much of the benefit society derives from the forest depends on the ongoing investment of private forest landowners. We must ensure that forest landowners have the tools and strategies necessary to practice sustainable forest management. Acknowledging the environmental services provided by the forest means that these services can be valued, and landowners can be compensated for them and encouraged to manage their forest to provide even greater value to society. With the successful collaboration between the state, the industry and landowners, we have shown that our forests can be managed sustainably for forest products as well as these other environmental values.

This State Forest Action Plan describes the critical issues facing the forest resources of Virginia and lays out the actions and initiatives necessary to address them. I encourage anyone who is interested in the forest of Virginia to read through this document to gain a better understanding of the issues they are facing. We are dependent on trees and forests for our continued health and the continued health of the forest is now dependent on us for thoughtful interventions and sustainable management.



The Virginia Department of Forestry, along with our partners in Virginia, and with the support of the US Forest Service, are committed to growing and sustaining our forest resources. Thanks to Bryant Bays, eastern regional forester, for his leadership in drafting this excellent plan which will help guide all of our efforts and communicate the importance of our work on behalf of the forest.

– Rob Farrell, State Forester of Virginia



Overview

Beginning in 2007, the US Forest Service (USFS) and the National Association of State Foresters (NASF) cooperatively embarked on establishing fundamental changes to their process of delivering services and programs within the individual states. The purpose of this “Redesign of State and Private Forestry” (S&PF) was to shape and influence the use of forestland to optimize the benefits from trees and forests for both current and future generations. This Redesign was codified into law through the 2008 Farm Bill. The 2014 and 2018 Farm Bills continued and reinforced these changes, which have now become operational within the USFS and the states through the Cooperative Forestry Program.

In addition to setting the three national priorities in law, each state is required to complete a comprehensive, statewide assessment of the forest resource and any potential threats to that resource. The first forest assessment of Virginia was completed in 2010 and was updated in 2015. This 2020 plan builds on the original plan and brings it up to date to reflect the current issues across the Commonwealth of Virginia. Both the Redesign effort and the state assessments continue to be focused on three consensus-developed S&PF national themes:

- ◆ **Protect forests from threats**
- ◆ **Enhance public benefits from trees and forests**
- ◆ **Conserve and manage working forest landscapes for multiple values and uses**

The comprehensive statewide assessment will be used to ensure scarce S&PF resources are focused on high-priority projects and areas with the greatest opportunity to provide meaningful outcomes. The plan will also provide a valuable opportunity to demonstrate the full scale of resources needed to address the identified priorities, both within a state and across a region, where appropriate.

Virginia recently completed an internal strategic plan for the agency in 2019 using the feedback received from a wide variety of constituents including: forest industry, private forest landowners, state agencies, and nongovernmental organizations. This 2020 state assessment and strategic plan was created internally by VDOF staff using this same feedback within the framework of the S&PF national themes. This Assessment and Strategy document will be used to target program delivery and to develop competitive proposals for working on landscapes that are identified as priority areas and addressing the top issues within state forestry.

The layout of this revised assessment first identifies the trends and threats affecting Virginia’s forestlands, then highlights the key issues that are in line with the national themes, and concludes with descriptions of the VDOF programs that are working to address the identified issues.

After approval of the Assessment and Strategy documents and implementation of the identified strategies, an Annual Report on Use of Funds will be produced. This periodic document will describe how S&PF funds were used to address the assessment and strategies, including the leveraging of funding and resources through partnerships, for any given fiscal year.

Note: For the purposes of this assessment, references to fiscal year (FY) are for the Virginia state fiscal year of June-July, unless otherwise indicated.



Virginia's Forest Trends, Conditions and Threats Summary

Several important changes, trends, and threats in Virginia are likely to significantly impact the health, quality, and extent of Virginia's forests in the foreseeable future.

Trends:

- ◆ Population growth and expanding metropolitan areas
- ◆ Changes in forest ownership
- ◆ Rising forest volumes
- ◆ Positive growth/drain ratio for hardwood and softwood forests
- ◆ Consistent timber harvest numbers and application of water quality Best Management Practices

Threats:

- ◆ Wildland fire and growing wildland urban interface
- ◆ Declining diminished tree species
- ◆ Declining hardwood resource
- ◆ Forestland fragmentation and conversion
- ◆ Forest health issues
- ◆ Changing forest industry
- ◆ Climate change
- ◆ Funding of conservation work and programs

These trends and threats will increase the need for: innovative and proactive wildfire prevention and suppression; water quality protection; forest stewardship; forest health management; and urban forestry efforts in all areas of the Commonwealth.

Section III gives a detailed analysis of all trends, conditions, and threats that affect Virginia's forests.

Nine Critical Issues Impacting Virginia's Forests

Using input received from a wide variety of sources and analysis of the trends and threats affecting Virginia's forest, nine primary issues were identified. These primary issues are organized by National Theme below.

A. National Theme – Protect Forests from threats

1. Protect forestland and associated woodland home communities from fire
2. Protect forests from forest health threats and invasive species
3. Conserve and restore diminished species

B. National Theme – Enhance public benefits from trees and forests



1. Enhance the role of forests in maintaining water quantity and quality
2. Support the forest economy and diversified markets for forest landowners
3. Expand and improve urban and community forests

C. National Theme – Conserve and manage working forest landscapes for multiple values and uses

1. Keep forests as forest
2. Promote a larger, connected forest landscape
3. Ensure the sustainable use of forest resources

This report describes each issue and highlights opportunities for action in high-priority forest areas of the Commonwealth. These issues have helped inform the development of state goals and strategies which will be found in the companion VDOF Strategic Plan.

Additional issues were identified that were not just limited to the geography of Virginia. These multi-state issues include:

- ◆ Wildland fire prevention and suppression in the wildland-urban interface
- ◆ Restoration of the Chesapeake Bay
- ◆ Forest health issues, including southern pine beetle mitigation, spotted lanternfly control, and emerald ash borer management

Success dealing with most of these multi-jurisdictional issues will depend largely on federal-level funding and collaborative leadership.

Virginia Department of Forestry Programs

VDOF has a number of program areas, each generally focused on a specific aspect of forestry or a forest resource or specifically tied to a national-level program of the USFS. The organization of the programs is well-suited to respond to the ongoing issues identified in the plan. These program areas are administered at the agency headquarters level, with a majority of the projects and activities being conducted through our field staff assigned to the three operational regions. Six program areas are specifically tied to USFS program areas. These include:

- ◆ Wildfire Suppression, Prevention, and Public Safety
- ◆ Forest Health
- ◆ Forest Legacy and Land Conservation
- ◆ Forest Stewardship and Management
- ◆ Urban and Community Forestry
- ◆ Forest Inventory and Analysis (FIA)

In addition, other notable VDOF program areas include:

- ◆ Water Quality
- ◆ Forest Research
- ◆ Tree Improvement
- ◆ Forest Products Marketing and Utilization
- ◆ Ecosystem Services
- ◆ Conservation Education



- ◆ Tree Nursery Program
- ◆ State Forest System
- ◆ State-Owned Lands Program

Section VI, provides detailed overviews and program emphases for all VDOF programs.



Section II: Coordination with Other Plans

One requirement of the assessment is that it coordinate with and incorporate (where possible) other similar natural resource-related plans for the Commonwealth, notably any Community Wildfire Protection Plans (CWPP) and the State Wildlife Action Plan.

Community Wildfire Protection Plans

Population growth and expanding urban sprawl are likely to continue across many parts of Virginia. Additionally, changing climates, invasive species, forest health threats, and inability to conduct traditional forest management activities, will likely continue to change the frequency and severity of wildfires, particularly around the wildland urban interface. The best tool to help counties and communities mitigate these growing threats is through the development of community wildfire protection plans that identify local threats and take steps towards mitigating them. VDOF fire specialists and forest technicians are tasked with working with communities to develop these plans and educate communities about the dangers of wildfire.

Virginia develops CWPPs at one of three levels, based on the local interest and need. CWPPs are useful for bringing together key local stakeholders to specifically focus on both identifying priority areas for wildland fire hazard mitigation, as well as targeting specific mitigation activities in those priority areas to reduce the overall risk from wildfire.

County level plans help to better focus wildland fire prevention and mitigation efforts at the county level, which in turn helps to better facilitate local stakeholder involvement along more typical governmental service boundaries. County level plans are effective at focusing local resources on the prevention and mitigation efforts in key targeted communities in a particular area, yet county level plans typically lack the specific detail needed to complete fully integrated program mitigation activities at the individual community level.

Community level plans are Virginia's primary focus. Community level plans concentrate planning efforts at the ground level to maximize the program's efficiency in mitigating wildfire hazard in individual communities. Virginia CWPPs are coordinated by agency mitigation specialists in coordination with local officials and community members. Figure 1 below provides an overview of the communities that have been assessed and shows the communities that still need an assessment. Of the more than 5,433 communities that have been assessed, approximately 500 communities now have CWPPs in place.



Virginia's Woodland Home Communities

5,433 Total Communities
3,781 Have Been Assessed (Blue)
1,652 Have Not Been Assessed (Red)

Of the 3,781 communities that have been assessed 506 have developed into Community Wildfire Protection Plans (Green Stars).

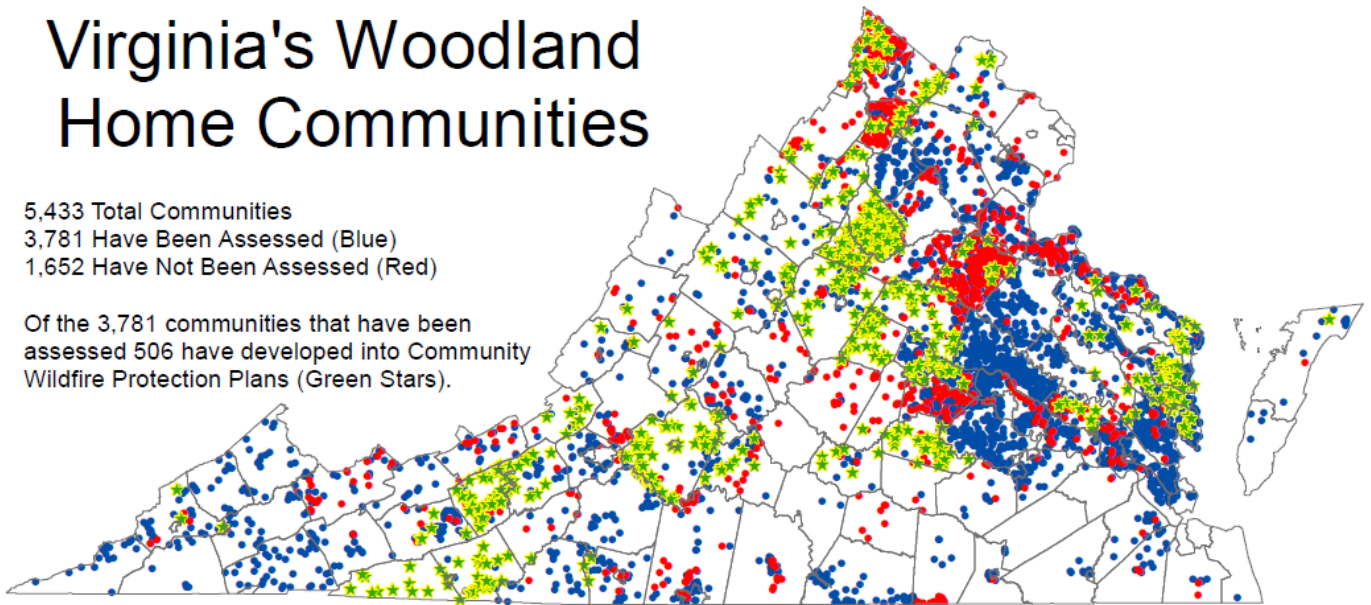


Figure 1. Virginia's Woodland Home Communities and Community Wildfire Protection Plans as of 2019.

Virginia Wildlife Action Plan

The 2015 Virginia Wildlife Action Plan was developed by the Virginia Department of Wildlife Resources (DWR) with input from a variety of stakeholders including VDOF. It is possible to view the entire document at this link: <http://bewildvirginia.org/wildlife-action-plan/>. It is organized geographically by Planning District Commissions (PDCs). Each PDC section includes area descriptions, issues, species of greatest need and concern and recommendations. The plan emphasizes habitat conservation as the best tool to conserve Virginia's wildlife.

The Wildlife Action plan has similar goals as are found in this plan including protection of riparian forests, improving hardwood forests and increasing hardwood regeneration, conserving forestland and reducing the fragmentation of large acreage forests, and actively managing forests with silviculture and prescribed fire.

In tract-based Forest Stewardship Planning, VDOF foresters utilize DWR databases and staff to address overall wildlife management and species of concern. Additionally, VDOF and DWR cooperate on bobwhite quail habitat restoration in focal landscapes through technical services to landowners and have worked together to establish, manage and conserve two diminished pine species – shortleaf and longleaf. Prescribed fire cooperation between both agencies is key to the continued application of fire to state lands, including those managed by each respective agency, and to the continuing development of staff skills and knowledge in using prescribed fire.



Stakeholder Groups Coordinated with for the Statewide Assessment and Strategy

From 2018 through 2020, VDOF has sought out a wide range of groups and stakeholders for engagement in this process and for the update of the VDOF agency strategic plan.

Groups and stakeholders include:

The Statewide Forest Stewardship Coordinating Committee – The committee discussed the plan and provided comments and suggestions for the plan update on March 27, 2019. Plan drafts were sent to the committee and members were given opportunity to provide feedback and direction during the plan development process.

Forest Legacy Committee – The Virginia Forest Legacy committee is a subcommittee of the Statewide Forest Stewardship Coordinating Committee with shared membership. Members of the Forest Legacy subcommittee and the VDOF Forest Legacy Coordinator were part of the input and information session discussed in the previous paragraph and was given opportunities for input on plan drafts. VDOF staff discussed Forest Legacy content with Mike Murphy, Region 8 USFS Forest Legacy Program manager on May 22, 2019 at New Kent Forestry Center, Providence Forge, Virginia. Direction from USFS that updating 2010 Forest Legacy Action Plan content in the same format was acceptable for the 2020 plan.

The Virginia Department of Wildlife Resources (State Wildlife Agency) – VDOF sought input on priority areas and assistance in tying the Virginia Wildlife Action Plan to the Forest Action Plan. VDOF staff reviewed the 2015 Wildlife Action Plan and input previously provided by DWR and used that information to support many of the critical forestry related issues that are identified in this plan, particularly in the areas of riparian forest protection, forestland conservation, and active forest management through silviculture and prescribed fire.

State Technical Committee – VDOF informed the committee of the assessment process, participation opportunities and timeline on June 27, 2019. Feedback regarding the assessment and new partners to contact during the public input session were discussed and the assessment draft was amended to incorporate the suggestions. Plan drafts were sent to the committee in early 2020 and members were given opportunity to provide feedback and direction.

Forest Industry Roundtable – On December 18, 2019, VDOF informed forest industry roundtable participants of the current progress on the forest action plan update and provided a summary of the assessment including identification of forestry related trends, threats and the primary issues that had been identified. Attendees of the roundtable were given the opportunity to receive a copy of the plan and provide comment. A copy of the plan draft was disseminated to members of forest industry and representatives of the Virginia Forestry Association.

Federal Land Management Agencies – All applicable federal land management agencies were contacted and multiple opportunities for input and information were provided. Specific agencies contacted included the National Park Service, USFS (George Washington and Jefferson National Forest) and US Fish and Wildlife Service. Additionally, outreach to the federally and state recognized tribes including Mattaponi, Pamunkey, Chickahominy, Eastern Chickahominy, Rappahannock, Upper Mattaponi, Nansemond, Monacan Indian Nation, Cheroenhaka (Nottoway), Nottoway of Virginia and Patowomeck was conducted and feedback included in the plan.

Military Installations – Virginia developed a Sentinel Landscapes application involving military installations across the Commonwealth in 2018-2020. Through this process a contact list of installation representatives and environmental staff was developed. These installation contacts,



representing the Army, Navy, Marine Corps, Air Force, and National Guard were contacted during the Forest Action plan update process, provided updates and plan drafts, and given opportunities for comment and feedback.

In addition, a multitude of stakeholders, including state and federal agencies, non-governmental organizations, forest products industry representatives, private citizens, elected officials, and others were provided opportunity for participation. Previous feedback received during the Virginia hardwood initiative, VDOF strategic plan update, and forest industry roundtables provided direction in the development of this plan.



Section III: Virginia Forest Trends, Conditions, and Threats

Forest Trends & Conditions

Population and Demographics

Virginia's population stands at more than 8.5 million, growing approximately 6.5 percent since 2010. The Commonwealth's population is projected to climb to nearly 10 million around the year 2040ⁱ. Two critical trends associated with this growth will have significant impact on the forestry resourceⁱⁱ

These trends are:

- ◆ **Expanding Metropolitan Areas** – The rate of people moving from metropolitan (metro) areas to surrounding suburbs and exurbs will increase and metro areas will continue to grow. Expanding metro areas include Northern Virginia, Greater Richmond, Winchester, Roanoke, and Hampton Roads. Growth is also expected to occur along the interstates connecting these metro areas. This will cause increasing urbanization leading to forestland conversion and fragmentationⁱⁱⁱ – not only for housing, but for roads, business areas, shopping venues, schools, recreational areas, and the other trappings of modern life. Conversely, populations in rural Virginia, particularly in counties along the North Carolina, Tennessee, and Kentucky state lines, have declined and are forecast to continue to decline.^{iv}

Metro areas are expanding across the Commonwealth, however, most of the largest areas of forestland fragmentation and conversion have occurred in the Central and Eastern portions of Virginia, as the land has less slope and is closer to major metro areas. Areas of less topography have experienced greater change to the distribution of forests as level and minimally sloping land are more available to be developedⁱⁱⁱ.

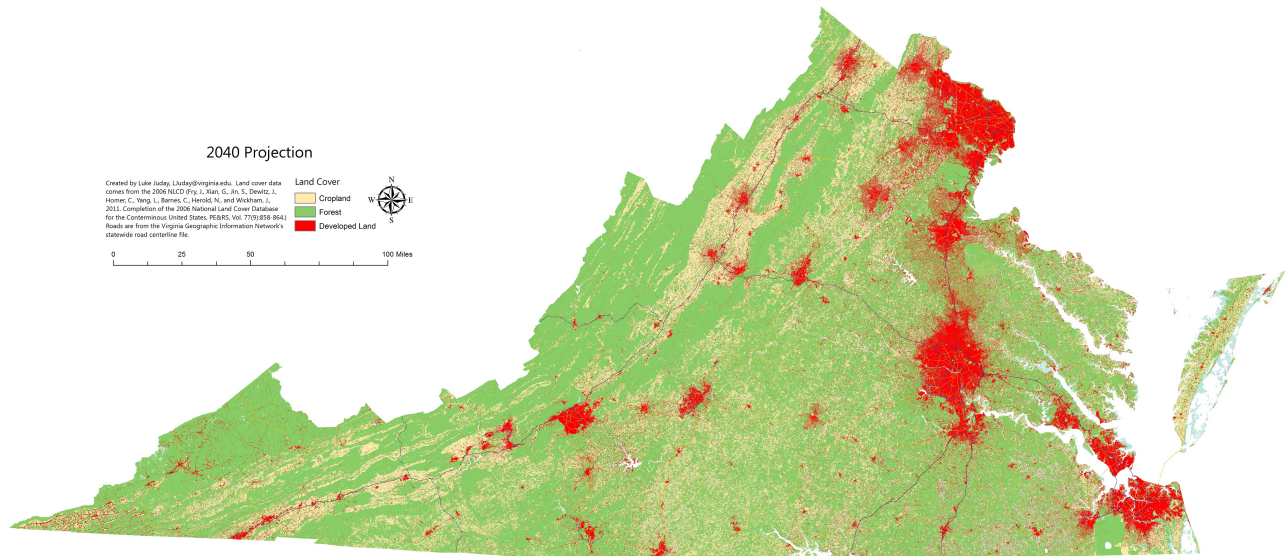


Figure 2. Projection of 2040 developed lands, shown in red.^v

- ◆ **Aging Population** – The average age of Virginia’s population continues to increase. By the year 2030, it’s expected that 19 percent of Virginians will be over age 65 (up from 12 percent in 2010), and a majority of this population will be female.^{vi} This population will likely have widely divergent views of what they want from their forestland, and the demand for services from the forest community will have to keep up with the increase in the number of landowners and the increasing diversity in services desired. Objectives for forestland ownership may begin to shift away from the traditional objectives of timber and hunting. Specific outreach to female forestland owners may be increasingly necessary.^{vii} Forestland owners 65 years and older own 41 percent of Virginia’s private forestland, placing more than four million acres at risk of conversion in the next decade.^{viii} Forestland will likely begin to be passed down to future generations, who often have different views on traditional forest management and ownership. Concern for the health of the environment, forest aesthetics, and desire for outdoor recreational spaces will likely increase.

Long term, we expect that individuals who are raised in suburban and urban environments will have less exposure to traditional forest management practices including timber harvests and prescribed burns. Typically, this leads to a lower acceptance and understanding of active forest management from the general population.



PERCENTAGE OF POPULATION OVER 65 YEARS

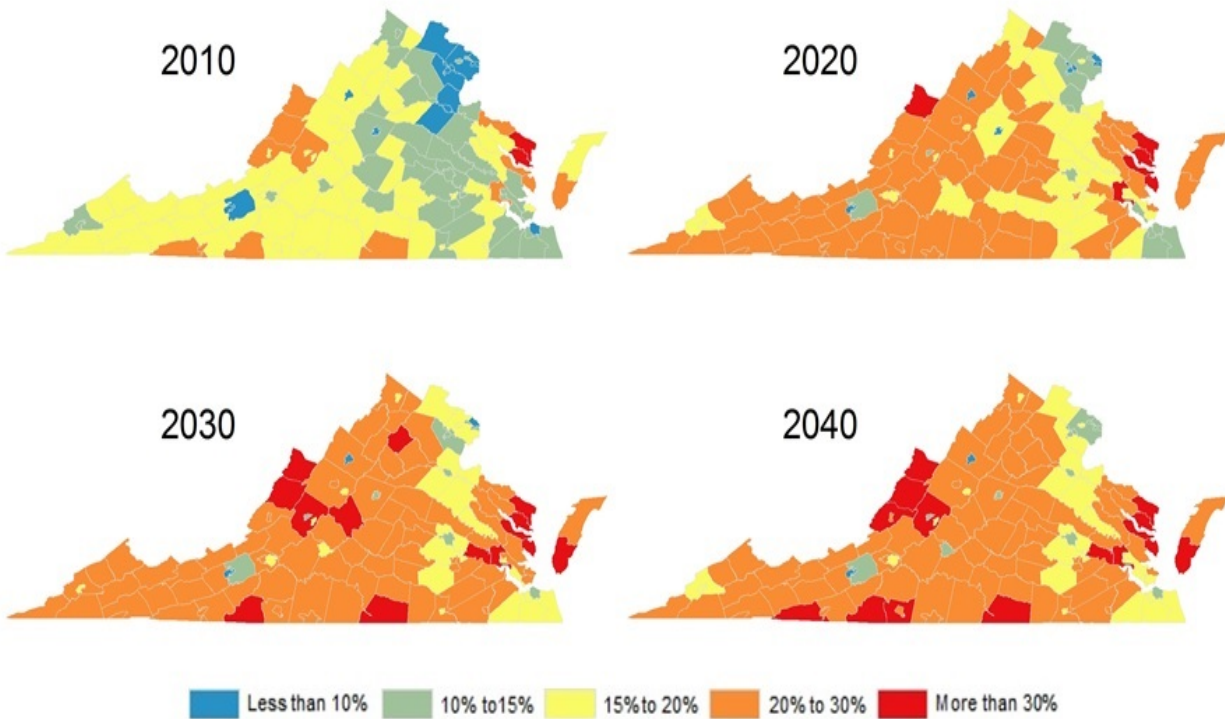


Figure 3. Virginia population estimates projected over the next 20 years.^{ix}

Besides these special trends, the overall increase in population will increase demand for forest-related recreational opportunities, expand the need for both traditional and non-traditional wood products from Virginia’s forests, and will lead to more discussions over the proper use of forests and what activities should take place in the forests – both private and public.

Forested Land

In 2017, more than 16 million acres – more than 62 percent of the land area of the Commonwealth – qualified as forestland.^x Of this forestland, 15.5 million acres are categorized as commercial timberland and more than 500,000 acres are categorized as reserved forestland.

The majority of Virginia’s forests are hardwood, with approximately 12 million acres of hardwood of mixed hardwood-pine forest types. Of these hardwood forests, the oak-hickory forest type is dominant. These hardwood forests are mostly of natural origin, developed from seed, advanced regeneration, or coppice regeneration.

Forest Types	
Forestland Timber Types	Acres
Upland Hardwood	9,620,100
Lowland Hardwood	726,200
Oak-Pine	1,608,600
Natural Pine	1,069,300
Pine Plantation	2,262,500



Non-Stocked	101,400
Total Timberland	15,388,100
Reserved Forestland	565,000
Other Forestland (Unproductive)	107,000
Reserved Other Forestland (Unproductive)	6,100
Total Forestland	16,066,200

Figure 4. Forest types in Virginia by statewide acreage.

It would be hard to define a “typical” hardwood forest in Virginia due to composition variances caused by age, soils, slope, elevation, past disturbance, stand treatments, and site productivity. Forest Inventory and Analysis segmented Virginia into 43 specific forests types with over 118 tree species.

Glossary of Forest Inventory Terms

Forestland – Land at least 10 percent stocked by forest trees of any size, or formerly having such tree cover, and not currently developed for non-forest use. The minimum area considered for classification is one acre. Forested strips must be at least 120 feet wide.

Timberland – Forestland capable of producing 20 cubic feet of industrial wood per acre annually and not withdrawn from timber utilization.

Reserved Forestland – Forestland withdrawn from timber utilization by legislation or statute (e.g., National Park lands or designated Wilderness Areas).

Forest Ownership

Most of Virginia’s forestland (more than 13 million acres) is privately owned. More than 521,000 individuals and families hold a total of 9.8 million acres. These private holdings average less than 75 acres in size, but range from one acre to thousands of acres.

By 2017, ownership of forestland by forest products firms had declined to slightly more than one percent of the total (206,800 acres). This is a reduction from four percent in 2007 and 11 percent in 1992. Forest industry ownership dropped very rapidly in the past 15 years due to land sales to investors, timber management investment organizations (TIMO), real estate investment trusts (REITS) and private individuals. Harvesting and tree planting still occur on these properties, but there is more varied and some less-intensive management. TIMOs and REITs account for more than 300,000 acres of forestland divested by forest industry. These two categories of owners continue professional forest management on the properties in their holdings. However, the long-term trend is likely further subdivision and development of these lands.

The balance of Virginia’s forestlands (18 percent) is owned by federal, state and local governments – the largest entity being the USFS National Forest lands at 1.7 million acres.

With its 25 state forests, VDOF holds more than 69,000 acres of forestland. Virginia State Forests are managed in an environmentally responsible and socially beneficial manner and are certified under the Sustainable Forestry Initiative (SFI) 2015-2019 Forest Management Standard and the American Forest Foundation Tree Farm System.

Through the Virginia state-owned lands program, VDOF currently manages more than 18,000 acres of state-owned forested land in Virginia. VDOF, in cooperation with the Division of Engineering and Buildings, along with the state agencies and institutions owning timberland, are mandated to provide forestry services on state properties exclusive of those owned by the Virginia Department of Wildlife



Resources and the Virginia Department of Conservation and Recreation. Legislation establishes a Forest Management of State Lands Fund to receive revenue from timber sales and to pay for forest management work, such as site preparation, purchase and planting of seedlings, spray release, Best Management Practice installation and payment for VDOF services. The fund is applicable to both general fund and special fund properties. Timber sale revenues from special fund properties deposited to the departments or institutions owning these properties net of forest management expenses.

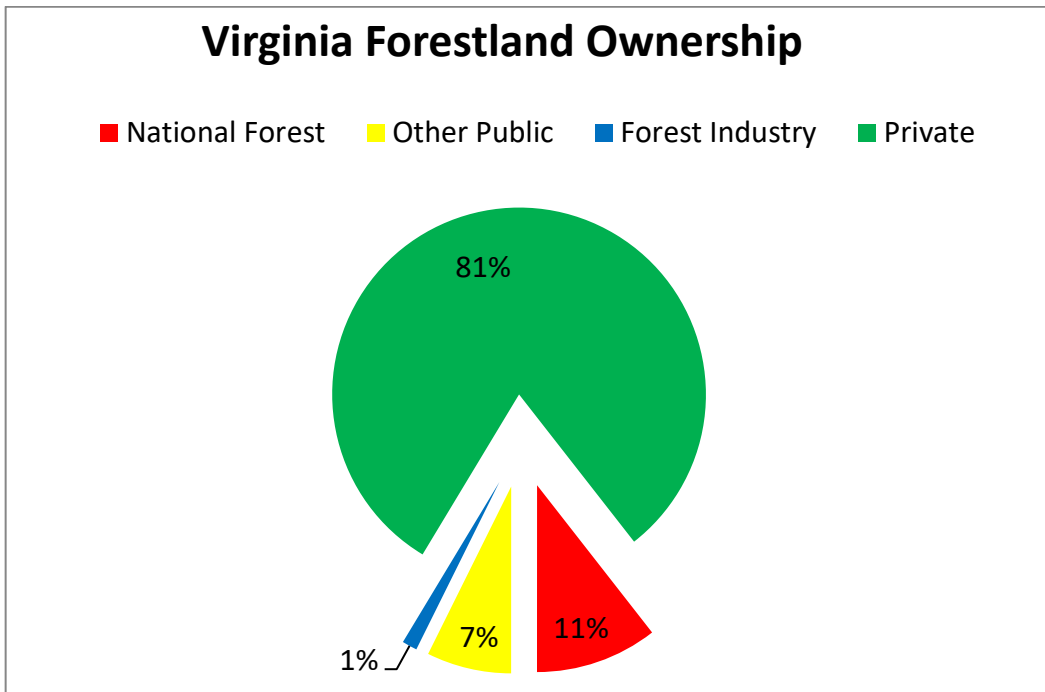


Figure 5. Breakdown of Virginia forestland owner by type of owner, 2017.

Forest Benefits

Each year, Virginia’s forests provide more than \$30 billion in economic benefits to the Commonwealth.^{xi} More than \$21.5 billion is generated by the forest products industry and related activities, including:

Forest Products Industry and Related Activities	
Forest Products Industry	Benefit
Production	\$771 million
Processing Core	\$6.56 billion
Processing Extended	\$3.22 billion
Distribution	\$869 million
Indirect Impacts	\$3.67 billion
Induced Impacts	\$6.49 billion

Figure 6. Benefits of forest products industry and related activities.



- ◆ 108,000 jobs in the forest products industry;
- ◆ Returning more than \$320 million annually to Virginia landowners for selling timber, and
- ◆ Specialty forest products, including such diverse items as maple syrup, pine tips for wreaths, fruits and nuts, pine cones and pine straw, mushrooms, ginseng, medicinal plants, firewood and more, add another \$60 million to local economies each year.

Forest and forest wildlife-related recreation in Virginia is enjoyed by more than 27 million people annually. These visitors contribute more than \$2.5 billion to state and local economies annually.

The future supply of merchantable wood volume appears secure, subject to the real possibility of continued significant loss and fragmentation of forested land. Figure 7 shows the continued upward trend in both pine and hardwood volume in the Commonwealth.

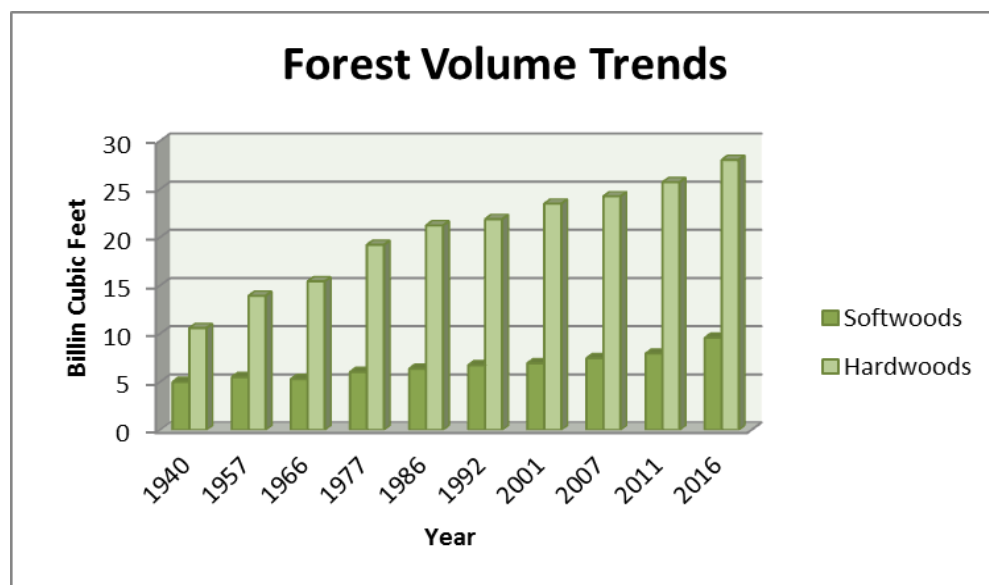


Figure 7. Forest volume trends by year and wood type.

In addition to the direct economic benefits, the extensive cover of forestland in Virginia provides its citizens with many valuable ecosystem services including:

- ◆ More than \$5.3 billion in annual protection of water quality – riparian forest buffers are the single best natural filter that can effectively remove pollutants like nitrogen and phosphorus nutrient load reductions from waterways.
- ◆ Protection of air quality – Virginia’s forests provide more than \$1.3 billion of air pollution abatement each year, based on conservative estimates of what it would cost to remove similar quantities of major pollutants through alternative means.
- ◆ Aesthetic quality.
- ◆ Moderation of climate, including the offsetting of carbon emissions that contribute to global warming.
- ◆ Provision of habitat and pollination for many plant and animal species.
- ◆ Sequestering more than 35 million tons of carbon annually.



These “non-market” services have been conservatively valued at more than \$6.5 billion annually.

Virginia’s Water Quality

Water quality is important to all Virginians. Studies have shown that the cleanest water comes from forested watersheds. These watersheds are critical sources of pure drinking water, wildlife and fisheries habitat^{xii} and areas that are treasured for their recreational value and purity of life. 60% of Virginia’s watersheds drain to the Chesapeake Bay. The remaining 40% of the watersheds comprise the southern watersheds, such as the Albemarle Sound Watersheds to the south and east, and the Upper Tennessee Watershed to the southwest, which includes the Clinch, Holston and Powell Rivers. All of these major watersheds contain impaired streams and the entire Chesapeake Bay is listed as an impaired water body. Impaired water bodies contain one or more contaminants than are allowed by state and federal water quality standards.

Increasing population, changes in land use, and more intensive use of the land are decreasing the forest cover within watershed drainages and adversely affecting the ability of forests to filter, slow, and store water. Impaired watersheds are present across Virginia and include the Chesapeake Bay. The Virginia Department of Environmental Quality has identified streambank restoration and establishment of forest riparian buffers as two possible steps to improve impaired waterways.

Distribution of Impaired* Watersheds in Virginia's Watersheds

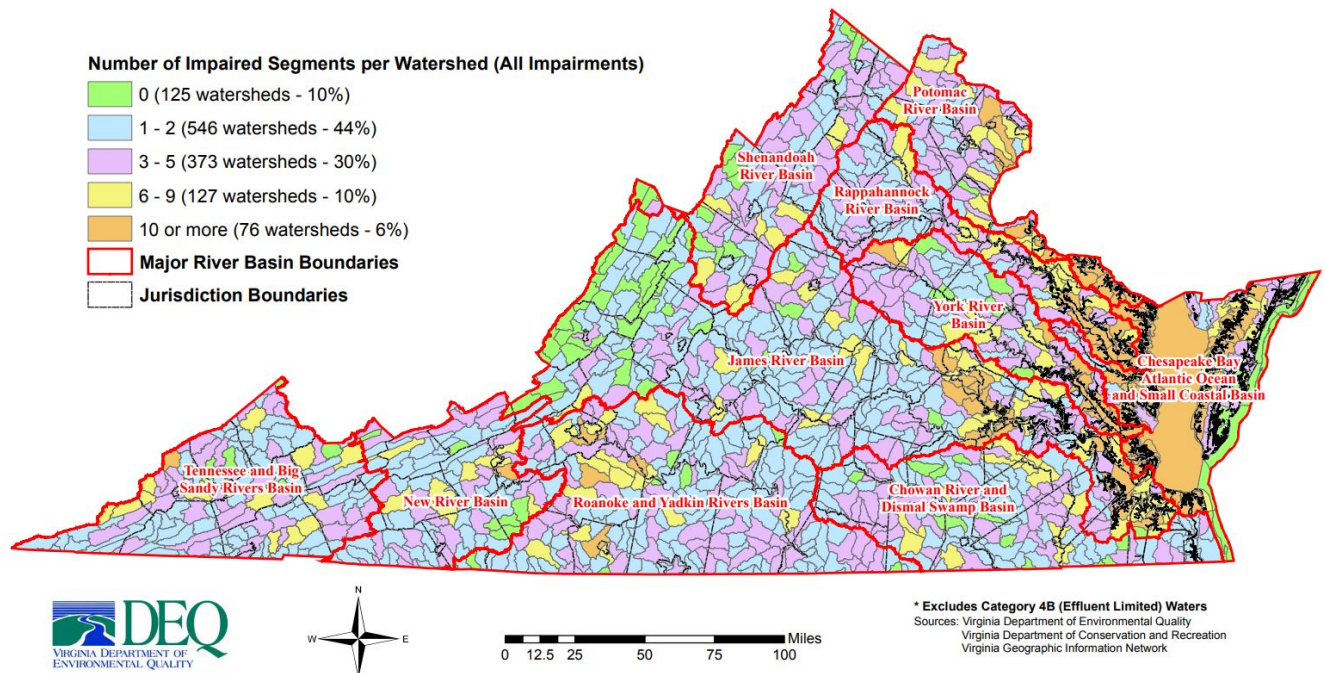


Figure 8. Distribution of impaired watersheds in Virginia per Virginia Department of Environmental Quality data^{xiii}.

Two of the ways VDOF works to ensure water quality protection are through promoting Best Management Practices (BMP) on forest harvesting operations to protect streams from sediment and improving and protecting watersheds through active forest management, riparian buffer establishment, and land conservation.



VDOF has been involved with the protection of our forested watersheds since the early 1970s with the development of our first set of BMPs for Water Quality. VDOF is now utilizing the fifth edition of those guidelines published in 2011 and has circulated copies of its latest version nationwide as well as to numerous countries worldwide. The backbone for VDOF's water quality effort is the harvest inspection program, which began in the mid-1980s. This program has provided for one-on-one contact between VDOF and the harvest operators and is a welcomed opportunity to educate the operators on BMPs and the latest in water quality protection techniques. In FY2019, VDOF field personnel inspected 4,004 timber harvest sites consisting of a total of 17,986 site visits (an average of 4.1 visits per site) across Virginia on 198,306 acres.

Timber Harvests in Virginia (2004-2018)

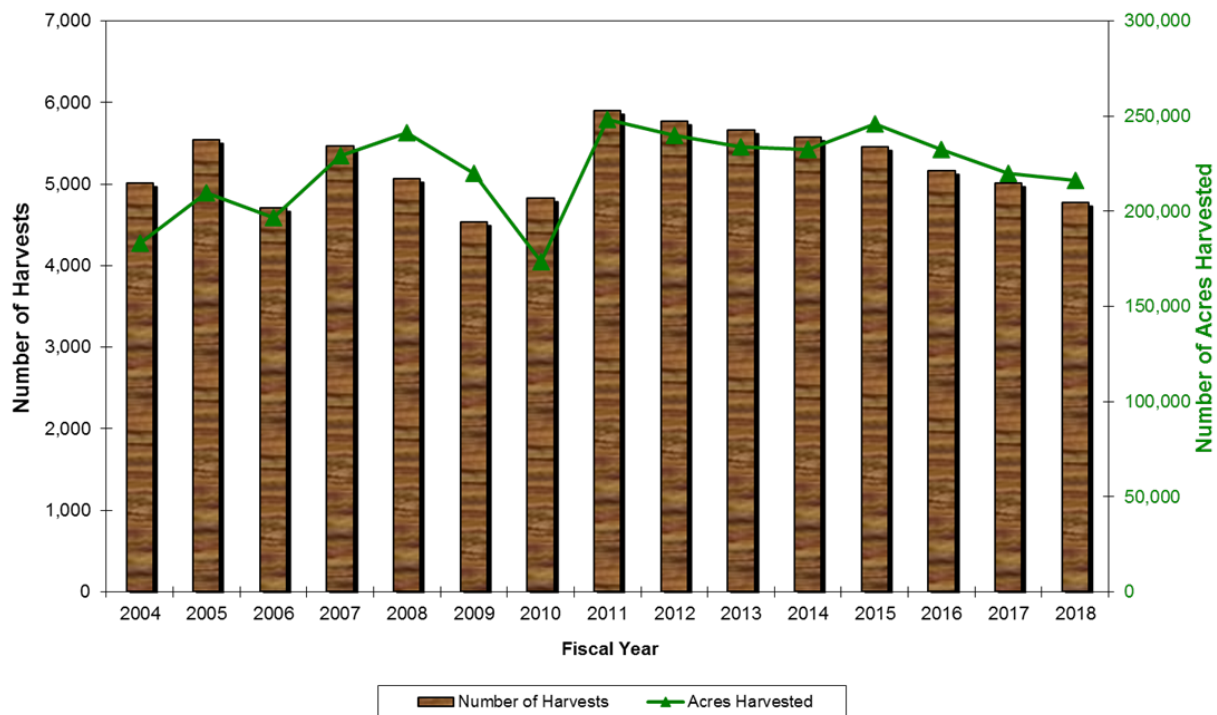


Figure 9. Overview of timber harvest figures in Virginia between 2004-2018.

In July 1993, the General Assembly of Virginia – with the support of the forest industry – enacted the Virginia Silvicultural Water Quality Law, § 10-1-1181.1 through § 10.1-1181.7. The law was created to provide Virginia with an enforcement mechanism to address water pollution originating from silvicultural activities. The law grants the authority to the State Forester to assess civil penalties to those owners and operators who fail to protect water quality on their operations. This law was amended by the General Assembly in 2009 to require inspection of timber harvest sites and to require timber operators to provide landowner contact information as part of the notification process. Virginia continues to be the only state in the southeastern US that grants enforcement authority under such a law to the state's forestry agency. In FY2018, VDOF was involved with 192 water quality actions initiated under the Silvicultural Water Quality Law. Of these actions, two resulted in special orders being issued for violations of the law. All penalties collected under this law



are placed in the Water Quality Penalty Fund, which is a non-reverting fund to be used for education, demonstration and research.

One of the most valuable BMPs for water quality is the uncut or partially cut streamside management zone. This voluntary measure assures an unbroken forest ground cover near the stream that provides shade for the water and wildlife corridors. Landowners can elect to receive a state tax credit for a portion of the value of the uncut trees in the buffer. By doing so, they agree to leave the buffer undisturbed for 15 years. 83 Virginia landowners elected to take this option in Tax Year 2018, an increase in number of applications over the previous year. This watershed protection option provided a tax credit of \$489,281 on timber valued at \$2,016,627 that was retained in the streamside areas across the Commonwealth.

VDOF continues to promote proper BMP implementation through training programs for harvesting contractors and through providing a BMP logger cost-share program. The BMP trainings cover a wide variety of water quality protection techniques including preharvest planning, map reading, GPS use, worksite safety, and BMP implementation. The cost share program, funded through Virginia's water quality improvement fund, provides a 50% match to contractors purchasing items that allow protect water quality including culverts and portable bridges.

A statewide audit system has been in place since 1993 to track trends in BMP implementation and effectiveness. Results from calendar year 2018 data show that the BMP harvest median implementation rate on 240 randomly selected tracts is 94 percent statewide; the harvest median score is the best judge of central tendency of the tract score. The audit results also showed that 99.17 percent of the sites visited had no active sedimentation present after the closeout of the operation. Audits over the period from 2015-2019 found that active sedimentation was found on an average of less than 1% of closed harvest sites.

Through the promotion of BMPs, enforcement of the Silvicultural Water Quality Law and our unique Logger BMP cost-share program, VDOF continues a proud history of ensuring the Commonwealth's forestlands provide the clean water that is so vital to our citizens.

Additionally, VDOF continues to be involved in several wetland initiatives related to bottomland hardwood sustainability and the wood pellet industry.

Watershed Protection

Forests provide the best protection for watersheds and the majority of Virginia's forests are privately owned. Because of this, one of the Commonwealth's and VDOF's goals is to increase the amount of forestland conserved, protected and established in Virginia's watersheds. The concept is to focus on tools and practices that will have a high benefit to water quality, specifically conserving land permanently, establishing and maintaining riparian buffer zones, planting trees on non-forested open land, and increasing urban forest canopy by planting trees. All of these activities are closely related to meeting water quality goals associated with the Chesapeake Bay restoration and watersheds for Virginia's southern rivers. It will be increasingly important to continue, and even increase these efforts as watersheds come under continued and increased developmental and conversion pressures while the demand for clean drinking water continues to go up. Within the Chesapeake Bay watershed, Watershed Implementation Plans (WIP) provides guidance and direction for work to clean the Bay. VDOF works with partners toward accomplishing WIP goals by promoting and increasing the implementation of riparian forest buffers and increasing urban tree canopies.

Approximately 47% of all Virginia surface water comes from non-federal forestland in Virginia with over half of the state's population using surface drinking water. Over 400 drinking water intakes are



present statewide that use at least some surface water that originated in non-federal forestland.^{xiv} Thus, it is particularly important to conserve and manage forests that protect Virginia’s drinking water supplies. Watersheds that are the most developed or likely to be develop are the priority areas to conserve healthy working forests. Healthy working forests provide safe, reliable drinking water. Conservation and stewardship of these forests can only be accomplished through partnerships with drinking water utilities, landowners and local governments. There also needs to be an increased awareness of good forestry and BMPs, as well compensation for forest landowners who retain and manage their forestlands to achieve healthy watersheds and clean water. The map below identifies forested Virginia watersheds and their importance to protecting surface drinking water.

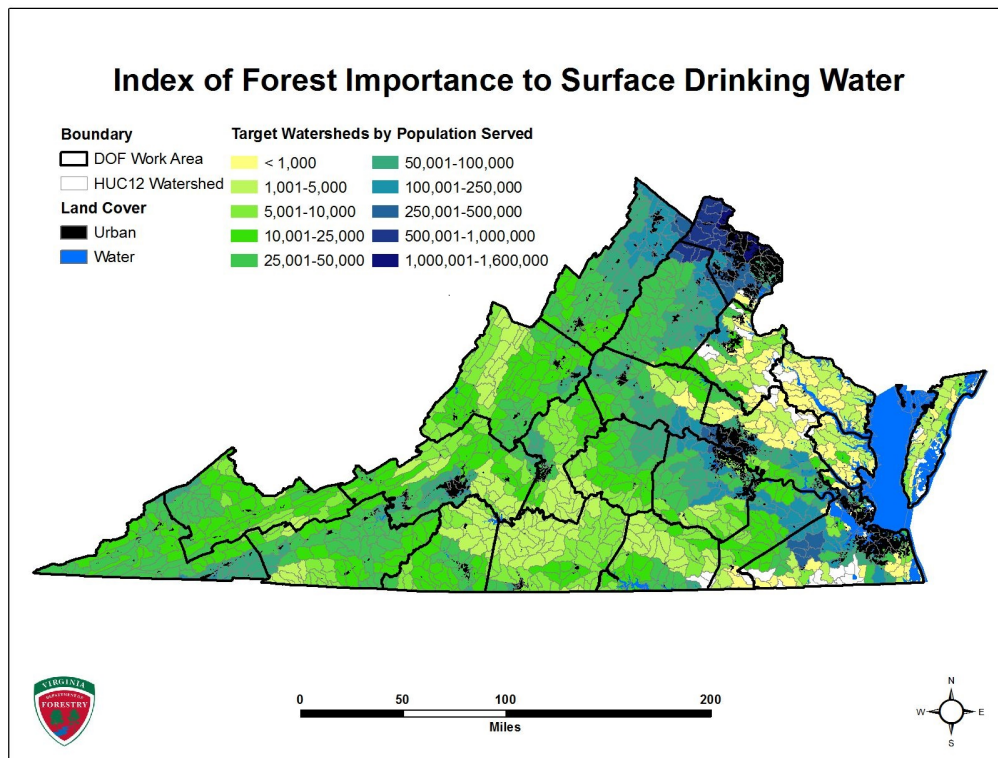


Figure 10. Index of forest importance to the contribution of drinking water by population served.

In 2019, VDOF launched the Forest and Drinking Water Forum in conjunction with the Southeast Partnership for Forests and Water. This initial engagement brought together water utilities, conservation organizations, government agencies, and forest landowners to identify opportunities to collaboratively strategize about the utilization and protection of Virginia’s forest resource that provides clean drinking water for all of the Commonwealth’s citizens.

Healthy Watersheds Forest Project

Since 2015, VDOF has partnered with other Chesapeake Bay jurisdictions and internally within Virginia with the Rappahannock River Basin Commission and other partners in leading a landscape-scale, Chesapeake Bay wide initiative called the Healthy Watershed Forest (HWF) project. The project has been funded throughout by the US Environmental Protection Agency (EPA) and the U.S Endowment for Forestry and Communities. The Virginia Environmental Endowment also contributed funding in Phase II.

The Rappahannock River Basin has been used as a proxy for the Chesapeake Bay Watershed through all three phases of the HWF project. In Phase I, Virginia successfully quantified that the value of



retaining more forestland to meet Chesapeake Bay TMDL nitrogen, phosphorus and sediment requirements could offset alternative TMDL management investments and thereby save private and public entities responsible for such investments, millions of dollars.

In phase II, Virginia partnered with multiple agencies in Pennsylvania, which peer reviewed and validated Virginia's phase I quantification methodology by applying it to a Pennsylvania watershed study area. Meanwhile, in Virginia, the project team engaged in more than 60 discussion and discovery sessions in the field during a year-long period to determine what is needed from the perspective of local leaders and private landowners to prioritize forestland retention as a land-use planning option to meet Chesapeake Bay Watershed goals. The project's Phase I and II findings contributed significantly to the December 2017 decision of the Chesapeake Bay Program management committee to credit forestland retention in the current version of the EPA TMDL model. In addition, the Virginia General Assembly in its 2018 session legislated some of the changes recommended by the localities in Phase II aimed at prioritizing forestland retention to meet water quality objectives.

Phase III, the project's final phase, began in 2018 and will end in June 2020. The goal of Phase III is to complete the successes of Phases I and II by addressing challenges associated with creating the policy and financial infrastructure needed to facilitate forest and agricultural land conservation/retention on a sustainable, Chesapeake Bay-wide basis. The ultimate goal has been: (1) to create a favorable regulatory environment and incentives for private landowner participation in land conservation; (2) contribute to the funding requirements of counties to help them meet basic services for their citizenry, and (3) do it through a model that can attract private sector financial interest at a scale required to achieve the Phase III goal. Two Rappahannock river basin localities (Fauquier and Essex) agreed to work with the project team to accomplish these goals.

Studies reviewed by the HWF/Phase III project team demonstrated that private investment capital wants to invest in forest conservation as an offset for environmental impact. Interviews with forest landowners within the pilot communities also found significant interest in accessing this investment capital as another income stream. The barrier is the scale mismatch. Institutional investors need a minimum project size of >\$50 million to be feasible. The key, therefore, has been to create a mechanism that can aggregate individual landowner interests and offer them at a scale large enough to attract private capital on a return on investment (ROI) basis.

Carbon credit markets were selected as the natural capital investment medium because they are readily available and accessible. To aggregate and facilitate forestland owner access to the carbon credit markets, the Virginia General Assembly, during its 2019 General Assembly session, amended the Commonwealth's Economic Development Authority Act to allow Economic Development Authorities to act as an aggregator for private landowner interests. The HWF project team is now currently working with local officials and technical experts to design and pilot this EDA mechanism.

Forest Management and Forest Stewardship

Forests provide a multitude of benefits to the Commonwealth and its citizens. These include: forest products; clean water; pure air; habitat for wildlife; outdoor recreation; natural classrooms; defense against environmental stresses, and settings for quality living. The value and quality of these benefits can be greatly enhanced through planning and implementation of good forest management practices. VDOF continues to strongly emphasize the need for long-range forest planning and silvicultural practice implementation in the agency's work plans and performance measures.

Planning provides the blueprint for future concrete implementation of practices. VDOF staff, landowners, contractors and other forestry professionals cooperate to put the plans into action. In



Virginia, plans are written for properties located throughout the state, from large to small, and in all landscapes, from rural to urban settings. All plans are designed to build healthy, valuable and productive forests. Forest management planning can also take the form of evaluating parts of a tract of land, making recommendations prior to a timber harvest, creating brief plans for use-value taxation qualification or outlining steps for a specific forest management practice. In a given year, foresters prepare nearly 3,500 plans covering more than 160,000 acres. A tangible outcome of this in the 2017-18 season was tree planting on more than 60,000 acres.

There are a number of programs designed to encourage and assist private landowners in implementation of these practices. In addition to planning assistance, state and federal programs help to offset landowner cost of doing the work. The flagship program for planting and improving pine forests is Virginia's Reforestation of Timberlands (RT) program. Since its inception in 1970, the program has been funded by a combination of a forest products tax on the wood-using industry and a portion of general fund tax money. The program has supported work on nearly 1.5 million acres.

Another essential part of any comprehensive forest management program is education and outreach to non-industrial private landowners. There have been countless presentations and field tours for landowners and other stakeholders, as well as general and technical assistance on an individual basis. The forestry community has strong, ongoing collaborations with universities and research cooperatives. VDOF enjoys a close partnership with the Virginia Cooperative Extension Service to utilize the best of both agencies' strengths to provide forest resource management programs for landowners.

Planning and professional advice prior to harvest is the key to successful resource management. Pine forests in Virginia have been very successfully and intensively managed through genetic improvement of seed, planting and intermediate stand treatments. Hardwood forests are more diverse, occupy a much larger acreage and have a longer growth cycle. These forests produce trees that are used for a wide range of products – from pallets and crossties to high-quality furniture and flooring. There remain many opportunities to improve management of hardwood forests through proper planning and appropriate management practices, and efforts are being made to do so. The largest effort is the Virginia Hardwood Initiative, which is focused on addressing significant biological, cultural, and sustainability challenges to the hardwood resource in the state. The goal of this initiative is to protect and create a healthy, valuable, and sustainable hardwood forest resource for multiple benefits through deliberate and strategic actions.

Several factors have and continue to impact the quality and species composition of Virginia's 10 million acres of hardwood forests. Hardwood markets are limited to sawmills in many areas of the state, which has led to years of selective harvesting and high grading. High graded forests, which face increasing numbers of invasive species, forest health issues, and fire exclusion, have significant species composition and quality issues. Limited advanced oak regeneration in the understory of oak forests, often a result of fire exclusion, invasive species, and deer overpopulation, points to future species composition changes in the future of Virginia's forests.

The Virginia hardwood initiative creates a strategy that addresses the best silvicultural practices to regenerate and grow hardwood forests, identifies the need for markets, addresses the transfer of technical knowledge to foresters and service providers, provides forest health strategies, acknowledges the importance of partnerships, and outlines the financial aspects of hardwood management.



Urban and Community Forestry

Trees and forests in communities provide numerous benefits to the citizens of Virginia. Aesthetic appeal, shade and contact with nature are the readily apparent benefits associated with community trees. Less apparent, but perhaps even more important, are the positive impact community forests have on clean air, water quality, business district enhancement, view-shed protection, community health and the quality of life in general. Through its Urban and Community Forestry (U&CF) program, VDOF helps Virginia communities maintain and enhance their community forests through project coordination, technical assistance, educational opportunities, and grants for specific projects.

Participation in the Tree City USA program has grown to 59 communities in Virginia as of 2019. Three Tree Line USA utilities and seven Tree Campus USA schools are recognized across the Commonwealth. More than 50 percent of Virginia residents live in a Tree City community, who have combined to spend more than \$26,800,000 on urban forestry management.^{xv}

Green infrastructure planning continues to be important across the Commonwealth as urban areas continue to spread. VDOF has formed strategic partnerships with the University of Virginia, Virginia Tech and the non-profit Green Infrastructure Center to engage Planning District Commissions (PDCs) in identifying critical forestland and stream corridors and developing strategies for protection. Through USFS and VDOF grants, 11 Virginia communities have received green infrastructure mapping and planning assistance from the Green Infrastructure Center.

Through funds from the USFS Chesapeake Watershed Forestry Program and Virginia Department of Conservation and Recreation Water Quality Improvement Funds, VDOF has developed the Virginia Trees for Clean Water program, which is designed to improve water quality across the Commonwealth through on-the-ground efforts to plant trees where they are needed most. Projects include tree planting activities of all types, including riparian buffer tree planting, community and neighborhood tree plantings and more. Grants are awarded through this program to encourage local government and citizen involvement in creating and supporting long-term and sustained canopy cover. Through 2019, this has resulted in more than 50,000 trees being planted and more than 18,000 volunteer hours logged across the state.

The U&CF program is working to increase state and local capacity due to low funding and staffing levels, particularly in small communities. Many communities outside of Virginia's largest metropolitan areas do not have access to trained urban foresters or horticulturalists. Targeted outreach to these communities, as well as training VDOF field staff to provide urban forestry technical expertise, is in progress. A select number of VDOF certified arborists are also trained as an Urban Forest Strike Team (UFST) and are available to assist communities with damaged urban trees during the recovery phase of a federally declared disaster. The team can provide rapid on-site evaluation of trees damaged during natural disasters.



Threats to Virginia's Forestland

The threats to Virginia's forestlands and resources are outlined below by National Conservation Priority Area.

National Priority: Protect forests from threats

Forest Health

Invasive species remain the most significant threat to forest health in Virginia. During the last century and most recently, our efforts to keep invasive species from entering North America and wreaking havoc represent a battle that we are largely losing. The pathogens that cause chestnut blight and Dutch elm disease have virtually eliminated the American chestnut and American elm, respectively, from our natural and urban forests. The pathogen that causes sudden oak death in western forests could potentially devastate Virginia's oaks and other species if introduced. Other pathogens that cause butternut canker, dogwood anthracnose and beech bark disease threaten those tree species with serious decline over longer time scales. Eastern hemlock and ash trees face the same threat from the hemlock woolly adelgid and the emerald ash borer (EAB) respectively.

Ever-increasing globalization and international trade activity have opened the floodgates for both purposeful and accidental introductions of invasive species to Virginia from all over the world. Every year, invasive species cause estimated economic losses for the US of more than \$2 billion in local government expenditures, \$1.5 billion in lost residential property values, \$1 billion in homeowner expenditures (e.g., tree removal and replacement), \$216 million in federal government expenditures, and \$150 million in losses to timber owners.^{xvi xvii} Purposeful introductions include: ornamental plants for gardens; erosion control; food for both livestock and people, and pets. Accidental introductions include "stowaways" in ship ballast water, in shipping crates, mixed in with seed from other parts of the world, and "hitchhiking" on travelers' clothes, luggage and vehicles. More recently, intrastate movement of firewood has been identified as a major vector for pests, such as EAB, gypsy moth and oak wilt, and it remains unregulated.

Invasive species spread aggressively and displace or destroy both native and commercially cultivated plants and animals. After development and habitat conversion, invasive species are considered to be the greatest threat to natural systems, agriculture and aquaculture. Invasive species damage and degrade crops, pasture and forestlands, clog waterways, spread human and livestock diseases, and destroy street trees. As international trade and travel continue to expand and increase, we face growing ecological and economic threats from invasive species to our farmlands, forests, rivers and streams, and quality of life.

All of this tree mortality in conjunction with trends towards increasing land parcelization and forest fragmentation serve to disturb intact forest and create ideal environments for invasive weeds. Many species of invasive weeds, including trees, shrubs, vines, grasses and forbs, plague Virginia's forests. Some of these plants were brought here by European colonists hundreds of years ago for urban and landscape plantings and erosion control. The characteristics most of these plants have in common are their ability for rapid growth and reproduction and their ability to colonize disturbed habitats, such as roadsides and forest edges. Once established, many invasive weeds are able to encroach upon intact forest and out-compete native plant species. Complete eradication of well-established invasive plants is all but impossible, and management is often impractical. Forests dominated by invasive weeds typically have less biodiversity, productivity, and natural beauty.



To change this disturbing trend, it will require bold, decisive and enforceable legislation at the federal level to ensure that no new organisms are introduced into North America via international travel or trade. Likewise, major restrictions on the movement of firewood, mulch and other unregulated or untreated goods between states must be in place to limit or slow the spread of newly established pests. Compliance must be enforced at all levels – anything less will continue to put Virginia’s forests at risk of catastrophic changes.

Wildland Fire

VDOF’s emphasis on fire management follows the National State and Private Forestry’s National Theme of Protecting Forests from Harm. Virginia’s Forest Action Plan specifically meshes with the National Cohesive Strategy in directing actions where the Commonwealth’s forestlands will be protected from damages resulting from wildfires. Virginia will be a national leader in the effort by: ensuring VDOF has adequate suppression equipment and radio communications to effectively interoperate with local, state and federal agencies; staffing the agency with sufficiently trained personnel; delivering appropriate fire prevention programming, and maintaining a staff trained in arson investigation and law enforcement that is prepared for the changing needs in wildfire protection and wildland urban interface (WUI). These goals align directly with VDOF’s mission to protect the forest resources.

Virginia’s growing population and expanding metro areas puts more of the population in contact with Virginia’s forests each year. Some of the major factors that contribute to Virginia’s wildfire threat include: increasing numbers of woodland home communities, native and invasive forest health threats, changing climates, and changing forest management regimes associated with new and changing ownership. Each year weather is a major factor in both the total acreage and number of fires that occur across the state. Over 95% of Virginia’s wildfires are caused by human actions.

Each year, the wildland firefighting efforts of VDOF protect more than 1,600 homes and other structures. These protected structures have a value in excess of \$155 million. Sadly, nearly 70 buildings of various types are damaged or destroyed by wildfires every year. As part of VDOF’s important legislative mandate to protect the homes, businesses and woodlands of the Commonwealth from wildfire, VDOF responds to nearly 800 wildland fires that burn more than 12,000 acres annually (based on a 10-year average between 2008 - 2017). Figure 17 shows the last 4.5 years of wildfires that required VDOF response.

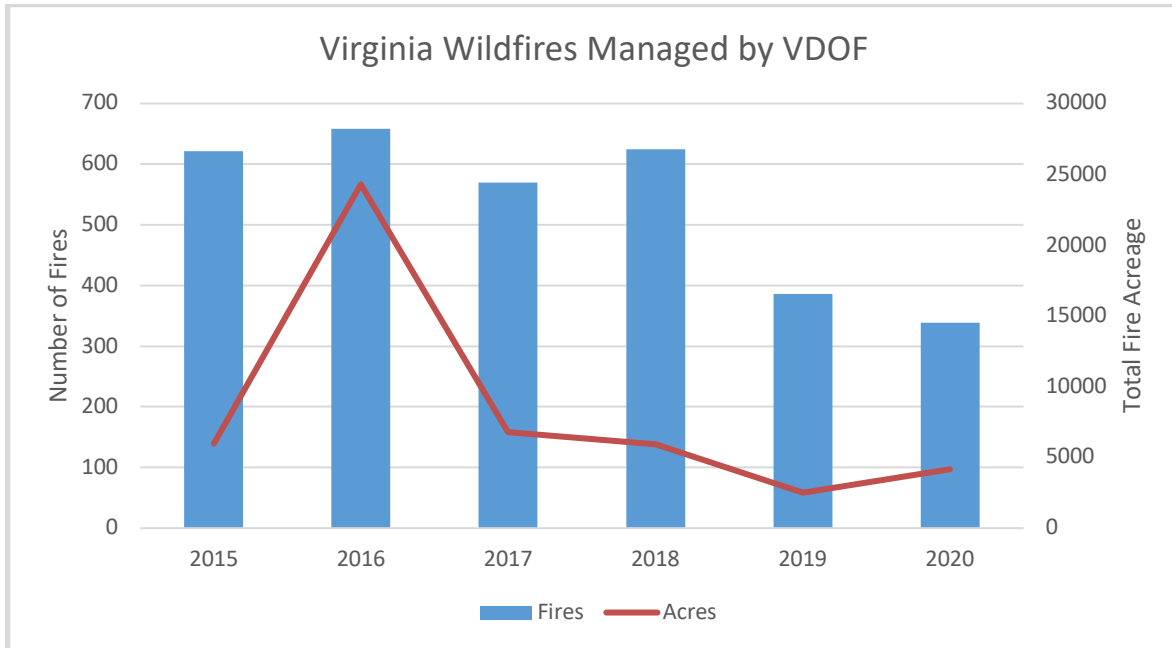


Figure 17. Wildfires and wildfire acreage on incidents managed by VDOF firefighters. 2020 data reflects partial year from January 2020 to September 2020.

One of the greatest impacts on the wildland fire environment in Virginia is the ever-increasing rate of home developments in the WUI. The rate of home development throughout the state has gone up at an increasing rate since VDOF began formal inventory of this trend in the early 1980s. WUI-related fire suppression requires greater numbers of suppression resources and a mix of more specialized equipment based on the need to protect residential homes at the same time as suppression activities are being completed on an uncontrolled wildfire. This situation leads to a higher personal risk for response personnel, increased fire sizes and greater potential for property loss.

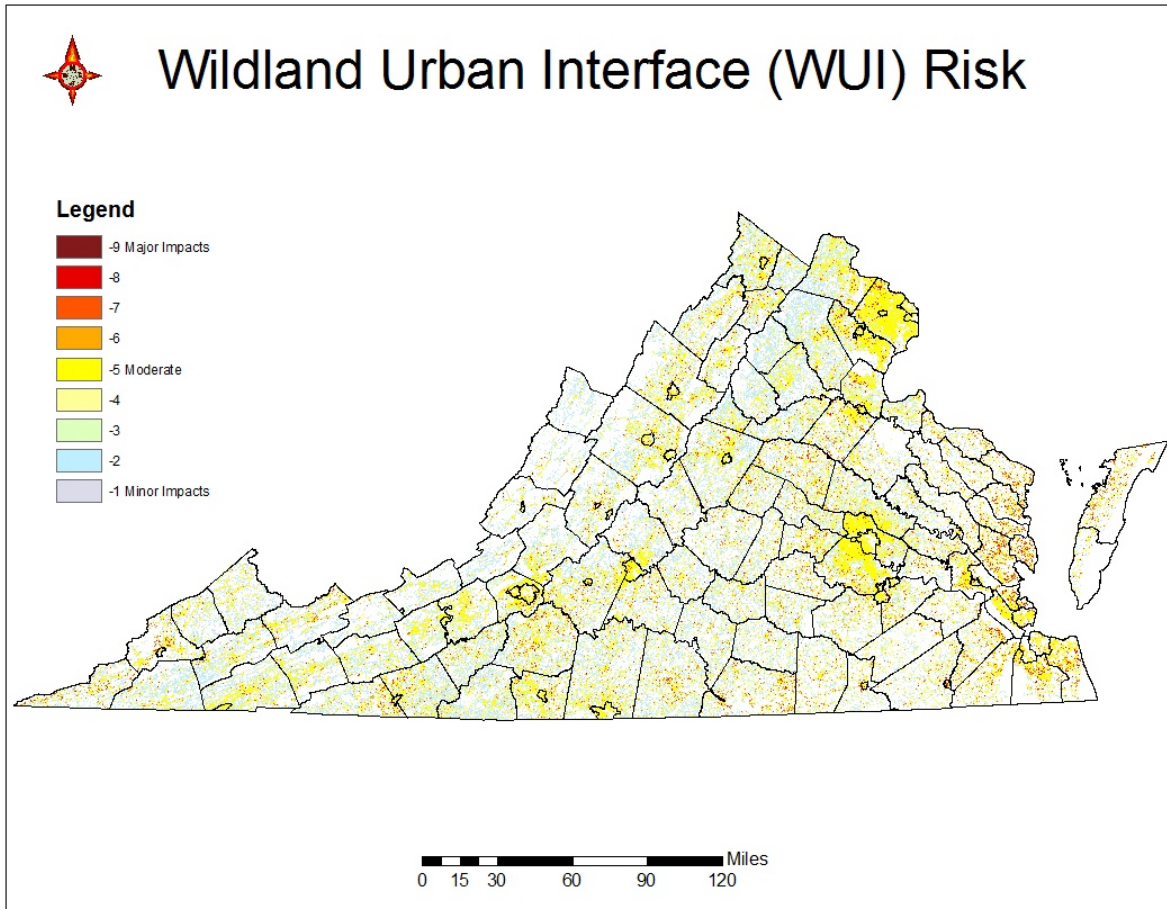


Figure 18. Virginia's highest risk wildland urban interface areas as delineated through Southern Wildfire Risk Assessment mapping.

One program to help respond to the increasing rate of WUI development is the national Firewise Communities USA program. The program identifies and works with high-risk woodland home communities to reduce the potential for damaging wildfire. Based on Southern Wildfire Risk Assessment information, the Commonwealth's highest risk woodland home communities are targeted for hazard mitigation activities, including Community Wildfire Protection Plans (CWPPs) designed to lower their overall fire risk. The program relies heavily on citizen involvement and is designed to give residents the information they need to come together for the improvement of their own community. The national Firewise Communities USA program then recognizes communities with the highest level of achievement. Virginia ranks as one of the top 10 states in the nation for number of Firewise USA communities, with 48 recognized communities as of December 31, 2019.

Diminished Species

Several important tree species and associated forest communities in Virginia have been, or are being, significantly reduced or eliminated over time. The causes vary, including: mortality due to native or introduced pests or pathogens; harvesting followed by replacement with alternative species, and changes in land-use patterns or priorities. These causal factors are ongoing, so it seems likely that additional species will continue to be negatively affected in the future. Their decline brings losses in biological, cultural and economic value. The most prominent examples of declining species include longleaf pine, American chestnut, and shortleaf pine.



Protecting and restoring Virginia's diminished species requires close coordination between VDOF, state agencies, and conservation partners. Of the many challenges that continue to emerge, funding, seed availability, and manpower characterize the majority of the challenges. In many parts of Virginia there continues to be low numbers of private contractors who are trained and willing to provide prescribed burn services to private landowners, which makes it difficult for small acreage private landowners to manage species like longleaf or shortleaf pine. Diminished species funding through a state quail initiative for shortleaf pine establishment and management recently ended after a successful number of years. The VDOF nursery has ramped up efforts to produce native Virginia longleaf seedling, but seedling availability continues to be a limiting factor for landowners seeking to establish Virginia longleaf pine on their property.

When European colonists came to Virginia in 1607, the uplands south of the James River were dominated by **longleaf pine** forests, which reached their northern range here. Covering between 1 million and 1.5 million acres in Virginia, this forest type stretched across 90 million acres of the southeastern coastal US. Maintained by frequent low-intensity fires, longleaf pine forests were extremely high in biological diversity and provided some of the most important resources needed by the early colonists in Virginia and as an early export. Over time, depleted seed stores, increased competition, fire prevention, and soil instability and seedling mortality due to feral pigs caused the longleaf forests of Virginia to decline. By 2000, longleaf had nearly disappeared, with only 150 to 200 mature longleaf trees left in Virginia. Cooperative efforts have reversed this trend, and the 2017 FIA results include 10,267 acres of longleaf seedling/sapling plantations. Efforts to establish new areas of native Virginia longleaf are limited by the amount of native seed that can be collected each year. Currently VDOF nurseries produce less than half of the target 500,000 longleaf seedlings each year due to lack of Virginia seed.

Prior to 1900, the **American chestnut** was present in the landscape from Maine to Alabama. In Virginia American chestnut grew in all but the far southeastern corner of the state. Trees were large and widespread, covering up to 40 percent of some forest types. The nuts were food for wildlife, livestock and humans. Farmers used the trees for lumber, firewood and split rail fences. In 1904, American chestnut trees were found dying in the New York City Zoological Garden from an unknown disease soon to be called the "chestnut blight." The disease apparently had entered this country on infected nursery stock and rapidly spread to surrounding states, including Virginia. Traveling at a rate of about 20 miles a year, the blight infected the last of the chestnut in the southern Appalachians by the early 1940s. By the 1950, overstory chestnuts were gone from Virginia forests. The losses were catastrophic, estimated at 25 percent of the total timber volume. Today, only widely scattered large trees can be found, and most are infected by the blight. Stump sprouts from blight-killed trees are very common; they live several years and then succumb to the blight, usually to be succeeded by other sprouts. VDOF began working on American Chestnut restoration in 1969, a work that continues to this day. The primary focus is crossing Chinese Chestnut and American Chestnut to create a blight resistant tree with the growth habits similar to American Chestnut.

Shortleaf pine has the widest range of any pine in the southeastern US (including almost all of Virginia) and is one of the four most important commercial conifers. Shortleaf was heavily used during settlement and development of the Commonwealth. The wood is straight and durable, particularly the heartwood found in older trees. Prior to European settlement, Virginia's forests were significantly affected by the use of fire by Native Americans. Shortleaf pine, with its moderately thick bark and ability to resprout following top-kill, allowed it to survive in this landscape. The land clearing, disturbance and abandonment regime associated with settlement was also favorable for shortleaf pine establishment. The areas with the highest concentration of shortleaf are in the southern Piedmont counties. While still present as scattered individuals or components of mixed stands, the conversion of many stands to loblolly pine has resulted in a dramatic decrease in the



number of acres of shortleaf pine – from 1.4 million acres in 1940 to just under 40,000 acres in 2017. Forest land fragmentation, conversion, and reduction of fire are contributing to the decrease of shortleaf occurrence.

Several other diminished tree species in Virginia are worth noting due to their unique niche in Virginia forest landscape. **Red spruce** is abundant in northeast Canada, but small pockets occur in the highest elevations of Virginia. Heavy harvesting, followed by burning in the late 1800s and early 1900s significantly reduced red spruce. If the climate warms, these remnant stands could be affected. An associate, **Fraser fir** occupies an even smaller range in southwest Virginia. Native populations are very small, but it is widely cultivated for Christmas trees in that area. **Table Mountain pine** occupies some of the most adverse dry and rocky ridges in the mountains. Dependent upon fire to open its cones, reduction in fire occurrence and bark beetle attacks may be affecting the overall population. Finally, **Atlantic white-cedar** hugs the coast in the mid-Atlantic region, most often occurring in bogs and on peat soils, which are somewhat uncommon in Virginia. Again, heavy harvesting more than 100 years ago severely reduced the abundance of this species, known for its durable wood. Restoration efforts are focused in the Great Dismal Swamp, although wildfires on the swamp have damaged much of the areas being restored.

National Priority: Enhance public benefits from trees and forests

Changing Forest Industry

Virginia's forest industry continues to adapt to changes in resources, the economy and world events that have affected the growth and decline of markets both domestically and internationally. Additionally, the near complete divestiture of forest industry land and forest industry consolidation will continue to create opportunities and challenges in the coming years.

The best news is that new businesses continue to come to Virginia, even as some have closed or changed owners. There is every indication that the forest industry will continue to increase beyond the \$21 billion annual economic contribution mark and provide 108,000 related jobs. As the economy continues to improve and we see both domestic and international markets for Virginia's forest products grow, we still need to be aware of challenges and issues that impact our forests and forest industries.

While some international markets are improving, the strong US dollar and weak economies in other countries continue to change product demands and where products go. Trade, tariff and phytosanitation issues are also affecting a number of international markets. Low energy prices, while beneficial to many, have had a significant impact on biomass energy and fuel use, which is a major market for low-quality wood and residues. On the domestic side, housing (a key indicator of wood demand) continues to recover more slowly than expected, leading to increasing volumes of pine sawtimber; at the same time, changes in demographics, forestland ownership, forestland loss and fragmentation, and changing product demands are increasing concerns on forest resource sustainability.

Based on the latest forest products tax data for FY2017, record harvest volumes overall were recorded in Virginia. Although most of the increase was due to the recent addition of mixed chips used mostly for bioenergy and fuel production, there was a general increase in harvest for all products. Other significant changes have to do with hardwood sawtimber, mostly due to increased exports to China. However, recent tariff and phytosanitation issues with the Chinese have reduced these exports significantly. The expanding distilled spirits industry has also created a large demand



for white oak sawtimber for barrel production. Other issues affecting forests and industry include lack of diverse markets, workforce availability, transportation/logistical constraints and the costs of doing business.

Active forest management on private and public lands is tied to the availability of markets and contractors to perform the management work. Rapidly changing markets make it difficult for landowners and foresters to complete management work that is necessary to maintain forest health, productivity, and income. Management becomes even more difficult in areas of the Commonwealth where forest products markets are very limited including the Eastern Shore and southwest Virginia. The result in many locations is that necessary forest management work does not get done or only the highest quality trees are harvested, which leads to forest degradation, stagnation, forest health issues, and forest land conversion to more intensive uses.

Urban Forest Management

As populations in urban areas continue to rise, proper urban forest management is critical to the health and well-being of citizens within the Commonwealth. Aging tree canopies, forest health problems, and increased development pose unique challenges when it comes to conserving and growing urban tree canopy coverage.

The growing presence of gray infrastructure has caused the urban heat island effect to become more of an issue across the Commonwealth. Populous areas with less tree canopy have been proven to be warmer than areas outside of a metropolitan area with more green space. Green infrastructure planning has begun to be used by Virginia municipalities to help combat urban heat island effect. Communities are more aware that large trees provide a number of other ecosystem benefits including flooding mitigation, air filtration, and stormwater management. Proper care and conservation of tree canopy is the only way to ensure urban areas reap the maximum benefits provided by trees.

The urban environment has not been immune to unwanted insects and disease, notably with the spread of Emerald Ash Borer beginning in 2008 and the 2018 arrival of Spotted Lanternfly to the Winchester area of Virginia. Emerald Ash borer is still spreading across the state and is likely to be present in every Virginia locality by 2030. Emerald ash borer has had a visible impact on urban trees across the state as highly visible street and park trees are killed and removed. Ash trees make up between 1-3% of the total tree population of the largest urban or suburban localities in Virginia. This represents a range of approximately 1-4% of the urban canopy^{viii}. Removal of dead and dying ash trees has worked against community efforts to expand urban tree canopies, increase riparian buffers to protect water quality, and to mitigate urban heat island effects. Since 2018, the Virginia Urban Wood Group has been working to assist localities with utilizing dead ash trees to reduce the amount of wood taken to landfills and has had early success in utilizing urban ash trees killed by Emerald Ash Borer. In addition to utilizing removed wood from ash trees, the Virginia Department of Forestry's Urban and Community forestry program has worked closely with municipalities to highlight treatment techniques and the importance of species selection and diversity. Diversifying the urban forest will mitigate future threats from insects and disease. Proper species selection and diversity of replacement stock is important to minimize the chances of future insect and disease outbreaks devastating our urban forests in the future.

Virginia is growing rapidly in both population size and in geographic area of metro areas, particularly in Hampton Roads, Northern Virginia, and Central Virginia. This growth has caused conversion of rural forestland to urban uses, often without open green spaces. Continued urban sprawl has led to increasing forestland fragmentation, canopy loss, and reduced urban ecosystem functions critical to maintain the health and wellbeing of Virginia's natural systems. Efforts to delineate urban tree



canopies and green infrastructure have been completed and are being used as the first step in prioritizing urban forests to conserve and enhance to restore important ecosystem services to Virginia's communities. Additionally, the Commonwealth is exploring how to expand local government authority to provide greater conservation of mature trees in the urban canopy that provide significant ecosystem services.

Climate Change

Climate Change will likely affect Virginia's forests during the next 10 years and could intensify many of the other threats and trends occurring in Virginia. Coastal Virginia is already dealing with sea level rise, continuing land abatement, saltwater intrusion, and its' effects on coastal forests.

Although the effects of climate change on the forest resource are somewhat unpredictable, Virginia and VDOF will need to monitor for, and develop appropriate responses to any identified impacts to the forest. The spread of invasive species will likely change as climates become more or less suitable across the Commonwealth requiring vigilance and tracking by VDOF foresters to manage for new invasions of nonnative species.

Species migration, particularly at high altitudes and for species at the southern edge of their range, is a real possibility. Inventory methods (notably the Forest Inventory Analysis) enable us to watch for overall changes in species dispersion and possibly conduct more detailed surveys if a potential problem is identified. VDOF will continue its efforts to restore shortleaf and longleaf pine to the landscape. Both of these species are drier-condition species that will fare better if some of the potential impacts of climate change are realized.

One of the most cost-effective and beneficial means to mitigate the effects of global warming is to increase tree planting and practice sound forest management. VDOF will continue to promote these practices, assist landowners with their implementation and educate the general public on the climate change benefits of forests and forest management. Additionally, VDOF initiated a Coastal Resilience program in 2019 to study the recent trends in Coastal Forestry and provide recommendations for management of urban and rural forests in the face of a changing climate. The first steps taken in the program have included adding riparian buffers to erodible shorelines on Virginia's Eastern Shore and studying the efficacy of conserving blocks of forestland to reduce coastal flooding around the City of Virginia Beach.

Steps to combat climate change are consistent with many of the VDOF programs and strategies already in place, including forestland conservation, protecting and increasing urban tree canopies, promoting forest health, and managing forests sustainably.

Conservation Education

Conservation education efforts remain a chronically under-funded and understaffed endeavor for most state agencies, and Virginia is no exception. With an increasing percentage of children having few, if any, ties to the natural world and our natural resources, it will be more important than ever to reach these future decision makers and give them an understanding of nature in general and forests in particular.

Tree Improvement

As the Commonwealth continues to experience the loss of forestland and society demands more and different benefits from forests, it will become more important to use the remaining forests in the most efficient and effective manner possible. One important way VDOF can help in this effort is to



continue and expand its pine tree improvement efforts. By producing seedlings that grow faster and produce more desirable characteristics, tree improvement work can help ensure a resource for the forest industry and support sustainable management and harvests of forests.

National Priority: Conserve and manage working forest landscapes for multiple values and uses

Forest Sustainability

To determine whether Virginia's private and public forests are healthy and are being managed sustainably, we can look at several indicators, including the growth-drain ratio, forest composition trends, loss of forestland, changes in forestland ownership and reforestation. The first of these (growth-drain ratio) is the ratio of the net growth versus the removal of forest volume due to harvesting and land conversion. The latest available forest inventory data indicate a net growth to removal ratio of 2.61 for hardwoods statewide. In other words, for every unit of hardwood removed, 2.61 units have grown to replace it. For softwoods (pine), the ratio is also positive: 2.31 statewide.

2012 inventory data suggested that softwood pulpwood-sized tree removals were exceeding growth of similar sized trees. In order to prevent this imbalance, VDOF developed a forest sustainability plan to improve forest management and production, created two pine sustainability forester positions (one each in Southside and South East Virginia), supported tree improvement research and fully funded the Reforestation of Timberlands (RT) program that provides financial assistance for tree planting and site preparation. The two pine specialists continue to promote good pine management practices, provide research data to VDOF foresters and landowners, and manage the RT program to ensure Virginia's pine resource continues to be managed sustainably in the face of changing markets and diversifying landowners.

On Virginia's state forests, VDOF models the ways that landowners can manage forests for multiple values. The state forest system receives no state general funds; instead, it supports its operations through timber sales, in much the same way a private forest owner does. Today, there are 25 state forests – biologically diverse, financially productive and sustainably managed. Forest certification is one option that VDOF models for landowners. Certification ensures that trees are harvested legally and responsibly. Some consumers prefer to purchase sustainably-sourced products, especially in global markets; so, certification can provide advantages for some forest owners. During FY2019, all forests in the state forest system achieved certification (69,288 acres) by both the Sustainable Forestry Initiative (SFI) and the American Tree Farm System (ATFS). Sustainable forest management ensures that the many benefits of forests will continue to exist in the future, ultimately benefitting all Virginians.

Loss of Forestland to Other Land-Use Types

Virginia experienced a continual loss of forestland until 2006, when the trend shifted and reversion rates exceeded diversion rates (likely related to the recession). Since 2013, reversion rates have begun to slow (for 2017, forestland losses exceeded gains once again) in Figure 11.

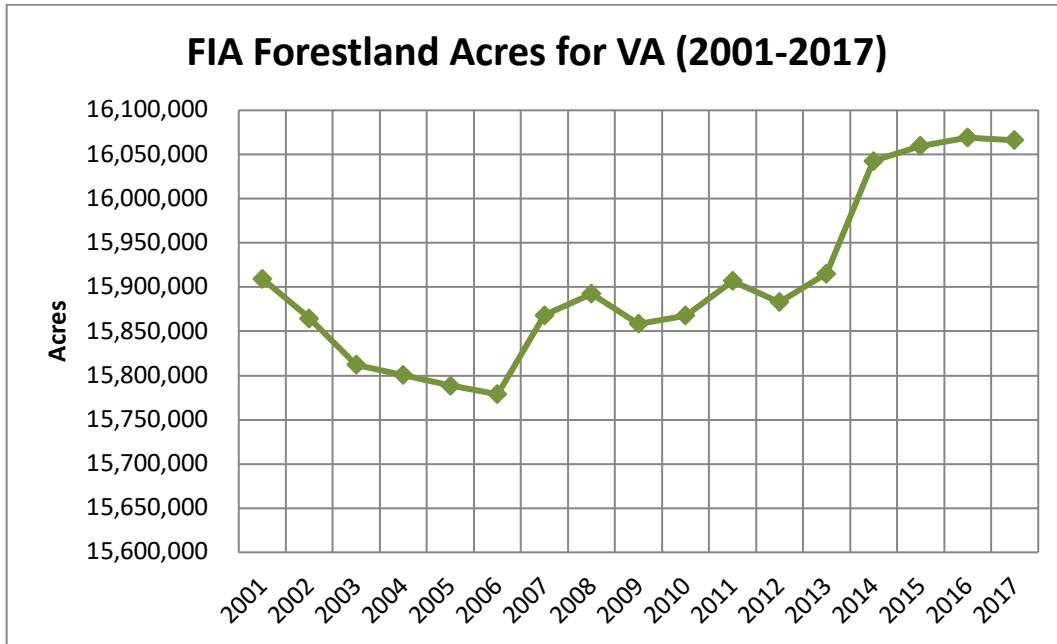


Figure 11: Forestland Acres in Virginia based on FIA data.

The continued decline of forestland acres in the early 2000s was driven by activities associated with Virginia’s expanding population and metropolitan areas across the state. The economic downturn in 2006-2008 greatly slowed development and conversion activities. As the economy has begun to recover, forestland acres begin to decrease once again due to development activities. Historically, Virginia gained forestland acres from 1940 (14.8 million acres) through the late 1970’s (15.9 million acres) due mostly to afforestation of idle croplands. The downward trend illustrated in Figure 11 began in the late 1980s to early 1990s.

The conversion of forestland to more intensive uses will reduce the ecosystem products and services provided by forests^{xix}. Not only will goods such as timber be removed but also the processes or systems that clean the air, store carbon, and filter drinking water will be affected, many of which are interconnected. Virginia’s forests are a key piece of the solution to improve water quality across the state and to improve the waters of the Chesapeake Bay. Beyond air and water quality, as forests are converted in portions of the state, there will be impacts to forest markets, ability to conduct active forest management, increasing invasive plant and animal species, and reduced wildlife habitat^{xx}.

Figure 12 provides the distribution of forestland by county as of 2016. Many of the counties shown in this map with 40 percent or more of the county being forestland are adjacent to the growing metropolitan areas discussed in the population trends section. Urban and suburban sprawl will affect the extent and health of these forests within the next ten years.

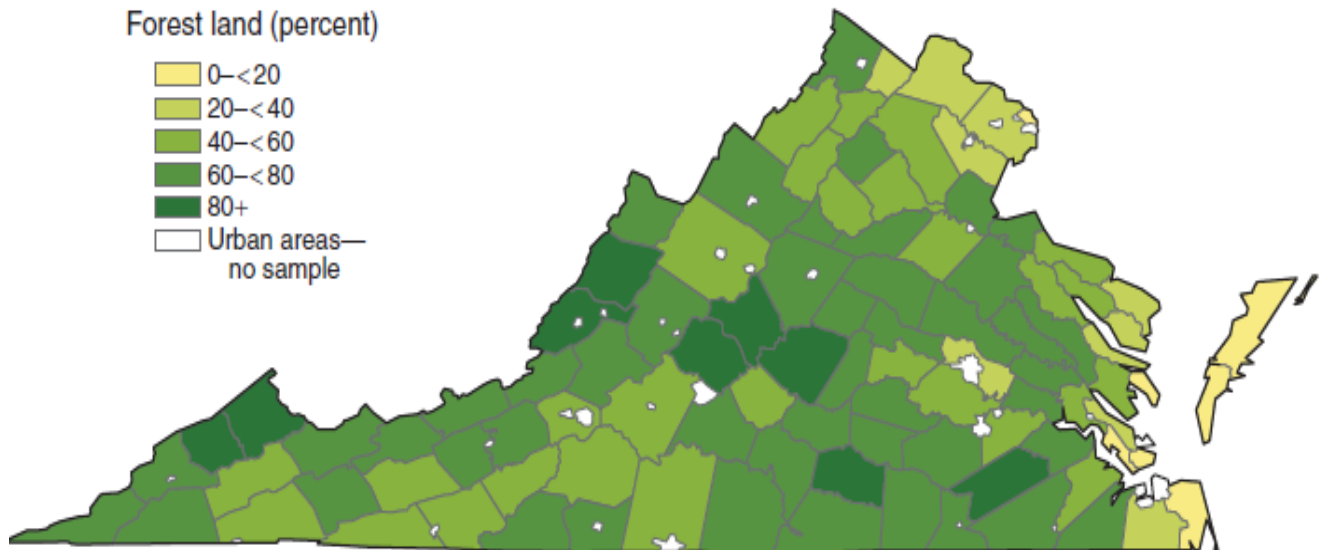


Figure 12. Distribution of forestland by county as of 2016.^{xxi}

Forest Composition^{xxii}

The forests of Virginia continue to display good diversity. Hardwood and hardwood-pine forest types make up more than 12 million acres of the Commonwealth's forest – more than 78 percent. The area of hardwood forest types has increased steadily since the first forest inventory in 1940, when 8.1 million acres existed.

Pine forests represent approximately 3.3 million acres (more than 21 percent) of Virginia's forestland. This is a decline from the 6.2 million acres of pine found during the 1940 inventory. Pine plantations now constitute more than 67 percent of the pine acreage. Plantations help offset the loss of natural pine acreage, due to their higher productivity when intensively managed. These productivity increases should continue in the future with the use of genetically improved seedlings from VDOF nurseries and other private sources.

A number of tree species have suffered significant decline over the latest inventory period, including: Table Mountain pine, pitch pine, shortleaf pine, and eastern hemlock (due to hemlock woolly adelgid infestation). Declines in ash, due to spreading emerald ash borer, are expected in future inventory updates.

Concerns also exist with the future makeup of the hardwood resource. The hardwood forests of Virginia are maturing, with more than 5.7 million acres in stands 70 years old or older. As the upland oaks continue to age and decline, the current scarcity of oak regeneration will result in fewer oaks and increasing maple, beech and gum dominated forests. Contributing factors leading to the decline of Virginia's oaks include: the exclusion of fire, lack of proper management, forest health issues, land use changes and scarcity of oak regeneration. In its place, shade-tolerant regeneration – such as red maple and blackgum – is becoming more prevalent. Figures 13 and 14 show the top 10 Virginia trees in terms of number of trees and total wood volume.



Most Common Tree Species by Volume	
Species	Total Cubic Feet
loblolly pine	6,648,983,896
yellow-poplar	6,592,050,623
chestnut oak	3,640,177,992
white oak	3,388,106,959
red maple	2,567,572,099
northern red oak	1,971,827,362
sweetgum	1,343,887,392
Virginia pine	1,319,110,958
scarlet oak	1,186,094,933
eastern white pine	1,053,328,815

Figure 13. Ten most common tree species in Virginia by total volume.

Most Common Tree Species by Number of Trees	
Species	Total Stems
red maple	1,396,133,001
loblolly pine	1,238,278,943
yellow-poplar	927,430,358
sweetgum	811,552,516
blackgum	613,824,492
American holly	565,263,384
Virginia pine	441,567,841
white oak	390,938,640
chestnut oak	313,926,789
American hornbeam	306,866,195

Figure 14. Ten most common tree species in Virginia by total number of trees.

Reforestation

Virginia has a strong history of tree planting that has been fostered over time. From Thomas Jefferson’s experimental tree planting at Monticello to conservation planting during the depression, from large-scale industrial forestry in the mid-20th century to scientifically proven techniques today, tree planting has been a tradition in the Old Dominion. Figure 15 below graphically displays trends in tree planting, which reflect the circumstances of economics, support, policy and demand. Due to ease of propagation, transplanting and good survival, pine planting (loblolly and, to a lesser degree, white) is dominant.



Early efforts focused on rehabilitating abused agricultural land through the Civilian Conservation Corps in the 1930s and the USDA Soil Bank Program of the 1950s. The paper industry and resulting demand for wood grew following World War II and resulted in large-scale mechanical site preparation and replanting of cutover woodland. Additionally, the Seed Tree Law was enacted in 1950. It requires either replanting or leaving pine seed trees. Planting on private, non-industrial lands took a monumental leap in 1970, with the enactment of the RT Program. Funded through a forest products tax (self-imposed by the forest industry) and general state tax funds, the program has provided cost incentives to landowners for site preparation, pine planting and release from competition, with more than 1.9 million acres assisted under the program through 2019.

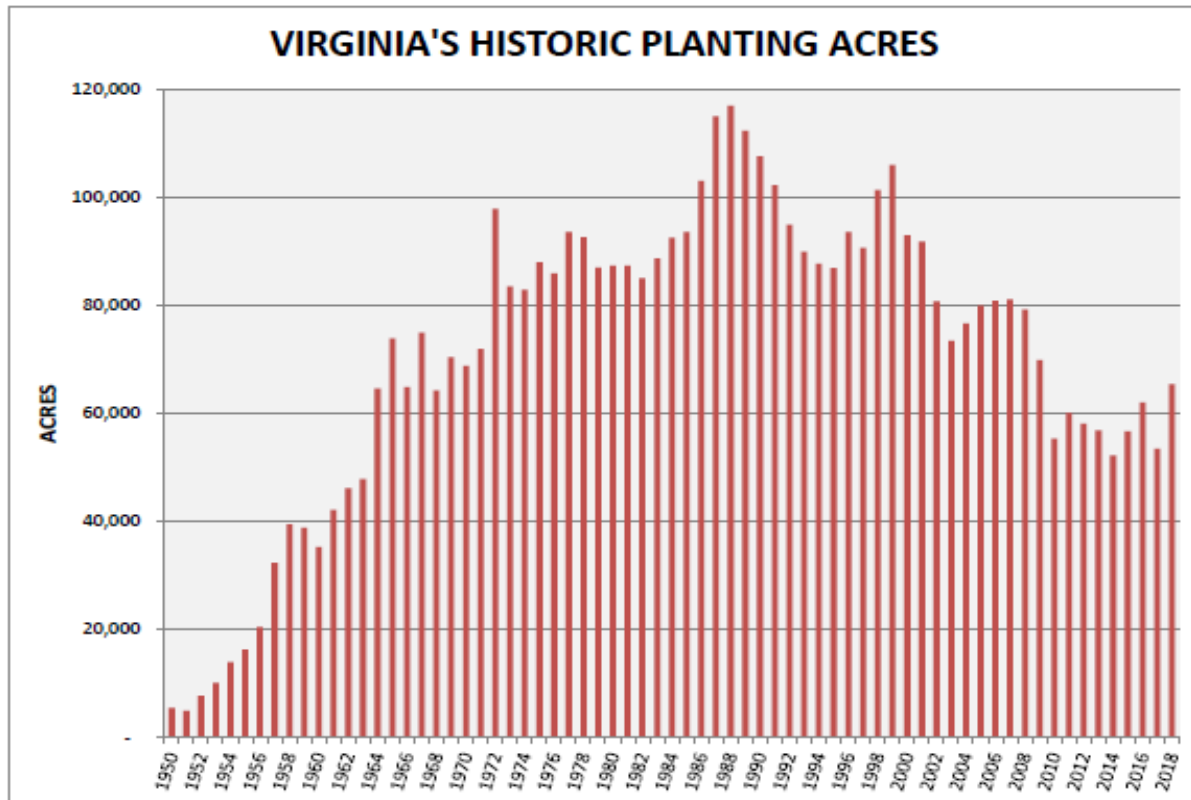


Figure 15. History of tree planting in Virginia by acreage from 1950-2018.

Tree planting increased with the growth of the RT program, the federal Forestry Incentives Program and a strong forest products industry. A significant surge in planting occurred in the late 1980s, due to the USDA Conservation Reserve Program – a program to retire highly erodible land. Combined with a strong timber economy, reforestation peaked in 1988 at 116,000 acres. The severe national economic downturn, beginning in 2008, softened wood demand, resulting in lower harvest and replanting acres. Planting has recovered and stabilized, but it is below previous high levels.

Hardwood tree planting increased somewhat in the late 1980s, due primarily to industrial plantations in southeast Virginia. There was also a spike in hardwood planting, beginning in 1999, due to riparian forest buffer planting through the USDA Conservation Reserve Enhancement Program.

Tree nursery production is directly related to planting and has expanded and contracted with these trends. At the height of tree planting activity, three VDOF and two forest industry nurseries were in



operation. Production at VDOF nurseries was 59 million seedlings in 2000. Currently, there are two state nurseries, with an anticipated 2020 production of 32 million seedlings. While much of this is due to fewer acres planted, seedling density has been reduced over the years as well from more than 800 trees per acre to less than 500 trees per acre. White pine production and planting has dropped as well, from a high of six million seedlings to less than one million.

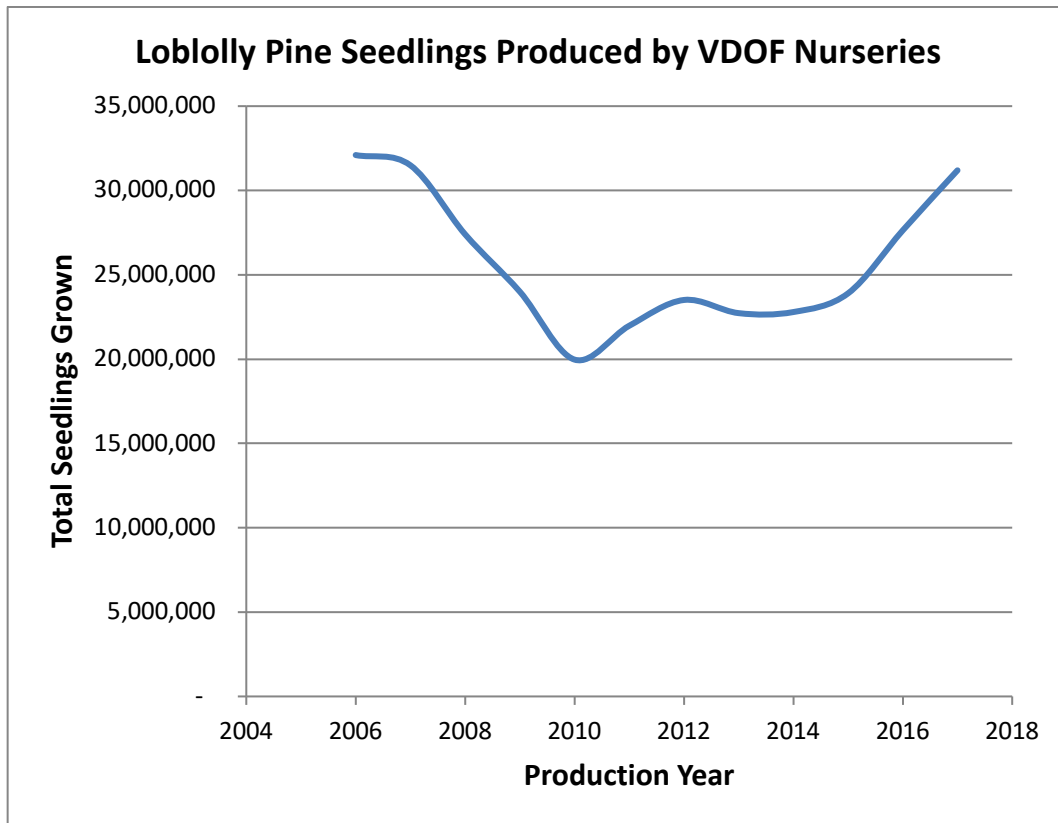


Figure 16. Loblolly pine production at VDOF nurseries from 2004-2018.

We can anticipate continued loss of forest and fragmentation of timberland. Ownership will be more diverse, with more non-timber objectives. However, the diversity of the resource and central location of the state will continue to make Virginia an attractive home for wood-using industries. There remain opportunities for tree planting on marginal open land for riparian forest establishment, mitigation of forest loss, bio-fuel power production and carbon sequestration. Significant advances in genetics, tree improvement and management techniques will allow higher production and tree quality on fewer acres. Land conservation efforts will keep lands available as sustainable working forests.



Section IV: Virginia's Nine Critical Issues

Through a collaborative process, VDOF developed a list of the nine most critical issues that would impact Virginia's forests during the next ten years. Within these issues are both identified threats and opportunities, including the largest threats to forest health, quality, composition and area. This list was developed through analysis of current and predicted forest trends and conditions. These primary issues are grouped by appropriate National State Assessment Theme and are ordered to match the 2019 VDOF Strategic Plan.

A. National Theme – Protect Forests from threats.

1. Protect forestland and associated woodland home communities from fire
2. Protect forests from forest health threats and invasive species
3. Conserve and restore diminished species

B. National Theme – Enhance public benefits from trees and forests

1. Enhance the role of forests in maintaining water quantity and quality
2. Support the forest economy and diversified markets for forest landowners
3. Expand and improve urban and community forests

C. National Theme – Conserve and manage working forest landscapes for multiple values and uses.

4. Keep forests as forest
5. Promote a larger, connected forest landscape
6. Ensure the sustainable use of forest resources



Southern Forest Land Assessment

Each of the nine critical issues that follow has a geographical priority map to identify the locations of the greatest threat to Virginia’s forest resource and to delineate the areas of opportunity. The starting point for determining priority areas was the 2018 Southern Forest Land Assessment (SFLA) data. Many of the specific issue priority maps pull from the same data sources as the SFLA map, however, several of the priority maps were derived from different data sources that were specifically tailored to the issue that is outside of SFLA data. Each priority map has an associated description stating the data sources used for the map.

There is a benefit to highlighting SFLA data in its initial form as it provides a layered depiction of the major issues across the state. The Forest Resource Priority map (Figure 19.) provides a ranking of private forestland that is a high, medium, and low priority when viewed as a combination of all of Virginia’s critical issues including protecting, enhancing, and conserving forestland across the Commonwealth in a consistent method with other Southern States. The layers used in this map include all 13 updated input layers weighted equally including forestland, forest patches, riparian areas, forested wetlands, priority watersheds, proximity to public lands, public drinking water, threatened and endangered species, site productivity, slope, developmental level, wildfire risk, and forest health. Water, urban, and public areas were excluded.

Approximately 24% of Virginia’s state and private forestland is rated as high priority, 45% medium, and 31% low.

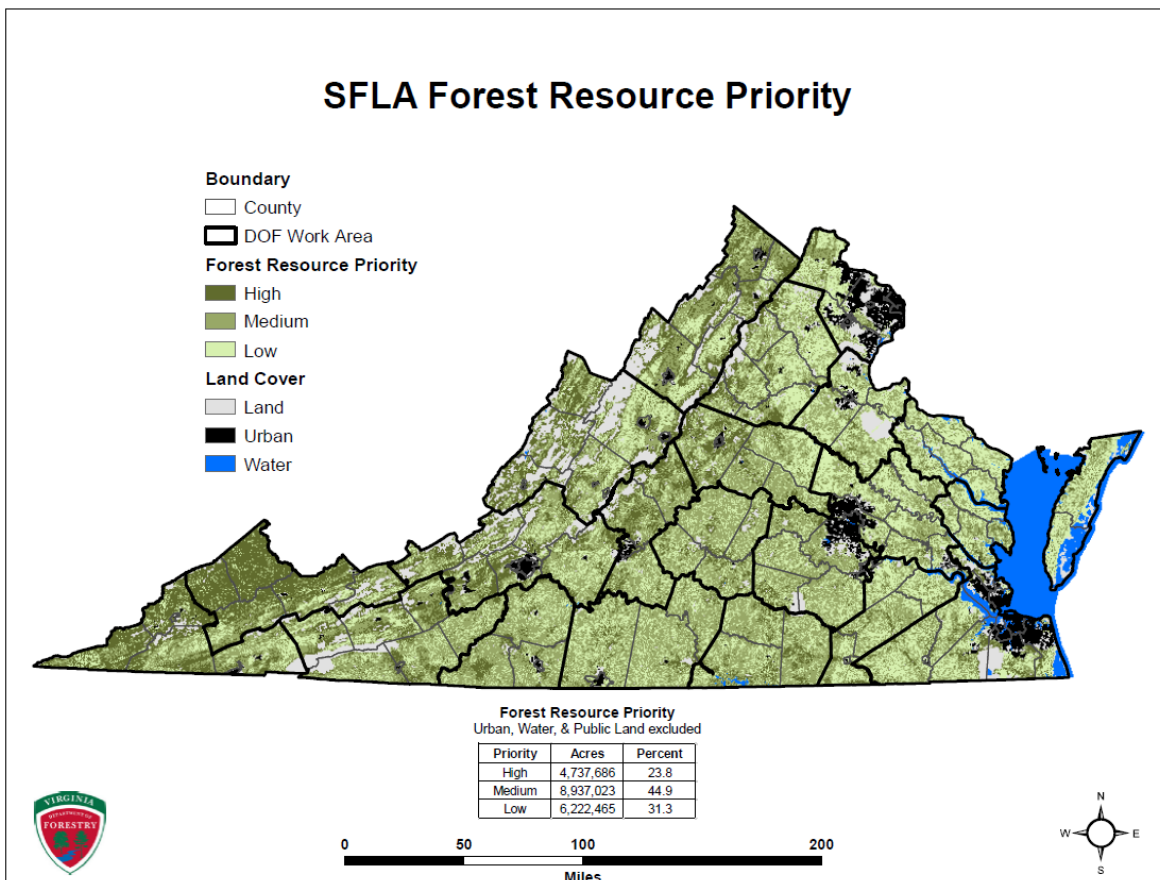


Figure 19. Forest Resource Priority showing the areas of High, Medium, and Low priority based on SFLA data.



Issue A1: Protect Forestland and Woodland Home Communities from Wildfire

Issue Description

The protection of lives, property and resources from wildfire is paramount and continues to be a foundational issue for Virginia. Each year in Virginia, nearly 10,000 acres are burned by almost 800 wildfires, resulting in damages exceeding \$3.5 million. Virginia's leading cause of wildfire continues to be careless debris burning, accounting for nearly 40 percent of all wildfire causes. Additionally, the state's rapidly growing population is pushing development of homes into formerly forested areas, resulting in increased fire risks and greater challenges for protecting citizens and homes. Virginia expects to see more development in the next 40 years than during the last 400 years.^{xxiii} Numbers of woodland communities and homes have increased substantially in recent years (as of 2020, there were 5,315 woodland communities representing nearly 400,000 homes), with a corresponding increase in the number of homes threatened or destroyed by fire. The state's increasing population, increasing home development in rural areas and increasing push by Virginia's citizens to enjoy the forests all combine to make wildfire a continuing threat.

Priority Areas

VDOF is utilizing the results of the GIS-based Southern Wildfire Risk Assessment (SWRA) project to prioritize those areas where information, planning and community interaction or treatments would be the most effective to reduce fuels and the overall risk from wildland fire.

The SWRA GIS project provides the unique ability to overlay and analyze various land form data, such as: land cover types, topography and water sources; infrastructure data, such as road networks and residential development, and point-specific information, such as historical wildfire occurrence and response resource locations, to provide distinct visual representation of the overall level of wildfire risk.

Figure 20 provides the most basic overview of the potential for fire risk and impacts in the Commonwealth over the risk gradients of low, medium and high. In addition to an SWRA map showing specific areas of risk across the Commonwealth, the final priority map summarizes the risk to categorize each work area by the most prevalent high, medium or low risk by work areas. Work areas with more than 50 percent of the area showing as high-risk would have the entire work area completely classified as high. This information allows fire managers in VDOF to identify the work areas most prone to wildfire.

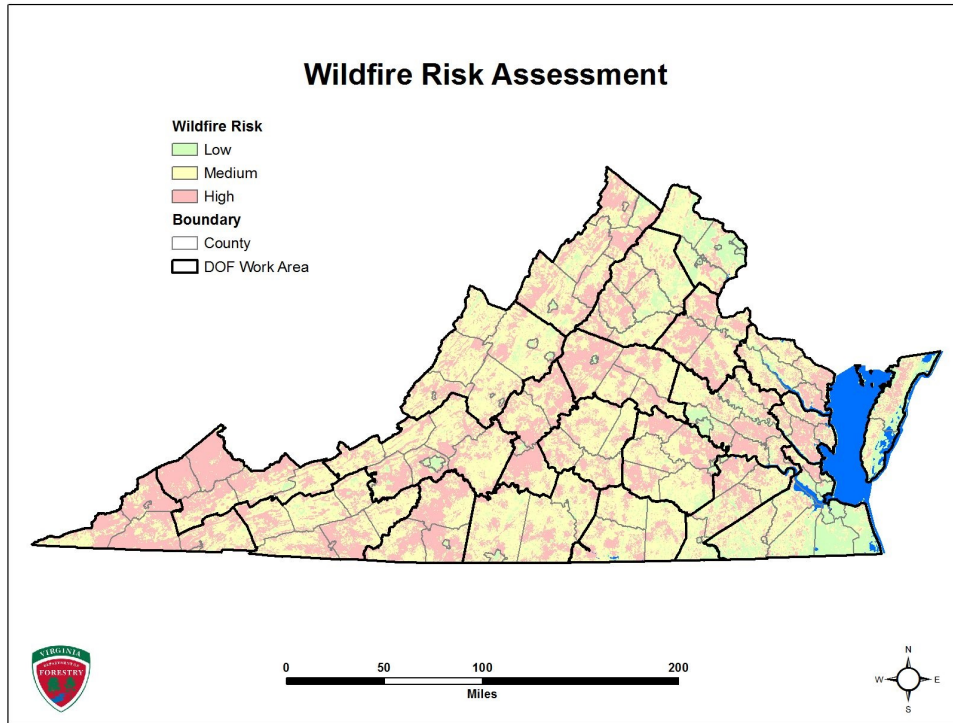


Figure 20. Wildfire risk by showing specific areas of high to low risk within VDOF work areas.

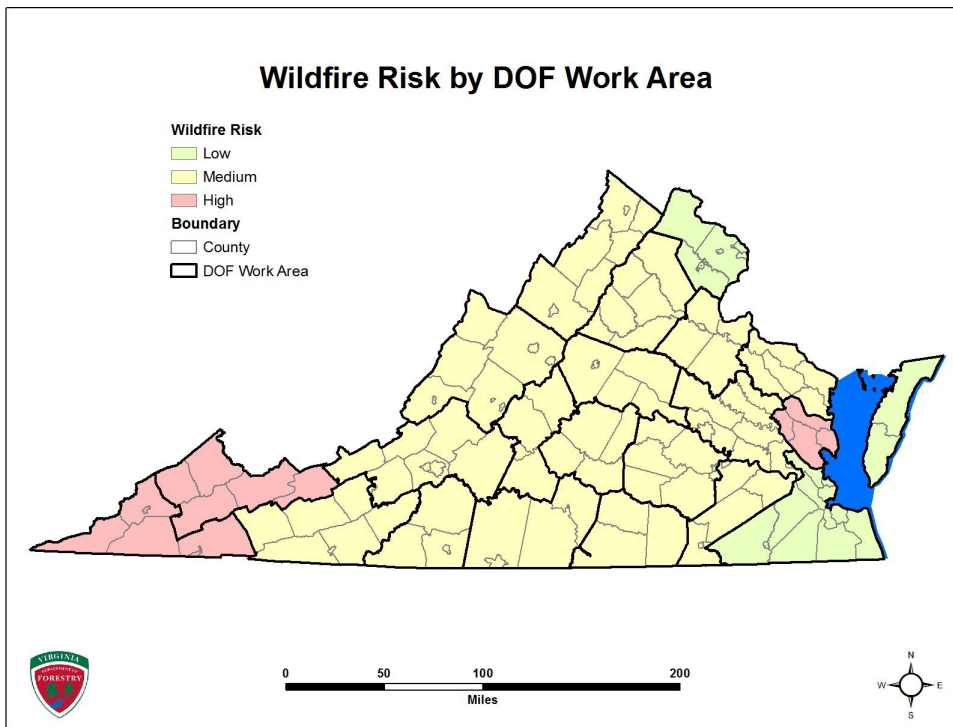


Figure 21. Wildfire risk summarized by VDOF work area.



Issue A2: Protect Forests from Forest Health Threats and Invasive species

Issue Description

VDOF forest health staff and county-based foresters monitor public and private forestland across the Commonwealth for a variety of native and invasive forest health threats. These threats change from year to year and will likely continue to change due to weather patterns, forest fragmentation, forest markets and the spread or introduction of new pests. Forest health issues and responses are occasionally an exercise in crisis management, often abruptly changing, and always scientifically and politically challenging. With limited resources – be it personnel, money or landowners willing to assist in control and eradication efforts – any forest health program is a constant struggle between predicting the future and dealing with the present. Active forest management, coupled with education of forest landowners on relevant forest health threats, is necessary to protect the long-term health of Virginia's forests.

Priority Areas

The VDOF forest health program has three major components, each covering efforts directed at multiple specific forest health issues. These three components are:

- ◆ Native Pests and Established Invasive Insects and Diseases
- ◆ Established Non-native Invasive Plants
- ◆ Non-established or New Invasive Species Threats

Native Pests and Established Invasive Insects and Diseases

The southern pine beetle (SPB) is the most economically destructive native insect pest in the southeastern US, historically causing tens or even hundreds of millions of dollars' worth of damage throughout the region annually. SPB hazard maps for the entire southern region are derived from the USFS 2012 National Insect and Disease Risk Map (NIDRM). A modified county-level hazard map below shows Virginia counties that are rated moderate to high hazard for SPB. This map also shows where pre-commercial thinning projects have occurred, a practice that reduces a stand's susceptibility to SPB. Many pre-commercial thinning projects in Virginia are cost-shared with USFS SPB program funds. A majority of the projects occur in areas with the greatest loblolly pine volumes in the Coastal Plain and Southern Piedmont, which also corresponds with locations identified as high hazard for SPB.

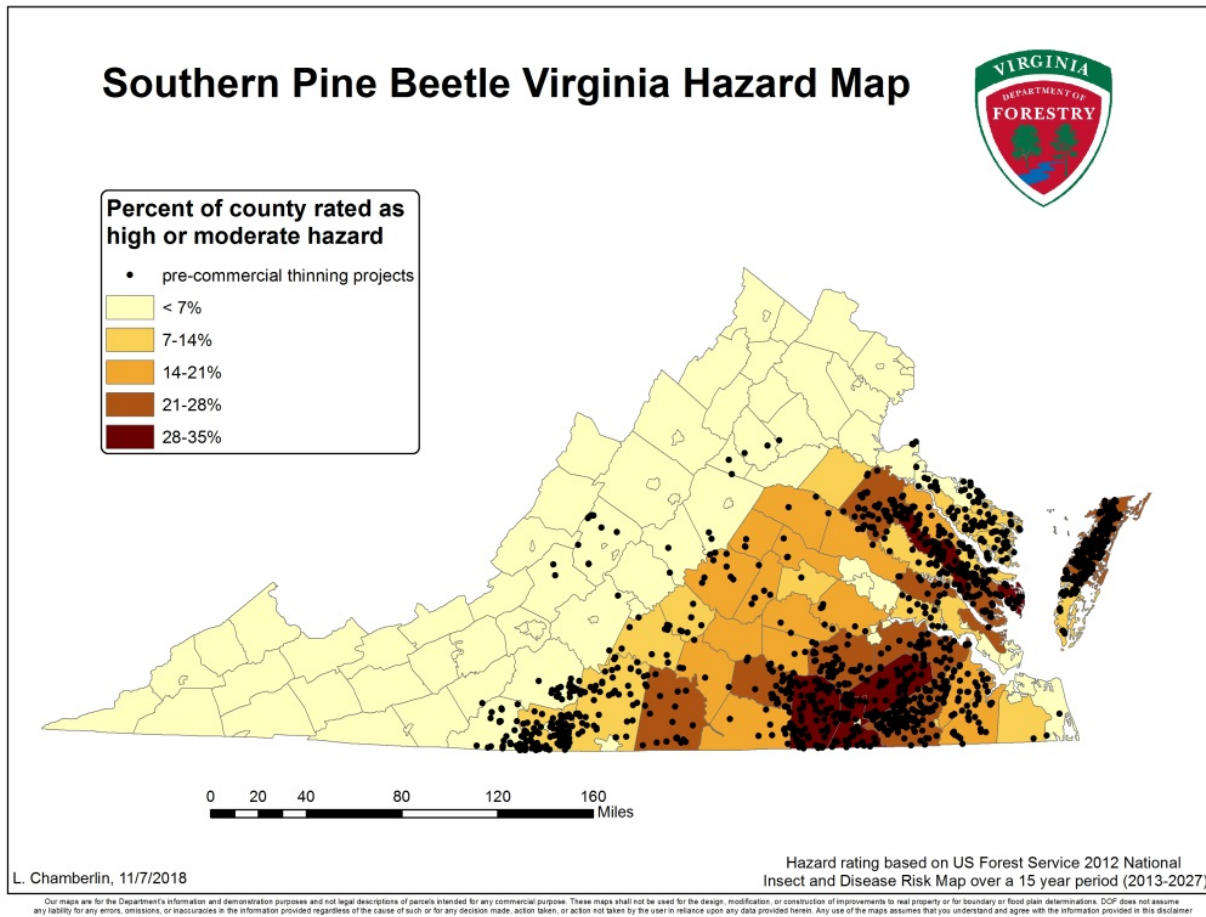


Figure 21. Locations of thinning jobs relative to southern pine beetle hazard regions.

The gypsy moth may be the most important biotic forest disturbance factor on a landscape scale in the Commonwealth. The first traces of defoliation in Virginia that were detected by aerial survey appeared in 1984. Since that time, gypsy moth has moved steadily south, and has had a profound impact on the forest ecology of the oak-hickory forest. In particular, the mountainous western part of the Commonwealth has witnessed the greatest impact from repeated annual defoliation. Oak decline closely mirrors maps of gypsy moth damage in terms of affected hosts and areas of greatest impact. Oak decline is a complex mix of abiotic and biotic factors and is difficult to study and quantify without more detailed surveys than currently exist. However, the 2012 NIDRM was an attempt at quantifying this phenomenon on a state level. This map, developed by USFS Forest Health Assessment and Applied Science Team (FHAASST), represents perceived risk of tree mortality based in part on host data layers and likely future damage to those resources based on known pest risks. While far from perfect, the NIDRM emphasizes the hazard to the oak resource posed by gypsy moth and oak decline, particularly in the western portion of Virginia.

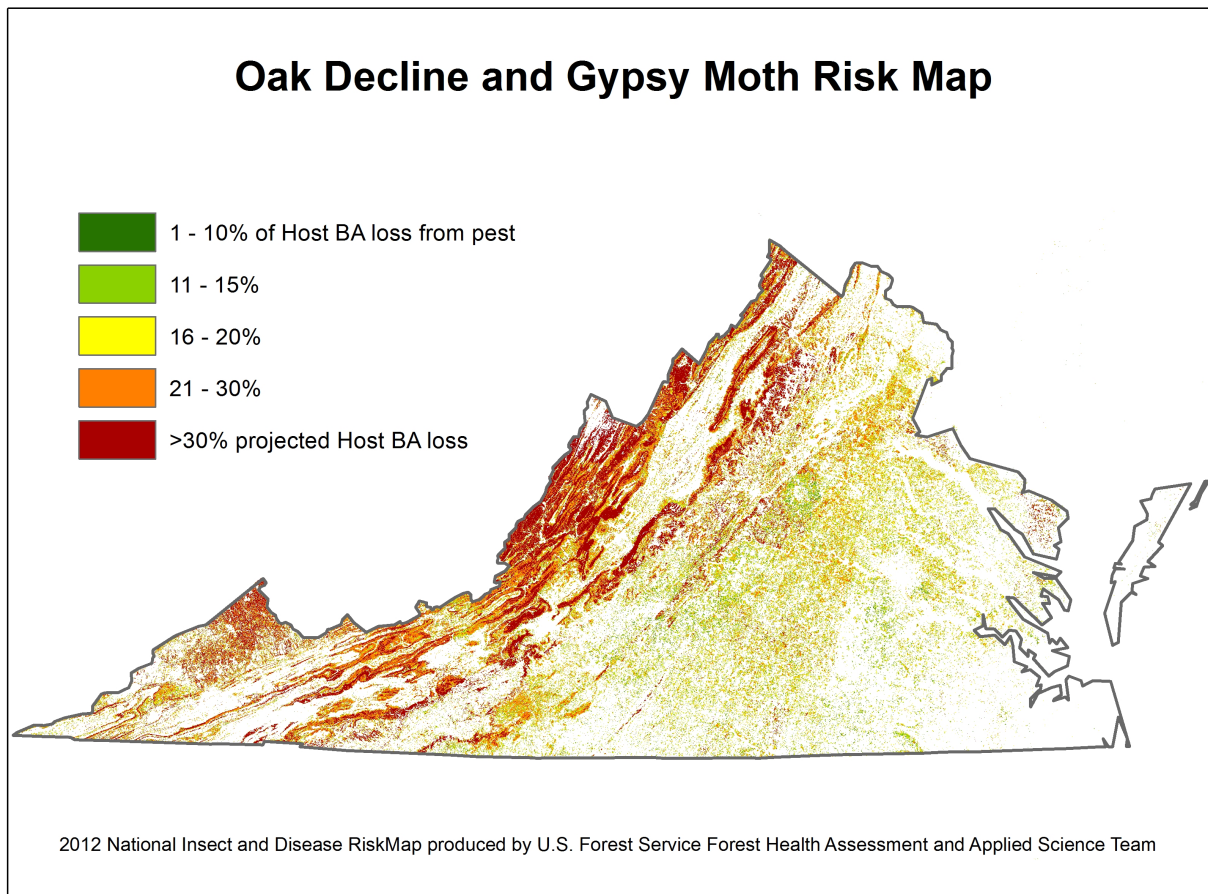


Figure 22. National Insect and Disease Risk Map (NIDRM) for Oak Decline and Gypsy Moth

Other established invasive insects and diseases include the hemlock woolly adelgid, the emerald ash borer (EAB) and beech bark disease. The hemlock woolly adelgid has spread throughout the entire range of eastern hemlock within the Commonwealth, with the exception of a few isolated hemlock populations. EAB is a relatively new invasive insect, but has aggressively spread across Virginia and is now found in all counties west of the City of Richmond. Beech bark disease has only been confirmed in west and southwest Virginia where elevation is more than 1,000 ft.

Established Non-Native Invasive Plants

While non-native invasive plants will also play an important future role in forest health assessments, we lack sufficient distribution data for most invasive plants to be able to quantify or map these impacts. Furthermore, the number of invasive plants and their complex interactions with native species prohibit us from making more than very general statements about their importance on a landscape-scale. However, they should be included in some fashion in future analyses of forest health.

Non-established or New Invasive Species Threats

There are a number of invasive species that threaten Virginia's forests but have not yet been found here or are not widely established. High-risk sites for these emerging threats are routinely



monitored. Early detection, rapid response and eradication/containment efforts are critical for the following invasive species threats.

- ◆ **Asian Longhorned Beetle:** If this pest were to become established in Virginia, it could pose an even greater threat to our forest resources than the emerald ash borer. Because its primary host is maple, we stand to lose a great deal more forest and urban trees from this pest if it were to spread and go uncontrolled within the Commonwealth.
- ◆ **European Woodwasp:** A particular concern is how *Sirex* will impact loblolly pine, known to be a preferred host. In the Southern hemisphere, where *Sirex* was introduced from Europe many decades ago, plantations of radiata pine in Australia and loblolly pine in Brazil have been devastated by this pest.
- ◆ **Sudden Oak Death (SOD) Pathogen:** Although lab inoculation studies have demonstrated that this pathogen can infect many of our native oak species, these studies are hard to carry over to a natural setting. It is still unknown what impact, if any, SOD would have in our eastern forests.
- ◆ **Wavyleaf Grass:** This relatively new invasive plant is showing up in a number of locations throughout the Commonwealth. It is extremely shade tolerant and seems to take over a site rapidly, virtually excluding native vegetation. In Maryland it has become a dominant understory weed. Our objective is to control, if not eradicate, this plant in Virginia.
- ◆ **Spotted Lanternfly:** Virginia's newest invasive species was first detected in 2018 in the City of Winchester and Frederick County. The spotted lanternfly feeds on more than 65 host plants worldwide, including tree-of-heaven, grape, apple, stone fruit, hops, maple, oak, walnut, poplar and pine. The spotted lanternfly could certainly become a major agricultural pest in Virginia, as well as a nuisance to landowners. Research is ongoing to determine its impact to forestry.

Issue A3: Conserve and Restore Diminished Forest Types

Issue Description

Several current or formerly important tree species have severely declined, or are declining, in numbers and/or range. These species include: American chestnut; longleaf pine; shortleaf pine; Atlantic white-cedar, and eastern hemlock. VDOF and a variety of partners and stakeholders are undertaking efforts to reverse these trends, but significant work and research still need to be accomplished for most of these species.

Shortleaf pine is native throughout most of the Commonwealth but was most prevalent in southcentral Virginia. Reestablishing shortleaf promotes forest diversity, forest health (particularly on poor soils where shortleaf pine thrives), allows for beneficial fire on the landscape and could be an important species during times of climate change and drought. Restoration of shortleaf pine will also lead to the restoration of fire-adapted ecosystems and their associated plants and wildlife, particularly bobwhite quail. Continuing research and education is necessary to find the best silvicultural system to increase shortleaf across the landscape. Shortleaf planting across portions of the Commonwealth increased recently, supported by a state-funded quail habitat cost-share program.



Longleaf pine forests are some of our most biologically diverse ecosystems; many species associated with longleaf ecosystems are threatened or endangered. Longleaf demonstrates numerous characteristics that contribute to longevity, which translates into ecosystem stability and potential for long-term carbon sequestration. These characteristics include high resistance to both pine beetles and fusiform rust, as well as tolerance of salt spray, wildfire, wind and ice. In addition to the economic or commodity values of longleaf ecosystems, there are equally-significant ecosystem benefits and aesthetic values. Open-structured longleaf pine forests maintained by frequent, low-intensity fires are some of our most biologically diverse ecosystems. They provide habitat for a great variety of wildlife species, such as bobwhite quail, red-cockaded woodpeckers, Bachman's sparrows and Mabee's salamanders, and they support a diverse flora including pitcherplants, orchids, lilies, showy wildflowers, grasses and sedges. Through longleaf restoration burns, plantings and research, an alliance of state and private partners has worked together to maintain longleaf pine on the landscape as an operational forest type. VDOF's Garland Gray Nursery now has the capability to grow Virginia longleaf pine seedlings in state. Continued collaboration with partners, as well as outreach to private landowners, will be necessary to continue to establish longleaf pine in the footprint of its' southeast Virginia range. Efforts to restore longleaf pine ecosystems will also rely on a strong network of prescribed burn managers who are able to safely implement prescribed burns across a range of private and government ownerships. Through cooperative efforts, VDOF, Virginia Department of Wildlife Resources, Virginia Department of Conservation and Recreation, the Nature Conservancy and the USFWS have been able to accomplish many longleaf burns in southeast Virginia to support and maintain restoration efforts on state, federal, and conserved lands. VDOF and private contractors provide burning services on private lands, but more trained contractors are necessary to ensure private lands burns can be completed.

The work on finding a hybrid Chestnut that resists chestnut blight is still underway. American chestnut was an important component of Virginia's forests, particularly the Appalachian forests. The American Chestnut Foundation and VDOF continue to work on backcross breeding to create a Chinese-American hybrid with a 15/16 American genetic makeup that retains the form of the American chestnuts and the blight resistance of Chinese chestnuts.

Priority Areas

Restoration efforts will be aimed at lands within these historic ranges of each species. Particular focus will be on lands that are likely to remain forested, such as public lands and areas under perpetual easement. In addition, we will try to ensure efforts to restore a species on a stand-level are prioritized based on its importance to biodiversity, likelihood of success and potential economic value.

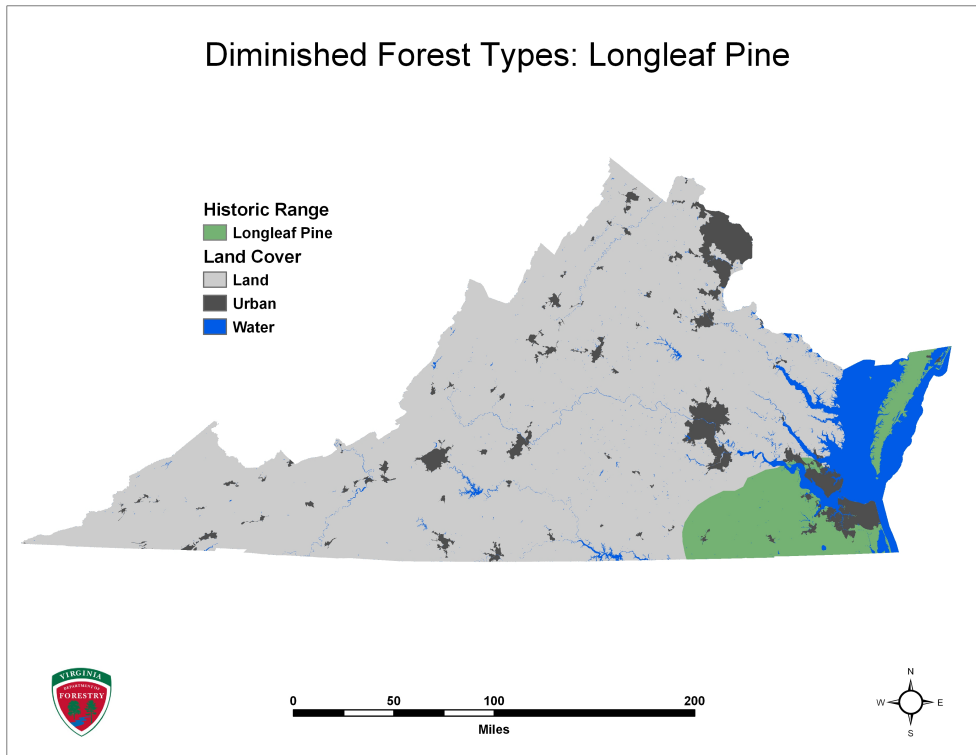


Figure 23. Longleaf Pine Historic Range. Natural range of longleaf pine in Virginia.

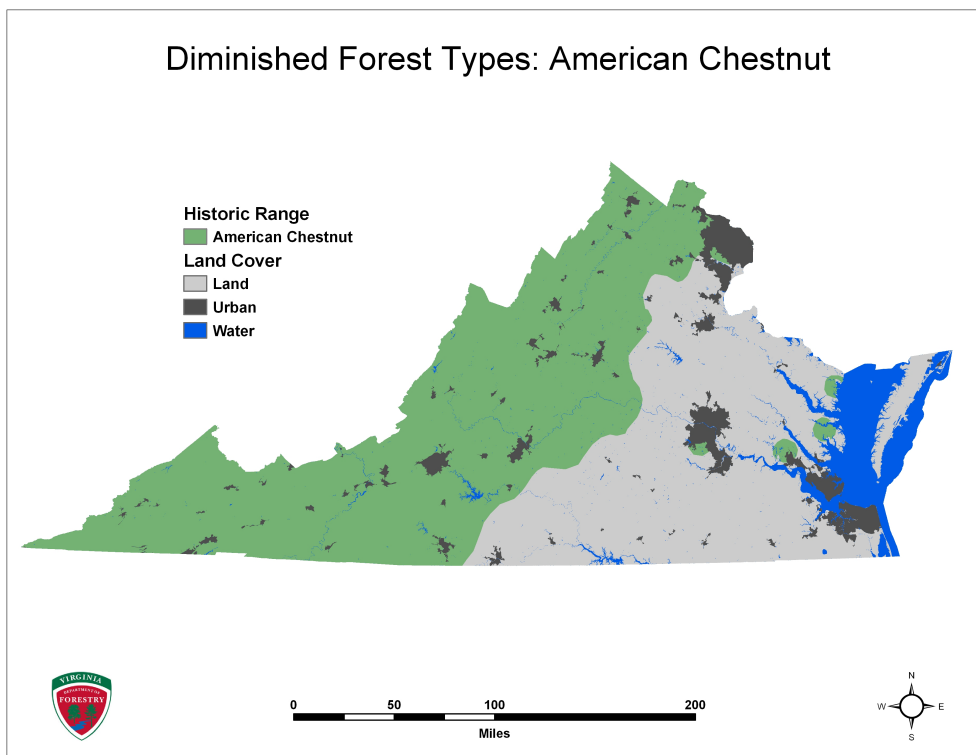


Figure 24. American Chestnut historic range in Virginia.

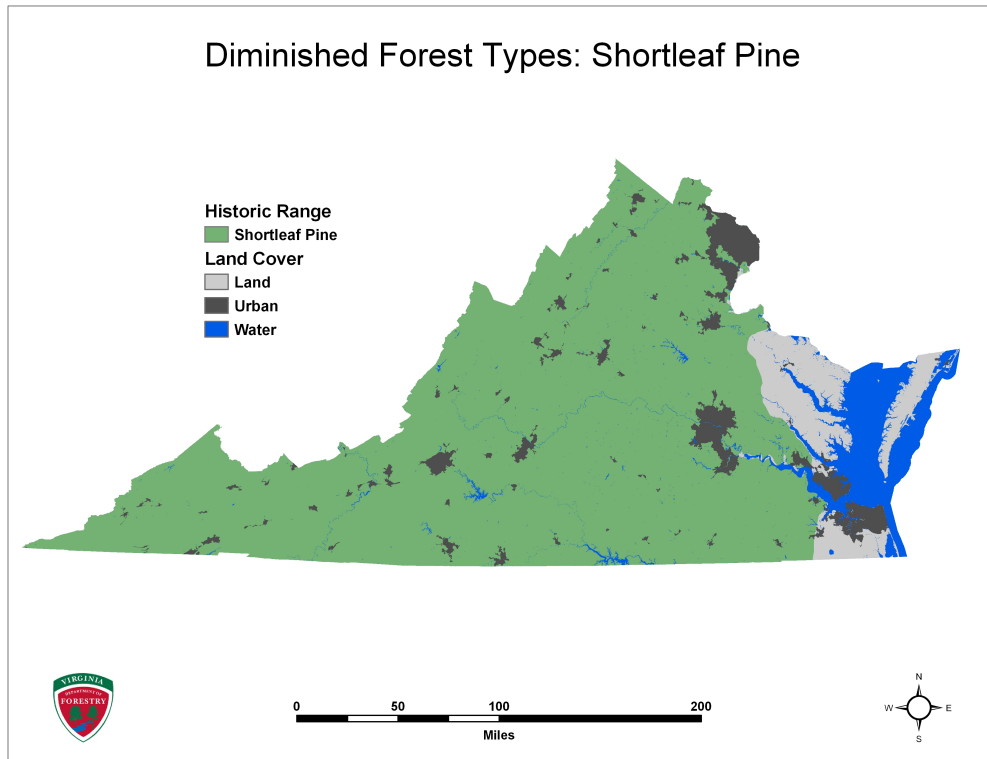


Figure 25. Shortleaf Pine historic range in Virginia.

Issue B1: Enhance the Role of Forests in Maintaining Water Quantity and Quality

Issue Description

The core mission of VDOF is protecting and managing healthy, sustainable forest resources for all Virginians. Forests have a significant role in water quality and provide superior watershed benefits over nearly every other land use; water quality is intricately connected to many other forestry priorities in the state. Through sustainable management of state forests and support for sustainable forest management on private forestlands, VDOF ensures that the Commonwealth's forests remain major contributors to water quality and healthy watersheds. These efforts support VDOF's core mission and align with the agency's current strategic plan.

In Virginia, 60 percent of the watersheds drain to the Chesapeake Bay. The remaining 40 percent of the watersheds comprise the southern watersheds, such as the Albemarle Sound watersheds to the south and east, the New River, and the Upper Tennessee Watershed to the southwest, which includes the Clinch, Holston and Powell rivers. All of these major watersheds contain impaired streams. Increasing population, changes in land-use and more intensive use of the land are decreasing the forest cover within watershed drainages and adversely affecting the ability of forests to filter, slow and store water. In order to protect these watersheds, concerted efforts will need to be made to conserve forestland and assist landowners with forest stewardship. Education and outreach to private landowners, planning districts and local governments is one step in sharing the importance of these forests. Creating incentives for landowners to retain working forests, such as the work being done with the Healthy Watershed Initiative, is the next step in forestland retention.



Forestry Best Management Practices for Water Quality

VDOF has been a leader in the protection of forested watersheds since the early 1970s when the agency published its first set of Forestry Best Management Practices (BMPs) for Water Quality. The fifth and current edition of those guidelines came out in 2011. A statewide audit system has been in place since 1993 to track trends in BMP implementation and effectiveness. The entire BMP Implementation Monitoring effort has also been automated to be compatible with VDOF's Integrated Forest Resource Information System (IFRIS) enterprise database system. The information compiled serves as the basis for VDOF reporting under Virginia's Chesapeake Bay Watershed Implementation Plan (WIP). In calendar year 2018, 93.3 percent of the timber harvest acres in Virginia conducted within the boundaries of the Bay Watershed met the necessary requirements of BMPs, and 94.0 percent of the timber harvest acres statewide met the necessary requirements of BMPs. The audit also showed that 99.17 percent of the sites visited had no active sedimentation present after the closeout of a harvesting operation. The goal for implementation under WIP II is 90 percent of timber harvest acres under BMPs by 2017 and 95 percent by 2025.

Silvicultural Water Quality Law Enforcement Actions

In July 1993, the General Assembly of Virginia – with the support of the forest industry – enacted the Virginia Silvicultural Water Quality Law, § 10.1-1181.1 through § 10.1-1181.7. The law authorizes the State Forester to assess civil penalties to owners and operators who fail to protect water quality in their forestry operations. Virginia is the only state in the southeastern US that grants enforcement authority under such a law to a state's forestry agency. In FY2019, VDOF was involved in 164 water quality actions initiated under the Silvicultural Law. Of these actions, one resulted in a special order and two resulted in emergency special orders being issued for violations of the law. In addition, there were 37 failure to notify violations by timber harvesting contractors during the fiscal year.

Flexible Riparian Buffer Program

VDOF is specifically tasked under Virginia code § 10.1-1105 with the "... prevention of erosion and sedimentation, and maintenance of buffers for water quality." The implementation of forested, vegetated riparian buffers is therefore a priority. Efforts in Virginia to retain forestland and promote riparian forest buffers must rely on an array of alternatives that assist and encourage landowners to retain their forests rather than convert them to other uses and to restore forest cover where it has been lost. However, federal requirements under USDA Conservation Reserve Enhancement Program (CREP) designed riparian forest buffer criteria do not work for everyone, and therefore the Commonwealth is not reaching all potential riparian forest buffer candidate landowners.

Using its strength as a state-wide agency with professional field personnel, VDOF has therefore begun working through partners to identify areas of high potential where trees can provide a solution to nutrient, sediment and physical stream challenges. The initiative will target currently unengaged landowners that have not participated or who do not qualify for existing programs. Partners, like Soil and Water Conservation Districts (SWCDs), other agencies and non-profits have often already identified these areas of need. VDOF will provide technical assistance and leverage funding to implement BMPs.

Two programs are currently underway. One is focused on the James River and the second is focused on the Shenandoah/Potomac watershed. The goal in each will be to deliver tangible, measurable and meaningful results, at substantial cost savings, on lands that have been difficult to reach through existing programs and that will help meet the special challenges associated with the James River and the Shenandoah/Potomac watershed. Based on its long and extensive experience in tree planting, VDOF has calculated that its costs to establish trees is typically less than \$250 per acre, compared to



more than \$1,000 per acre for some federal forest buffer programs. Planning for and effecting the establishment of natural forests costs even less.

Retaining and Creating Forests to Combat the Impacts of Sea Level Rise

The health of Virginia's coastal forests is a relatively new and growing concern. Virginia is experiencing some of the highest rates of sea level rise in the nation and has suffered a 250 percent increase in federally declared disasters during the last 20 years.

A combination of sea level rise, geologic forces, land subsidence, weather and development have caused the gradual retreat of coastal forests in Virginia. Fringes of "ghost forests" can be seen along marsh edges, as saltwater influence makes its progression inland. Stands of snags, scattered through marshes and wetlands, show where mature trees are now unable to persist and forest regeneration is prevented. Tied in with this are the other issues that accompany sea level rise and salt water influence, including; southern pine beetle infestation; fine fuel buildup, and proliferation of phragmites grass. In many coastal areas, development threatens to grow out towards the coastline, giving coastal forests no suitable place for retreat and re-establishment.

The combination of these factors (e.g., tree loss and sea level rise) are not only impacting the environment, but are also having a significant impact on the many military installations along the Virginia coast. From a military perspective, the Virginia coastline includes the comprehensive influence areas for Joint Base Langley-Eustis and many of the other military installations in the greater Hampton Roads region. This area encompasses key military air training corridors where dark skies are critically important. Notably, the 2018 draft Department of Defense/Virginia joint land use study (JLUS) plan for Joint Base Langley-Eustis focuses on one subject only: sea level rise and associated flooding.

Trees are a large part of the answer to mitigating the negative impacts of sea level rise and persistent coastal flooding. Through silviculture, we can use the forest management practices traditionally used for timber management and wildlife habitat enhancement to manage forest stands in coastal areas for flood mitigation. Rising sea levels and coastal flooding impact all manner of properties and ownerships, including private landowners, municipalities, and federal and state land managers. Several projects and initiatives are in process to provide solutions for Virginia's coastal landowners.

VDOF's coastal resiliency program began a project in 2019 with the Green Infrastructure Center to evaluate the resiliency of coastal forests from threats including development, forest health issues and wildfire. The outcome is a Resiliency Plan scheduled for completion in 2021 for the York River Watershed in Eastern Virginia that links risks with opportunities for improved forest management and green planning. This plan will provide a template for Virginia's coastal communities protect coastal forests against changing climates.

Virginia Trees for Clean Water

Through its Virginia Trees for Clean Water program, VDOF is improving water quality across the Commonwealth by promoting on-the-ground tree planting efforts. To date, VDOF has assisted 123 projects resulting in more than 45,250 trees being planted in Virginia communities, including special projects such as: riparian buffer tree planting; a Turf to Trees program, and community, neighborhood and street tree plantings.

Priority Areas

All areas of the Commonwealth collectively need high-quality water and forests to protect these waters. In support of meeting this ubiquitous need, there are ways to make water quality efforts more



effective. The following priority area map (Figure 23) was generated using data from the Southern Forest Land Assessment (SFLA) GIS data, and utilizes these SFLA data layers, by order of weight, from greatest to lowest: Riparian Area; Priority Watersheds; Slope; Public Drinking Water; Wetlands; Threatened and Endangered Species; Development Level, and Forestland. Areas in red are at the highest risk of impacting local and/or regional water quality when disturbed by land-use activities. Areas in green indicate a high level of water quality protection and/or a low level of possible deleterious impact.

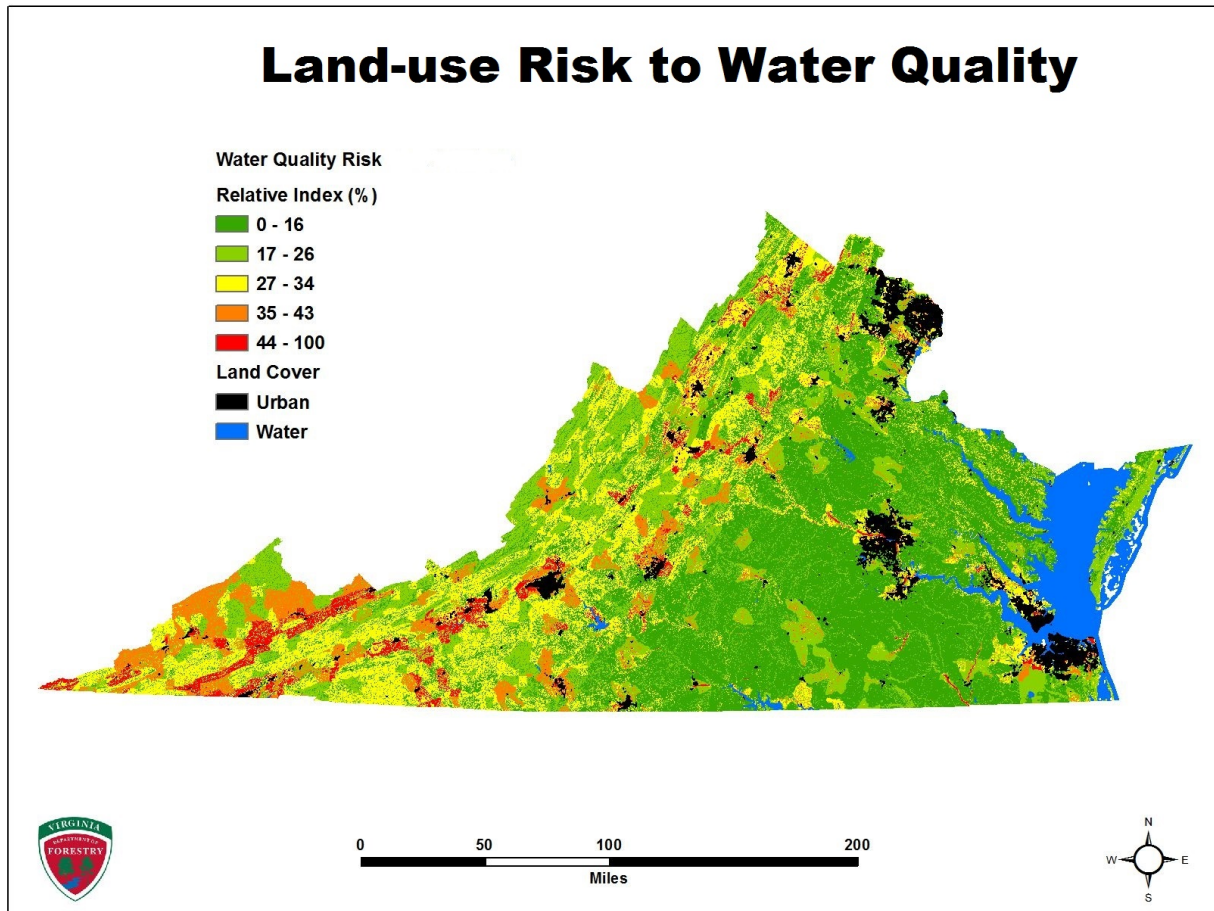


Figure 26. Map of Virginia showing the areas of risk to impact local water quality when disturbed by change in land-use.



Issue B2: Support the forest economy and diversified markets for forest landowners.

Issue Description

Virginia's forest industry spans all product areas. Virginia has approximately 100 hardwood sawmills and 75 softwood sawmills; lumber produced is used in construction, furniture, cabinets, flooring, decking, railroad ties, pallets and other products. More than half of the grade hardwood lumber produced in Virginia is exported. Pulp, paper and panel industries utilize more than one million cords annually. Additional products include post and poles, animal bedding and shavings, industrial wood products, mulch and soil amendments, fuelwood, wood pellets and boiler fuels.

Unfortunately, all these markets are not uniformly found across the state. The variability can lead to areas where market demands are so strong that there are concerns such as early and over harvesting that could be unsustainable, as well as areas where only the very best timber is harvested, leading to poor management and harvesting that impacts the future health of the forest. Forest markets tend to be better in the Coastal Plain and Southern Piedmont compared to mountain areas.

Areas of concern across the Commonwealth are a lack of markets for low-grade wood and biomass, larger pine timber, and lack of markets of any kind in certain areas of the Commonwealth. VDOF continues to work to obtain new resources to identify and promote emerging markets as well as opportunities to enhance the traditional markets that have been the backbone of the industry.

As part of our efforts to maintain sustainable working forests, VDOF continues to work with partners to improve landowner access to forest certification programs and certified wood markets. Virginia is also working with regional and national partners to educate other countries on the health and sustainability of our forests through articles, meetings and tours. As demands for documenting the sustainability of forest products increase, it is important that our landowners and industry can provide those assurances. Only 15 percent of Virginia's non-industrial forest landowners are engaged in certification.

Major green building program requirements make most wood harvested in Virginia ineligible for credit, but forest products industries are increasingly making location and expansions decisions based on the availability of certified sustainable wood, particularly secondary wood manufacturing companies. All these things are creating a competitive disadvantage or exclusion from some markets for many of Virginia's forest landowners.

Ecosystem Services

Ecosystem services and benefits provided by forests are undervalued. Even with the financial contribution provided by the forest products industry (\$21 billion annually) losses to the forestland base are unacceptable. It is imperative to develop markets for ecosystem services, such as water quality, carbon sequestration, and biodiversity and account for the conservation of these important services.

More than 62 percent of Virginia is forestland area. This represents a significant potential for forests to contribute critical benefits essential to human life and a high standard of living. These forests are our natural capital that provide vital ecosystem services. The link between economic and environmental sustainability is driving the emergence and development of new ecosystem service markets and inclusion of ecosystem services in land development planning.



The infrastructure for capturing the economic value of provisioning ecosystem services, such as supplying traditional forest products, is established. However, the same cannot be said for the vast array of regulating and cultural ecosystem services. Virginia's forests reduce nutrient and sediment loads delivered to streams, sequester (capture) and store carbon that may contribute to climate change, enhance biodiversity, foster pollination and improve air quality through removal of various air pollutants. Each year, Virginia's forests capture more than 10 million tons of carbon – that's 25 percent of our state's emissions sequestered for free by our forests.

The market infrastructure for voluntary carbon transactions is emerging, however it is not yet adequately established to enable forest landowners to realize an economic return for providing other "free" ecosystem services, such as clean air (e.g., reduced ozone, nitrous oxides, particulate matter) and clean water.

Better valuing the environmental benefits and services provided by forests will be key to slowing the loss of forestland in Virginia. The loss of these forested acres and the ecosystem services they provide represents a significant cost to society. This loss often necessitates the need to engineer expensive, technological solutions to address potential climate impacts, stormwater management and nutrient loading abatement. In addition to initiatives that promote market-based conservation, it is important to promote inclusion of ecosystem service considerations in our land-use planning activities.

Opportunities

New opportunities and programs are under development in Virginia to improve forest management practices and to create or enhance markets in new geographic areas. These programs include: community wood energy programs to provide markets for low or no value trees; urban wood utilization to offset small lot management costs; developing service providers for small lot forestry, and developing specialty non-timber forest products to increase revenue flow to landowners.

Additionally, opportunities that are being explored include the development of value added and advanced manufacturing, such as cross-laminated timber (CLT) production and expansion of biomass fuels and energy.

Maintaining diverse markets, cutting-edge technology and a trained workforce are necessary for all forest-related businesses to remain prosperous and relevant in today's world. Working with Virginia Department of Agriculture and Consumer Services (VDACS) International Marketing Division, VDOF is increasing efforts to promote Virginia's forest industry and products around the world to maximize opportunities to participate with and improve access to international customers.

Priority Areas

The need for forest markets in proximity to the forest resources is necessary for forest landowners to be able to actively manage their timberlands. Starting with the map of all mills in Virginia below, there are portions of the Commonwealth where few mills or no mills is apparent. Southeast Virginia and southwest Virginia are two areas where further market development would allow for greater active forest management. Additionally, the Eastern Shore of Virginia has no forest products markets of any kind, which makes it difficult for private landowners to actively manage their pine timberlands.

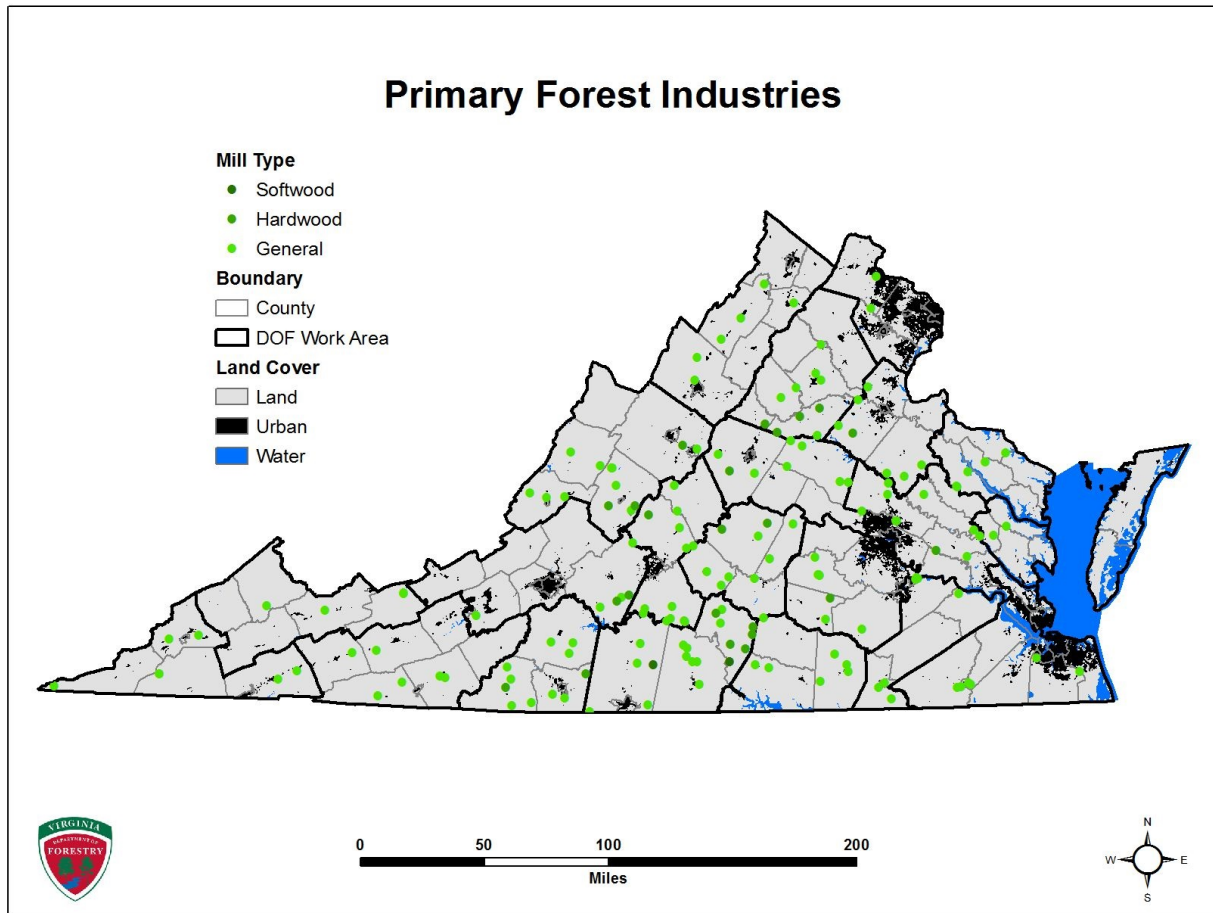


Figure 27. Locations of primary forest product industries current in operation as of 2020.

Issue B3: Expand and Improve Urban and Community Forests

Issue Description

Urban forests and tree canopy are critical to improving air quality, cooling urban landscapes, reducing urban stormwater runoff and contributing to the quality of life for residents. In Virginia, the decline in air quality, particularly in and near the urban centers, is of great concern. Virginia's urban areas are rapidly expanding, often leading to tree canopy loss and fragmentation of the remaining forestlands.

Urban and community forests absorb and clean pollutants from land runoff and also reduce peak storm flows, thereby minimizing flooding. This is particularly important should changing climates cause increased storms and rainfall that affect Virginia. A national study of the value of urban tree cover for reducing stormwater problems and improving air quality shows that the trees in our cities save more than \$400 billion from not having to build structures to clean our air and water.^{xxiv} The urban forests perform this work far more cost effectively than any engineered solutions. Urban tree canopy goals are now an accepted air quality improvement strategy in mandated regional air quality improvement plans. In addition, well-managed urban tree populations have been shown to make a



positive contribution to community well-being, community aesthetics, business district appeal and residential property values.

The VDOF urban and community forestry (U&CF) program was established in the 1980s and has been almost exclusively tied to federal funding for project delivery. Since then, VDOF has been using this support for in-depth planning, prioritization and focused delivery of programs and projects throughout the Commonwealth. The innovative nature and success of multiple projects through the years has contributed the program’s national recognition.

Priority Areas

Although the word “urban” affords the assumption that most work will be completed in population-dense areas, our programs and/or actions will be delivered where appropriate across the state. Small communities and suburban areas as well as large cities all fit the criteria for focused aid through this program. The map below, using 2010 US Census data, shows the urban and highly populated areas of the state where urban and community forestry programming will be focused.

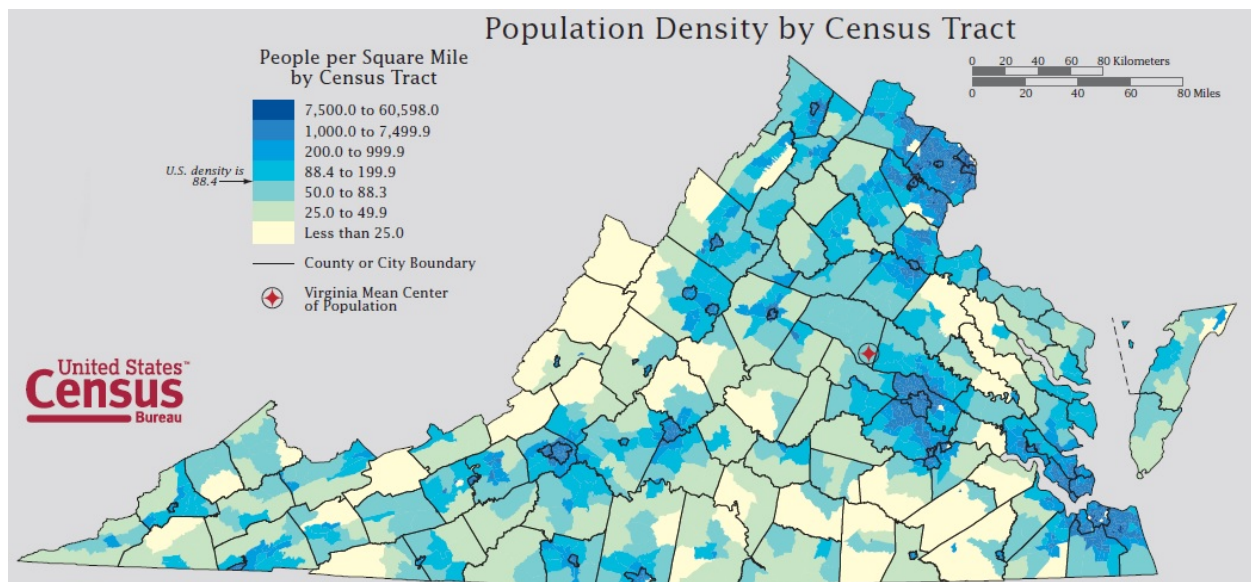


Figure 28. Urban and highly populated areas of Virginia as designated by U.S. Census tracts.

These priorities are part of the five-year U&CF Strategic Plan and are structured into six priority areas, including:



State and Local Capacity in Urban and Community Forestry

Strengthening urban and community forestry programs at all levels is the focus in this priority area. The goal is to build the capacity of city, town and county governments, as well as local and regional non-profit organizations, to implement effective local urban forestry programs. The strategies in this priority area focus on making the case for localities to increase professional staff and budgets for urban forestry management by showing the multiple benefits provided by effective urban forest management. Education, technical assistance, quantifying urban forest values and advocacy are key components of these strategies.

Ecosystem Service Values and Other Public Benefits of Urban and Community Forests

This priority area focuses on assisting communities to assess their urban forest and quantifying the ecosystem services values that their urban forest provides in terms of air quality, water quality, stormwater management, carbon sequestration, energy conservation and heat island temperature modification.

Using tools such as Urban Forest Effects Model (UFORE) urban forest values can now be quantified in ways not possible a decade ago. This information can be used in decision making at the local level, and its availability has the potential to positively impact local decisions and budgets related to urban forests. More quantitative data on the contribution of urban forests to business district enhancement, public well-being and even public health are now available.

Using geospatial analysis and continuing VDOF's urban tree canopy (UTC) initiative are key strategies within this priority area. These efforts will require strong partnerships with university and regional partners that are identified.

Impacts of Urbanization and Fragmentation

As Virginia's population grows and, to an extent, decentralizes, the forest cover also becomes more fragmented and disparate, thereby losing, or at least decreasing, some of the important benefits that forestland provides. The once highly contiguous forests of Virginia have been broken into smaller, more isolated areas of forestland. VDOF has played a significant role in advancing the green infrastructure concept of ecosystem management and land conservation in Virginia. Using green infrastructure concepts will be key to the strategies in this priority area that will address ecosystem management along the rural-to-urban continuum.

U&CF grants and three USFS Redesign grants have already provided some green infrastructure and other land planning/conservation tools that can be employed in this priority area. (See <http://www.uap.vt.edu/forests/forests.html> and <http://www.gicinc.org/projects.htm>). Working with our university and non-profit partners (e.g., Green Infrastructure Center, various land trust organizations, etc.), critical forested landscapes can be identified. Using the land-use planning modules in the USFS Changing Roles to train VDOF field personnel will assist them in working with local planning officials on green infrastructure and other land planning/conservation efforts. Continuing efforts to conserve and enhance urban green space and open space will make cities and towns more desirable places to live. Promoting greenway efforts is also an effective strategy in developing green infrastructure networks. As funding levels permit, U&CF grants can support local green infrastructure planning and education efforts.



Underserved, Diverse and Non-Traditional Populations

Delivering the U&CF program to underserved and diverse audiences has been a long-standing commitment of the program, as well as a continual challenge. Our existing partnership with the Community Design Assistance Center (CDAC) at Virginia Tech has been quite successful in reaching underserved communities, and working with CDAC will continue to be an important strategy in the future.

VDOF has recently signed a Memorandum of Understanding with Virginia Tech and Virginia State University (VSU). VSU is Virginia's other land grant institution and serves a predominantly minority population. The U&CF program has already established ties with personnel at VSU, and VSU is now represented in the Virginia Urban Forest Council (Trees Virginia) and the Virginia Natural Resources Leadership Institute (VNRLI) (sponsored by the U&CF program). The U&CF program will work to develop this partnership and use VSU as one gateway to engage and serve minority populations.

Other strategies include an outreach program to economically underserved southwest Virginia, communities where environmental problems abound, as well as increased efforts to include more diversity in Trees Virginia and VNRLI through more intense recruitment efforts, and collaboration with the federally and state recognized tribes within Virginia (including Mattaponi, Pamunkey, Chickahominy, Eastern Chickahominy, Rappahannock, Upper Mattaponi, Nansemond, Monacan Indian Nation, Cheroenhaka [Nottoway], Nottoway of Virginia, and Patawomeck tribes).

Urban Forestry Profession in Virginia

This priority area has both an internal and external focus. External strategies include: continuing VDOF's support of the developing urban forestry program at Virginia Tech; promoting the International Society of Arboriculture (ISA) Certified Arborist Program; offering or supporting seminars, workshops, etc., to professionals, and working with Trees Virginia to provide scholarships to students in urban forestry related disciplines.

Internally, VDOF will continue to build its numbers of ISA Certified Arborists and make other urban forestry training available to field personnel (e.g., conferences, workshops, seminars, etc.). There will also be a focus on presenting the USFS Changing Roles training to our field personnel.

Natural Disasters Affecting Urban and Community Forests

This priority area will focus on how VDOF can assist communities in preparing for catastrophic storm events that can potentially have a devastating impact on urban forests. Factoring in the urban forest into community emergency preparedness plans will be emphasized. Another strategy will focus on training VDOF personnel in Urban Forest Strike Team (UFST) concepts. VDOF must also pursue a stable funding source to support UFST deployment.

Issue C1: Keep Forests as Forest

Issue Description

Due to the wide range of benefits that forests provide, including clean air and water (including drinking water), wildlife habitat and forest products, the loss of forestland affects the quality of life for all Virginians. Virginia's timber industry supports 108,000 jobs and contributes \$21 billion to the Commonwealth's Gross State Product (GSP). Strong domestic and global markets for wood products provide an economic incentive for landowners to manage their forestland and maintain their properties in forest, rather than converting the land to other uses. Without markets, forestland is at



risk of being lost, perhaps permanently. Additionally, intact, working forests provide important stabilization of the climate through carbon sequestration and carbon storage. Actively managed forests are healthier and more adaptable to changing climates. Conserving manageable blocks of forestland is necessary to retaining this important climate mitigation tool.

The fragmentation and conversion of forestland to other uses continue to be two of the most significant threats to the forest resources of Virginia. Forestland conversion in Virginia is largely determined by the decisions of individual landowners acting within the framework of local land-use policy. Slowing the loss of forestland due to conversion will involve influencing the land-use decisions of individual landowners as well as the land-use policies of the Commonwealth and its localities. A primary strategy, therefore, has been to test financial mechanisms that capture the natural capital benefits (e.g., carbon credits, water quality credits, wetland mitigation banking, recreational use fees on private lands, etc.) so they can be passed on to forest landowners and rural localities as alternative incentives for continued land stewardship efforts that support retention of working forest, agricultural and open lands and preserve open space and wildlands for recreation, watershed protection, and habitat preservation. This is the key goal of the Healthy Watersheds Forest phase III project referenced previously.

Virginia has made significant gains in permanently conserving land, but there is a need for increased efforts to ensure healthy, working forests will be retained for future generations, particularly as the urban and suburban portions of Virginia continue to expand. Even on private lands the Commonwealth already designates as permanently conserved, such as via a conservation easement, forest conversion to agriculture use is permitted in most cases. Additional opportunities for outreach to private landowners, particularly landowners who have not previously received assistance from a forestry agency, will be a key to conserving the forestry footprint in Virginia.

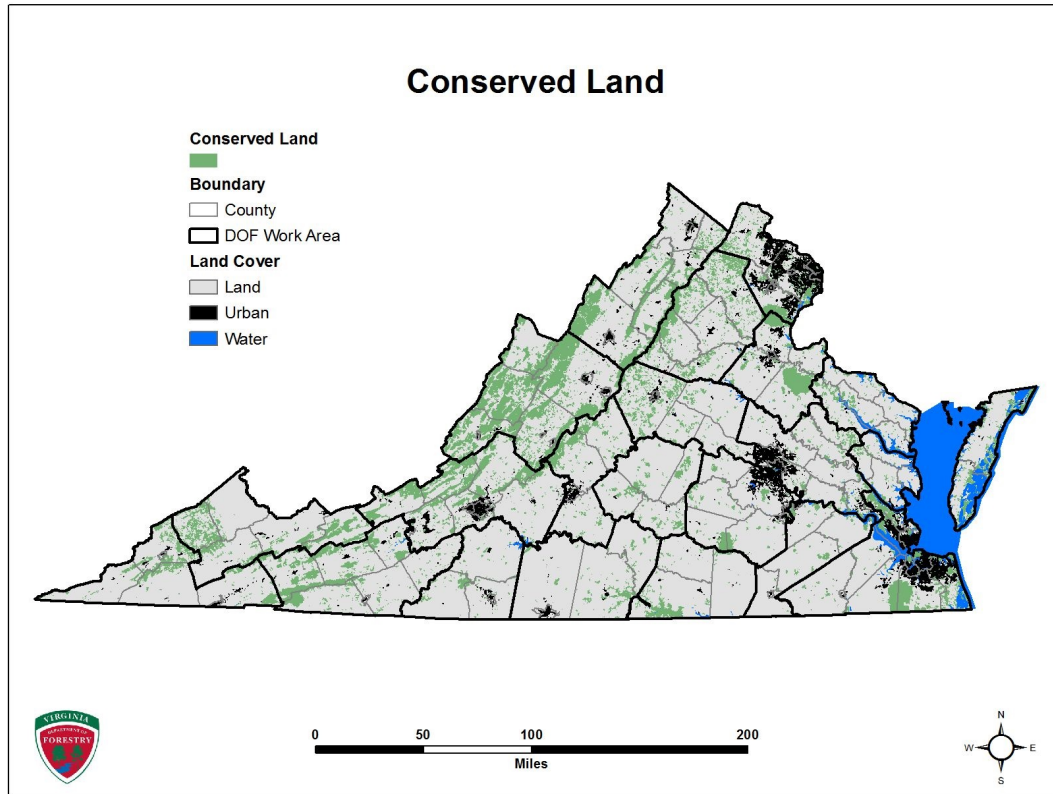


Figure 29. Virginia’s Conserved Lands as of 2020. Many of these conserved tracts are still susceptible to loss of forestland due to conversion.

Issue C2: Promote a Larger, Connected Forest Landscape

Issue Description

Larger, intact forests can support a greater diversity of plant and animal species while also resisting diseases and invasive species and providing unique recreational opportunities. Larger forests can also better support sustainable forest products timber management. However, forest fragmentation is increasing rapidly as roads, utility corridors and buildings break up forests into patches that are often too small to manage for timber or for conservation goals (e.g., supporting wildlife biodiversity). Unfortunately, communities often expend most of their resources in designing and constructing gray infrastructure (e.g., roads, utilities) at the expense of natural resources or “green infrastructure.”

In addition to having larger blocks of forests, it is also important to connect them. Comprehensive local land planning is essential to achieving important successes. When forests are isolated, species within them are at greater risk of decline since many species of animals and plants cannot readily recolonize isolated areas. Connecting forests through wide, vegetated corridors facilitates the movement of animals, pollinators and plants over time to ensure species can repopulate areas.

In addition to the widespread forest fragmentation across the Commonwealth, an underground pipeline project, the Mountain Valley Pipeline, is planned to cross portions of the Commonwealth. This pipeline will impact thousands of acres of forestland through fragmentation and a permanently open right of way. Approximately \$5 million of mitigation funds from the Mountain Valley pipeline are earmarked for forest enhancement. These funds are being administered by the US Endowment



for Forests and Communities. These funds have to be used on land protected from conversion, so they will be used for hardwood forest enhancement projects in the 25-county area around the Mountain Valley Pipeline route.

Opportunities to counter this trend of forest fragmentation are similar to those of traditional rural forest management but must be adapted to smaller scales. Outreach and education to private forestland owners is important. Education that promotes retaining intact forestland during family transfers, outreach to landowners who have not traditionally received services from forestry agencies, and programming that provides insights on small lot forest management are necessary. Virginia's Generation NEXT program, which is a collaboration between Virginia Cooperative Extension and VDOF, is an outreach program specifically targeted to forest landowners. These workshops have provided the necessary tools to landowners as they begin planning for intergeneration land transfers. Education is generally just the first step in reducing fragmentation of family forests. Additionally, contractors who are willing to work on small acreage blocks should be identified to ensure landowners have ready access to contractors able to manage their forests. Local government planners should be encouraged to plan their counties growth to minimize impacts on the largest blocks of forestland.

Priority Areas: Issues C1 and C2

To better focus forestland conservation efforts, VDOF's forestland conservation program has developed an updated Forestland Conservation Value (FCV) model (revised 2018 and 2020) that identifies the highest priority forestlands that are not under permanent protection for conservation in Virginia (Figure 27). The intent is to maximize the efficiency of limited resources by focusing forest retention efforts (Issue C1) on the highest quality, most productive and most vulnerable forestland statewide. The model uses the most up-to-date land cover data and considers six key components, including watershed integrity, size of forested blocks, management potential, proximity to other conserved lands, threat of conversion and diminished tree species. It then assigns a relative FCV rank to all forestland in the state from 1 (lowest) to 5 (highest). In order to prioritize connectivity in the forested landscape (Issue C2), the model inputs are weighted to boost scoring based on close proximity to conserved lands and large forested blocks.

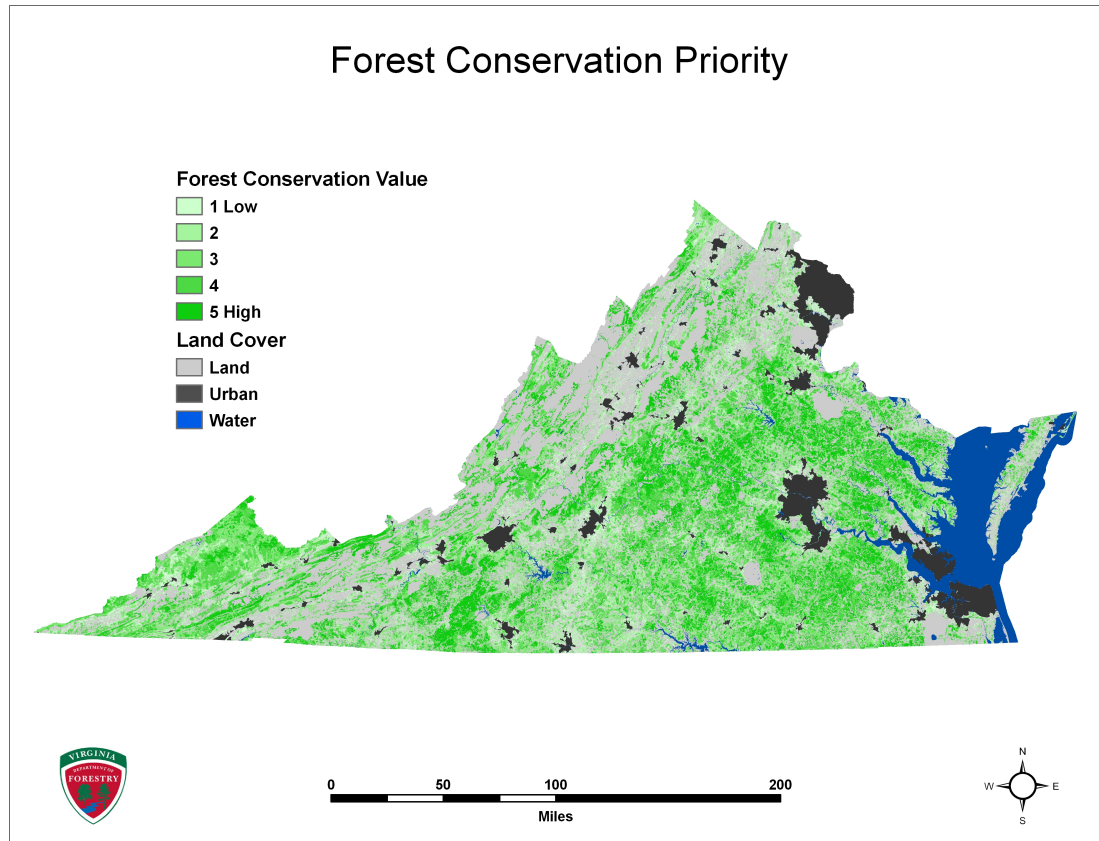


Figure 30: VDOF Forestland Conservation Prioritization (VDOF FCV model 2018).

Issue C3: Ensure the Sustainable Use of Forest Resources

Issue Description

Forests are dynamic ecosystems that contribute significant value in the lives of Virginians. Forests contribute to clean water, air, renewable energy, forest products, wildlife habitat, soil retention and local economies. The continued sustainable use of Virginia's forests is impacted by several factors, including loss and fragmentation of forestland, changing forest markets, forest health threats and a changing climate. More specifically, sustainability of a resource can be quantified by measuring forest growth, forest removals and losses due to mortality. Forest Inventory and Analysis (FIA) information is highly useful in tracking trends in sustainability. Growth is affected by forest management, silviculture and genetic improvements. Removals are closely tied to forest industry activity and markets, both domestically and globally. Mortality is closely tied to forest health, insects, disease, decline, and major and continuing weather (abiotic) events.

Current and past FIA data allows us to closely track sustainability by comparing net growth (growth less mortality) and removals (harvesting and land conversion to other uses). A ratio of growth to removals is an indicator of current conditions and trends. The overall trend for total wood volume is a long-term increase (more than double) since the first FIA survey was completed in 1940 (see figure 28 below). In terms of growth and removal, there tends to be slightly more variation on a year-to-year basis, but the overall trend is highly positive. The ratio of growth to removal is more than two-



and-a-half to one hardwood and nearly two-and-a-half to one for pine, meaning that there is more than twice as much wood being added than is being harvested.

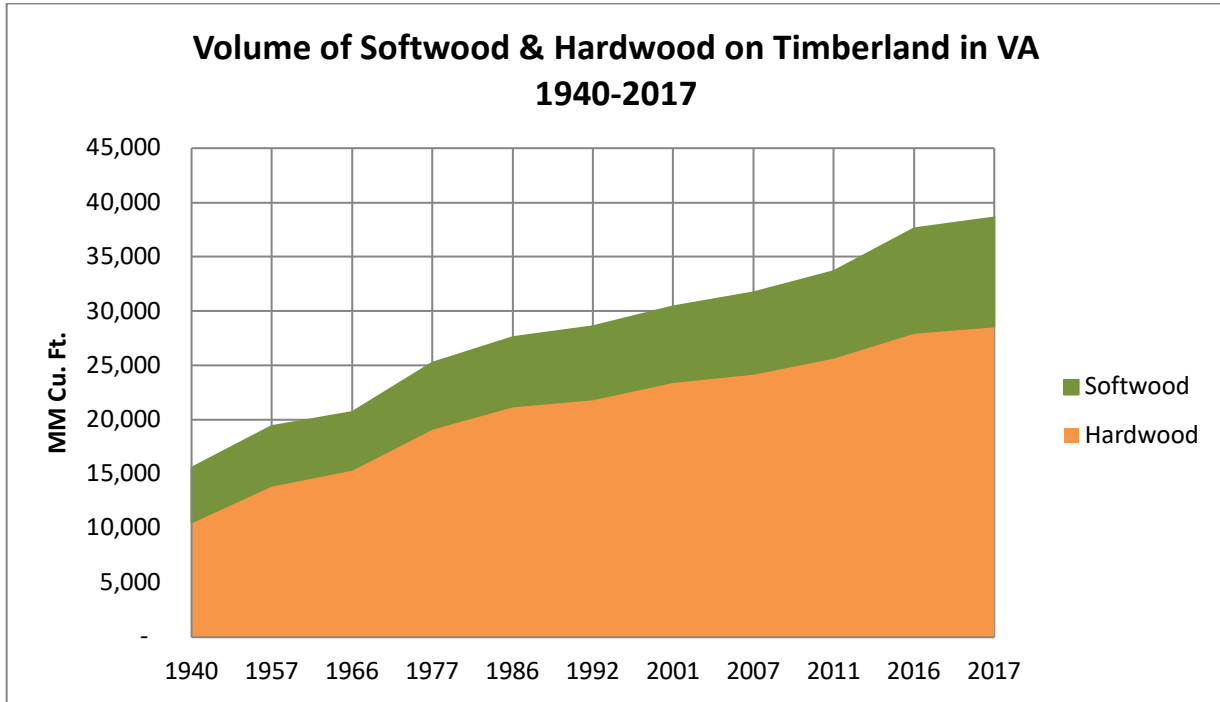


Figure 31. Virginia hardwood and softwood volumes over the period of 1940-2017.

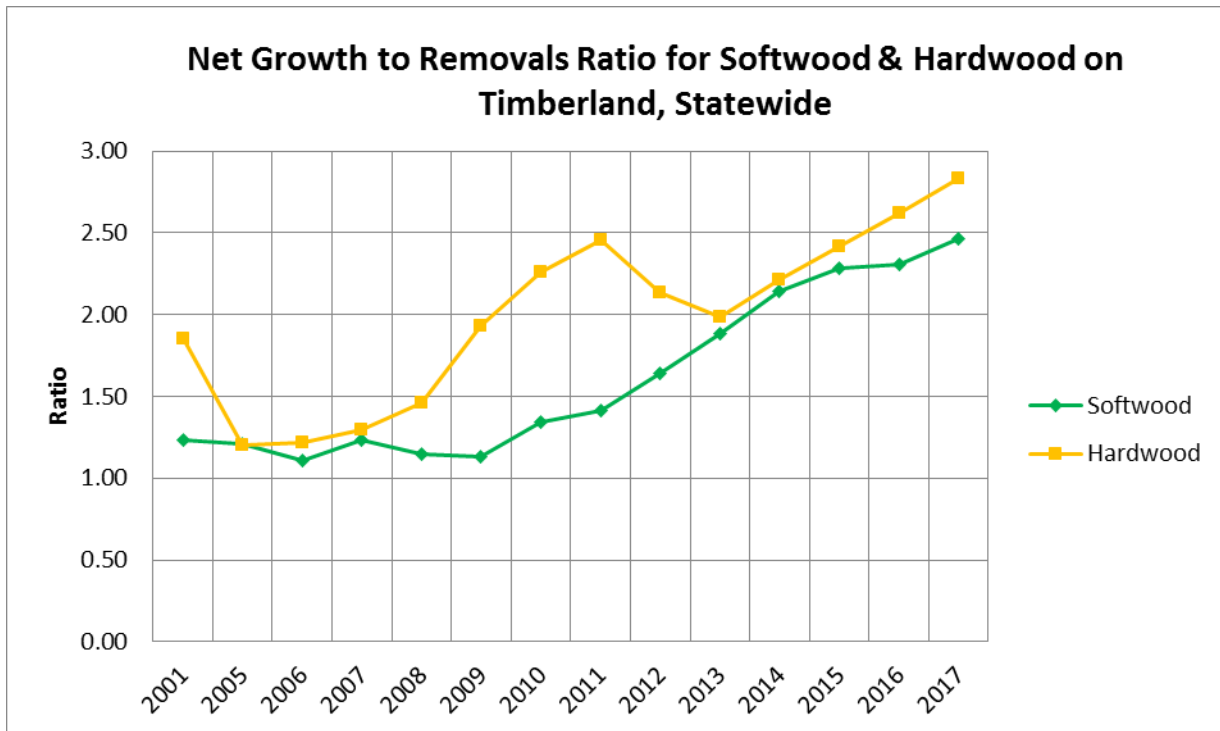


Figure 32. Virginia hardwood and softwood net growth to removals ratio over the period of 2001-2017.



Several specific elements have and will affect these trends. A dedicated focus on pine sustainability in southern and eastern Virginia in the past several years has yielded positive results. Dedicated staff, emphasis on best silvicultural practices, deployment of the best genetics and strong funding support from the Virginia Reforestation of Timberlands (RT) program have all contributed to this success.

Hardwood forests, while still adding volume, are being considered more carefully. A number of factors have and continue to impact the quality and species composition of our hardwood forests. These factors include markets limited to sawtimber, which resulted in generations of high-grading/selective harvesting. The practice of high-grading, along with nearly a century of fire exclusion, a major increase in invasive species and related forest health issues, and forest fragmentation, has resulted in significant species composition and quality issues that seriously threaten the sustainability of Virginia's vast hardwood resource. One concern is the scarcity of adequate oak regeneration in the forests, which is partially due to the exclusion of fire. Another concern involves invasive plants and invasive pests. Invasive species pose an enormous threat to forest health and have the potential to change the composition and structure of our forests. Gypsy moth, oak decline, emerald ash borer, thousand cankers disease, tree-of-heaven and paulownia are just some of the many invasive species that put Virginia's hardwood forests at risk. To address these concerns and to plan for a healthy, sustainable hardwood forest resource, VDOF, along with a broad base of interested partners, is launching a hardwood management program. This is aimed at identifying practices that have the best potential to improve hardwoods, including training and education for landowners and service providers, as well as the development of incentive programs.

A changing climate will affect forest health, distribution of certain species and the footprint of coastal forests. VDOF will monitor potential impacts to the forest and develop appropriate responses when impacts are identified. Effects along Virginia's coastal forests are the most evident thus far. Ghost forests have developed as coastal lands have been submerged and salinity increased in the water and soil. Sea level rise, land subsidence and salt water intrusion are significant issues that are being studied. Species migration, particularly at high altitudes and for species at the southern edge of their range (e.g., red spruce), is a real possibility. Inventory methods (notably Forest Inventory Analysis) should enable us to watch for overall changes in species dispersion and possibly conduct more detailed surveys if a potential problem is identified. VDOF will continue its efforts to restore shortleaf and longleaf pine to the landscape. Both of these species are drier-condition species that will fare better if some of the potential impacts of climate change are realized. Additionally, the salt tolerance of longleaf pine may allow for increased plantings in coastal areas of southeast Virginia.

One of the most cost-effective and beneficial means to mitigate the effects of climate change is to increase tree planting and practice science-based, active forest management. VDOF will continue to promote these practices, assist landowners with their implementation and educate the general public on the climate change benefits of forests and forest management.

Forest Sustainability Priority Areas

The priority area for sustainability, particularly pine sustainability, is focused in southcentral and southeastern Virginia. This geographic area represents the pine woodbasket of the Commonwealth where the majority of southern yellow pine management is currently occurring.

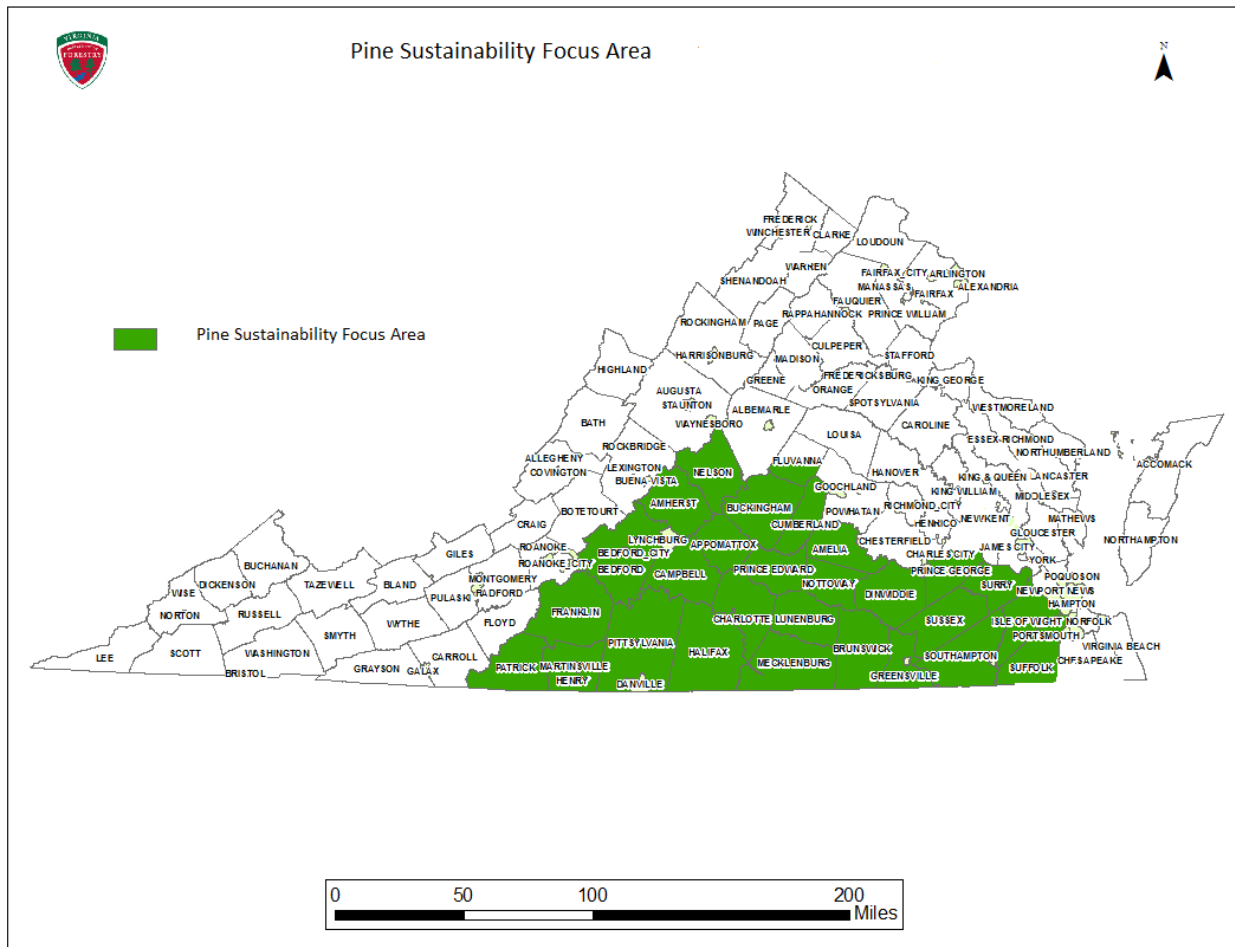
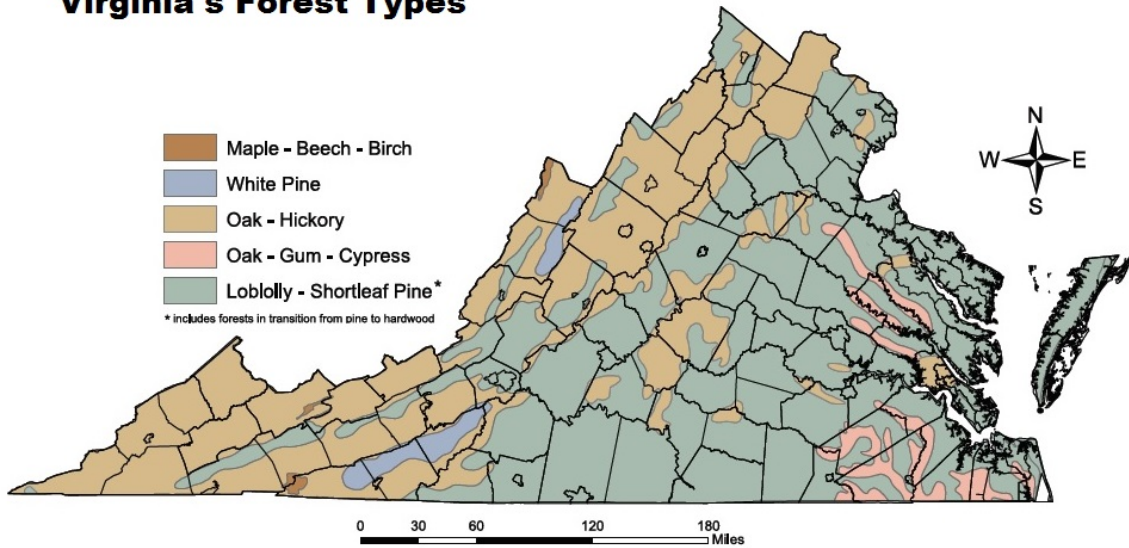


Figure 33. Map showing Virginia’s pine sustainability focus areas, labeled in green.

Hardwood sustainability efforts will be focused statewide to promote working hardwood forests and to support markets and service providers that are available. As the Virginia hardwood initiative is rolled out and fully implemented in the coming years, demonstration or target areas will likely be utilized first in areas of the Commonwealth that have primarily hardwood forests. The map below (Figure 34) shows the portions of the state that have primarily hardwood forest cover.



Virginia's Forest Types



Data source: Southern Forest Resource Assessment, USDA Forest Service - Forest Health Protection, September 1999

Our maps are for the Department's information and demonstration purposes and not legal descriptions of parcels intended for any commercial purpose. These maps should not be used for the design, modification, or construction of improvements to real property or for boundary or flood plain determinations. DOF does not assume any liability for any errors, omissions, or inaccuracies in the information provided regardless of the cause of such or for any decision made, action taken, or action not taken by the user in reliance upon any data provided herein. Any use of the maps assumes that you understand and agree with the information provided in this disclaimer.

Figure 34. Virginia's general forest cover types, showing the primarily hardwood and pine areas of the Commonwealth.



Section V

Multi-State Issues and Priority Areas

Nature in general, and forests in particular, are not easily contained within human-made, artificial, administrative boundaries, such as state borders. Often, impacts to forests come from a variety of sources, including neighboring states and even other countries. When impacts come from a variety of sources and/or jurisdictions, ways to deal with those impacts generally must be a collaborative effort among the jurisdictions from where the impacts originate.

Possibly the best example of this in the eastern US is the massive effort to restore the Chesapeake Bay to its original vitality. Impacts enter the Bay from six states and the District of Columbia. Untold state, county and municipal administrative areas overlay the Bay’s 62,499 square miles of drainage area. Without cooperative efforts from these many different areas, few gains can be made in the cleanup effort.

Much like the Chesapeake Bay, forests spread across many jurisdictions. Sometimes, priority areas for improving these forests will need to be multi-state in nature. During the course of Virginia’s statewide forest assessment, several potential multi-state priority areas were identified. These include:

Potential Multi-State Priority Areas	
Multi-State Issue	Cooperating States/Entities
Chesapeake Bay Restoration	WV, MD, PA, NY, DE, DC, Federal Agencies
Emerald Ash Borer	KY, TN, NC, VA, other southern states
Southern Pine Beetle	NC, TX, VA, other southern states
Upland Oak Initiative	DE, PA, IA, WV, MD, NY, OH, NJ, MA, MO, Southern States
American Chestnut Restoration	NC, WV, TN, KY, MD, American Chestnut Foundation
Longleaf Pine Restoration	Atlantic and Gulf Seaboard states
Shortleaf Pine Restoration	Range-wide in 19 states
IMT leadership Development	Southern States
Wildfire Prevention	Southern States
Wildfire Arson	Southern states
Wildland-Urban Interface Hazard Mitigation	Southern states

Figure 35. Primary issues affecting regions large than Virginia.



Chesapeake Bay Restoration

Sixty percent of the Commonwealth of Virginia lies within the Chesapeake Bay watershed. Figure 33 shows the entire bay watershed and the six states within which it lies.

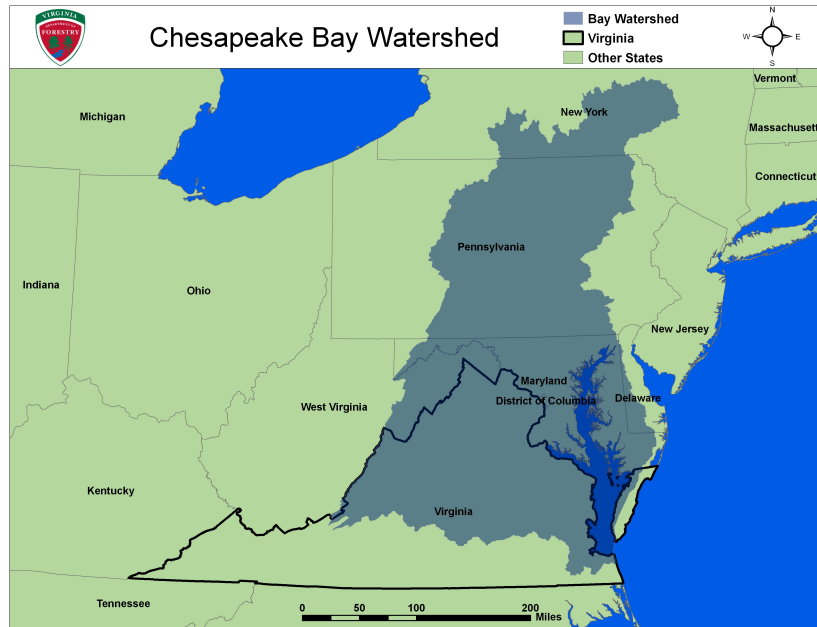


Figure 36. Chesapeake Bay watershed area.

The Chesapeake Bay is the country's largest estuary and a National Treasure. In 2014, the six watershed states, the District of Columbia and the federal government signed the Chesapeake Bay Watershed Agreement. Building upon decades of previous partnership agreements between the states and the federal government, the 2014 agreement set goals for habitat, water quality, aquatic organisms and stewardship.

As one of the three states containing the largest portion of the watershed, Virginia has a long history of economic integration with the Bay and has been participating in restoration efforts for the past 25 years. Federal efforts have begun to ramp up to address the Presidential Executive Order 13508, "to protect and restore the health, heritage, natural resources, and social and economic value of the nation's largest estuarine ecosystem and natural sustainability of its watershed," and the subsequent Total Maximum Daily Load (TMDL) development for the Chesapeake Bay.

VDOF has been actively engaged in participation on the Chesapeake Bay Forestry Work Group since its beginning in the late 1980s and, as a result of that participation, has been engaged in the development of the Chesapeake 2000 agreement among the various signatory states and the District of Columbia that is the foundation for the various Executive Committee Directives involving the Bay restoration effort to date. Three of the major restoration directives directly involving forestry actions in which VDOF is actively engaged are: (1) The restoration and establishment of riparian forest buffers and establishing new forests (afforestation); (2) conserving forested acres on areas identified as forests of "high-value," and (3) development of goals for urban tree canopy establishment and restoration in urban areas throughout the Bay watershed. VDOF will continue its involvement in this important effort for Chesapeake Bay restoration.

The Bay restoration effort and VDOF involvement will continue to be a priority for the agency as well as many other agencies within the Virginia Secretariats of Agriculture and Forestry and Natural



Resources. The increased emphasis on the Bay cleanup effort as a result of the Presidential Executive Order will require all signatory states and the District of Columbia to participate in the renewed effort and will have to incorporate new and innovative mechanisms for the environmental restoration effort. Virginia has developed a Watershed Implementation Plan (WIP) to meet goals for Bay water quality improvement. For these collaborative efforts to achieve the scale of success necessary to improve and restore the Bay, both federal funding and federal collaborative leadership will be vitally important.

Forest Health Issues

VDOF is significantly involved in a variety of forest health issues, including the efforts to combat the impacts of native pests such as the southern pine beetle, established invasive species such as the emerald ash borer, and new emerging threats. Many of these efforts are funded by federal grants, mostly from the USFS. Virginia would like to participate in multi-state collaboration with these issues but would require additional funding, perhaps through the Landscape Scale Restoration (LaSR) Program, to do so.

Emerald Ash Borer

VDOF's emerald ash borer (EAB) program is currently funded by a multi-state USFS LaSR grant. This project, entitled "The Grand SLAM: Slowing Ash Mortality in the South", is a cooperative effort among Virginia, North Carolina and South Carolina. The SLAM strategy was developed in 2009 by McCullough et al. in Michigan and we aim to adapt SLAM to southern landscapes to minimize ecological and economic losses of ash trees. Our "Grand SLAM" approach has the following four objectives: (1) protect high-value trees in urban settings; (2) manage ash on state and private forestland using integrated pest management; (3) conduct outreach at minor league baseball games to disseminate information to the public, and (4) collaborate with wood utilization and fire protection programs to address the hazards of standing dead ash and tree removal. This multi-state project includes states in different stages of the EAB invasion wave and Virginia's EAB coordinator will work with other southern states to share expertise, provide technology transfer and facilitate a cohesive strategy.

Southern Pine Beetle

Virginia participates in a region-wide southern pine beetle (SPB) survey every spring and monitors the landscape for bark beetle spots throughout the year. This data is then applied to models that predict the probability of future SPB outbreaks on a county level. These multi-state survey efforts are coordinated and funded by the USFS Southern Pine Beetle Prevention Program. This federal program has supported VDOF's pine bark beetle prevention program since 2004 by providing funds to three kinds of projects in addition to the necessary and routine functions of detection and evaluation. Most important and helpful has been the establishment of a cost-share program to enable thinning of overstocked stands. Pre-commercial thinning (PCT) and first commercial thinning are important tools for reducing the potential impacts of SPB, but PCT is often seen as not economical by many landowners due to up-front costs. Thus, despite the intrinsic benefits, there is a need for cost-share incentives to make this practice more widespread on private forestlands. Secondly, federal support has allowed us to begin restoration of native longleaf pine in those areas where it once flourished. Thirdly, we have been able to restore recently infested pine on certain state forest lands, some of which would otherwise have reverted to stands of mixed species and ages, which are very difficult to manage.



Diminished Species Restoration

American Chestnut

VDOF has long been involved in American chestnut restoration with its archiving of hybrids and back-crossing work at Lesesne State Forest. VDOF has been cooperating with the American Chestnut Foundation by raising Foundation seedlings at our nurseries and planting them at Matthews State Forest. More recently, VDOF has assisted the Forest Health Initiative scientists at the University of Georgia and the USFS Southern Research Station in their efforts to safely and effectively develop an American chestnut that is resistant to the chestnut blight and root rot and which can be safely restored to our forests. Commitment to American chestnut restoration spans beyond the borders of the Commonwealth, with a high level of interest in states throughout the original range. As research advances, and blight-resistant planting stock becomes more reliable and available, implementation will follow. This has already started, with work on National Forest land and in surface mine reclamation in other states.

Longleaf Pine

Virginia is the northern terminus of the range of this distinctly southern tree. Virginia has been engaged with the larger restoration efforts occurring across the south (such as those efforts by American's Longleaf and the Longleaf Alliance). More particularly, Virginia has partnered with North and South Carolina on joint longleaf-focused initiatives and grants. In particular, VDOF partnered with North Carolina Forest Service to grow longleaf seedlings. The Virginia Longleaf Cooperators Group began in 2012, and this loosely organized group has been very effective with moving restoration forward through collaborative burning, cone collection, site preparation, planting, outreach and financing. From a few hundred remaining native trees at the turn of the 21st century to an estimated 10,000 acres in a period of 20 years, longleaf restoration is working.

Shortleaf Pine

Shortleaf pine has been a declining forest component throughout much of its range since the 1940s; extensive harvesting, conversion to loblolly pine, agriculture, development and natural forest succession have decreased this forest type to a mere fraction of its previous abundance. Virginia has been engaged with the Shortleaf Pine Initiative, a range-wide restoration program, and has participated in forest management efforts with nearby southern states. In Virginia, VDOF efforts have focused on revitalizing orchard and seed production, landowner assistance, and funding through state and federal partners.

Upland Oak Initiative

Oaks are the preferred hardwood species throughout their range in the eastern U. S., prized for lumber, wildlife value and their beauty. Active hardwood silviculture on private land has lagged far behind that of pine. Additionally, oak is facing many challenges, such as aging cohorts, oak decline, invasive and native insects and diseases, and regeneration challenges due to deer and poor stand conditions. Markets and demand for quality oak, particularly white oak, has generally been increasing, leading to concerns over sustainability. To address this, Virginia launched a Hardwood Management Initiative in 2019 as a long-term approach to improve the resource. Regionally, the White Oak Initiative also started with partners across the range of white oak, with headquarters in Kentucky. Virginia is allied with many other states as these efforts develop. These regional efforts will include technical training, research, outreach, demonstration, and implementation of practices.



Incident Management Team Leadership Development

Effective emergency incident management requires a unique mix of experienced personnel with specialized expertise in many different operational areas. Ultimately, incident management team (IMT) personnel are pulled together for the purpose of organizing, directing and managing the operational and logistical needs of the assigned response resources. On top of needing to be proficient in all aspects of emergency incident operations, IMT members also need to be effective personnel leaders and managers. As all agencies struggle to transfer the institutional knowledge of their more experienced and seasoned employees to the younger staff members, leadership development and training is often one shortcoming of the new employee development process. Virginia, working alongside the 12 other Southern states, has made it a priority to increase the quality and quantity of leadership-focused training for agency incident managers. Seizing continued opportunities for both multi-state cooperation and funding in this area will help to maintain a high level of incident management readiness for all agency cooperators.

Wildland Fire

Wildfire Prevention

Debris burning and arson remain among the top causes of wildfire in Virginia and throughout the southeastern US. Efforts to raise the public awareness of these problems, in an effort to prevent unwanted human-caused fires, are a priority of all wildland fire suppression agencies. Multi-state information and education programs are very effective strategies which have proven themselves successful for many years. Continued collaborative efforts focused on all aspects of wildfire prevention will remain an effective strategy throughout the southern US.

Wildfire Arson

Effective wildfire prevention programs must rely on a two-pronged approach of wildfire prevention and wildfire law enforcement. While enforcement actions related to outdoor debris burning are fairly straightforward to implement, the challenge of combating wildfire arson often taxes the already limited resources of wildfire suppression agencies. In certain areas across Virginia, arson remains the leading cause of wildfire. Arson enforcement is the most effective strategy for eliminating these unwanted fire starts. Successful arson enforcement programs must rely on multiple-agency coordination, supported by targeted funding, using additional personnel at the local level. This focus remains a priority for Virginia.

Wildland-Urban Interface Hazard Mitigation

Nearly every state in the US is facing the expansion of residential construction into the wildland-urban interface (WUI). Human population movement into more rural areas places property, natural assets and human lives at increasing levels of risk from the damages of wildfire. Virginia is a nationally recognized leader in the area of WUI hazard mitigation and plans to work with other state cooperators across the south to complete mitigation programs designed to better protect higher risk communities from the potential damages of wildfire. The foundation of our effective program includes promotion of the Southern Wildfire Risk Assessment, planning efforts in high-risk residential communities, and targeted use of available hazard mitigation funding.



Section VI:

Program Areas within the Virginia Department of Forestry

VDOF has a number of program areas, each generally focused on a specific forest resource or aspect of forestry in Virginia or specifically tied to a national-level program of the USFS. These program areas are administered at the agency headquarters level, with a majority of the projects and activities being conducted through our field staff assigned to the three operational regions. Six program areas are specifically tied to USFS program areas. These include:

- ◆ Wildfire Suppression, Prevention and Public Safety
- ◆ Forest Health
- ◆ Forest Legacy/Land Conservation
- ◆ Forest Stewardship and Management
- ◆ Urban and Community Forestry
- ◆ Forest Inventory and Analysis (FIA)

In addition, other notable VDOF program areas include:

- ◆ Water Quality
- ◆ Forest Research
- ◆ Tree Improvement
- ◆ Forest Products Marketing and Utilization
- ◆ Ecosystem Services
- ◆ Conservation Education
- ◆ Tree Nursery Program
- ◆ State Forest System

Wildfire Suppression and Public Safety

Program Overview

VDOF is responsible for the suppression and management of all wildfires in the Commonwealth occurring on private and state-owned lands. VDOF's unique mix of county-based emergency response personnel along with specialized tools and equipment routinely pulls the agency into other key public safety roles during almost any local and/or statewide emergency. VDOF is one of the Commonwealth's Virginia Emergency Support Team (VEST) agencies called upon when the Governor declares an emergency.

VDOF maintains active wildfire suppression-based cooperative agreements with the federal land management agencies in the Commonwealth and is a participant in multi-state wildfire suppression compacts. The agency's cooperative links to these agreements helps to ensure that Virginia remains effectively and efficiently focused on wildfire prevention and suppression, regardless of forest ownerships.



Each year, the wildland firefighting efforts of VDOF protect more than 1,600 homes and other structures. These protected structures have a value in excess of \$155 million. Sadly, nearly 70 buildings of various types are damaged or destroyed by wildfires every year. As part of our important legislative mandate to protect the homes, businesses and woodlands of the Commonwealth from wildfire, VDOF responds to nearly 800 wildland fires that burn more than 12,000 acres annually (based on a 10-year average, 2008 – 2017).

The agency relies on highly trained and experienced personnel operating a fleet of 160 4x4 engines, fourteen specially equipped wildland brush trucks and 89 bulldozer/wildland fire-plow suppression units for quick response to any reported wildland fire or other weather-related emergency. The assistance of Virginia's 768 fire departments and close working relationships with federal land management agencies and other public and private landholders in the Commonwealth ensure that wildland fire response in Virginia is both efficient and effective.

VDOF fire suppression operations are organized at the county level and rely on close cooperation with local fire department resources. County personnel are linked to one of three VDOF regional offices that provide dispatch coverage, a common communications network and the ability to easily combine local resources for larger incidents. VDOF responders are unique in that they must fill roles in fire management and suppression, as well as being forestry law enforcement officers for the Commonwealth.

VDOF's experience in emergency incident management has made the agency one of the leads for all risk incident management teams (IMT) in Virginia. This specialized skillset has proven to be a vital asset in recent natural disasters, such as tornado outbreaks, large wildland fires (including South Hill, Eades Hollow, Mount Pleasant, and Rocky Mountain) and the 2009/2010 winter storms.

On a national basis, VDOF wildland fire managers have come to the aid of other states across the nation. Recent IMT deployment to Hurricane Harvey in Texas, along with an average of more than 90 out-of-state agency wildland firefighter deployments annually, show the agency's level of experience and overall willingness to provide assistance to others in times of need.

Program Focus Areas

Firewise Virginia Program

VDOF initiated a program in the early 1980s to focus wildfire prevention and hazard mitigation efforts at Virginia's highest risk woodland home communities. The program provided information and cultivated the community spirit in these targeted communities to push homeowners into taking more responsibility for making their property, and the community as a whole, more fire safe. A culminating feature of this effort was the development of a comprehensive pre-suppression plan that VDOF referred to as a "Woodland Home Plan." Once established, a community was revisited at least every five years for prevention-focused information and to complete any needed updates of the plan.

During the next 20 years, VDOF continued to expand its program as the number of woodland home communities in Virginia grew exponentially.

By early the 2000s, VDOF had incorporated the then-emerging national Firewise USA Community program into this effort, and by the end of 2018, Virginia was one of the top 20 states in the number of identified Firewise USA communities, with 41 recognized communities statewide.



Community Wildfire Protection Plans

A key tool of any targeted woodland home community is the Community Wildfire Protection Plan (CWPP). Virginia's CWPP development has taken advantage of earlier efforts with the development of Woodland Home Plans and incorporated key ideas as outlined under the Healthy Forests Restoration Act (HFRA) as passed by Congress on November 21, 2003. The act clearly defined the role and importance of CWPPs and outlined how they may directly relate to hazardous fuel reduction funding in years to come. VDOF has completed CWPPs for nearly 400 high-risk communities; however, this represents only slightly more than 10 percent of Virginia's highest-risk communities, so the effort continues.

Key points for any CWPP, as defined within the HFRA, include:

- ◆ CWPPs are generally developed by local government with assistance from state and federal agencies and other interested partners.
- ◆ Plans can take a variety of forms and may be as simple or complex as necessary, based on the specific needs and desires of the local community or county.
- ◆ Plans do not need to be complicated, but they should effectively address local forest and range conditions, values-at-risk and priorities for action.

The minimum requirements for a CWPP are:

- ◆ **Collaboration**– a CWPP must be collaboratively developed by local, state and federal officials as appropriate.
- ◆ **Prioritized Fuel Reduction**– a CWPP must identify and prioritize areas for hazardous fuel reduction treatments to reduce the wildfire risk to the community.
- ◆ **Treatment of Structural Ignitability**– a CWPP must recommend measures that communities can take to reduce the ignitability of structures in the area covered by the CWPP.

Statewide Wildfire Risk Assessment

VDOF completed a GIS-based, statewide wildfire risk assessment product in 2001. Taking advantage of the latest GIS technologies, the assessment – which was completed by VDOF in the early 1990s – expanded on a county-by-county assessment of conditions. This product provided an unbiased tool to help qualify and quantify Virginia's overall wildland fire risk.

Using this tool, a wildfire hazard rating of low, medium or high was established for all areas of the Commonwealth. The established hazard ratings can then be used in conjunction with key overlays, such as woodland homes or dry hydrants, to prioritize key agency program needs and focus areas.

In 2005, the GIS-based efforts were further supplemented by the regionally-based Southern Wildfire Risk Assessment (SWRA), a collaborative effort of the Southern Group of State Foresters. Established to provide a uniform GIS-based information tool for the entire southeastern US, the SWRA validated the results of the earlier VDOF-initiated risk assessment for the Commonwealth and provided a means to better compare and prioritize Virginia needs with those of the other 12 southeastern state forestry agencies.

Results of the SWRA revealed that more than one third of Virginia is rated as moderate to extreme wildfire risk to people and their homes and nearly one half of the state is rated as moderate to very high in terms of significant fuel hazards and the potential for dangerous fire behavior.



In 2014 the SouthWRAP Internet Portal opened, giving VDOF field staff an interactive tool to assist with the Firewise program, support suppression efforts and provide additional opportunities to collaborate with partner groups.

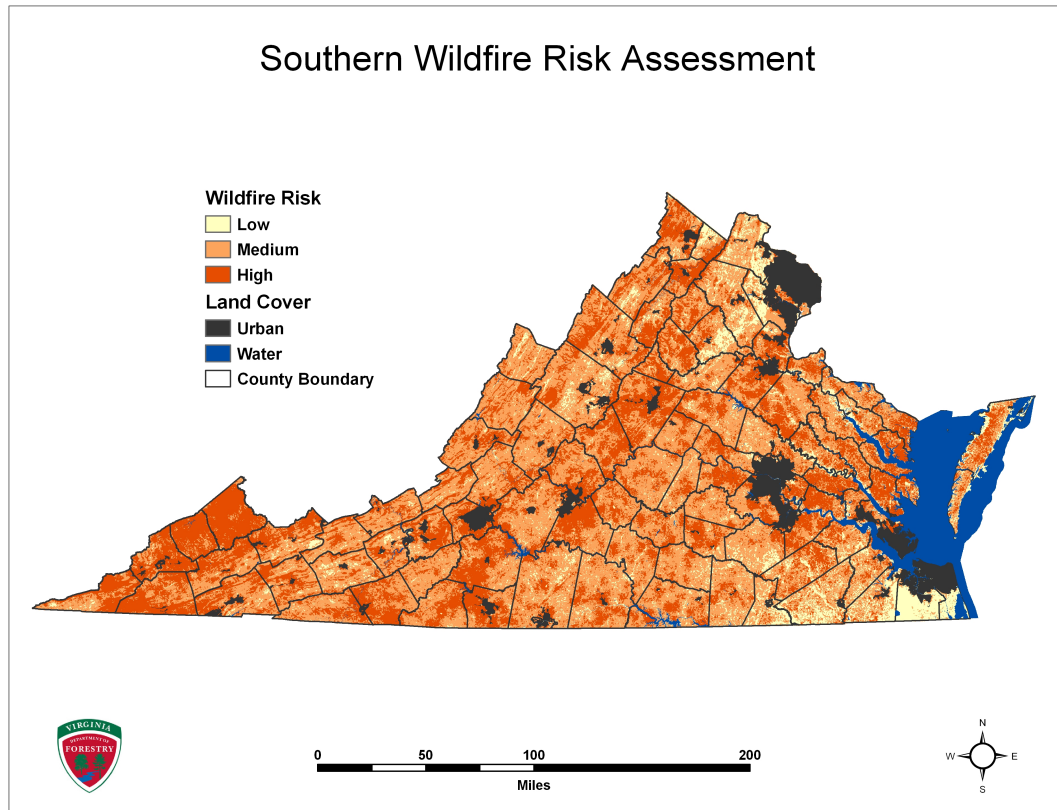


Figure 37. Virginia portion of the Southern Wildfire Risk Assessment (SWRA)

Moving forward, key focuses will include updating the original data layers, highlighting the higher priority needs of the Commonwealth and comparing Virginia needs to those of the other states.

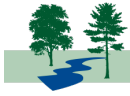
Dry Hydrant Program

The Virginia Dry Hydrant Grant Program is funded by the General Assembly using money from the Virginia Fire Programs Fund. The program is administered by the Department of Fire Programs and VDOF and is assisted by an advisory committee.

The objectives of the program are to:

- ◆ Establish new dry hydrants to improve the rural water supply for fire suppression needs;
- ◆ Conserve energy by reducing miles traveled to shuttle water;
- ◆ Reduce losses from wildland and structural fire, and
- ◆ Conserve processed domestic water supplies in urban and urbanizing areas.

All fire department entities within the Commonwealth of Virginia are eligible to apply for the program on an annual basis.



Volunteer Fire Assistance Program (VFA)

The Volunteer Fire Assistance Program is a pass-through grant-funded program of VDOF. The USFS provides funding for the program, and VDOF administers the program in Virginia.

The primary program goal is to increase the fire protection capability in the Commonwealth. This is accomplished by making available financial assistance to rural volunteer fire companies to provide additional training and the acquisition of small equipment and wildland personal protective equipment (PPE). Since the 1975 inception of this program, 5,857 grants have been made that provided a total of \$4,427,927 in matching grant funds.

The grant program improves the capability and effectiveness of America's 26,000 Rural Volunteer Fire Departments – 580 of them in Virginia – to protect lives and other rural investments.

Wildfire Prevention

Virginia's natural resources put the “wealth” into our Commonwealth. The past, present and future quality of life and economic prosperity for our citizens is linked to the State's forest resources. VDOF is responsible for wildfire protection on private and state forestland. While fire can play a beneficial role in the forest ecosystem, it can also be a destructive force that endangers these natural resources, our property and even our lives. There is a reason Smokey Bear changed his slogan to "Only You Can Prevent *Wildfires*" – the destruction of land by fire has expanded beyond just the forest. Wildfire refers to any uncontrolled, outdoor fire, anywhere.

The loss of our natural resources affects all of us, and forests provide more than just fiber for the wood products industry.

Prior to the establishment of the Virginia Division of Forestry in 1914 (in 1984 it became the Virginia Department of Forestry), it was not uncommon for many hundreds of thousands of acres of forestland to be burned in wildfires each year. One of the main roles of the newly established Division of Forestry was to “prevent the destruction of forests by fire.”

It took several years for the Division of Forestry to develop programs, initiate laws, build a workforce and develop cooperation with various timber-related industries and the USFS, which itself was established only nine years earlier.

Fire occurrence began to drop in 1927, due to a combination of factors that formed the foundation of Virginia's wildfire prevention program, which continues today. The main aspects of Virginia's program include education and law enforcement. VDOF considers law enforcement to be an integral component of the State's prevention campaign and views it as a learning opportunity for the public, not just a punitive tool.

Law Enforcement

The VDOF law enforcement program is based on and revolves around several Virginia statutory legal codes. Primary to the VDOF program is the Virginia code § 10.1-1136, which gives forest wardens power to “enforce all forest and forest fire statutes and regulations of the Commonwealth.” In addition, according to code § 10.1-1124, Virginia counties and certain cities pay annual sums for the State Forester to furnish forest fire protection, prevention, detection and suppression services and, thus, all associated forest fire statutes. On July 1, 2009, this “fee” was raised to \$0.09/acre of commercial forestland.

All VDOF field personnel attend an agency provided Law Enforcement training to learn about the various wildland fire codes, issuing court summonses for violations, procedures for completing fire



reports, officer survival techniques, “first responder” expectations and information on basic wildland fire origin and cause determination. An advanced fire origin and cause determination course, emphasizing the importance of determining a wildfire’s cause, is also offered.

Education

Virginia has been and continues to be a leader in wildfire prevention education. Since Smokey Bear’s inception in 1944, Virginia has used the wildfire prevention mascot Smokey as a focal point in delivery of an educational campaign, especially directed to school-aged children throughout the Commonwealth. Smokey Bear programs are delivered in every rural county and most urbanized counties in Virginia. Reducing human-caused forest fires is considered an agency “key measure” by the Governor’s office.

Smokey and his messages of “Only You Can Prevent Wildfires”, “Smokey’s Friends Don’t Play with Matches and Lighters” and “Always Be Careful with Fire” have served the agency well.

As mentioned earlier, determining the causes of wildfires is critical to developing messages and programs addressing those causes in an attempt to reduce the incidence and extent of wildfires. Since 95 percent of all wildfires are the result of human negligence in Virginia, we have the opportunity to reduce this negative impact through a strong prevention education program. The leading causes of human-related wildfires are uncontrolled debris burning, woods arson, the careless discarding of smoking materials, unsafe equipment operation and unattended campfires.

Each of these “causes” is addressed in a variety of ways – from school Smokey Bear programs targeting pre-kindergarten through third graders, to the use of our web page and other social networking, as well as through a variety of campaigns using mass media to reach adults.

Forest Health

Program Overview

Forest health is an essential part of our economy and provides benefits to humans and wildlife populations in Virginia. VDOF monitors the Commonwealth for major forest health disturbances, including insect pests, pathogens, non-native invasive plants and severe weather events. Pest problems particular to Virginia include recurrences of the southern pine beetle (SPB) as well as threats from a number of non-native, invasive pests such as gypsy moth, hemlock woolly adelgid, emerald ash borer (EAB), beech bark disease and thousand cankers disease. Recent droughts have exacerbated oak decline while non-native invasive plants run rampant in our forests following disturbances and forest fragmentation. Collectively, these problems directly cost the commonwealth tens of millions of dollars per year, with millions more likely in indirect costs. The data collected via forest health monitoring activities in Virginia is used to help forest landowners make informed management decisions.

VDOF has one forest health program manager, one forest health specialist and six field personnel that have been designated as forest health liaisons and agree to spend five percent of their time assisting with forest health monitoring activities. The VDOF forest health program receives numerous federal grants to support survey, monitoring and special projects for pests such as EAB, SPB and hemlock woolly adelgid. In some cases, it is difficult if not impossible, to carry out the work associated with some of the grant-funded projects relying solely on VDOF forest health staff. Therefore, we make extensive use of pass-through agreements, particularly with Virginia Tech, to accomplish survey or



research projects. These mutual agreements utilize the time and expertise of university researchers while supporting their academic programs.

The forest health program at VDOF aims to protect and improve the forest resource in Virginia, and makes recommendations and decisions based on unbiased scientific data. The mission of VDOF's forest health program is:

- ◆ To survey and monitor Virginia for major forest pests, pathogens, non-native invasive plants and other disturbances;
- ◆ To collect and summarize these data and report them to VDOF and USFS annually, and provide information upon request to all other interested parties, and
- ◆ To provide outreach and assistance to VDOF foresters, private industry, forestry consultants and Virginia forest landowners regarding pest identification and general forest health conditions and concerns.



Program Focus Areas

Forest health disturbances may cause economic and ecological damage to the urban and rural forests of Virginia, now or in the future. VDOF's forest health program monitors for and develops widespread awareness of important insects, pathogens and non-native invasive plants. Additionally, the forest health program staff continues to train VDOF personnel, other state and federal partners, and municipal and non-profit agencies to deal with these issues. Invasive plant awareness and eradication demonstration areas are developed through partnerships throughout the state. Pest management is accomplished through projects incorporating numerous activities engaged in insect, pathogen, and invasive plant management. VDOF's forest health program's scope of work includes prevention, detection, and forest health monitoring, technical assistance, and evaluation.

Prevention

Partnerships

Regular communication with forest health professionals in Virginia and other states is a priority throughout the year, particularly about new developments and information on the spread of invasive insects like EAB, spotted lanternfly and gypsy moth. By maintaining engagement with other forest health professionals, we learn from previous experiences and ensure that we are working in the most effective and efficient manner. The VDOF forest health program is a member of the Virginia Association of Forest Health Professionals, the Southern Group of State Foresters Forest Health Committee, and attends the annual Southern Forest Insect Work Conference. Partnerships with other state agencies, such as the Department of Agriculture and Consumer Services (VDACS), the Department of Conservation and Recreation and the Department of Wildlife Resources (DWR), foster collaboration across the Commonwealth. VDOF is a member of the Virginia Invasive Species Working



Group chaired by the Virginia Secretary of Natural Resources and the Virginia Secretary of Agriculture and Forestry with an objective to coordinate the development of strategic actions to be taken by the Commonwealth, individual state and federal agencies, private businesses and landowners related to invasive species prevention, early detection and rapid response, control and management, research and risk assessment, and education and outreach.

Outreach

Information concerning new and emerging forest health threats is disseminated to pertinent individuals and organizations via educational programs and materials. The VDOF forest health staff give forest health update presentations at workshops to civic groups, landscapers, arborists and the urban forestry community. Early detection and prevention are always emphasized during these presentations since prevention is almost always less costly than treatment of an established pest. Landowners are encouraged to maintain and improve forest health through pre-harvest planning, appropriate regeneration, careful thinning, sanitation, BMP implementation and timely harvest. Publications and other educational material are produced when grant funds are available. Forest health information is provided to news media as warranted and requested; interviews with various newsprint and television stations are conducted throughout the year.

Early Detection

There are many potentially destructive pests that are not yet found in Virginia but could cause severe widespread damage if introduced to our forests. Early detection and rapid response (EDRR) is the best defense if prevention fails. EDRR increases the likelihood that, if an invasive pest is found, it will be eradicated before it becomes established. VDACS surveys for regulated pests and VDOF works with the Cooperative Agriculture Pest Survey program to communicate any further survey needs. Virginia is routinely monitored for Asian longhorned beetle and other exotic wood boring beetles, and the state participates in EDRR surveys when requested by the USFS. These surveys are conducted in high-risk sites including nurseries, log yards and lumber mills. VDOF monitors for laurel wilt disease in red bay and sassafras trees and is continually on the alert for potentially-destructive pests such as the *Sirex* woodwasp. Information regarding looming forest health threats is distributed at workshops and trainings to increase awareness in the state.

Detection and Forest Health Monitoring

Trapping

Insect traps are placed in Virginia to survey for emerging pests and to monitor the spread of established pests. Purple prism traps are placed throughout Virginia to monitor for EAB in areas where ash damage had been observed, but the county remains “unconfirmed” until an EAB specimen is recovered. Lingren funnel traps are installed every spring as part of a southern-wide SPB survey. This system for predicting SPB infestation trends using pheromone traps has been implemented across the South since 1986 and the results are used to forecast future SPB outbreaks. VDOF periodically deploys EDRR traps to monitor for bark and ambrosia beetles and specifically traps for the redbay ambrosia beetles in sites that are high-risk for laurel wilt disease. In some cases, VDOF forest health staff will sort and identify specimens caught in traps, but more often the samples are sent to insect identification labs.



Surveys

The VDOF forest health program surveys, maps and reports the occurrence of large-scale forest health conditions, both recurring and unanticipated, in accordance with established USFS Forest Health Monitoring (FHM) reporting standards. Ground surveys are conducted routinely by VDOF staff and aerial surveys are conducted to map widespread severe tree damage when deemed necessary. VDOF contracts out aerial survey work with the Virginia Department of Aviation. Gypsy moth is a common invasive pest for which aerial survey may be necessary, but also native defoliators such as the yellow poplar weevil, the fall cankerworm, and oak button gall wasp. Generally, it has not been practical or even possible to survey the entire Commonwealth aerially each year; therefore, there is considerable reliance on ground-based survey and detection from county foresters and technicians, specialists from other agencies, and the public. Close coordination with pest specialists from other municipal, county, state and federal agencies is essential. With limited time, money and staff being problems for most agencies, pooling of resources to respond to both established and emerging forest health threats is a necessity.



New Technology

VDOF continues to evaluate new technology for collecting, documenting and reporting ground and aerial survey information more effectively and efficiently. Digital Mobile Sketch Mapper (DMSM) software is fully integrated into our forest health monitoring program and has become an essential tool during aerial surveys. DMSM is tablet hardware, software and back end data support processes that allow trained aerial surveyors (in light aircraft) and ground observers to record forest disturbances and their causal agents. The ability to quickly map and document damage on a tablet during surveys has greatly enhanced the quality and quantity of forest health data. We continue to explore the use of other data collection applications such as Collector, an ArcGIS application that allows for collection of spatial data on a mobile device.

Throughout the season, the VDOF forest health program monitors changes in Virginia using ForWarn (Eastern Forest Environmental Threat Assessment Center product) and the Forest Disturbance Monitor (Forest Health Assessment and Applied Sciences Team and FHM product). Both are USFS web-based software designed to detect major disturbances in forest cover via Moderate Resolution Imaging Spectroradiometer (MODIS) satellite imagery. With limited funds available for long flights, this satellite imagery enables us be smart about when and where to conduct aerial surveys and is useful for planning routes. We continue to learn more about the strengths and limitations of these tools as they are developed and fine-tuned.



VDOF has implemented a pilot drone program with funds from a USFS Landscape Scale Restoration (LaSR) grant to investigate the use of unmanned aerial systems (UAS) in forest management, fire protection and forest health. Two forest health program employees have obtained Remote Pilot Certificates from the Federal Aviation Administration (FAA) to fly a drone under the FAA's Small UAS Rule (Part 107). This certificate demonstrates that you understand the regulations, operating requirements and procedures for safely flying drones. We continue to investigate how an UAS will supplement our forest health monitoring activities in the future.

Reporting

The VDOF forest health program submits all required documentation and reports to the USFS and other interested parties. When forest pests reach levels that cause noticeable widespread damage, information is widely disseminated to area foresters and Virginia landowners. One page "Pest Reports" are commonly produced for seasonal defoliators or other timely forest health disturbances, and the VDOF blog "Field Notes" has been a helpful platform to distribute information to the online community and social media followers. USFS Forest Pest Alerts and Forest Insect and Disease Leaflet (FIDLs), "Don't Move Firewood" posters and pamphlets, and other extension materials are routinely handed out at speaking engagements, state fairs and other public venues. All pertinent forest health updates and information are summarized and disseminated annually in the Virginia Forest Health Review which is published online every December/January.

Technical Assistance

Treatment

When treatment funds and resources are available, treatment on State Lands is generally prioritized since it has the dual effect of improving forest health and also creating demonstration areas that showcase effective treatment methods. Invasive plant removal projects conducted on State Forests are often accompanied by educational signage. Virginia's pine bark beetle prevention program (supported by federal SPB funds) supports pine restoration on State Forests that have historically been hotspots for SPB outbreaks. Through this program, we have been able to restore recently infested pine stands, some of which would otherwise have reverted to stands of mixed species and ages, which are very difficult to manage. High-value and specimen trees are treated for the EAB, the hemlock woolly adelgid or other established pests/diseases. VDOF partners with other state agencies to conduct similar treatment activities on other state-owned land.



Biological Control

In many cases, biological control is the only practical and sustainable treatment option when dealing with widespread pests in a forested setting. The VDOF forest health program supports the release of biological control agents that have been researched and approved for release by the USDA. Parasitoid wasps have been released on State Forests to control EAB since 2017, and predator beetles are still being released to protect hemlock trees from the hemlock woolly adelgid. VDOF implements and



encourages biological control as part of an integrated pest management approach that also may include chemical treatment and other pest mitigation strategies.

Support PRISMs

VDOF supports Partnerships for Regional Invasive Species Management (PRISM) groups such as the Blue Ridge PRISM, a cooperative weed management area that covers 10 counties in the Blue Ridge area of the Commonwealth. This group includes county, state, federal, NGO, private and non-profit members that work to leverage resources and expertise to manage non-native invasive plants. VDOF supports PRISMs mainly in an advisory role by sitting on steering committees and promoting the work and mission of these groups at appropriate educational workshops and outreach events.

Training and Diagnoses

The VDOF forest health program receives requests for diagnoses and treatment recommendations. A very high priority is given to responsiveness and forest health staff promptly respond to individuals or organizations who contact the agency with forest health-related questions or concerns. Responses may take the form of phone calls, emails or on-the-ground technical assistance visits. Field visits are conducted by department field personnel or the forest health program staff if satisfactory service cannot be provided via phone or email. If further expertise is needed, pathologists and entomologists with Virginia Cooperative Extension or the USFS are notified.

Forest health training is conducted for VDOF field personnel and other natural resources professionals. Useful publications and webinars are widely distributed and information on local pests is made available when the need arises. The VDOF forest health program staff is part of the Virginia Association of Forest Health Professionals steering committee that hosts an annual meeting in the winter. This meeting is a great venue to learn about current forest health issues as well as acquire pesticide applicator recertification. Many VDOF staff, other state agency and federal employees, consulting foresters and arborists, and landowners attend this meeting.

Evaluation

The forest health program evaluates the impact of forest health disturbances, both biotic and abiotic. This process may involve aerial surveys, long-term monitoring plots, and/or destructive sampling. Mapping damage after a storm event is often necessary to quantify the damage and create a record of locations that may suffer the effects of the storm for years to come. Post-release surveys are conducted on land where biological control agents have been released to evaluate their success in establishing a population and/or controlling the target pest. Long-term monitoring plots are installed to evaluate the spread and effect of certain forest health disturbances that may have a cascading or widespread impact on the landscape. The VDOF forest health program often collaborates with research institutions such as Virginia Tech to conduct/support research projects that evaluate forest health in Virginia.



Forest Legacy and Land Conservation

Program Overview

The VDOF forestland conservation program was formally established in 2007 to address the conversion and fragmentation of Virginia's forestland. The primary objective of this program is to keep Virginia's forestland intact and in forest. The program is overseen by a manager who reports directly to the Assistant State Forester. One forestland conservation specialist is assigned to each of the agency's three operational regions. VDOF land conservation efforts focus on three areas of emphasis: (1) Accepting and/or purchasing open-space easements and fee simple acquisitions, including those supported by the USFS Forest Legacy Program; (2) Intergenerational forestland transfer outreach efforts, and (3) Management of the Century Forest Program.

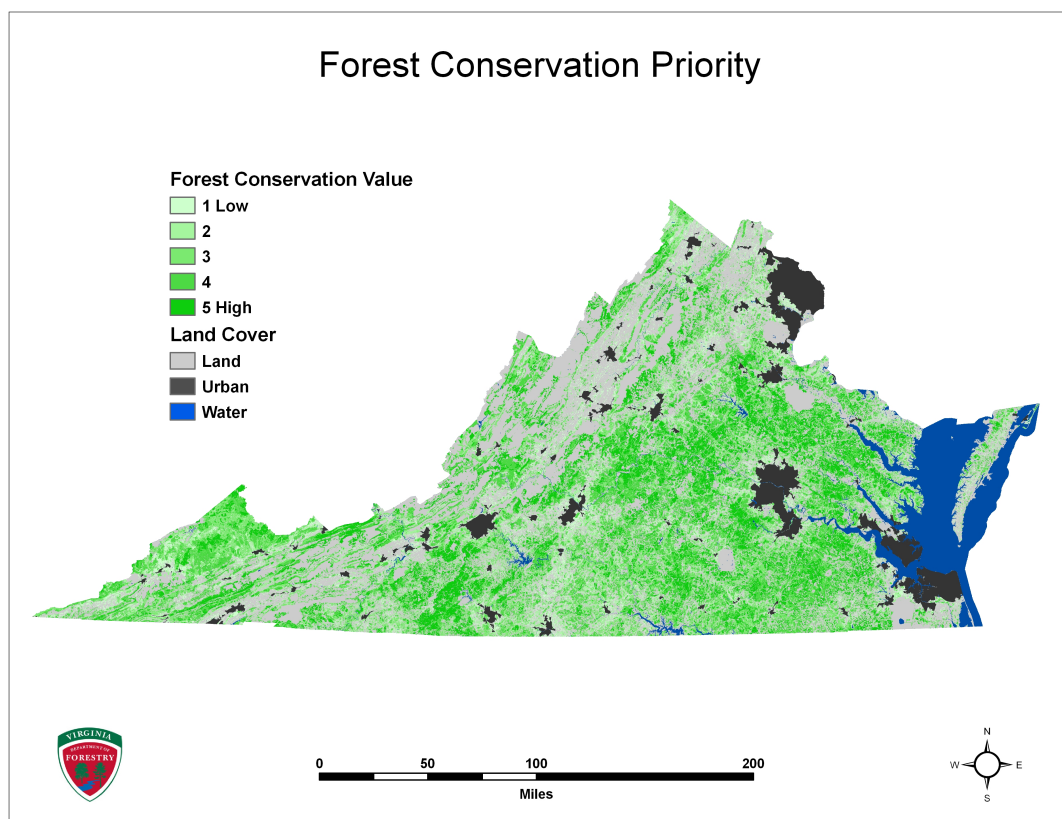


Figure 38. Virginia's forestland conservation priority areas.

Program Focus Areas

Working Forest Conservation Easements

Since 2007, VDOF has maintained an open-space easement program that promotes the retention of forestland, proper forest management and protection of soil and water quality. VDOF currently has 190 easements in its portfolio, protecting more than 84,000 acres and more than 400 miles of watercourses with permanent buffers.



Forest Legacy

The Forest Legacy Program (FLP) is an important part of Virginia's land conservation efforts. The 2020 updated version of Virginia's Forest Legacy Guidelines is shown in its entirety in Appendix A of the Strategic Plan that accompanies this document.

The FLP assists state governments in the identification of, and protection of, important private forest tracts that are threatened by conversion to non-forest uses. One of the primary tenets of the FLP in Virginia is to ensure the conservation of working forests that provide the multiple benefits inherent to healthy, productive forests. FLP effectively supports both the acquisition of conservation easements and the fee-simple purchase of properties, such as State Forests and other state-owned lands protected from development.

The FLP was initiated in Virginia in October 1999, when Governor James S. Gilmore III designated VDOF as the State Lead Agency for the program. VDOF is responsible for managing the program and the associated federal grant funds for the conservation of important state forestlands. VDOF believes that diverse, well-managed working forests are the healthiest and the most productive and, consequently, provide the most public benefit when protected from the economic pressure for development. In the program's first 20 years, through September 2019, FLP funding helped support the acquisition of conservation easements or fee-simple purchase of 23 tracts totaling 18,526 acres.

Program Eligibility Criteria

The Eligibility Criteria for Virginia's FLP were revised in 2007 and again in 2008 during an interim revision to the program's Assessment of Need document (see Strategic Plan Appendix A). The current Eligibility Criteria for Virginia's FLP, defined at the time of these interim revisions, are:

- ◆ Threatened by conversion to non-forest use (fragmentation and reduction in linkages);
- ◆ Continued production of timber and other forest commodities (local and regional economic base);
- ◆ Consideration of natural heritage resources (e.g., natural communities, habitat for rare, threatened and endangered species, significant geologic features), and
- ◆ Watershed values (i.e., water quality, wetlands, riparian buffers, groundwater recharge, public water supplies).

Forest Legacy Priority Areas

The FLP must be focused to be effective with limited funding availability and to meet the demands of a competitive grant application and approval process. By identifying areas of the state that possess the highest conservation value (based on the program's Eligibility Criteria), limited grant funding can be best utilized to conserve those areas most deserving of conservation. This strategy also puts the state in a position to compete well at the national level.

Beginning in 2007, Virginia undertook a process to identify the priority areas for the state. This process resulted in the designation of a revised Forest Legacy Area for the state in 2008, as shown in Appendix A of the Strategic Plan, based on the revisions to the Eligibility Criteria, and the resulting GIS analysis at that time.

In mid-2009, it became apparent that the GIS analysis in 2008 was flawed because some of the data in one of the models used was not converted from 100x100-meter resolution to 30x30-meter resolution before the analysis was done. Once this change was made in January 2010, and the GIS analysis was repeated, additional hydrologic units ranked highly enough to be included in the Forest



Legacy Area using the same parameters as in 2008. These corrections resulted in a 19 percent increase in land area for the Forest Legacy Area – for a total area of 16 million acres, of which 11.7 million acres are forested. One additional minor adjustment to the Forest Legacy Area was approved by USFS in 2017. The Forest Legacy Priority Area is 63 percent of the land area in Virginia. The current map for Virginia’s Forest Legacy Priority Areas is shown in Figure 36.

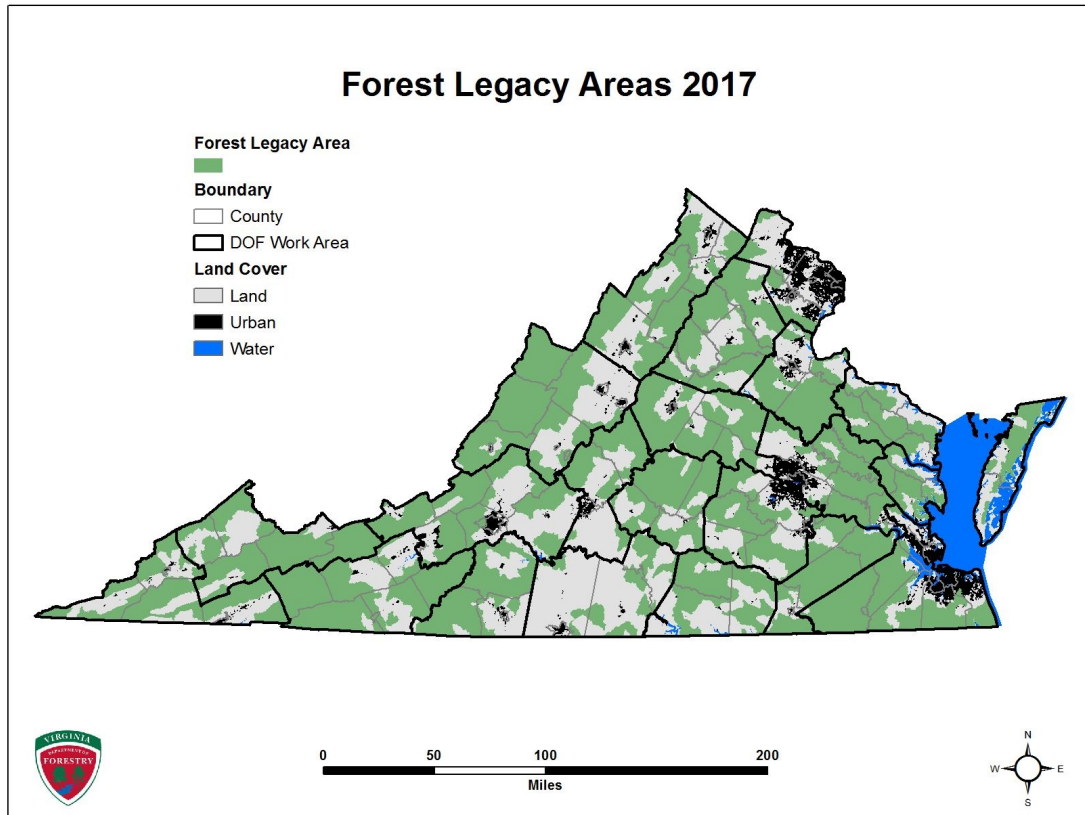


Figure 39. Virginia’s forest legacy program priority areas, updated in 2017.

Generation NEXT

Much literature demonstrates that family forestland is most at risk of parceling and fragmentation, and possibly passing out of forest use or even family hands, at the time of intergenerational transfer. Respondents to a 2018 Benefits and Barriers Analysis in Southside (Virginia) overwhelmingly expressed a desire to keep their family woodlands intact, in forest and in family ownership; yet 79 percent of them had not developed a succession plan. Generation NEXT is programming provided in partnership with Virginia Cooperative Extension and Virginia Tech designed to help family forestland owners make informed and intentional decisions regarding passing their land forward to the next generation. During the period 2009-2020, 349 families, owning more than 132,000 acres, have participated in programming. Eight out of ten participants indicate that the program would increase the likelihood of their property staying intact, in forest, and/or in family ownership, demonstrating the impact of this type of outreach.



Century Forests

Virginia's 2007 commitment for the Chesapeake Bay Program Forest Conservation Directive includes an annual target of permanently protecting 25,000 acres of forests identified as high-priority for conservation within the Bay watershed. The high-priority acres were identified through GIS analysis conducted by VDOF. The Chesapeake Bay Program provides support for VDOF to conduct outreach to landowners of high-priority forestlands. In 2016, Governor Terry McAuliffe signed Senate Bill 252 into law and created the nation's first Century Forest program. This program recognizes Virginia families whose forestland properties have been in the same family for 100 years or more, include at least 20 contiguous acres of managed forests, are lived on or managed by a descendant of the original owners, and have a documented history of timber harvests or other forest management activities. Forty-four families, cumulatively owning 15,136 acres with tenures ranging from 107 years to 279 years, have been recognized since the law went into effect on July 1, 2016.

Virginia Sentinel Landscapes Partnerships

In July 2013, federal agencies announced a new initiative to reduce the adverse effects of incompatible development around military installations. Known as the Sentinel Landscapes Partnership, the aim is to sustain military readiness, preserve forest and agricultural land and protect wildlife habitat by focusing on areas where these priorities overlap. Federal partners, including the US Departments of Defense, Agriculture and the Interior, are working with states, non-governmental organizations and the private sector to recognize landowners for practices that both benefit their operations and are compatible with the military's test and training mission.

Incompatible land uses that threaten the military mission also endanger working lands— farms, ranches and forests—which are vital to sustaining agricultural and working forest productivity, safeguarding natural resources, and maintaining a rural way of life. The Sentinel Landscapes Partnership gives the federal government and states an unparalleled opportunity to capitalize on the link between national defense, conservation and working lands. Total funding committed to Sentinel Landscape designations by the federal partner agencies and leveraged by additional funding from state, private and non-profit partners through August 2016 (the latest data available) has been \$86 million.

The 2017 Virginia Statewide Joint Land-Use Study (JLUS) Strategic Plan of 11 military installations recommended that Virginia address encroachment at state military installations from a broader perspective. The Commonwealth is therefore now pursuing an operational risk management framework for assessing installation/range encroachment conditions to identify opportunities for action and synergy. This includes evaluating regional situations, socioeconomics, environment and natural resources infrastructure needs, and the planning and regulatory climate of local jurisdictions.

As a component of this framework, VDOF is currently leading a Virginia effort jointly sponsored by the Virginia Secretary of Agriculture and Forestry and the Virginia Secretary of Veterans and Defense Affairs along with numerous federal, state and local government partners, conservation organization partners, agriculture and forestry organization partners and others to submit applications to the federal government to create two Virginia Sentinel Landscapes in 2020. The purpose is to launch regional conservation partnerships in support of Governor of Virginia Ralph Northam's land and water conservation and rural economic development initiatives that also support military compatible land and air use and conservation buffers. More than 85 percent of the Commonwealth's airspace is used by the military for training purposes, emphasizing the need for dark skies and retention of low-density land use such as forest and farm land.



Virginia's goal is to create a key, landscape-scale, national security and conservation corridor that enhance national military air and land mission training readiness across Virginia, provide security to the US Capitol region, prioritize conservation of working forest and agricultural lands most at-risk of conversion to alternative land use, further improve the health of the Chesapeake Bay, and support the Governor's efforts to develop a statewide coastal resiliency master plan. Maryland and North Carolina have already created Sentinel Landscapes and the Commonwealth's proposed Sentinel Landscapes would align with and potentially connect to those areas.

Local Government

In Virginia, local governments are key stakeholders in land conservation efforts. Often, they are caught in the middle between the competing interests of demands to conserve land and preserve rural or working landscapes, and the need to fully realize the tax potential on private lands to provide for the many other needs of their citizens. VDOF's outreach efforts focus on making all stakeholders understand the many benefits forests provide to society, emphasizing the costs avoided when land remains in forest, and developing understanding for the tools available under state law that assist in land conservation, including land-use taxation and Agricultural-Forestral Districts. VDOF conservation specialists work with local governments and landowners to encourage working forest conservation through zoning, comprehensive plan updates and land-use policies.

Forest Stewardship and Management

Program Overview

The Forest Stewardship Program in Virginia was started in 1990 and was designed according to the National Stewardship Standards developed by the USFS. The program is implemented through the State Stewardship Operating Plan, which is included in Appendix B of the Strategic Plan. A description of the program and its elements follow – taken from the 2015 National Stewardship Standards and Guidelines.

Virginia has embraced the Stewardship philosophy of management, as evidenced through significant accomplishments over time. Plans have been prepared on 11,341 properties for more than 1.6 million acres of private, non-industrial forestland. Through the program, high-quality multiple resource management plans are developed, which lead to implementation of good resource management actions.

The purpose of the Forest Stewardship Program is to encourage the long-term stewardship of non-industrial private forestlands, by assisting the owners of such lands to more actively manage their forest and related resources.

The Forest Stewardship Program provides assistance to owners of forestland and other lands where good stewardship will enhance and sustain the long-term productivity of multiple forest resources. The program provides landowners with the professional planning and technical assistance they need to keep their land in a productive and healthy condition. The planning assistance offered through the Forest Stewardship Program may also be used in prioritization with USDA programs and/or forest certification programs.



State Forest Stewardship Coordinating Committees

The State Forester has established and ultimately administers the State Forest Steward Coordinating Committee. The Committee includes, to the extent practicable, individuals representing the cooperating state and federal conservation agencies, private landowners, associations and organizations.

The Committee addresses stewardship planning and implementation concerns and overall program coordination and meets at least once per year. The Committee's primary functions are:

- ◆ To provide advice and recommendations to the State Forester concerning implementation of the Forest Stewardship Program, and other associated landowner assistance and cost-share programs.
- ◆ To provide assistance and recommendations concerning the development, implementation and updating of the State Forest Action Plan;
- ◆ To provide assistance and recommendations concerning priority issues and geographies for focused program delivery and to encourage Landscape Stewardship, and
- ◆ To provide advice and recommendations concerning the Forest Legacy Program in Virginia.

Landowner Eligibility and Requirements

The program is designed for non-industrial private forestlands. Private non-industrial forestlands managed under existing federal, state or private sector financial and technical assistance programs are eligible for assistance under the Forest Stewardship Program. Forest resource management activities on such forestlands must meet, or be expanded or enhanced to meet, the requirements of the Forest Stewardship Program.

Participation in the Forest Stewardship Program is voluntary. Landowners can participate in the program in a variety of ways:

- ◆ Receiving technical assistance
- ◆ Participating in educational programs
- ◆ Agreeing to manage their property according to an approved Forest Stewardship Management Plan. (Participating landowners also understand that they may be asked to participate in future management plan monitoring.)

Program Outreach and Education

Virginia strives to have outreach efforts in important forest resource areas and priorities defined in the State's Forest Action Plan. Within these areas, the Forest Stewardship Program should be accessible to all landowners and community stakeholders as appropriate. In addition, outreach efforts should:

- ◆ Identify and address underserved communities and groups;
- ◆ Balance the needs of current participants and potential future participants;
- ◆ Coordinate with other landowner assistance programs to avoid duplication and support ongoing efforts as appropriate;
- ◆ Identify opportunities for landscape-scale and/or multiple landowner planning and technical assistance delivery, especially where ownerships are relatively small;



- ◆ Consider collaboration with other non-federal lands within the important forest resource areas, and
- ◆ Develop appropriate landowner outreach and social marketing strategies for different/diverse landowner groups and local resource management concerns, including the use of demographic data to segment landowners according to interest and responsiveness, tailoring messages and the right service deliverer to these different segments, identifying and focusing on priority landscapes over multiple years and employing multiple interactions with landowners, and continuous evaluation of effectiveness in order to improve success over time.

Outreach for Traditionally Underserved Landowners

VDOF recognizes that there are traditionally underserved groups of landowners who may need specific outreach methods. Each year, VDOF cooperates and provides funding to the Virginia Tech Cooperative Extension Service for landowner outreach. A portion of these funds are specifically set aside for outreach to these groups. Specific examples of use of these funds have been minority landowner tours and mini-grants for specific projects. VDOF and the Virginia Tech Cooperative Extension Service work with Virginia State University in these efforts.^{xxv}

The Forest Stewardship Program and associated outreach efforts adhere to the USDA non-discrimination policy: The USDA prohibits discrimination in all its programs and activities on the basis of race, color, national origin, sex, religion, age, disability, political beliefs, sexual orientation, or marital or family status.

Accomplishment Reporting

Virginia maintains and annually reports Forest Stewardship Program accomplishments. Information reported includes numbers of acres of new plans and the total number acres covered by current plans, and general landowner technical assistance and education. Increasingly, there is an emphasis on all types of forest management planning, and specifically implementation of forest management plans.

In Virginia, accomplishments are tracked through the Integrated Forest Resource Information System (IFRIS) that locates Forest Stewardship Plans and accomplishments on the landscape as facilitated through the use of available spatial analysis and plan writing/tracking tools.

Program Focus Areas

VDOF has professional field staff located throughout the Commonwealth. Additionally, as a tax-supported public service agency, VDOF is tasked to provide services to landowners throughout all areas of the state. VDOF has done so, and will continue to do so, based upon requests. There is an increasing emphasis on delivering forest management assistance through many forms of plans, and on implementation of forest management practices. Plans are a way to engage landowners to act to achieve their objectives and positive resource outcomes. Recognizing this, and with guidance from the USFS, VDOF has selected a priority area in which to focus and invest the federal funds from the Forest Stewardship Program. The priority area is represented on Figure 40.

USFS provided parameters to Virginia and other states in selection of the priority area. The area was to be geographically based, not to exceed 50 percent of the total eligible forest land, and to address critical issues like protecting water resources, enhancing wildlife habitat, and supporting jobs and the economy. VDOF analyzed data and selected the priority area because of a high concentration of



active forest management, demonstrated by high levels of practice implementation. Also, wood-using facilities and resulting jobs are abundant in the area. The area includes watersheds of important streams and rivers of emphasis including the Middle James, New, Roanoke and Chowan Rivers. It also included areas of other agency emphasis including the extensive southern pine basket, the highly productive hardwood forests of the Blue Ridge Mountains and the heart of white pine production. Additionally, it encompasses focus areas for longleaf pine, shortleaf pine, American chestnut and Atlantic white-cedar restoration. It also contains regions that will benefit from focused attention to non-native invasive species management, southern pine bark beetle monitoring, and riparian forest buffer establishment.

Again, this will allow focused use of Forest Stewardship Program federal funds on the priority areas. Landowner assistance and meeting resource needs are equally important in all areas of the Commonwealth, and thus are referred to as Stewardship Supporting Counties.

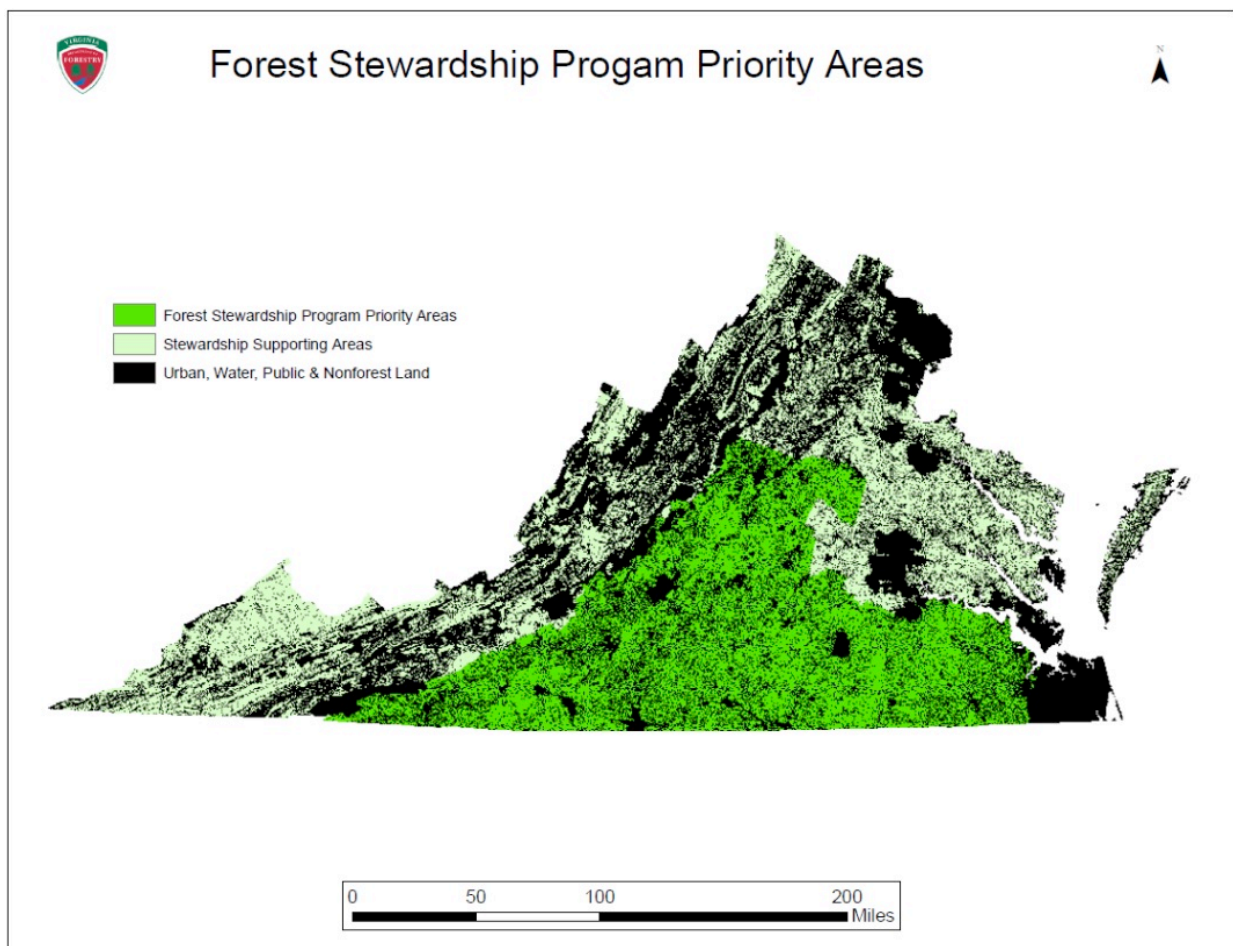


Figure 40. Virginia’s Forest Stewardship program priority areas, dark green, and Stewardship supporting areas, light green.



Forest Management of State-Owned Lands

In addition to providing management plans and technical assistance to private landowners, VDOF is mandated by law (titles § 10.1-1121 through § 10.1-1123 of the Code of Virginia) to provide forestry services on state properties exclusive of the Virginia Department of Wildlife Resources Department of Conservation and Recreation. Legislation establishes a Forest Management of State Lands Fund to receive revenue from timber sales and to pay for forest management work such as site preparation, purchase and planting of seedlings, spray release, BMP installation and payment for VDOF services.

VDOF prepares forest resource management plans on more than 18,000 acres of forestland owned by other state agencies and institutions. Management plans consider the agency/institution owner's goals and objectives for the properties. Concern over the proper forest management of state-owned lands started in 1952, when the General Assembly called for "the protection and perpetuation of the State's forest resources." Legislation subsequently recognized that "the growth of commercially valuable timber was in the public interest." A second declaration of public policy by the General Assembly in 1971 not only recognized the need for VDOF to assist the owners of forests but also widened the scope of previous legislation to include "the conservation of other State natural resources." Current codes were established in 1980. Numerous properties managed for, and are open to the public for, recreation, protection, conservation, perpetuation and educational uses of the forested resources found on them. Timber sale revenues from the properties carry out management objectives.

Urban and Community Forestry

Program Overview

Trees and forests in communities provide numerous benefits to the citizens of Virginia. Aesthetic appeal, shade and contact with nature are the readily apparent benefits associated with community trees. Less apparent, but perhaps even more important, are the positive impact community forests have on air and water quality, business district enhancement, view-shed protection, community health and quality of life in general. Through its urban and community forestry program (U&CF), VDOF helps Virginia communities maintain and enhance their community forests.

History

Virginia's U&CF program developed slowly through the 1980s in scattered field offices, but solidified at the agency headquarters level with the inception of federal funding through the 1990 Farm Bill. The initial focus of the program was to support developing municipal programs through the Tree City USA program and small grants through the USFS-funded U&CF grants (federal pass through). The program was also supported by the assistance of the Virginia Urban Forest Council that was founded in 1993. In the mid-1990s, there was emphasis on municipal tree planting as the agency administered the Small Business Administration Tree Planting Grants program.

The U&CF program was administered centrally by an urban and community forestry coordinator with minimal support and activity at the field level. As program funding increased and urbanization accelerated, field involvement in the program grew, although no staff was formally assigned to the U&CF program. Using the International Society of Arboriculture (ISA) Certified Arborist Program, federally provided training opportunities, an aggressive internal training program and the Conservation Fund's Green Infrastructure Training Course, the agency expanded the capacity of its field staff to become involved in U&CF activities. The program was further developed by the



formation of strategic partnerships with Virginia Tech, the University of Virginia, ISA and several regional non-profits. Finally, the agency added the federally required partnership coordinator position in 2005 that has dramatically expanded the effectiveness and reach of the program.

However, since 2005, USDA funding for the program has been declining from its peak in 2004. Now in 2020, there are still only two full-time staff persons delivering the program. However, field participation has dramatically increased and regional supervisors are more supportive of their personnel participating in U&CF activities. More specialized community forestry positions have been added in Northern Virginia and Richmond, which report directly to regional supervisors. Further, field expertise in U&CF has steadily increased due to ongoing training efforts by the U&CF staff. Unfortunately, the VDOF agency staff as a whole has decreased by one-third since the mid-1990s. As in other programs, reduced staff levels have affected U&CF program.

Program Description

VDOF's U&CF program meets the USFS requirements by having the following components:

- ◆ Urban and Community Forestry Coordinator position (UFC);
- ◆ Partnership Coordinator position (PC);
- ◆ A state Urban Forest Council that is supported both financially by the agency and receives “in-kind” support from the agency staff, and
- ◆ A five-year strategic plan that guides the implementation of the program.

The U&CF program is delivered through the following:

- ◆ U&CF grants (local governments, 501 c3 non-profit organizations, state agencies and public universities);
- ◆ Educational sessions (conferences, workshops);
- ◆ Technical assistance from the UFC, PC and field staff;
- ◆ Limited Water Quality Improvement Grants to support tree planting efforts, and
- ◆ Support of Urban Tree Canopy (UTC)* analyses in selected communities.

The U&CF grants support strategic partnerships with Virginia Tech, the University of Virginia, selected community colleges and the state Urban Forest Council (Trees Virginia), as well statewide and regional tree advocacy organizations. The U&CF grants also are used to build local municipal capacity and support local organizations. VDOF, along with several partner organizations, plans and implements a diverse schedule of workshops and conferences that promote good urban forestry practices and/or deal with key urban forestry policy issues.

Although resources and staff limit technical assistance, the agency has a highly qualified cadre of ISA Certified Arborists (39) and an excellent network of university specialists it utilizes regularly. As one of the states that is a party to the six states' Chesapeake Bay Agreement, VDOF has access to funds to support water quality improvement projects through strategic tree planting.



Program Focus Areas

The U&CF program has identified eight focus areas for its activities. These are:

- ◆ State and Local Capacity in Urban and Community Forestry
- ◆ Ecosystem Service Values and Other Public Benefits of Urban and Community Forests
- ◆ Planning for the Impacts of Urbanization, Fragmentation and Canopy Loss
- ◆ Underserved, Diverse and Non-Traditional Populations
- ◆ Benefits to Human Health and Well-Being of Community Forests
- ◆ Urban Forestry Profession in Virginia
- ◆ Natural Disasters and Poor Urban Forest Health Affecting Urban and Community Forests
- ◆ Urban Wood Utilization

State and Local Capacity in Urban and Community Forestry

This area focuses on both financial resources available at the local level as well as the availability of professional expertise in day-to-day urban forest management.

There is inadequate political and financial support for urban and community forestry programs at the state and local level. At the state level, urban and community forestry is funded almost exclusively by federal dollars; state-level staffing is minimal. The state legislation dealing with urban forestry issues applies predominantly to Virginia's most populated areas (i.e. Northern Virginia, Hampton Roads and Roanoke) or funding that deals with urban and community forestry. At the local level, many municipalities do not fund urban and community forestry programs or employ qualified professionals to manage urban forest resources. While there is support and staffing for urban forestry programs in larger metropolitan areas, few communities outside of the Northern Virginia, Hampton Roads and Roanoke areas have strong programs. This is especially true for communities with populations under 25,000. Many of these communities can be identified in the USFS Community Accomplishment Reporting System (CARS) data reported annually. CARS data identify these communities as being in the formative or developing categories. The U&CF program will help to address this issue by providing the technical resources that will help local urban forestry managers quantify the benefits of urban forests and pro-active management to local governments. This, in turn, will help local managers advocate for larger local budgets focused on urban forestry management.

Apart from the limited resources available at the state and local level, there are few sources of funding for local programs. More sources of funding need to be developed so that programs can have increased flexibility as to the timing of funds available and the type of projects that might be funded. VDOF's U&CF program will work with national and regional non-profit organizations to develop funding opportunities from other sources outside the USFS and advocate for state funded urban forestry initiatives.

Beyond the issue of funding, many communities with populations under 25,000 do not have professional urban foresters, arborists or horticulturists on staff to inform on urban forestry related policy or issues in the field as they arise. The U&CF program can address this situation by targeted educational efforts and providing technical assistance from its field staff and its 39 ISA Certified Arborists on staff distributed throughout the state (Figure 38). The program already has a solid record in developing strong educational programs.

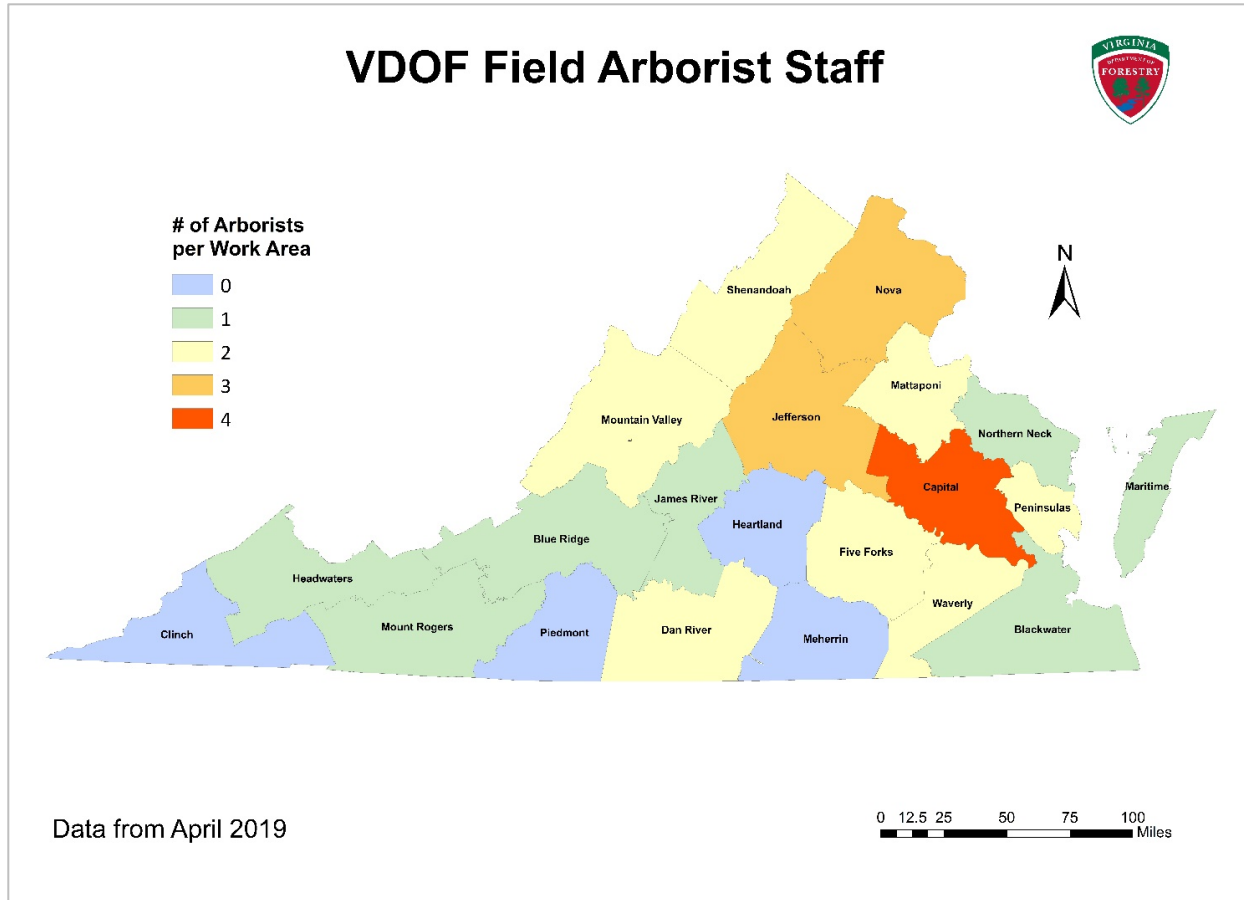


Figure 41. VDOF field staff who are Certified Arborists, shown by VDOF work area.

In 2019 and 2020, the U&CF program will be working on an estimate of the economic contribution of the community forestry industry in Virginia. In 2018, the Arbor Day Foundation reported that Virginia’s Tree City USA communities invested almost 24 million dollars in community forestry programs. This is only a fraction of public expenditures on Virginia’s community forestry and does not include private expenditures. Having a better understanding of the industry, including the number of jobs, will help communicate the relevance of Virginia’s community forestry programs moving forward. It will also help make the business case for active urban forest management within Virginia’s growing communities.

Ecosystem Service Values and Other Public Benefits of Urban and Community Forests

This priority area focuses on helping communities these urban forests provide in terms of air quality, water quality, stormwater management, carbon sequestration energy conservation and heat island temperature modification.

Using tools, such as i-Tree, urban forest values can be quantified in ways not possible a decade ago. This information can be used in decision making at the local level, and its availability has the potential to positively impact local decisions and budgets related to urban forests. The U&CF program will promote assessment work to establish these values in Virginia’s communities through educational efforts, focused grant projects and cooperative efforts with Virginia Tech’s Urban Forestry Program



(Department of Forest Resources and Environmental Conservation) and the University of Virginia's Department of Urban and Environmental Planning (School of Architecture).

Planning for the Impacts of Urbanization, Fragmentation, and Canopy Loss



Figure 42. Representation of urbanization and canopy loss in urban areas from 2002 to 2018.

Virginia's landscape is transforming at a rapid rate. As of 2019, the current population is estimated at 8.58 million, an increase of more than 380,000 since the 2010 Census. Virginia is growing at a rate of more than one percent, ranking 13th in the United States (US). This growth is increasing urbanization and sprawl across Virginia and is negatively affecting forestland. Rapid urbanization in Hampton Roads, Northern Virginia and Central Virginia is resulting in a rapid conversion of rural forestland to urban uses. Figure 39 above shows aerial imagery in shows some of the impacts of a growing population in Northern Virginia. A large forested parcel was converted into a subdivision within a 15-year period.

Poor models for land development have resulted in degraded forest ecosystems. Adequate amounts of open green space are not being conserved, managed or protected in communities. Urban sprawl is fragmenting forests and negatively impacting the ecological health and aesthetic quality of Virginia's communities. Urban sprawl has not only contributed to costly transportation problems in Northern Virginia and Hampton Roads, it has resulted in fragmentation as well as changing land-use patterns and values that threaten traditional forestry practices where traditional forestry was once vibrant.

Virginia's growing population will also negatively affect already urbanized areas. Development pressures, such as housing, roads and utility expansion are contributing to continued urban fragmentation and forest canopy loss. As canopy loss occurs, reduced urban ecosystem functions (e.g., higher summer temperatures, poorer air quality and the reduced natural systems for stormwater management) also occur. The U&CF program can be only part of the solution to this problem. Its contributions to this issue will be in developing programs that make cities and towns more livable by protecting and enhancing forests; riparian areas and other green space.

The U&CF program has been a leader in promoting green infrastructure planning starting with the first statewide training on green infrastructure in 2005. Since that time, the program has supported local initiatives with U&CF grants and some regional initiatives with USFS Landscape Scale Restoration grants. Strategic partnerships have been formed with the Department of Urban and Environmental Planning at the University of Virginia, where faculty teaches a "how to" class for future



planners on green infrastructure planning, and the non-profit Green Infrastructure Center Inc. Projects with the Green Infrastructure Center supported by the U&CF program are discussed at <http://www.gicinc.org/projects.htm>. The green infrastructure planning process uses a series of cooperative, iterative steps to characterize existing conditions of our natural assets, identify and prioritize threats, define management objectives, and develop and implement strategies to protect these resources. The U&CF program will continue to promote green infrastructure planning across the state, including expanding efforts toward managing water quality and community forestry resources using a larger watershed approach. Adding a watershed focus to our work will help us identify and quantify more regional community forestry needs. Working across jurisdictional boundaries, we will be able to leverage ideas and to support goal setting and skill sharing with other non-forestry professions to develop specific actions required to solve water and forest resource challenges.

The U&CF program will also expand its efforts in the coming years to collaborate more with VDOF fire programs in working with Wildland-Urban Interface (WUI) communities. Our goal is to create more sustainable community forests by providing them with more information and trainings on caring for individual trees and community forests. We will also work with VDOF's fire prevention program to provide recommendations for types of trees, landscape designs and pruning recommendations to assist these homeowners in creating well-designed and defensible spaces to reduce the spread of fire and risk to adjacent buildings.

VDOF and the U&CF program have also been working to increase participation in the Arbor Day Foundation's Tree City USA program. Communities that qualify for the program must meet minimum standards including establishing a tree ordinance, tree board or department and a community forestry program. Figure 40 shows the Virginia's Tree City USA communities in 2019.

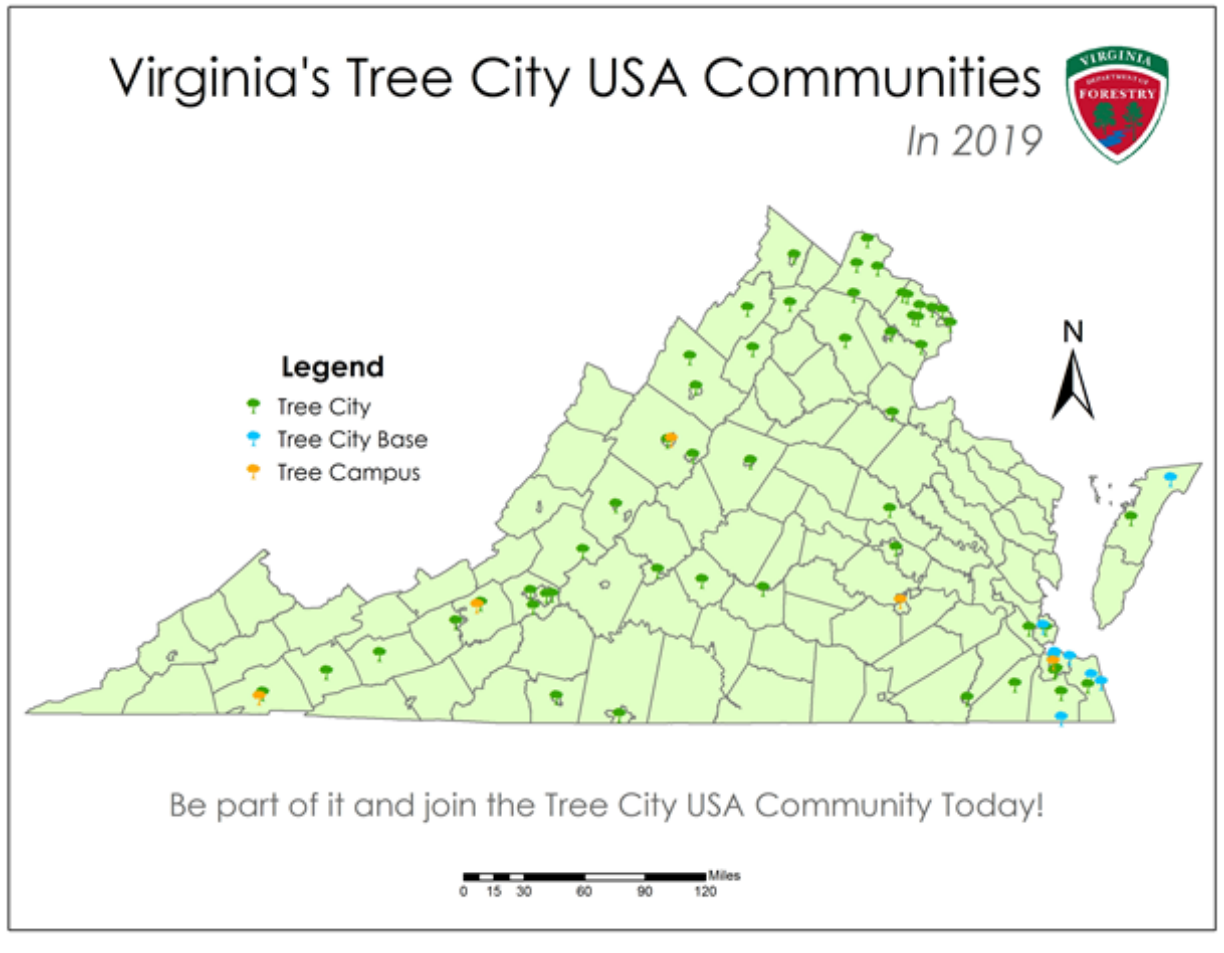


Figure 43. Virginia's Tree City USA Communities as of 2019.

Underserved, Diverse and Non-Traditional Populations

The U&CF program has had mixed results with respect to this priority area. In terms of reaching underserved communities, the program has been successful through its focused funding outreach effort in partnership with Virginia Tech's Community Design Assistance Center (CDAC). CDAC is an outreach program of Virginia Tech's College of Architecture and Urban Studies and targets its conceptual planning services to economically challenged communities, many in Southside or Southwest Virginia (areas considered economically depressed). This outreach program has also provided services to some ethnically and culturally diverse communities. The regular U&CF grant program has indirectly benefited ethnically diverse populations, but the program has no strong partnerships with organizations that represent ethnically and culturally diverse populations. Developing such partnerships will be crucial to the continued success of the program, as Virginia is rapidly becoming a more diverse state in terms of both culture and ethnicity. This is especially true in the Northern Virginia area around the District of Columbia and Hampton Roads, but is evident everywhere in the state.

Virginia State University (VSU), a land-grant institution, is now represented in the Virginia Urban Forest Council (Trees Virginia) and the Virginia Natural Resources Leadership Institute (sponsored by the U&CF program). The U&CF program will work to develop this partnership and use VSU as one gateway to engage and serve minority populations.



In the Southwest Virginia coal counties (an economically depressed region), many communities are plagued with long-term environmental problems. The U&CF program has been working with local partners for a decade, known as the Clinch River Valley Initiative (CRVI), to organize public forums, host trainings for teachers and students, and establish a mini-grant program through which students may apply for funding to do environmental projects in their schools.

Benefits to Human Health and Well-Being of Community Forests

The network of trees and community forests and contribute to improved human health outcomes, well-being and quality of life in urban environments. Numerous studies have found relationships between human exposure to urban forests and associated human mental and physical health benefits.

Some of these include:

- ◆ Higher birth weights (Dzhambov, Dimitrova, and Dimitrakova 2014),
- ◆ Fewer deaths from cardiovascular and lower-respiratory-tract illness (Donovan et al. 2013),
- ◆ Stress reduction (Thompson et al. 2012)
- ◆ Lower prevalence of asthma rates (Lovasi et al. 2008)
- ◆ Positive Correlation between access to green spaces and physical activity (Akers 2012).
- ◆ Exposure to green improves academic success (Matsuoka 2010)
- ◆ Faster recovery from surgery (Ulrich 1984)
- ◆ Greater social ties between people and stronger feeling of belonging (Kuo et al. 1998)
- ◆ Forest bathing and associated mental health benefits (Lee 2009; Lee 2011; Lil 2010)

Urban forests play an extremely important, multifaceted role in maintaining and improving the environmental conditions of cities but also contribute to the health of the people that live there. Since more than 80 percent of Virginians live in urbanized areas, it is increasingly important to invest in and take care of these forests. The U&CF program will focus program delivery efforts on partnerships to promote the Healthy Trees, Healthy Lives campaign, support ongoing research on the relationship between urban forests and human health, and work with municipalities to promote the BMPs for tree maintenance to keep these forests healthy. The program will also promote the Right Tree in the Right Place for new plantings and encourage equitable access to green spaces for all.

Urban Forestry Profession in Virginia

As Virginia continues to urbanize, there will be a need for adequately trained professionals in both the public and private sector. The U&CF program has partnered with the Mid-Atlantic Chapter of the International Society of Arboriculture (MAC-ISA) to promote the Certified Arborist Program. This partnership has resulted in more than 950 arborists becoming ISA certified, and this certification is now recognized as a green industry standard in Virginia. The U&CF remains active with MAC-ISA and will continue to promote the program and host training sessions. Within VDOF, 39 employees have achieved this ISA certification and the U&CF program will continue to offer this opportunity to its employees. A supporting grant allowed for nine of VDOF's ISA Certified Arborists to also become Tree Risk Assessment Qualified. Internal and external training opportunities are offered to VDOF's Certified Arborists to maintain certification and keep up-to-date on new and emerging technologies and best management practices for the arboriculture industry.

The U&CF program also works closely with the urban forestry program at Virginia Tech by providing grant support and through the state Urban Forest Council (Trees Virginia). U&CF also has strong



partnerships with the landscape architecture program at Virginia Tech and supports several interdisciplinary planning projects enabling students and faculty from urban forestry, horticulture and landscape architecture to work together. The U&CF program will continue this effort through focus funding to Virginia Tech's CDAC.

The U&CF program has been providing training opportunities to professionals in the field through a variety of conferences, workshops, forums and field days it implements or supports with its partners. These efforts have been and will continue to be supported with U&CF grants, Trees Virginia and the U&CF program's partnership with MAC-ISA and the Mid-Atlantic Horticulture Short Course (MAHSC).

Natural Disasters and Poor Urban Forest Health Affecting Urban and Community Forests

Natural Disasters

Tornadoes in Georgia and, most recently, hurricane Michael in 2018 show how vulnerable urban forests can be to the natural elements. When Hurricane Isabel hit Virginia 2003 there was tremendous urban tree damage in eastern Virginia cities. While VDOF responded to this event along with other state agencies, its response was not one that dealt directly with response and recovery for the urban forest. This storm event highlighted the need to develop an urban forestry response where professional urban foresters could deal directly with storm-related urban forestry problems. The Urban Forest Strike Teams (UFST) were created in response, with the first trainings being conducted across the Southern states in 2007. Since the initial trainings, all the southern states (USFS Region 8) and most states from the northeast area have sent participants to subsequent trainings. Since their inception, UFSTs have responded to ice storms, hurricanes, tornados, flooding, derecho, drought, snow storms and straight-line wind disasters. Figure 41 below shows the response efforts of UFST's across the South and Northeast.

Some next steps in the evolving UFST concept are to have UFSTs formally integrated into response efforts led by the Virginia Department of Emergency Management (VDEM) and/or Federal Emergency Management Agency (FEMA). This is critical as funding to support UFSTs for out-of-state deployments is currently limited.

The U&CF program also wants provide training to localities in preparedness and response for storms with regard to their urban forests. The goal of this training will be to see that the urban forest is considered in storm planning and that these communities are aware of how to request and use Virginia's 55 trained UFST personnel.



Figure 44. Map of Urban Forest Strike team responses after natural disasters in the U.S. south and northeast.

Urban Forest Health

Community forests provide functional ecosystem benefits such as stormwater reduction, improved air quality, carbon sequestration and storage, and many human health benefits that positively influence a person's quality of life. Healthy and resilient community forests are essential to



maximizing these benefits. However, many urban trees are exposed to additional pressures of living in urban environments such as pollution, heat extremes and poor soil conditions, and in many cases outbreaks of invasive plants, pests and diseases begin in urban settings – all of which are heavily influenced by human activities and negatively impact the benefits of these forests. Figure 42 shows the impact of English ivy in the City of Richmond. VDOF staff recently developed an urban forest management plan for this property.

Figure 45. Invasive English ivy growing in a forest understory of a cemetery in Richmond, VA.



The introduction of Dutch elm disease, gypsy moth, emerald ash borer (EAB) and Asian longhorned beetle have permanently altered urban forests and collectively cost hundreds of millions of dollars to remove and replace impacted trees.

The U&CF program aims to combat these issues through education, outreach, training and partnerships so Virginia's municipalities can fight and protect their urban forests for future generations. We will encourage species diversity in urban setting, work with municipalities to modernize approved municipal planting lists, complete urban forest management plans, educate Tree Stewards to perform invasive plant removals and keep VDOF staff and partners up-to-date on the treatment methods for major pests and disease through trainings and workshops to preserve urban trees when appropriate.

Urban Wood Utilization

Urban trees have their greatest value when they are living, and when they die they are typically seen as an expensive waste problem. Thousands of tons of wood are extracted from urban forests due to storm damage, purposeful tree removal to accommodate expanding grey infrastructure, and natural tree mortality. In light of climate change, improving economies and the arrival of invasive insects such as EAB, the number of trees removed from our urban forest landscape will substantially increase, possibly to exponential proportions.

The priority area focuses on making use of the whole tree, as part of our commitment to sustainable urban and community forests. Whether the wood is best used for firewood, wood chips or processed and slatted into lumber the U&CF program will work with municipalities by creating urban wood use plans, developing contacts and marketing opportunities for valuable wood to incorporate tree-cycling into their future vision for a greener city.

Over the past 2 years, VDOF has been working to enhance public exposure, conduct outreach and engagement with communities across Virginia. Recently, a board seat was added to state Urban Forest Council (Trees Virginia) specifically for urban wood utilization. Trees Virginia has added a business directory (<http://www.treesvirginia.org/education/directory>) to help Virginians manage and utilize urban trees. Several business development workshops have been conducted around the state and VDOF is working closely with several municipalities to develop and highlight urban wood utilization programs. Figures 43 and 44 show some of the products of this work including a sawmill demonstration for city trees in Harrisonburg, VA and a table created from the wood for the Rockingham County Parks and Recreation Department.





Figure 46. Demonstration portable sawmill.

Figure 47. Table created from an urban wood utilization program in Harrisonburg, VA.

Forest Inventory and Analysis

Program Overview

The Forest Inventory and Analysis (FIA) program in the Commonwealth of Virginia is the cooperative effort between VDOF and the USFS, Southern Research Station (SRS) to provide the annualized Forest Inventory in Virginia. Originally, FIA or “Forest Survey” was a federal function required by the McSweeney-McNary Forest Research Act of 1928 to assess the condition of the Nation’s forests. The 1998 Farm Bill required that the forest inventories be conducted on an annual basis to provide up to date, statistically reliable information on the condition and composition of the forest resources. In 1997, VDOF entered into a cooperative arrangement with SRS to have VDOF staff conduct the field data collection required for annual forest inventories, while SRS retained the processing, quality assurance and publication/dissemination roles.

The FIA project with VDOF is assigned to the Forest Resource Management (FRM) branch. Staffing consists on one inventory manager, who reports the FRM director, and six FIA specialists (located one per previously-designated VDOF region), assisted by six wage employees who report to the inventory manager. The inventory manager serves as the technical liaison between the FIA program with the SRS, USFS and VDOF. VDOF FIA staff members are evaluated on the number of plots completed annually and the overall accuracy of the field work, as evaluated by the quality assurance staff of SRS.

The field data collection effort consists of measuring approximately 4,600 permanent sample plots on a five-year rotation. The project is organized such that 20 percent of the sample plots are visited annually. This data is averaged with the plots measured the previous four years to provide an annual update. After five years, the rotation begins again. The goal is to have the updated data available to users six months after the field work is completed.

The initial Forest Survey of Virginia was completed in 1940 by federal personnel. The field work for the subsequent surveys completed in 1957, 1966, 1977, 1985 and 1992 was also accomplished by federal staff.

The original cooperative agreement for the fieldwork between VDOF and SRS in 1997 provided a 50 percent federal/50 percent state funding ratio. However, in 2000, the ratio was adjusted to 75 percent federal/25 percent state funds.

In 1997, state crews began establishing and measuring the new mapped FIA plot design. The five panels/five years of field work for 7th Survey was completed in 2002. Subsequently, the 8th Survey was completed in 2007, the 9th in 2011, and the 10th in 2016. The data for the 10th Survey is compiled and published by the USFS as Virginia’s Forests, 2016 (Resource Bulletin SRS-223).

Virginia FIA crews are starting the second year of the 11th Survey of Virginia’s Forests. The entire 11th Survey field work should be completed by 2023.

Program Focus Areas

Users of this data include the USFS, VDOF, forest industry, local governments, other federal and state agencies, non-governmental organizations and federally and state recognized tribes in Virginia. The



forest inventory results are disseminated in hard-copy publication form and by online data query applications.

VDOF utilizes FIA data to assess counties for fire protection coverage, estimate damage from storm events (such as hurricanes and ice storms), estimate the rate of forestland loss to development, evaluate changes in ownership patterns, land fragmentation, and changes in forest composition, and to assess reforestation rates, among other uses.

The USFS utilizes the FIA data as a basis for the 10-year Resource Planning Act (RPA) process, as well as allocation of federal funds to state forestry agencies. While the National Forest System uses the FIA data to analyze forest trends beyond National Forest borders, the number of FIA sample plots on the George Washington/Jefferson National Forests have been doubled through additional funding to VDOF to intensify the inventory. At this time, the additional sample plots have been installed and remeasurement is taking place.

In 2018, VDOF forest inventory staff began installation of Urban FIA plots in Northern Virginia. In addition to assessing the tree canopy, measurements are taken to assess impervious surfaces and energy reduction benefit from tree canopy.

Forest industry uses the data to estimate resource availability, based on various procurement circles. The interest in biomass utilization has significantly increased the use of FIA for resource estimation.

Water Quality

Program Overview

The VDOF water quality program consists of two major components:

- ◆ Operational forestry
- ◆ Watershed forestry

Each component includes multiple, ongoing initiatives, with activities carried out by a combination of headquarters program staff and field personnel.

Operational Forestry

The operational forestry component of the VDOF water quality program is responsible for the protection of water resources associated with silvicultural operations. This involves the development, promotion and implementation of forestry Best Management Practices (BMPs) for water quality. VDOF has been active in water quality protection since the mid-1970s when the first BMP guidance was developed by the agency. Since that time, the program has evolved to include: an “enforceable mechanism” known as the Virginia Silvicultural Water Quality Law – an intensive harvest inspection program; a BMP implementation field auditing process; a research component; a forest harvesting educational program, and a state-of-the-art database management system to track timber harvesting geospatially through a seamless process from timber harvest notification through tract closeout.

Harvest Inspection Program

The backbone of the operational forestry water quality program allows for the one-on-one interaction of VDOF field employees with timber harvesting operators for the purpose of



enforcement of the Silvicultural Water Quality Law to protect water quality during the timber harvest operation. It provides the VDOF inspector the opportunity to interact with the harvest operator to provide guidance on harvest planning, BMP installation and tract closure, as well as to provide oversight on job performance to protect water quality during the operation. Figure 45 depicts the timber harvest activity in Virginia since 1996. VDOF provides inspections on active timber harvest sites every 30 days to ensure that water quality is protected during the course of the operation.

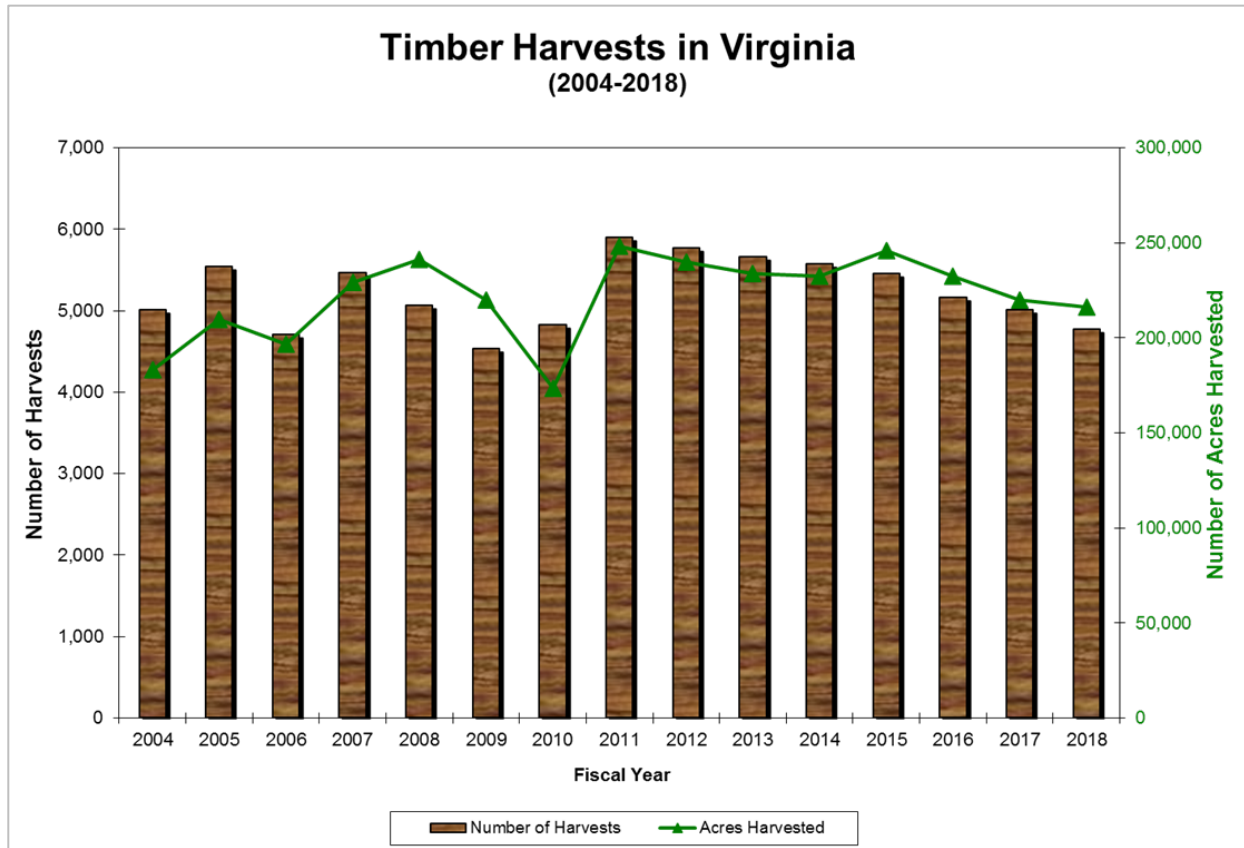


Figure 48. Timber Harvests in Virginia (2004-2018).

BMP Implementation

A statewide audit system has been in place since 1993 to track trends in BMP implementation and effectiveness. Results from calendar year 2018 data showed that the BMP harvest median implementation rate of 240 randomly selected tracts was 94 percent. The audit results also showed that 99.17 percent of the sites visited had no active sedimentation present after operation close-out. The information compiled using this audit process forms the basis of reporting for the Watershed Implementation Plan in response to the Total Maximum Daily Load (TMDL) for the Chesapeake Bay. Since the information is captured through GIS technology, this information is compiled spatially for reporting forestry operations within the Bay watershed boundaries. For calendar year 2018, the BMP implementation rate harvest median score for forest harvesting within the Bay watershed was 93.3 percent.

The entire BMP implementation monitoring effort has been automated over the past several years to be compatible with VDOF's enterprise database system known as Integrated Forest Resource Information System (IFRIS)



BMP Cost-share program

During FY2006, VDOF developed and implemented a BMP logger cost-share program. Funding for this unique initiative was made available through a grant from the Commonwealth's Water Quality Improvement Fund. This program provides a 50 percent cost-share to timber harvesting contractors who implement appropriate BMPs on eligible stream crossings. The program will cover items, such as culvert pipes, equipment time to construct water diversion structures and material to revegetate the site. But probably the one feature of the program that will have a lasting effect on water quality in the Commonwealth is that the program provides cost-share for the purchase of portable bridges that will continue to provide water quality protection for sites beyond the original site for which they were purchased. In FY2016, this program funded 30 stream protection projects throughout the Commonwealth. No funding was available for this program in FY2018 and FY2019. Funding for this program is anticipated for FY2020 and FY2021.

Law Enforcement

On July 1, 1993, the Virginia General Assembly adopted into law the Virginia Silvicultural Water Quality Law (§ 10.1-1181.1 through § 10.1-1181.7), which requires the State Forester to protect water quality from impacts occurring as a result of silvicultural activity. This law was enacted with broad support from the forest products industry across the state. It is a civil law that requires the State Forester to inspect sites that do, or are likely to, impact water quality primarily from sediment deposition as a result of the silvicultural activity. The law provides the State Forester with the authority to: issue Special Orders to install corrective measures; issue Stop-Work Orders if the situation is bad enough to warrant it, and to assess civil penalties of up to \$5,000 per violation with each day constituting a separate violation. In 1998, the law was amended to include a requirement for timber operators to notify VDOF when they were beginning a new operation. A separate penalty matrix and tracking system had to be developed at that time to support this extended law enforcement effort.

Enforcement of this law is a mandated function of the VDOF by the Code of Virginia. There are several other water quality laws, such as the Debris in Stream Law and the Big Sandy Law in Southwest Virginia, for which VDOF also has enforcement authority. In addition to these, VDOF also provides technical expertise to the forestry community on Clean Water Act interpretation and Chesapeake Bay Preservation Act guidance.

During FY2019, VDOF handled 175 water quality actions initiated under the law, a decrease of 29 percent from FY2018. Of these actions, two resulted in a Special Order and two involved the issuance of an Emergency Special Order (Stop Work Order) for violations of the law. There were also 41 Failure to Notify violations.

The harvest inspection program previously identified is the main process that supports the law enforcement effort for water quality by VDOF.

Education

Logger education is another key focus area of the VDOF water quality program. Since the development of the first BMP Manual for Virginia, VDOF staff have helped provide harvesting contractors with water quality protection training ranging from harvest planning and map reading, to using GPS units to implement forestry BMPs. This training is offered through agency-sponsored events as well as through the agency's participation in the Sustainable Forest Initiative SHARP (Sustainable Harvesting and Resource Professional) Logger Training Program. Since 1997, this



program has enabled VDOF to assist in training 9,272 harvesting professionals in 304 programs relating to water quality protection. For FY2019, there were 22 training programs offered with a total of 441 participants.

Water Quality Data Management

Data management for the Water Quality Program is incorporated into the VDOF enterprise data management system IFRIS. This system provides a mobile platform for data input from field inspections of silvicultural operations. It allows for tracking of law enforcement actions involving the Silvicultural Water Quality Law and operator performance under law enforcement actions. It provides a portal for harvest operators to notify VDOF of their harvesting operations, and if they use latitude/longitude for notification, the system allows the operator access to a group of maps for them to use for harvest planning purposes. The system also keeps track of harvest inspection records for field inspectors to use for workload planning purposes. Harvest activity is tracked geospatially so that the agency can know at any time how much activity is occurring in a specific watershed and the impacts to that watershed from law enforcement actions.

Watershed Forestry

The watershed forestry component of the VDOF water quality program is responsible for the preservation and establishment of forests for the enhancement of water resources in both rural and urban areas. The objective of this portion of the program is to establish the forest's value in providing water quality and quantity sustainability. VDOF has established several programmatic areas of concentration: the Riparian Forest Buffer Establishment Program; the Riparian Forest Buffer Tax Credit Program, and the Urban Stormwater Management Program. In addition, VDOF has been involved with the Chesapeake Bay Clean-up Initiative since its inception and has been a part of the Chesapeake Bay Forestry Workgroup – a group composed of the six signatory states plus the District of Columbia and US Environmental Protection Agency (EPA).

Riparian Forest Buffer Establishment Program

Forested riparian buffers along streams provides the best protection and habitat for stream health and water quality enhancement. VDOF is involved with the establishment of riparian forest buffers on agricultural and abandoned agricultural lands. These efforts involve partnership with the Soil and Water Conservation Districts (SWCD), the USDA Farm Service Agency (FSA) and Natural Resources Conservation Service (NRCS), the Chesapeake Bay Program, and several non-profit watershed groups. VDOF is the agency responsible providing technical assistance for riparian forest buffer establishment and for reporting the riparian forest buffer establishment goals for the Chesapeake Bay restoration effort. This effort utilizes various state and federal assistance programs and private funding sources to develop forested buffers to assist landowners in establishing these valuable forests. VDOF field staff assist landowners in identifying projects, providing assistance program guidance, and assisting with project implementation and quality control. The agency has developed buffer planting guidelines as well as a methodology for planting quality checks and survival counts to support the various programs and to ensure that buffer establishment projects will be successful.

Watershed Implementation Plans (WIPs) are the roadmap for how Bay states and the District of Columbia will work to attain a healthier, more vibrant Chesapeake Bay. Virginia's clean-up plan, referred to as the Phase III Watershed Implementation Plan (WIP), will guide local, state and federal actions through 2025, and places greater emphasis on the relationship between trees and the Chesapeake Bay. VDOF works with its partners to ensure a watershed-wide focus on attaining Virginia's commitments to clean the Bay through initiatives that promote and increase the



implementation of riparian forest buffers and urban tree canopy, as well as track improved urban stormwater efforts. These efforts, coupled with strengthening stewardship of conserved working forestlands, demonstrate VDOF's key role in achieving the Commonwealth's goals for a healthy Bay.

One such partnership with the James River Association (JRA) and the Virginia Environmental Endowment (VEE) underscores the critical importance of establishing riparian buffers in the James River watershed to improve local water quality and meet Virginia Chesapeake Bay goals. Riparian forested buffers (forested streambanks) are one of the most cost-effective mechanisms for capturing pollution from the land and improving the water quality outflows of a river system. The James River Buffer Program aims to establish more than 700 acres of riparian forested buffers in the Middle James region of the river. This initiative to restore river and streamside forest buffers springs from funding from the VEE James River Water Quality Improvement Program grant awarded to VDOF (\$750,000) and the JRA (\$1.45 million).



Riparian Forest Buffer Tax Credit Program

A tax credit for the retention of riparian forests during a timber harvest was established by the Virginia General Assembly in 2000. Eligible landowners who retain a forest buffer as part of the timber sale can receive up to 25 percent of the value of the timber left in the buffer up to a maximum of \$17,500 for a tax year. The tax credit requires that the buffer be retained for 15 years and is monitored by VDOF for the tenure of the credit. This monitoring is done through “change detection” technology requiring all buffers that receive the credit to be GPS mapped. VDOF has the responsibility for determining and issuing the tax credit for the landowner. This option was taken by 83 landowners in Tax Year 2018, an increase from the previous year. This watershed protection option provided tax credits totaling \$489,281 and valued at \$2,016,627 on timber retained in streamside areas – an increase in both the buffer value and tax credit issued.

Forest Research

Program Overview

VDOF has supported an applied forest research program for more than 65 years. The program has developed and demonstrated many of the silvicultural practices that are currently applied to forest lands across the Commonwealth. Numerous reports, fact sheets and analytical tools have been developed and published summarizing research on a wide array of subjects, and stakeholder presentations at training events and workshops are frequent.

The staff currently includes one forest research program manager, one tree improvement forester and one tree improvement technician. With a modest budget and staffing level, partnerships and collaboration are essential to leverage our efforts. To that end, we have ongoing relationships with a wide range of research cooperatives, universities, other state and federal agencies, and non-government stakeholder organizations. Findings are shared in scientific reports and outreach forums as new summaries become available.

VDOF continues to develop, establish and monitor research and demonstration projects that meet practical forest management challenges and address emerging issues. The important products of those efforts are applicable results, techniques and recommendations that VDOF employees, Virginia landowners and others can apply to continuously improve the forests of the Commonwealth.

Program Focus Areas

As part of the agency lands division of VDOF, the current applied forest research program is divided into five general subject areas: loblolly pine silviculture; hardwood silviculture; pine genetics; diminished species restoration, and forest growth and yield modeling. Studies designed to address specific information needs or biological systems are installed and monitored across the state – usually for periods of years or even decades.

Loblolly Pine Silviculture

Ongoing work in pine silviculture includes studies of: combinations of thinning and nutrients for maintaining forest vigor and increasing productivity (in collaboration with the Virginia Tech/North Carolina State Forest Productivity Cooperative); effects of planting density and inter-planting following mortality to maximize product yields; effects of various competition control methods and



strategies; planting and genotype deployment patterns to address varying product objectives, and performance of containerized seedlings.

Hardwood Silviculture

The hardwood silviculture topic will receive elevated attention in the coming years in support of Virginia's Hardwood Initiative. We will continue to demonstrate and evaluate regeneration and growth responses of hardwoods following various harvest methods, crop tree release/fertilization, effects of deer on regeneration and impacts of thinning and timber stand improvement. Increased education and outreach is anticipated.

Pine Tree Improvement

VDOF supports the ongoing selection, testing and deployment of the best loblolly, shortleaf, eastern white and longleaf pine for Virginia citizens. Our tests involve comparisons of new open-pollinated and control-pollinated seedlings, currently in our fourth generation of progeny tests in collaboration with the North Carolina State University Tree Improvement Program. Planning for the fifth generation of selection, breeding and testing began in 2019.

Diminished Species Restoration

Conservation and restoration of rare or at-risk species is a high-priority subject area. We maintain studies pertaining to three diminished species: shortleaf pine (planting density); American chestnut (breeding for blight resistance, establishment methods), and longleaf pine (geographic seed source and planting density). We will continue to work in collaboration with the American Chestnut Foundation, the Longleaf Alliance and the Shortleaf Initiative on these projects.

VDOF has long been involved in American chestnut restoration with its archiving of hybrids and back-crossing work at Lesesne State Forest and continues to collaborate with the American Chestnut Foundation on research related to resistance breeding, orchard development and outplanting requirements. Commitment to American chestnut restoration spans beyond the borders of the Commonwealth, with a high level of interest in states throughout the original range. As research advances, and blight-resistant planting stock becomes more reliable and available, implementation will expand.

VDOF continues to take a lead role in the Virginia Longleaf Pine Cooperators group, with ongoing efforts to restore longleaf pine ecosystems in Virginia. We continue to identify and protect sites where native longleaf is present as well as those places suitable for the establishment of this species. Maintenance and preservation of the native seed source allows for increased production of native Virginia longleaf pine seedlings. To that end, we are nearing completion of a grafted orchard where as many native genotypes as possible are being archived for future seed production (targeted capacity is 500,000 +/- seed per year on average). Education for resource professionals and landowners, partnerships with other agencies and organizations, and the use of incentive programs continue to enable us to manage longleaf pine in the landscape now and in the future.

Shortleaf pine has been a declining forest component for much of its range since the 1940s, as extensive harvesting, conversion to loblolly pine, agriculture or development, and natural forest succession have decreased this forest type considerably. VDOF's intent is to maintain or re-establish shortleaf pine in the landscape in its natural range as a viable silvicultural option to offer to landowners. The strategies designed to meet this goal include developing geographic seed sources and supplies, developing external marketing plans, conducting internal agency training, increasing demonstration on suitable public forests, conducting research to use in marketing and management,



and providing incentives, such as cost-share funding, agency funding opportunities, partnerships or cooperatives.

Growth and Yield

Our collaboration with the Virginia Tech/North Carolina State Forest Productivity Cooperative and the Virginia Tech Forest Modeling Cooperative have helped develop the Loblolly Pine Decision Support System, which integrates a number of models to give foresters a user-friendly method of comparing the effects of different silvicultural options on forest structure and cash flow during the life of the stand. We continue to install and monitor long-term plots in conjunction with that project so that the models can be continuously updated with data from the most current genotypes grown under the silvicultural regimes being employed by today's landowners.

Pine Tree Improvement

Program Overview

The tree improvement program focuses on the selection, testing and production of superior pine seed – primarily loblolly, but also eastern white, shortleaf and longleaf pines. It is supported by one tree improvement manager and one technician – both reporting to the research program manager. The decade since the last state assessment has seen a number of successes and challenges.

Prior to tree improvement, loblolly seeds were collected from unimproved natural stands – mostly from trees felled during logging operations. In 1956, the North Carolina State University Industry Cooperative Tree Improvement Program (NCSU-TIP) was created. Our objective as a cooperative member is to breed, test and select trees that result in economic benefit to Virginians and other cooperative members. The cooperative has accumulated 7,511 selections to conserve the loblolly pine genetic resource for future generations of breeders and foresters, and 6,230 control crosses among loblolly pine selections have been tested in field trials. Membership and workflows in the cooperative have changed drastically in the last decade. With corporate mergers in the late 2000s, membership was shrinking to a point where our capabilities to conduct breeding was inadequate. The then 12 companies and four state agencies who were full members of the cooperative decided to consolidate breeding activities as much as possible at a breeding center at the Arrowhead facility in Georgia. In order to find more funds, a summit in Crossnore, North Carolina was held and produced a strategy to reshape the cooperative. It was decided to invite non-traditional companies and agencies to become contributing members of the cooperative (more details in the 60th annual report of the NCSU-TIP). Today the membership is 10 full member companies and state agencies, 21 contributing members, and seven research associate members.

By 1988, all seedlings produced in Virginia nurseries were from this genetic improvement process. Cone collection from the first-generation orchard was phased out in 1997, and collections from the second-generation orchard peaked in 2003. By 2009, 30 percent of the seedlings produced in Virginia were from our third cycle orchards and 70 percent from the second-generation orchard. Since 2012, all seedlings have been from the third cycle.

After a pilot-scale controlled pollination effort in 2009, we have acquired experience on the work flow and phenology for producing improved full-sib seedlings of loblolly pine. VDOF is now contracting out full-scale controlled pollination on our best three selections each year. In 2015, we installed 20,000 pollination bags that produced 131.8 pounds of seed – enough to produce 1.9 million



seedlings. In 2019, 25,000 pollination bags were installed. The controlled pollination effort continues to expand. Individual crosses will have productivity gains of 90 percent or more.

The challenge for producing control pollinated (also known as full-sib) seeds in the Virginia is climate. The environment is too harsh and the risk of losing an entire crop due to late frost is very high. To overcome this situation, VDOF has decided to establish a special orchard designed for controlled pollination at our property in Milledgeville, Georgia (formerly the site of our second-generation orchard) where climate is more suitable such operations. In the spring of 2017 VDOF tree improvement staff and other tree improvement experts from the NCSU-TIP visited the site to analyze the soil map and discuss different designs for establishing the new orchard. Thirty acres were mapped out and then clear-cut. During the 2019-2020 winter, the area has been burned and we are in the process of leveling the ground for future planting of rootstock onto which we will graft our best parent trees for future controlled pollination.

Program Focus Areas

Selection and Breeding Research

As part of the NCSU-TIP we continue to make selections and controlled crosses of superior genotypes for testing. Each year, we establish approximately six to eight acres of new progeny tests, and maintain and remeasure those tests already established. Data from these tests are the basis for selections that will be included in our future seed orchards.

Through the same cooperative, we are engaged in making selections and controlled crosses of superior genotypes for testing. In 2018, we finished crossing for the fourth cycle breeding populations. The first of the fourth cycle test data were collected in 2018 in the Atlantic Coastal and Northern and Piedmont Regions. VDOF had five tests measured from which 12 selections were identified for the fifth cycle breeding populations. These selections and future selections will be grafted in a new breeding and/or production orchard. Coop members and NCSU-TIP staff involved in breeding are planning another summit in August 2019 in Crossnore, North Carolina to work on a new strategy for the fifth cycle breeding plan.

Seed Orchard Maintenance

All actively producing seed orchards must be continually protected from fire, insects, diseases and other potentially damaging agents. They are mowed, fertilized, irrigated, protected from deer damage and sprayed for insect control whenever needed to ensure their health and continued productivity as seed collection areas. The loblolly, eastern white, shortleaf and longleaf seed production areas comprise a combined total of more than 350 acres that are under this program.

Cone Collection and Seed Processing

Whenever seed is needed, and as crops are available, the tree improvement program is responsible for deciding which families will be harvested and how many cones and seeds will be produced. The cone collection and seed cleaning/sorting efforts are accomplished by both internal VDOF crews and, when needed, contracted crews.

Seed Orchard Establishment

In the last few years, new and more productive families have been selected and added to the cooperative germplasm. A lot has been learned about phenology for flower and pollen production for



many selections. The third cycle orchard will soon reach an age where efficient operation is no longer economical and will need to be replaced. For an optimal age of operation of 30 to 35 years, we plan to have the newest first blocks of our fourth cycle orchard established so that we can start harvesting cones in 2027. Forty acres will be established at VDOF's New Kent Forestry Center by the end of 2025 and 20 acres in the Appomattox-Buckingham State Forest by 2027. At the property in Milledgeville Georgia, 20 acres of a special orchard for controlled pollination will be established within the next 4 years.

We are also planning rousing the third cycle orchards, leaving approximately 20 to 25 trees per acre in order to release the most productive families and reduce competition for water and nutrients.

Proposed Action Plan

VDOF will continue to produce seed of important pine species to meet the production needs of our nurseries. We will maintain and protect the existing orchards, establish new orchards and establish and assess progeny tests for future selection work. We will select, breed and test the parent trees for a fifth-generation loblolly orchard. As budgets and resources allow, we will work to expand the availability of control pollinated seedlings.

Forest Products Marketing and Utilization

Program Overview

VDOF has been active in forest products utilization and marketing for decades. The program's goal is to promote a prosperous forest industry and markets for forest-related products. Management and duties have moved between dedicated forest products personnel or have been dispersed among various programs over the years due to budget concerns and changing priorities. In 1999, the various forest utilization and marketing activities were consolidated, and a program manager was hired to address the increasing changes that were occurring in the forest industry and related markets. Since then, the program has been placed under various divisions and now resides in the forestland conservation division. Although most of the core activities and program manager were retained during the various moves, each division had different priorities. The program evolved to address all types of forest products and benefits. Program staffing includes a utilization and marketing manager, a special assignment utilization and marketing forester and shared office staff. Additional assistance includes temporary, usually grant project-specific personnel. The assistant state forester manages ecosystem services related projects.

The purpose of the utilization and marketing program is to help Virginia to have a prosperous forest products industry and to assist with creating markets and other benefits for forestland owners.

This is to help support Virginia's largest manufacturing sector, maximize incentives for forest landowners to keep their lands in forest and provide opportunities for better forest utilization and management.

The utilization and marketing program covers several areas. There can be considerable overlap since many of the projects fall into multiple areas and involve other programs. The first three are more general and cover all sectors of forest products and markets. The final area includes more specialized programs that are focused on specific forest sectors or grant projects.



Program Focus Areas

- ◆ Technical assistance to forest industry and other customers
- ◆ Promotion of Virginia's forest industry and economic development
- ◆ Development and dissemination of forest resource and industry data
- ◆ Grant programs and special projects

Technical Assistance

This area focuses on collecting and distributing information to businesses and forest landowners in Virginia so that they can be more competitive. The program accomplishes this by: providing information collected at trade shows, during plant tours and from other industry contacts about the latest equipment, technology and markets relevant to Virginia firms; assisting with demonstrations of new equipment and techniques; promoting techniques that improve efficiency, and investigating new products and ways to increase value from forest resources. This assistance can occur with individual companies on-site or in group training and educational programs held with partners at more centralized sites. Great effort is made to work with improving competitiveness of existing and traditional forest industry while also helping businesses to grow by introducing them to new markets.

Promotion of Forest Industry and Economic Development

Improving markets for Virginia's forest resources is vital to maintaining a prosperous forest industry and maintaining working forests. VDOF works with other state agencies and organizations to promote Virginia's forests and industry at regional, national and international trade shows and events. Data compiled by the utilization and marketing program are used to develop materials for promotional materials. Much of this information is also used in media articles and public meetings to highlight the importance of Virginia's forests and forest industry to the state's economy and quality of life.

Part of this area includes working with state economic development agencies, as well as other agencies, to encourage business to locate or expand in Virginia. Maintaining current information on forest resources and industry, and in the form needed, is vital to this effort. New markets are requiring that different types of information be available for potential businesses to evaluate. Being involved with various agencies, groups and associations, such as the VA Forestry and Forest Products Associations, Virginia Biomass Energy Group, Southern Group of State Forester's Services, Utilization and Marketing (SUM) Committee, and newly formed Virginia Wood Utilization Team helps with these efforts.

VDOF is planning a new series of forest industry roundtables that will bring together representatives from all sectors of forest industry to discuss issues facing the industry and what the state can do to address them. These roundtables will be a follow up to a session held several years ago to address existing and emerging issues affecting forestry and forest industry. Besides efforts to maintain a prosperous, competitive forest industry, there is also an emphasis on rural economic development to try to maintain jobs in these areas and encourage keeping land in working forests.



Development and Dissemination of Forest Resource and Industry Data

Through cooperative agreements with various agencies and organizations, forest resource and industry information is collected, analyzed and disseminated to stakeholders and other interested parties. This information is used to: promote Virginia's forests and industry; monitor forest and forest industry sustainability, ownership and other changes; analyze economic impact and quality of life issues, and assist localities with comprehensive planning. Virginia landowners, businesses and others also request information on types, values, production and location of various products. Information sources used include: IMPLAN input-output model to calculate economic impacts and contributions of forestry in Virginia; Virginia Forest Products Tax database; USDA Timber Products Output (TPO) and Forest Inventory and Analysis (FIA) databases, and Virginia Forest Products, Timber Buyers, and Service Providers databases.

Grant Programs and Special Projects

Virginia's utilization and marketing program tries to work with all types of forest products and markets to maximize the options that may be available to forest landowners and industry. Many times, new or changing markets have issues that need to be addressed to best take advantage of new opportunities. Virginia is involved with several such projects, and the major ones are described here.

Biomass Energy

Changing forest markets and demand for more locally produced renewable energy have increased focus on biomass energy. Although demand and opportunities continue to fluctuate depending on fossil fuel prices and government policies, VDOF is working with partners to identify better ways to evaluate and use forest resources for bioenergy production. We are also working with partners to increase domestic production and use of biomass fuels and energy through several initiatives, including seminars and tours about bioenergy use and providing technical and other support. Association with other state, regional and national agencies and groups, such as the Virginia Biomass Energy Group, Southern Regional Extension Forestry and USDA Forest Products Lab are also helping in this effort.

Forest Certification (legal and sustainable forest products)

Demand continues to build, both domestically and internationally, for "green" products that come from sustainably grown forests. In many cases, customers want some kind of guarantee or documentation that the products were legally obtained and come from certified, sustainably managed forests. Although programs exist to certify privately-owned forestlands – which are the majority of the forests in Virginia – they are not used by the majority of landowners due to cost, requirements and other issues. If demand continues to grow for specific documentation and tracking on the source and management forest products, landowners that are not participating in current programs could see their ability to sell and value of forest products diminish. Forest industry could also suffer by not being able to source materials or produce products that have certified labeling. VDOF is working with partners to try to reduce the barriers for landowner participation in current sustainable forestry programs, as well as looking at alternative ways to verify legally obtained and sustainable wood. As part of this effort, VDOF has certified all of its State Forests under the Sustainable Forest Initiative (SFI) program and the American Tree Farm. Due to the importance of forests and forest industry to Virginia, this program is looking at the certification issue throughout the forest products supply chain.



Forest Operator and Service Providers for Changing Forests and Markets

As forest markets, land ownership and demographics change, new opportunities appear to meet these needs. However, they also have an impact on many traditional businesses. Virginia, like many other states, has seen a concerning decline in timber harvesters and other forest operators and service providers. These operators are the key links to healthy, sustainably-managed forests and the provision of raw resources needed to produce the forest products on which we all depend. There are ongoing efforts to train people for careers in forestry and to assist current businesses to adjust to changing markets, as well as to encourage the development of new businesses to meet landowner needs. Focus areas include small-acreage forest landowners and urban wood utilization.

Specialty Forest Products



The forests of Virginia provide many non-traditional products that can provide income to landowners and small businesses, especially in rural areas. By working with cooperative extensions, universities and other partners, VDOF has supported ongoing research, educational programs and demonstrations in a number of areas, including the control of invasive species through utilization, lump charcoal production, shiitake mushroom propagation, specialty woods for custom furniture and other use, and production of forest-based foods, medicines, and more.

Figure 49. Demonstration charcoal production, a non-traditional forest product.

Ecosystem Services

Program Overview

Beginning in 2006, VDOF began to explore how Virginia landowners could benefit from greater involvement in and exposure to the emerging arena of ecosystem services. In 2008, this exploration led to the formation of the and conservation division within the agency, with the division director serving the primary role as ecosystem services program manager for VDOF. Because both the discipline of ecosystem services and the agency's ecosystem services program are both new and fast evolving, the ecosystem services program area is not established in the same manner as most of our other program areas, with relatively defined roles, program offering, target audiences, and priority areas.

VDOF has become involved in various initiatives related to ecosystem services during the past three years. These efforts have evolved as part of VDOF's effort to find ways to slow the loss of forestland being converted to other land uses. In addition to traditional forest products, it has become apparent that we need to better articulate and value the many other environmental benefits and services provided by forestland. These initiatives are outlined here.



Program Focus Areas

InFOREST

One of the first steps in being able to value ecosystem services for both developing markets and mitigation efforts is quantification of these services. Unless we are able to quantify these services, it is nearly impossible to participate in a marketplace. In addition, accurately quantifying the loss of specific ecosystem services will allow for more credible mitigation to take place.

VDOF has collaborated with various partners to develop a web-based, GIS-enabled platform for mapping, report writing and running various ecosystem service calculators. InFOREST allows a user to develop an "ecosystem service portfolio" for various ecosystem services provided by a tract of land. The services include: carbon sequestration; nutrient load reduction (nitrogen and phosphorus); sediment load reduction, and biodiversity.

This tool enables the user to make what-if scenario comparisons of the portfolios when certain land management practices or land-use changes are anticipated or made on the tract. The ability to do this enables natural resource managers, land-use planners, landowners and other users to make more informed decisions on activities that impact the forest resource. In addition to enhancing landowner ability to participate in developing ecosystem service markets, other utilities for these tools include performing environmental mitigation analyses for municipal infrastructure (e.g., roads, powerlines, developments, etc.), and enabling county governments and other land-use planners to make informed natural resource decisions as demands from growing populations are addressed.

Tool development includes a user-friendly interface where users can spatially outline their area of interest, enter any additional required data and run their report. The GIS utilizes extant data (field or remotely-sensed) as well as new inputs when needed. The best available models that are already developed are being utilized to "run behind the scenes" to generate the quantities of ecosystem services provided. For example, the FASTLOB model (carbon sequestered in southern yellow pine), Forest Vegetation Simulator (FVS) model (carbon sequestered in hardwoods) and GWLF model (Generalized Watershed Loading Function Model for nutrients and sediment) are all peer reviewed, scientifically validated models that yield good results.

Outreach

A great deal of effort has been made to increase awareness of ecosystem services and emerging markets. Presentations are made annually at conferences, various universities, landowner workshops, state agency meetings and stakeholder groups. Drafting and incorporating appropriate ecosystem service language into County Comprehensive Plans and Forest Stewardship Management Plans will be done. PowerPoint presentations have been developed and are provided to other speakers upon request. An ecosystem services brochure has been developed for landowners.

As the ecosystem services program continues to develop alongside the discipline itself, additional initiatives will surely be added to the agency's efforts. Our ability to fully take advantage of future opportunities will hinge largely on appropriate funding being secured to staff the effort, at both the headquarters program level and the field implementation level.



Conservation Education

Program Overview

VDOF's mission is to protect and develop healthy, sustainable forest resources for Virginians. Conserving the forestland base is critical to the health of the environment, to the supply of forest products and to overall quality of life. Conservation education efforts spread this message to Virginia's citizens, to help ensure a bright future for Virginia's forests.

For many years, information transfer was a mainstay of VDOF's education efforts. Clientele often had long-standing connections with the land and were somewhat familiar with the agency's message. Many contacts with the public still involve information transfer, which can provide specific resources to those who know what they need to learn. For example, a forester might provide resources to a landowner with experience growing hardwoods who would like to try growing pines. Information transfer can also be a critical first step in changing people's awareness of forest resources and issues. Examples of this type of information transfer include providing publications, hosting exhibits and interacting with people at both large-scale events (e.g., Virginia State Fair, Virginia Highlands Festival, Sawmill and Logging Expo) and numerous local events.

In recent years, many Virginians, including landowners, have moved away from an intimate association with the land. Therefore, more in-depth education has become an important tool to change citizens' knowledge, skills, attitudes and behaviors regarding forestland. Education is particularly important to conservation of the forestland base, since most of the state's forestland is privately owned. VDOF often partners with other agencies and groups to conduct educational programs, such as workshops, tours and training programs. Partnerships maximize staff, knowledge and financial resources. They also help to reach wider audiences, especially those who are traditionally underserved, including members of federally and state recognized tribes in Virginia.

Long-term efforts to conserve forestland will depend on tomorrow's forest landowners, decision makers and voters. Making forestry relevant to today's young people is a key component to the conservation message. VDOF works with many partners – schools, agencies, youth organizations, and forest business and industry – to teach Virginia's youth about all types of forests, from vast wilderness areas to managed State Forests, pine plantations, backyard woods and even urban street trees.

VDOF uses a variety of resources to support its educational programs. Existing resources from Project Learning Tree (PLT), Virginia Cooperative Extension, universities and other research-based sources are used whenever possible to avoid duplication of effort. When there are gaps to fill, VDOF also produces its own educational materials. Most programs are delivered by local field staff, but the agency also has a conservation education coordinator and two forest education specialists who develop and deliver programs on State Forests and other locations. Volunteers, such as Master Naturalists, Tree Stewards and PLT facilitators, assist with programs as well.

Program Focus Areas

Project Learning Tree

Project Learning Tree (PLT) is a curriculum supplement that teaches youth about the environment, stimulates thinking, encourages informed decision making and inspires action. Each year, more than 1,200 Virginia teachers and non-formal educators are trained to use PLT with students and other



groups. Trainees include pre-service teachers (education majors in colleges and universities), who are then prepared to use PLT in their first classrooms. In a recent survey of PLT-trained educators, 75 percent had used PLT in their teaching. Ninety-five percent of those educators who used PLT said the activities enhanced their ability to teach state standards in science.

Forestry Camp

For more than 60 years, Holiday Lake Forestry Camp, now called Camp Woods and Wildlife, has provided field experiences in natural resource management to young Virginians. Approximately 80 campers aged 13 to 16 attend the week-long residential camp annually. Hosted and staffed by VDOF, the camp also receives financial and staff support from other agencies, businesses and organizations.

State Forest Education

VDOF continues to explore ways to use state lands as educational spaces. Forest education specialists at the VDOF headquarters in Charlottesville and the Matthews State Forest in western Virginia plan and lead programs, such as school field trips and Girl/Boy Scout merit badge training. Most State Forests do not have staff to maintain infrastructure and deliver programs, so VDOF has established self-guided activities, such as trails, geocaches and driving tours, on some forests.

Local Programs for Youth and Adults

VDOF field staff (foresters and technicians) understand local needs and build relationships, so they are the agency's best resource for educating people where they live. Many staff have been trained in teaching methodology and resource materials for hands-on education. Continued training will occur as funds are available. VDOF staff offers educational programs for both youth and adults, many in partnership with other agencies and organizations. Examples of youth programs include: natural resource days for students; Arbor Day programs in schools and communities, and Envirothon training sessions. Adult programs include: landowner short courses or single-day workshops on forestry topics; forestry tours, and forestry training for Master Naturalists. Statewide, more than 1,200 youth and adult programs reached an estimated 18,000 citizens in the past year.

Virginia Master Naturalist Program

The Virginia Master Naturalist program trains volunteers to do educational, scientific and stewardship work benefiting the state's natural resources. VDOF is one of five state agency sponsors of the program, which now has 27 chapters. VDOF staff serves as advisers for eight of these chapters and are involved with training or projects in almost every chapter. In its first four years, the program's 800+ volunteers have donated more than 94,000 hours in education, stewardship and citizen science projects – a value of nearly \$2 million.

Outreach to Underserved Audiences

As with most VDOF programs, partnerships are critical in reaching out to traditionally underserved audiences. Key partners in outreach are Virginia State University; Virginia Polytechnic Institute and State University, Cooperative Extension, and the Black Family Land Trust. Programs included presentations to civic groups, local government, landowner/homeowner associations or other local organizations; workshops; training for colleges, volunteers and organizations/agencies; tours and field days; Project Learning Tree educator trainings, and exhibits at community events or fairs. An



opportunity to cultivate new and partnerships exists in many areas statewide, including with Virginia's Indian tribes.

Virginia's State Nursery System

Program Overview

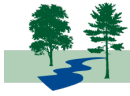
VDOF's nurseries serve an important role in the sustainability of Virginia's forests as well as the agency's forest conservation role. The enabling legislation allowing establishment and continued operation of the state nurseries is found in the title §10.1-1114 of the Code of Virginia. During their more than 100 years of operation, these nurseries have grown more than two billion seedlings and provide more than 30 million seedlings of various species annually including four species of pine (white, loblolly, shortleaf, and longleaf) and forty-eight species of hardwood.



The multiple management objectives of the VDOF nurseries include: providing seedlings to meet reforestation demands; providing genetically improved seeds for the reforestation program; providing seedlings for wildlife habitat improvement, riparian buffer protection and pollinator enhancement, and providing seedlings for natural urban aesthetics. Seedlings are purchased primarily by planting contractors, forestry consultants and private forest landowners, but the forest industry also purchases seedlings for its lands. The seedlings are selected for Virginia's climate and for maximum growth. Several species, including loblolly pine, are a result of genetic improvement work; VDOF has been a member of the North Carolina State Cooperative Tree Improvement Program (NCSC-TIP) since it formed more than sixty years ago.

The nurseries are a self-supporting operation with no general funds dedicated to them. The financial support for their operations comes through the generation of revenues from seedlings sales. The sale of forest tree seedlings supports both the operational and capital expenses of the nursery program as well as the tree improvement and seed orchard operations and the research program.

The nurseries have three forestry centers that cover more than 1,200 acres. The largest forestry center is New Kent Forestry Center (NKFC), where tree improvement and seed orchard operations are based. Augusta Forestry Center (AFC) covers 178 acres in Augusta County adjacent to the South River. AFC produces bare root seedlings, including several conifer species and more than 40 species of Virginia hardwoods. AFC also collects 10,000 or more pounds of hard mast seed from local sources every year. AFC serves as the UPS shipping center for landowners who prefer to have their seedlings delivered to them directly. Garland Gray Forestry Center (GGFC) is the loblolly pine seedling nursery and covers 213 acres in Sussex County adjacent to the Nottoway River where the sandy soils are ideal for seedling production. Loblolly pine bare root seedlings are offered in four different varieties: Premium (PRS >50); Elite (PRS > 60); Virginia's Best (PRS > 65), and Controlled Pollinated – CP (PRS > 90). The PRS rating is a trademarked productivity rating determined by the NCSC- TIP based upon field data at age six of a loblolly family's performance. For example, a PRS rating of 50 denotes that the family will have a 50 percent or higher productivity gain over non-improved stock. All of the



loblolly varieties are open-pollinated except for the CP variety. All of the loblolly pine seed are currently collected from the third cycle families in the NKFC orchard. There is also a duplicate third cycle loblolly pine and a white pine orchard located within the Appomattox-Buckingham State Forest, and seeds are collected from there as well. Fourth cycle families have been planted in the orchards for the next generation of improved seed.

GGFC added a 600,000-cell containerized seedling operation in 2018 to begin growing its longleaf pine seedlings in-house. Previously, the North Carolina Forest Service nursery in Goldsboro had grown VDOF's native Virginia containerized longleaf seedlings under contract. In addition to the longleaf seedlings, the containerized operation at GGFC will grow loblolly pine and other species per customer needs.

The nursery systems are staffed by a nursery manager, a nursery assistant manager at GGFC and one at AFC, two program support technicians, three nursery technicians, a nursery technician/mechanic and several part-time positions. Contract crews are utilized during the seedling lifting and shipping seasons.

During the past few years, landowners' planting objectives have become more diversified, with an evident shift to wildlife habitat enhancement, pollinator protection, riparian buffers (Conservation Reserve Enhancement program projects) and forest sustainability. The nurseries are developing methods to provide landowners with more options by adding new species as well as the containerized seedlings. Also, landowners can buy seedlings in very small quantities for their small projects.

Program Focus Areas

Developing a sound business plan is the main priority for the nursery staff. With the changes in demand and economics, it is challenging to be profitable.

Providing the best genetically improved and most productive seedlings will always be a demand on the nurseries. When the tree improvement team creates a new strand, the nurseries offer the best seedlings to landowners as quickly as possible. Research in blight-resistant American chestnut hybrids continues to progress with many test plots established. These seedlings should be available for the public for out-planting in the future.

Enhancing the awareness of the VDOF nurseries to the general public is another program focus. An information and education campaign will help landowners understand the concepts and benefits of planting seedlings and available cost-share programs. Providing more education will help the environment and attract new tree planters while fulfilling landowner objectives, whether those are economics, stand enhancement or a combination of aspects for good quality forestland management.

Virginia's State Forest System

Program Overview

Virginia's State Forests are unique among other Virginia state lands in their purpose, funding and use by the public. Some state lands have uses focused mainly on one objective, like recreation or historical interpretation. State forestlands have multiple objectives and are managed to provide the greatest benefit to the citizens of Virginia. These multiple objectives must be met within the 70-year-old, self-supporting mandate of the state forest system. The primary goal of this mandate, and of the state forest system overall, is maintaining the forest ecosystem as a whole. Since 2015 Virginia State



Forests have been certified by SFI (SFI 2015-2019 standard) and the American Tree Farm (American Forest Foundation (AFF) 2015-2020 Standards of Sustainability),

The state forests are well-distributed around the Commonwealth and vary in size from 121 acres to 19,808 acres. The largest state forests, primarily located in central Virginia, are the core of the self-supporting concept and provide the majority of the income to fund the forest system. The smaller forests, some of which are not working forests, have developed uses that meet the needs of the local community.

Forestland in Virginia's state forest system totals 69,441 acres and is found on 25 different forests in all regions of the state with vastly differing landscapes and extremes in population and demographics. Except where restricted by deed or access issues, these lands are open to the public, but often roads and trails are restricted to foot traffic. The main purpose of these forests is to provide a working demonstration of forest management that focuses on six core principles. These principles include: the conservation of biological diversity; the utilization of the productive capacity; the maintenance of health and vigor; the enhancement of carbon cycle budgets; the improvement of socio-economic benefits, and the protection of water quality.

The multiple objectives for which the Virginia State Forests are managed include: the demonstration of good forest management; a land base for applied forest research and wildlife habitat; the protection of watersheds; the support of biodiversity, and opportunities for outdoor recreation. It is important to know that the Virginia state forest system is self-supporting. Ninety-five percent of the operational income is generated through timber sales, but other sources of income include hunting permits, building rentals and donations. A State Forest Use Permit was enacted by the Virginia General Assembly in July 2009 and is now required by forest users who ride horses, fish, hunt, trap or ride mountain bikes. The revenue raised from this permit is yet to be determined.

Recreational opportunities on state forests are focused on self-directed activities, some of which are not available on many other state lands. These activities include hiking, bike riding, horse riding, orienteering, hunting, fishing and wildlife viewing. The central Virginia state forests provide for an especially unique opportunity to enjoy the out-of-doors due to their large size, which provides for an outdoor experience far removed from many of the distractions found in more densely populated areas. State forest resources are finite, however, and cannot provide everything to everyone.

The State forest system is staffed by a state forest manager, assistant manager, program support technician, three foresters and four equipment operators. Timber management constitutes the majority of the work performed by state forest personnel. Selected regional VDOF personnel contribute to the management of smaller state forests.

As the areas surrounding the state forests continue to grow in population, recreational uses of the land will evolve with changing expectations from the general public. VDOF remain aware of the changing expectations of the public and will work towards providing recreational opportunities compatible with state forest timber management objectives while providing a rewarding outdoor recreation experience.

During the past few years, forest users have become more diverse, and this can create situations that generate conflict among various user groups. Some users may object to particular implemented forest management practices in certain areas on the forest. Traditional uses, such as hunting and fishing, are popular uses of the forest, while newer interests, such as hiking, horseback riding, mountain biking, adventure races, orienteering, bird watching and as a place where people come just for the solitude, are becoming more popular.

Increased recreational use of the state forests will have a greater impact on state forest infrastructure, funding, specialized staffing, timber management and the forest ecosystem.



Developing strategies for recreational uses on these lands will become even more important if conflict is to be minimized, timber management is to continue in a self-supporting manner, and if the quality of the forest for recreational uses is to be maintained and improved.

Recreation is a secondary management objective on the state forests, and decisions concerning recreation must be made in regard to the primary objective of timber management. Many recreational activities are compatible. Each activity will be managed to minimize impact on the natural resources, meet recreational needs and reduce visitor conflicts.

Every 10 years, the forests are inventoried and plans are developed to establish harvest levels, which determine income. A payment in lieu of taxes is paid to each county in which a forest is located. Twenty-five percent of the gross income is returned to the county. An exception to this rule covers the Cumberland and Appomattox-Buckingham State Forests. Beginning in 2007, 12.5 percent of the gross revenue generated from these forests is specifically retained to enhance and maintain recreational resources on the respective state forest within that county.

In the 1990 Farm Bill, the federal government established the Forest Legacy Program with the intent to protect important forestlands that are under threat of conversion to other uses. This enabled VDOF, working in partnership with the USFS, to acquire the 2,043-acre Sandy Point State Forest in King William County and the 1,811 acres that established the Dragon Run State Forest in King and Queen County.

In 2009, VDOF added 7,752 acres to the Dragon Run State Forest in King and Queen County. This property was purchased from The Nature Conservancy with funds provided by state bonds. While not actually on the Dragon Run water course, it provides protection to those acres in the Dragon Run watershed, which is widely recognized as an important watershed in the state for its pristine ecologic condition. At 9,563 acres, this places Dragon Run State Forest as the third largest state forest in Virginia – behind the Appomattox-Buckingham and Cumberland State Forests.

Program Focus Areas

Management of the timber on the state forests is the main priority for the state forest staff. When the state forest system was established, the funding system was designed to demonstrate to private landowners that a managed forest could be profitable. As the expectations and uses of state forestlands have changed, funding operations has become more challenging under the self-supporting system.

Recently acquired lands will require the creation of management plans creation, infrastructure development, and initiation of management. These forests consist of 16,500 acres on which considerable work is needed to improve roads, establish recreational trails and develop other basic infrastructure.

Enhancing recreational opportunities on the state forests is receiving additional attention. The development of equestrian areas, new or improved parking areas, new trails and more extensive signage – combined with improving the existing trail systems – should make the state forest system well-positioned to accommodate old and new users alike.



Section VII: Linking Issues to Actions

The primary purpose of this Virginia Assessment of Forest Resources has been to gather a snapshot of the current condition of the forests in Virginia, identify threats to the forest resource, and articulate desired outcomes for Virginia's forests of the future. The companion document, the VDOF Strategic Plan lists six goals, 17 objectives, 35 measures and 56 strategies, all aimed at shaping Virginia's future forests and achieving these desired outcomes.

Out of the assessment process, the most important threats and those having the broadest potential impact were identified. These include:

A. National Theme – Protect Forests from threats.

1. Protect forestland and associated woodland home communities from fire
2. Protect forests from forest health threats and invasive species
3. Conserve and restore diminished species

B. National Theme – Enhance public benefits from trees and forests

1. Enhance the role of forests in maintaining water quantity and quality
2. Support the forest economy and diversified markets for forest landowners
3. Expand and improve urban and community forests

C. National Theme – Conserve and manage working forest landscapes for multiple values and uses.

1. Keep forests as forest
2. Promote a larger, connected forest landscape
3. Ensure the sustainable use of forest resources

Each issue has a variety of objectives and associated strategies aimed at helping achieve the desired future outcome. In order to bridge the gap between identified issues and practical actions, this section lists the applicable objectives from the companion strategic plan, grouped by the issue they are designed to address. Specific strategies associated with these objectives can be found in the companion strategic planning document.



Protect Forests from Threats

A1. Protect forestland and associated woodland home communities from fire

- ◆ Objective 1A: Ensure that VDOF maintains an appropriate and efficient level of readiness to respond to wildfire and other emergencies and provide support to cooperating response agencies.
- ◆ Objective 1C: Be proactive in preventing the loss of forest resources and other property due to wildfire and other natural and human-caused events
- ◆ Objective 4A: Recruit and retain an inclusive workforce that is engaged with VDOF's mission.
- ◆ Objective 4B: Implement relevant and timely training programs and policies that develop technical competence while sustaining safe work environments.
- ◆ Objective 5A: Ensure VDOF has adequate equipment, tools, facilities, and resources.
- ◆ Objective 6B: Cultivate partnerships to increase VDOF's influence and reach.

A2. Protect forests from forest health threats and invasive species

- ◆ Objective 2A: Provide more proactive forest management planning to increase production and ensure resource sustainability on private and public lands.
- ◆ Objective 4A: Recruit and retain an inclusive workforce that is engaged with VDOF's mission.
- ◆ Objective 5C: Ensure VDOF adapts to address the changing needs of forest resources and society.
- ◆ Objective 6B: Cultivate partnerships to increase VDOF influence and reach.

A3. Conserve and restore diminished species

- ◆ Objective 1C: Be proactive in preventing the loss of forest resources and other property due to wildfire and other natural and human-caused events
- ◆ Objective 2A: Provide more proactive forest management planning to increase production and ensure resource sustainability on private and public lands.
- ◆ Objective 3C: Promote and expand the use of prescribed fire to meet multiple management and training objectives.
- ◆ Objective 4A: Recruit and retain an inclusive workforce that is engaged with VDOF's mission.
- ◆ Objective 6B: Cultivate partnerships to increase our influence and reach.



Enhance public benefits from trees and forests

B1. Enhance the role of forests in maintaining water quantity and quality

- ◆ Objective 2A: Provide more proactive forest management planning to increase production and ensure resource sustainability on private and public lands.
- ◆ Objective 2B: Enhance the timber harvest inspection program to better help loggers protect water quality.
- ◆ Objective 3B: Enhance the capacity of forests and trees to provide water quality and quantity.
- ◆ Objective 6B: Cultivate partnerships to increase our influence and reach.

B2. Support the forest economy and diversified markets for forest landowners

- ◆ Objective 2A: Provide more proactive forest management planning to increase production and ensure resource sustainability on private and public lands.
- ◆ Objective 2C: Expand VDOF's role in support of Virginia's forest economy to develop new income streams for landowners and pursue new markets for existing producers and additional manufacturers for underutilized forest products.
- ◆ Objective 3C: Promote and expand the use of prescribed fire to meet multiple management and training objectives.
- ◆ Objective 5C: Ensure VDOF adapts to address the changing needs of forest resources and society.
- ◆ Objective 6B: Cultivate partnerships to increase VDOF's influence and reach.

B3. Expand and improve urban and community forests

- ◆ Objective 3A: Expand the canopy of healthy tree cover to improve the quality of life in Virginia communities.
- ◆ Objective 3B: Enhance the capacity of forests and trees to provide water quality and quantity.
- ◆ Objective 4A: Recruit and retain an inclusive workforce that is engaged with the Agency's mission.
- ◆ Objective 5C: Ensure VDOF adapts to address the changing needs of forest resources and society.
- ◆ Objective 6B: Cultivate partnerships to increase our influence and reach.



Conserve and manage working forest landscapes for multiple values and uses.

C1. Keep forests as forest

- ◆ Objective 1B: Ensure functional woodlands remain a part of Virginia's landscape by protecting forestland from fragmentation or conversion to non-forest uses.
- ◆ Objective 2A: Provide more proactive forest management planning to increase production and ensure resource sustainability on private and public lands.
- ◆ Objective 2C: Expand VDOF's role in support of Virginia's forest economy to develop new income streams for landowners and pursue new markets for existing producers and additional manufacturers for underutilized forest products.
- ◆ Objective 3B: Enhance the capacity of forests and trees to provide water quality and quantity.
- ◆ Objective 5C: Ensure VDOF adapts to address the changing needs of forest resources and society.
- ◆ Objective 6A: Increase agency visibility and communications with key audiences.
- ◆ Objective 6B: Cultivate partnerships to increase our influence and reach.

C2. Promote a larger, connected forest landscape

- ◆ Objective 1B: Ensure functional woodlands remain a part of Virginia's landscape by protecting forestland from fragmentation or conversion to non-forest uses.
- ◆ Objective 2A: Provide more proactive forest management planning to increase production and ensure resource sustainability on private and public lands.
- ◆ Objective 5C: Ensure VDOF adapts to address the changing needs of forest resources and society.
- ◆ Objective 6B: Cultivate partnerships to increase our influence and reach.

C3. Ensure the sustainable use of forest resources

- ◆ Objective 1C: Be proactive in preventing the loss of forest resources and other property due to wildfire and other natural and human-caused events
- ◆ Objective 2A: Provide more proactive forest management planning to increase production and ensure resource sustainability on private and public lands.
- ◆ Objective 5C: Ensure VDOF adapts to address the changing needs of forest resources and society.
- ◆ Objective 6A: Increase agency visibility and communications with key audiences.
- ◆ Objective 6B: Cultivate partnerships to increase our influence and reach.



Works Cited

- ⁱ US Census bureau website – State Population Projections July 1, 2018
Retrieved from:
<https://data.census.gov/cedsci/table?q=United%20States&g=0100000US&tid=ACSDP1Y2017.DP05>
- ⁱⁱ University of Virginia Weldon Cooper Center, Demographics Research Group. (2019). Virginia Population Projections. Retrieved from <https://demographics.coopercenter.org/virginia-population-projections>.
- ⁱⁱⁱ Iris E. M. Fynn*, James Campbell. 2018. "Forest Fragmentation and Connectivity in Virginia Between 2001 and 2011." *Journal of Landscape Ecology*.
- ^{iv} University of Virginia Weldon Cooper Center, Demographics Research Group. 2019. Virginia Population Projections. Retrieved from <https://demographics.coopercenter.org/virginia-population-projections>.
- ^v University of Virginia Weldon Cooper Center, Demographics Research Group. 2019. Virginia Population Projections. Retrieved from <https://demographics.coopercenter.org/virginia-population-projections>.
- ^{vi} University of Virginia Weldon Cooper Center, Demographics Research Group. 2019. Virginia Population Projections. Retrieved from <https://demographics.coopercenter.org/virginia-population-projections>.
- ^{vii} Sarah M. Butler, Emily S. Huff, Stephanie A. Snyder, Brett J. Butler, and Mary Tyrrell. 2018. "The Role of Gender in Management Behaviors on Family Forest Lands in the United States." *Journal of Forestry*.
- ^{viii} Marla Markowski-Lindsay, Brett J. Butler, David B. Kittredge. 2017. "The future of family forests in the USA: Near-term intentions to sell or transfer." *Land Use Policy*.
- ^{ix} University of Virginia Weldon Cooper Center, Demographics Research Group. 2019. Virginia Population Projections. Retrieved from <https://demographics.coopercenter.org/virginia-population-projections>.
- ^x In November 2018, VDOF staff completed the first panel of the 11th Survey of Virginia's forest resources. Information from nearly 5,000 plots measured during the past five years was analyzed and summarized by the US Forest Service.
- ^{xi} Report "The Economic Impact of Virginia's Agriculture and Forest Industries", Weldon Cooper Center, University of Virginia, May 2017
- ^{xii} Report "Virginia's 2015 Wildlife Action Plan, Virginia Department of Game and Inland Fisheries, September 2015
- ^{xiii} Virginia Department of Environmental Quality, 2020 305(b)/303(d) Water Quality Assessment Integrated Report
Retrieved from:
[https://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityAssessments/2020305\(b\)303\(d\)IntegratedReport.aspx#maps](https://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityAssessments/2020305(b)303(d)IntegratedReport.aspx#maps)
- ^{xiv} Liu, Ning; Dobbs, G. Rebecca; Caldwell, Peter V.; Miniati, Chelcy Ford; Bolstad, Paul V.; Nelson, Stacy; and Sun, Ge. 2020. Quantifying the role of State and private forest lands in providing surface drinking water supply for the Southern United States. *Gen. Tech. Rep. SRS-248*. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 405 p. <https://doi.org/10.2737/>
- ^{xv} Tree City USA summary 2018, Arbor Day Foundation, arborday.org
- ^{xvi} Aukema JE, Leung B, Kovacs K, Chivers C, Britton KO, Englin J, et al. (2011) Economic Impacts of Non-Native Forest Insects in the Continental United States. *PLoS ONE* 6(9): e24587.
<https://doi.org/10.1371/journal.pone.0024587>
- ^{xvii} Lovett, G.M., Weiss, M., Liebhold, A.M., Holmes, T.P., Leung, B., Lambert, K.F., Orwig, D.A., Campbell, F.T., Rosenthal, J., McCullough, D.G., Wildova, R., Ayres, M.P., Canham, C.D., Foster, D.R., LaDeau, S.L. and Weldy, T. (2016), Nonnative forest insects and pathogens in the United States: Impacts and policy options. *Ecol Appl*, 26: 1437-1455. doi:10.1890/15-1176
- ^{xviii} Urban Tree Canopy Analysis of Virginia Localities, Virginia Department of Forestry, June 2011
Retrieved from: https://www.gep.frec.vt.edu/va_utc.html



-
- ^{xix} Smail, Robert A.; Lewis, David J. 2009. Forest-land conversion, ecosystem services, and economic issues for policy: a review. PNW-GTR-797. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 40 p.
- ^{xx} Report “ Virginia’s 2015 Wildlife Action Plan, Virginia Department of Game and Inland Fisheries, September 2015
- ^{xxi} Brandeis, Thomas J.; Hartsell, Andrew J.; Randolph, KaDonna C.; Oswalt, Christopher M. 2018. Virginia’s forests, 2016. Resour. Bull. SRS-223. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 99 p.
- ^{xxii} In November 2018, VDOF staff completed the first panel of the 11th Survey of Virginia’s forest resources. Information from nearly 5,000 plots measured during the past five years was analyzed and summarized by the US Forest Service.
- ^{xxiii} Report “Virginia Outdoors Plan”, Virginia Department of Conservation and Recreation, 2008
- ^{xxiv} Gangloff, Deborah; Moll, Gary. “Putting Trees on the Payroll,” American Forests, Autumn 2003, Vol. 109 Issue 3.
- ^{xxv} There are two land-grant universities in Virginia – Virginia Polytechnic Institute and State University (Virginia Tech) and Virginia State University (VSU). Land-grant universities are U.S. institutions of higher education that were designated to receive benefits under the Morrill Acts of 1862 or 1890. It is important to note that VSU is an 1890 Institution – an historically black university and one of only 19 institutions designated with land-grant status under the Second Morrill Act of 1890.