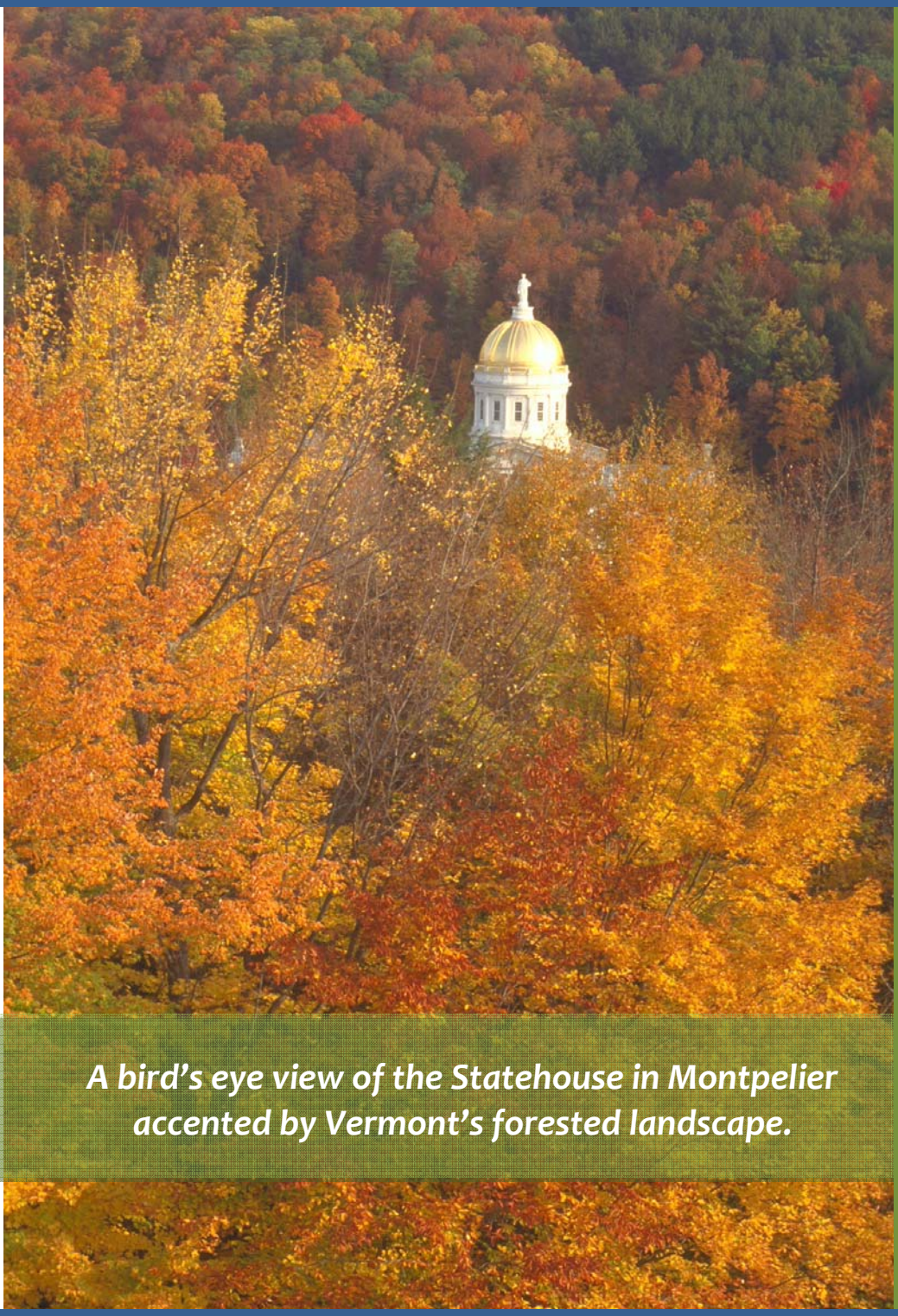
2010 Vermont Forest Resources Plan



A bird's eye view of the Statehouse in Montpelier accented by Vermont's forested landscape.

DIVISION OF FORESTS

VERMONT DEPARTMENT OF FORESTS, PARKS AND RECREATION

AGENCY OF NATURAL RESOURCES

JUNE, 2010

State Assessment and Resource Strategies

Acknowledgements

Vermont Department of Forests, Parks and Recreation

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The Plan was funded in part by the National Association of State Foresters and the USDA Forest Service, State and Private Forestry.

Recognition is given to all the people who offered technical support and assistance to this project. Special recognition is given to Ginger Anderson, Bill Baron, Barbara Burns, Janet Carlson, Kathy Decker, Robert De Geus, Erik Engstrom, Danielle Fitzko, Lars Lund, Jay Maciejowski, Bill Moulton, Gary Sabourin and Sandy Wilmot.

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Executive Summary

The Secretary of the United States Department of Agriculture, through the 2008 Farm Bill, called for a re-examination and assessment of the nation's forests, identification of priority areas for federal assistance, and a description of resources necessary to address statewide and regional strategies. This effort centers around three national priorities: *conserve and manage working forest landscapes for multiple uses and value*; *protect forests from threats*; and *enhance the public benefits from trees and forests*, all in support of the sustainability of the nation's forests. The Farm Bill directs states to look at forest sustainability and is the foundation of the **2010 Vermont Forest Resources Plan - *State Assessment and Resource Strategies*.**

In Vermont, we recognize that sustainable forests begin with healthy forests. And that managing forests sustainably involves the recognition of connections among ecological, social and economic systems to maintain forest health while preserving options for future generations and meeting the needs for the present.

The **Vermont 2010 Forest Resources Plan - *State Assessment and Resource Strategies* (Plan)** is a proactive, comprehensive and balanced approach to the management of Vermont's forests. The Plan provides an assessment of conditions and trends of the forest resources in the state, discusses threats to them, and identifies priority areas to focus resources. Finally, the Plan identifies long-term strategies for assuring that our forests are healthy and providing ecological services while meeting the economic needs of the citizens of Vermont. For each strategy, the role of the Division of Forests and our various stakeholders, as well as financial resources needed, is identified. The strategies will be the basis of specific actions later identified in annual work plans and federal grant narratives.

The keystone to this effort is our vision statement for the future of forests in Vermont. It embodies the concepts of healthy forests and the sustainable use of all forest services. It should be noted that the use of the term 'forest' is meant to reflect a forest continuum, from urban trees and remnant forests in our cities and towns to woodlots and rural forest blocks in our remote landscapes. Vermont's forests are a mosaic – all have value and provide an important service.

Vision Statement for Vermont's Forests

The forests of Vermont will consist of healthy and sustainable ecosystems, a prosperous and sustainable forest products industry, abundant recreational opportunities and a combination of ownership patterns supporting a working forest landscape and large, unbroken forest tracts. Citizens, government and businesses understand their proper roles, responsibilities and rights, and work together to support the values of forests for this and future generations.

The following five Desired Future Condition statements describe those conditions that are needed if the vision for Vermont's forest is to be realized. These five statements are the basis for long-term goals, strategies and the specific actions needed to achieve them. They also characterize the health and sustainability of Vermont's forests.

Desired Future Condition 1*: Biological Diversity*

Conserve biological diversity across all landscapes.

Desired Future Condition 2: *Forest Health and Productivity*

Maintain and enhance forest ecosystem health and productivity.

Desired Future Condition 3*: Forest Products and Ecosystem Services*

Maintain and enhance forest contribution to ecosystem services.

Desired Future Condition 4*: Land Ethic*

Maintain and enhance an ethic of respect for the land, sustainable use and exemplary management.

Desired Future Condition 5: *Legal, Institutional and Economic Framework*

Vermont has a legal, institutional and economic framework in place for forest conservation and sustainability.

The landscape of Vermont has experienced many changes during our history. As we enter the 21st century, our forests have the potential to provide us with an abundance of ecological, economic and social benefits. However, the sustainability of Vermont's forests depends upon keeping forests forested, which is one aspect of health and productivity. Decisions and actions we make today will influence our forests for years to come. Livable communities, functioning natural systems and our quality of life depend

on healthy, sustainable forests. We must accept and embrace responsibility as stewards of this valuable resource.

Conversion of forests to other uses is the greatest threat to sustainability and the over-arching goal of this Plan is *no net loss* of forest cover. The key priority areas and issues identified through the State Assessment, confirmed during public outreach, and targeted in our resource strategies, are:

- Multi-state landscape scale initiatives; in particular, the Northern Forest Lands, Connecticut River Valley and Lake Champlain Basin.
- State and multi-state priority issues; in particular, invasive species, water quality, forest habitats and diversity, renewable energy and biomass, and maintaining and diversifying markets.
- Communities with less than average urban tree cover (UTC) but more than average population and impervious surfaces; ranking high for UTC enhancements.
- Communities ranking high and medium for UTC enhancements and not attaining US Forest Service criteria for sustainable urban forestry programs.
- Forest buffers along riparian corridors and their associated wetlands.
- Non-conserved forest blocks associated with public water supply, source protection and recharge areas.
- Non-conserved land identified as high priority habitat blocks and travel corridors.
- Forests at risk from invasive or cyclic forest insects, plants and diseases.
- Lands important in maintaining Vermont's statewide recreation trail network.
- Habitats at risk from atmospheric pollution or climate change factors.
- Forest land eligible and not enrolled in the Use Value Appraisal Program.

Introduction

Vermont's forests are dynamic. Native American influences to the landscape of Vermont were minimal, and early European settlers found nearly all the state covered by forests. Forest clearing became widespread around 1800 as Vermont's farmers began supplying wood products, food and wool to a rapidly growing nation. By 1860, less than one-half of the state remained forested and Vermonter George Perkins Marsh, arguably the nation's first environmentalist, warned of the impacts of soil erosion from clearing forests. The migration of people to the western United States led to a decline in agriculture allowing forest succession to reclaim Vermont's landscape.

Vermont's forests are an invaluable resource. Forested ecosystems provide the basis for numerous natural communities that support biological diversity. Forests underpin our economy and enhance our quality of life. We depend on the forest for timber, maple syrup, firewood, along with values and services such as watershed protection, wildlife habitats, carbon sequestration, outdoor recreation opportunities and scenic beauty. Vermont has a working forest landscape; one that provides goods and services through stewardship, management and conservation.

From the 1940's to the present, there has been a transformation of Vermont's forest on a wide scale. Forests are maturing as shown by increases in tree size and number. This has resulted in decreases in growth rate and changes in species composition. At the same time, human social pressures have resulted in forest habitat fragmentation from development, and we've witnessed the introduction and spread of invasive plant and insect species. Coupled with changing climate conditions, future forest conditions may not favor all native biota. Many landowners lack the knowledge and skills to manage forests at a time when concerns for the role of forests as a source of both biomass and carbon storage emerge. Against this backdrop, there is evidence in the decrease in the forest products industry region-wide. We must work with partners to better understand and monitor these changes so we can adapt our strategies to maintain the health and productivity of Vermont's forests.

Background

The Food, Conservation and Energy Act of 2008, commonly referred to as the Farm Bill, was enacted June 19, 2008. The Farm Bill requires each state to complete a Statewide Forest Resource Assessment and Statewide Forest Resource Strategy (SARS) within two

years of the bill's enactment in order to be eligible to receive funds under the US Forest Service, Cooperative Forestry Assistance Act of 1978.

The Division of Forests has a long history of proactive planning. Documents such as the Vermont Forest Resources Plan and the Forest Stewardship Program Plan have offered a vision for Vermont's forests. However, they have not necessarily been linked to specific programs and have lacked clear and measurable indicators. Other planning documents such as the Urban and Community Forestry Program Action Plan and the Forest Resource Protection Action Plan have provided program specific goals, actions and metrics, but have not been linked within the broader vision. As a result of the planning requirements in the Farm Bill, we have the opportunity to identify landscape scale resource opportunities and have addressed this challenge with the **Vermont 2010 Forest Resources Plan - *State Assessment and Resource Strategies,*** creating a forest sustainability strategy that will link the over-arching vision to program specific approaches.

The Division began this process by reviewing the charge as outlined in the Farm Bill and advice provided by the Northeastern Area of State and Private Forestry (NA) in relation to other strategic plans completed or being conducted by the Division and partners. Appropriate elements from all these planning efforts were used for the ambitious process of meeting the requirements for SARS. They include:

- **Vermont Forest Resources Plan - *A Forest That Works for All*** - The Forest Resources Plan provides overall guidance and strategic planning for the Division of Forests. This is an ongoing effort since the 1960's, covering a ten-year timeframe and articulates a vision for Vermont's forests, the roles and responsibilities of the department, other agencies and the public in the stewardship of public and private forest land. The plan identifies specific programs and actions to meet those objectives. Although ten years old, much of this document was still relevant.

- Division of Forests, **Appreciative Inquiry Process**, Forest Health and Sustainability Working Groups - The Appreciative Inquiry process is a unique planning tool that focuses on the best of an organization's strengths and identifies steps on how to replicate those strengths throughout the organization. At the initial planning meeting, staff unanimously agreed that all our work should be based on maintaining or restoring forest ecosystem health. Working groups met after the initial planning meeting and have set the stage for an ambitious

program of measuring and evaluating the health and sustainability of Vermont's forests.

- **Criterion and Indicators of Forest Sustainability in the Northeastern Area** - Seven criterion and 18 base indicators were agreed to be the foundation of measuring and tracking forest sustainability by the Northeastern Area Association of State Foresters (NAASF) and the Northeastern Area State and Private Forestry (NA). The commonality of this approach across almost one-half of the country highlights the importance of this on-going effort. We have decided to use components of this framework in conducting our assessment and developing resource strategies.

- "**The Vermont Way Forward**" - A Vermont Agency of Natural Resources (ANR) initiative to transform the ANR into the next generation of environmental stewards. The Forestry Division was charged with making recommendations on managing Vermont's forests of the future with an eye toward sustainability. The timing of this effort was concurrent with the 2008 Farm Bill and provided an opportunity to utilize this process to begin public involvement and develop recommendations to incorporate in SARS. This plan incorporated input from twenty-eight stakeholder groups.

- **Vermont Wildlife Action Plan** - This plan represents a similar requirement by the US Fish and Wildlife Service to state wildlife agencies, and led to the creation in 2005 of Vermont's Wildlife Action Plan. These proactive plans examine the health of fish and wildlife, and prescribe actions to conserve species and vital habitats.

- **Primary Industry Summit** - The Department of Forests, Parks and Recreation hosted a day long summit in December, 2006 for members of the forest products industry to identify key issues and problems facing the forest products industry. A list of possible solutions and recommendations were presented to Governor Douglas later in the day.

- **Forest Plan** – Management of the Green Mountain National Forest is guided by the Land and Resource Management Plan (Forest Plan), which was most recently revised in 2006. The revised plan is strategic in nature, with emphasis on ecological, social and economic sustainability over the long-term. The Green

Mountain and Finger Lakes National Forests' held a series of collaborative, monthly public meetings during the Forest Plan revision project.

- USDA, State and Private Forestry (SPF), "**Redesign**" - State forestry agencies partner with the SPR on the delivery of several federal forestry programs as outlined in the Cooperative Forestry Assistance Act. This partnership recognizes the federal role in supporting private forest landowners and the role of states in providing technical assistance. Changing threats to our forest resources and limits in financial support offered by the USFS have led to a "Redesign" effort to identify new opportunities for collaboration. Through the re-authorization of the Farm Bill in 2008, melding of programs into a targeted, yet comprehensive landscape level approach to resource management, will improve state delivery. Three 'priorities' are at the core of the 2008 Farm Bill: ***Conserve and manage working forest landscapes for multiple values and uses; Protect forests from threats;*** and ***Enhance public benefits from trees and forests.***

- **Forest Legacy Program, Analysis of Need (AON)** - In order to participate in the Forest Legacy Program, each state must document the threat of loss of traditional forest values and benefits and, with the approval of the USDA Forest Service, delineate an area or areas (Forest Legacy Area) in the state in greatest need of assistance from the program. The process for doing this is referred to as the Assessment of Need (AON). It was drafted in 2009 and awaits final USDA Forest Service approval.

- **Economic Resurgence in the Northern Forests** – The Sustainable Economy Initiative, including the states of Maine, New Hampshire, Vermont and New York, identified the regions assets and opportunities, and developed strategies for revitalizing the Northern Forest economy.

- **State Comprehensive Outdoor Recreation Plan (SCORP)** – Updated every five years, Vermont's SCORP identifies essential issues that affect the future of outdoor recreation and recommended actions for the preferences and needs of a statewide recreating public.

- **Imaging Vermont** - The Vermont Council on Rural Development (VCRD) led a two-year project, Council of the Future of Vermont, where they learned from Vermonters about their hopes, aspirations and visions for the future of the state. The results are outlined in the final report, Imaging Vermont. VCRD determined

the areas of critical need in the state and their next project work areas: revitalizing Vermont communities, creating a working landscape partnership, stimulating the need for broadband across Vermont, and working with Vermont leaders to forward the results of the Council.

- **Vermont's Changing Forests** – Key findings on the health of forested ecosystems from the Vermont Monitoring Cooperative. This report is a multidisciplinary synthesis of research conducted on monitoring forest ecosystem health in Vermont over the past 18 years.

- **Internal Division Plans** - A number of Division of Forests programs have plans including Urban and Community Forestry, Forest Resource Protection and Forest Resource Management. Some engaged stakeholders in development and are strategic while others are truly internal work plans. Long-range management plans are prepared for parcels under the direction of the Agency of Natural Resources. Community Wildfire Protection Plans have also been created for two communities.

Throughout the Plan's development, public input was sought from a variety of partners and stakeholders; see Appendix A: Planning Process Summary for public involvement for details.

Methodology

Although there is a specific methodology and required components for developing the SARS, the Division of Forests decided to imbed these conditions within the framework of our past forest resources planning efforts. As a result, we began the planning process by taking a step back and reviewed the vision statement for Vermont's forests and the mission of the Division of Forests.

After careful consideration, it was decided to keep the vision statement as outlined in the 1998 Vermont Forest Resources Plan. As stated earlier, this is a reoccurring planning effort that engages a broad group of constituents within the state and is tied to our long-standing partnership with the USFS. It has served us well in the past twelve years, connects well with the three priorities outlined in the Farm Bill, and plots an appropriate course into the future. The vision statement for Vermont's forests is:

'The forests of Vermont will consist of healthy and sustainable ecosystems, a prosperous and sustainable forest products industry, abundant recreational opportunities and a combination of ownership patterns supporting a working forest

landscape and large, unbroken forest tracts. Citizens, government and businesses understand their proper roles, responsibilities and rights, and work together to support the values of forests for this and future generations.'

Extensive dialogue with staff offered during the Appreciative Inquiry process made the beginnings of a revised mission statement for the Division of Forests:

'The Forestry Division will lead the state in fostering a land ethic that recognizes our responsibility to manage for and promote healthy forests and is founded upon the principles of respect for the land, sustainable use and exemplary management. This ethic is the foundation which guides all of our decisions and actions.'

A mission statement for any organization is only valuable if it is clearly defined. The following definitions serve as the foundation within the Plan and are the basis of the Division's mission statement:

- **Healthy Forest Definition:** A healthy forest has the capacity for self renewal of its ecological productivity, diversity, complexity and resiliency.

- **Sustainable Use Definition:** The production and use of resources to meet the needs of present generations without compromising the needs of future generations.

- **Respect for the Land Definition:** Appreciating the value of the land and understanding and accepting responsibility for our impacts on a finite, non-renewable resource.

- **Exemplary Management Definition:** Forestry practices which serve as a model and are deserving of imitation because they reflect a sustainable land ethic with thoughtful strategies used for planning, implementation and evaluation.

From these statements, came the definition of sustainable forestry:

"Sustainable forestry is the management of forests that maintain their health, productivity, diversity and overall integrity in the long-run, in the context of human activity and use."

Forestry has traditionally been defined as the management and use for human benefit of the natural resources that occur on and in association with forest lands. However, the Division of Forests felt that the definition would be strengthened by recognizing that maintaining the health of the forest is critical to its sustainability. By focusing on the health of the forest, the productive capacity of the soil, water and air, maintenance of the diversity of flora and fauna and the interaction and relationship between all those forest systems, we can sustain our working forest landscape and the services they can provide.

In order to effectively monitor progress in fulfilling our mission and a vision for Vermont's forests, while addressing the forest-related issues as outlined in the Farm Bill, we decided to build upon Criterion and Indicators (C&I) for the conservation and sustainable management of temperate and boreal forests. The Montreal Process, named after the meeting location, encompasses a set of 7 criteria and 64 indicators as the framework for assessing forest sustainability.

The criteria define categories of conditions or processes by which sustainable forest management may be assessed while the indicators provide the means for describing and measuring various aspects of the criteria (The Montreal Process, 2005). The C&I have been further refined within the northeastern area of the United States, by the NAASF and NA, streamlining the critical indicators (Forest Sustainability and Planning, 2001). The Division of Forests integrated the existing Desired Future Condition (DFC) statements from the previous forest resources plan with criteria in the **2010 Vermont Forest Resources Plan - *State Assessment and Resource Strategies***.

When building the Plan and reflecting on the mission and vision statements that will serve as the guide, we determined that the seven criteria needed some modification to build upon existing planning efforts and tie into the three national priorities. Because forest ecosystem health and vitality is at the core of forest sustainability and key to the mission of the Division, we combined the elements of Northeastern Area criterion 2 and 3 into one criterion unique to Vermont. The wording was changed slightly on several criteria to better reflect needs in the state. In addition, we merged elements of criterion 4 into a new criterion 3 and criterion 6 into a final criterion 5. Table 1 shows the relationship between the Northeastern Area Base Criteria, the Farm Bill priorities and the Vermont 2010 Forest Resources Plan's Desired Future Conditions.

Relationship between Northeastern Area Criteria, Desired Future Conditions and Farm Bill Priorities

Northeastern Area Criteria	Desired Future Conditions	Farm Bill Priorities
1) Conservation and biological diversity	1) ***Biological Diversity*** - Conserve biological diversity across all landscapes	Conserve working forest landscapes
2) Maintenance of productive capacity of forest ecosystems 3) Maintenance of forest ecosystems health and vitality 4) Conservation and maintenance of soil and water resources	2) ***Forest Health and Productivity*** - Maintain and enhance forest ecosystem health and productivity	Protect forests from harm
5) Maintenance of forest contribution to global climate cycles	3) ***Forest Products and Ecosystem Services*** - Maintain and enhance forest contribution to ecosystem services	Enhance the benefits from trees and forests
6) Maintenance and enhancement of long-term multiple social economic benefits to meet the needs of society	4) ***Land Ethic*** - Maintain and enhance an ethic of respect for the land, sustainable use and exemplary management	All three
7) Legal, institutional and economic framework in place for forest conservation and sustainable management	5) ***Legal, Institutional and Economic Framework*** - Vermont has a legal, institutional and economic framework in place for forest conservation and sustainability	All three

Table 1: Relationship between Northeastern Area Criteria, Desired Future Conditions and Farm Bill Priorities.

Outline for Strategies

The vision and mission statements serve as the foundation for the Plan. Desired Future Condition statements, derived in part from the Montreal Process criterion, describe those conditions that are needed if the vision for the future is to be realized. These five statements are the basis for long-term goals, strategies and the specific actions needed to achieve them. They recognize the many benefits of Vermont's forests and the rights and responsibilities of all forest owners, public and private, to manage and use their land in a sustainable manner. The Desired Future Conditions should be viewed as a whole; they are not mutually exclusive, nor are they intended to apply to every landowner or acre of land in the state.

The five Desired Future Conditions and associated indicators characterize the health and sustainability of Vermont forests. The first three relate specifically to forest conditions, attributes or functions. Ecosystem services include the values or benefits associated with the environmental and socio-economic goods and services that forests provide to the people of the state. The fourth condition and indicators represents Vermonters understanding of the resource, its benefits and how we can all be stewards. The last condition and indicators relate to the overall policy and legal framework within Vermont and the Division that contribute to sustainable forests.

To assist in understanding the outline of the Resource Strategies, the following definitions are provided:

- **Desired Future Condition:** A category of conditions or processes by which the vision may be assessed. They are based upon criterion; characterized by a set of related indicators which are monitored periodically to assess change. The Division of Forests has identified five Desired Future Conditions that must be met to maintain forest sustainability in Vermont.

- **Indicator:** An indicator is a quantitative or qualitative variable which can be measured or described and when observed periodically demonstrates trends. As a starting point, the Division of Forests utilized the 18 base indicators as adopted by NAASF and NA. These base indicators were recommended for use in forest sustainability assessments.

- **Threats:** A set of issues and factors that influence a Desired Future Condition in a negative manner.

- **Strategies:** Within a set of goals, the strategies are designed to mitigate identified threats, monitor indicators and achieve the Desired Future Condition.

Resource Strategies

The strategies to be carried out by the Division of Forests in the upcoming five years are the key components of this Plan. Strategies selected for the Plan include those that continue programs with measured need and success; meet obligations under state statutes, rules and procedures; and new initiatives that will aid progress toward Desired Future Conditions.

The strategies are presented by Desired Future Condition - a broad statement that collectively leads to achieving the vision of Vermont's forests. Under each Desired Future Condition are goals and strategies which could, as a whole, direct the state towards a desired future.

As with previous Forest Resources Plans, this Plan builds on a foundation of partners. At the end of this section is a matrix summary that lists strategies followed by Division programs engaged in the activities, partner organizations that may be involved, financial resources needed to carry out each strategy, and its relationship to the national priorities.

Desired Future Condition 1: *Biological Diversity*

Conserve biological diversity across all landscapes

Overview

Connections between forest communities are important to fundamental ecological processes and the future of biological diversity associated with forests. Biological diversity is represented at many levels from genetic to species to ecosystems. It is critical that Vermont's forests contain healthy and sustainable populations of native plants and animals. The primary objective of the conservation of biological diversity is the survival of species and their genetic variability. Viable breeding populations of species and their natural genetic variation are part of interdependent physical and biological systems. By conserving biological diversity, forests should have the ability to function, reproduce and remain productive.

The breaking up of habitats into smaller, non-contiguous patches as a result of habitat conversion can render important habitats inaccessible, isolating populations and degrading remaining habitat patches through edge effects that favor edge-tolerant species such as raccoons and crows, as well as invasive exotic species that can out-compete native and rare species. The result of habitat fragmentation is often increased predation, increased mortality, reduced mobility and changes in habitat micro-climates (Vermont Department of Fish and Wildlife, 2005).

Base Indicators of Forest Sustainability

- Area and percent of forest land[1].
- Number and distribution of large forest blocks.
- Area and percent of conserved forest land.
- Area and percent of forest by forest type, and successional stage as indicated by size and age classes.
- Area of contiguous forest land lost to fragmentation.
- Acres and condition of unique or fragile sites under conservation protection.
- Bird population trends, including breeding bird survey.

Issues and Threats

[1] Forest land is land that is at least 10 percent stocked with trees of any size or that formerly had such tree cover and is not currently developed for a nonforest use. The minimum area for classification of forest land is one acre. The components that make up forest land are timberland and all noncommercial forest land (National Forest Inventory and Analysis Database, 2008).

Perhaps the single biggest threat to biological diversity is conversion of forests to other uses. Conversion may stem from parcelization, changing landowner objectives and development. Results of conversion include fragmentation of wildlife habitats, impact to the natural processes, increases in exotic invasive species and the loss of the integrity of natural communities. Spatial information on the location, ranking and value of forest ecosystems across the landscape is an important aid in effective conservation of biological diversity. Finally, we need more research to determine long-term impacts of acceptable management practices on biodiversity in maintaining balance between ecological and economic values and benefits.

Goals and Strategies

Desired Future Condition 1: *Biological Diversity*

Conserve biological diversity across all landscapes

Goal 1: Maintain a mix of forest structure and complexity across the landscape.

Strategy 1: Encourage management activities that sustain a diversity of forest conditions and ages.

Strategy 2: Maintain a mix of programs aimed at keeping forests in forests including UVA[2], Forest Legacy, local and regional planning and land acquisition.

Goal 2: Protect and conserve natural communities, genetic diversity, rare and endangered species, unique habitats, corridors and buffers.

Strategy 3: Work with partners to identify landscapes and support species of greatest conservation need.

Strategy 4: Conserve genetic diversity of species of concern.

Strategy 5: Support activities and leverage resources to protect and conserve landscapes and species of greatest conservation need.

[2] UVA stands for Use Value Appraisal Program.

Desired Future Condition 2: *Forest Health and Productivity*

Maintain and enhance forest ecosystem health and productivity

Overview

Ecosystem health depends upon the integration of all natural resource components and ecological functions. The health of the forest includes the productive capacity of the soil, water and air, and their interaction to support all biota. People have multiple effects on forest ecosystems; human impacts include land conversion, species and forest structure conversion through harvesting, suppression of natural fire cycles and floods, degradation through incompatible uses, acid deposition and the introduction of non-native species. These in turn, influence ecological processes and ultimately forest dependent plant and animal species (Stein, et al., 2005).

Our soil resource is a basic component of all terrestrial ecosystems and the loss of soil influences the vitality and species composition of forest ecosystems. Soil erosion and compaction can degrade aquatic ecosystems and associated forests, forest productivity, recreational opportunities and water supplies.

Monitoring the volume of wood products harvested annually relative to the amount which could be removed sustainably provides an indication of a forest's ability to provide a continuing supply of forest products, and economic and forest management opportunities. However, productivity should be viewed broadly, considering all the products produced from the forest such as water, air and carbon. Maintaining the health and productivity of our working forest landscape, truly a "forest that works for all" is critical to sustainability.

Base Indicators of Forest Sustainability

- Area of forest land at risk due to potentially damaging agents.
- Area of timberland[3].
- Annual removal of wood volume compared with net growth.
- Acres of public and private lands under forestry management plans.
- Trends in forest phenological measures favoring productivity.
- Acres and rate of change of dead and dying trees by species.
- Acres of forest land exceeding their critical load for acid deposition.

[3] Timberland is forest land not withdrawn from production that is capable of growing 20 "cubic feet" of industrial wood annually *(National Forest Inventory and Analysis Database, 2008)*.

Issues and Threats

There is the realization that the functions and benefits of forests are all interrelated and the maintenance of ecological productivity should include all values and services. There is much more to learn on forest systems and threats from human impacts. The role of forest management in maintaining forest health is often misunderstood by the public, as are the benefits of urban forests. A lack of quantitative information regarding natural and anthropogenic changes leads to uncertainty in developing management strategies.

Goals and Strategies

Desired Future Condition 2: *Forest Health and Productivity*

Maintain and enhance forest ecosystem health and productivity

Goal 1: Identify trends in forest ecosystem health and productivity.

Strategy 6: Work with partners to understand Vermont's forested ecosystem.

Strategy 7: Monitor and report current forest health and evaluate potential threats.

Goal 2: Maintain productive capacity of forests.

Strategy 8: Encourage appropriate forest management that maintains health and productivity.

Strategy 9: Maintain and enhance soil productivity.

Strategy 10: Rehabilitate degraded landscapes to restore ecosystem health.

Strategy 11: Support wildland fire preparedness planning and suppression activities.

Goal 3: Retain native flora and fauna across the landscape.

Strategy 12: Prevent the introduction and slow the spread of invasive exotic species.

Strategy 13: Support monitoring and programs that maintain Vermont's common flora and fauna.

Strategy 14: Encourage retention and planting of native plant species.

Desired Future Condition 3: *Forest Products and Ecosystem Services*

Maintain and enhance forest contribution to ecosystem services

Overview

Forests provide natural assets we call ecosystem services that are vital to human health and livelihood. The forests of Vermont have played a defining role in our treasured working landscape for more than three centuries. Maintenance and enhancement of traditional and emerging forest products sectors is critical to keeping forests as forests and supporting landowners who invest in this resource.

The accumulation of biomass as living vegetation, leaf litter and soil carbon (carbon pool) is an important forest function in regulating atmospheric carbon. The production rate of biomass is a measure of forest health and vitality. The ecological and sustainable management of productive forests and use of durable forest products can be a factor in controlling the amount of carbon entering the world's atmosphere.

Forests are an important part of the earth's hydrological cycles particularly in regulating surface and ground water flow. Changes in historic stream flow and the timing of flow can reflect on the health of aquatic ecosystems. Forests also play an integral role in protecting and enhancing water, as well as air quality.

Urban forests should not be ignored when describing benefits derived from forests. It is clear that the ecosystem services provided by trees and forests in the heart of our communities contribute not only to providing ecosystem functions, but to improved quality of life. Since urban forests are intermixed with a myriad of gray infrastructures such as roads and utilities, they should be looked at as 'green infrastructure,' a necessity towards sustainable communities.

Finally, Vermont's forests serve the needs of Vermonters and visitors for recreation and by supporting tourism. Recreational opportunities need to recognize the diverse personal needs and expectations for exercise, connection to nature, spiritual renewal, solitude and social interactions while balancing multiple recreational uses and the need for long-term maintenance.

Base Indicators of Forest Sustainability

- Area of forest land adjacent to surface waters.

- Percent of forest cover.
- Percent of tree canopy cover over urban areas.
- Status of forest ecosystem biomass and forest carbon pools.
- Wood and wood products production, consumption and trade.
- Miles of hiking, biking and other recreational trails.
- Federal, state and town facilities supporting forest recreation opportunities.
- Employment and wages in forest-related sectors.
- Property loss due to wildland fire.
- Percent of population living in communities developing or managing programs to plant, protect and maintain their urban and community trees and forests.

Issues and Threats

The lack of public understanding and valuing of ecosystem services is a threat to their management and protection. All too often, decisions on land use and management are short-term solutions, with long-term consequences. Keeping forest land intact may seem like a simplification of the problem, but the benefits of forested ecosystems that society has taken for granted are only now being realized. In all land based decisions, we need to account for the role that trees and forests have in providing ecosystem services, even in developed urban environments. Additionally, we need to recognize that differing management strategies may be necessary to meet the services and values we are seeking to maximize. For example, as potable drinking water continues to be a vulnerable commodity, we must consider the increased value of forests for its ability to produce clean water. With almost eighty percent of Vermont's forest in private ownership, it is critical that landowners can earn a return on their investment.

Goals and Strategies

Desired Future Condition 3: *Forest Products and Ecosystem Services*

Maintain and enhance forest contribution to ecosystem services

Goal 1: Maintain and enhance the production of forest products.

Strategy 15: Work with partners to assess Vermont's capacity to produce raw materials for forest products.

Strategy 16: Support the forest-based economy including maintaining and diversifying markets to encourage forest management activities and local production and use of forest products.

Strategy 17: Support research that improves the procurement and utilization of the full suite of forest products.

Strategy 18: Encourage stable solid wood and biomass supply to support forest industry.

Goal 2: Maintain and enhance water resources.

Strategy 19: Encourage inclusion of soil and water conservation considerations by foresters, forest landowners and loggers through appropriate forest planning and practices.

Strategy 20: Encourage trees and forests for flood mitigation and storm water management.

Strategy 21: Identify, conserve, restore and protect priority forested watersheds valued for water resources.

Goal 3: Maintain and enhance recreational opportunities.

Strategy 22: Build partnerships that enhance forest-based recreational opportunities.

Strategy 23: Work with partners to maintain forest access, land stewardship awareness and outreach, and well-maintained trail networks that support recreational opportunities.

Goal 4: Maintain and enhance forest carbon.

Strategy 24: Support research that improves the understanding of measuring, monitoring and trends in forest carbon, including applications for forest carbon marketing.

Strategy 25: Work with partners to enhance forest carbon market opportunities.

Goal 5: Maintain and enhance air resources.

Strategy 26: Support research and monitoring that improves the understanding of trends in air quality, weather, climate and how they affect forests.

Strategy 27: Work with partners to enhance opportunities for improving air resources.

Strategy 28: Monitor changes in forests in relation to air resources.

Desired Future Condition 4: *Land Ethic*

Maintain and enhance an ethic of respect for the land, sustainable use and exemplary management

Overview

To promote sustainable forest management, cooperation among forest landowners, practitioners, the public and government is critical in fostering ongoing and productive involvement. Educational opportunities enable the array of forest owners, industry professionals and users to understand and respect Vermont's forests. The Department must lead by example and set the standard for a land management ethic that respects the land and recognizes all appropriate uses.

Base Indicators of Forest Sustainability

- Investments in forest health and forest management research.
- Patterns and trends in forest ownership, land use and conservation easements.
- Acres enrolled in forest stewardship programs.
- Number of demonstration areas on Agency lands.
- Number of communities with conservation commissions and other related committees.
- Acres of federal, state and municipal forests.
- Local wood product production and consumption.
- Percent increase in urban forest canopy.
- Number of workshops and educational programs on forestry.
- Number of volunteer hours submitted annually related to natural resource management.

Issues and Threats

Because Vermonters use and value forests in many ways, debate over the future of our forests is often spirited. Issues including fragmentation of forest land, protection of wildlife and their habitat, unsustainable recreation activities, timber harvesting practices, taxation of forest land, status of forest health, acquisition and management of public land and the protection of private property rights are all common themes. There also exists an under appreciation of the forest products economy and urban forests in Vermont. It is in the public interest that private property owners hold a high stewardship ethic and practice sustainable forest management and public entities (town, state and federal) serve as stewardship leaders. Economic factors often create

obstacles to long-term stewardship and the quality of stewardship may vary greatly. Educating all residents on the values and benefits of trees and forests is critical to forest sustainability. However, affecting a change in ethics is not an easy task.

Goals and Strategies

Desired Future Condition 4: *Land Ethic*

Maintain and enhance an ethic of respect for the land, sustainable use and exemplary management

Goal 1: Encourage public understanding of forest systems.

Strategy 29: Encourage the understanding of different forest systems and how they interact.

Strategy 30: Enhance public education and outreach on forest health and productivity issues.

Goal 2: Increase public awareness of the critical role trees and forests play in sustaining Vermont communities and residents.

Strategy 31: Enhance public awareness and education of the components of functioning urban ecosystems.

Strategy 32: Strengthen public media outreach opportunities related to forest issues.

Strategy 33: Support forestry education activities and programs.

Strategy 34: Provide information to all stakeholders on ecosystem services and the importance of forests to all ownerships.

Strategy 35: Promote wildland fire prevention to protect forested communities.

Goal 3: Increase public understanding and the application of exemplary forest management, conservation and protection.

Strategy 36: Educate the public on the value of keeping forest land forested.

Strategy 37: Promote forest stewardship through educational efforts to all citizens.

Strategy 38: Encourage citizen involvement in forest health and protection.

Strategy 39: Support environmental literacy programs by forest professionals that improve natural resource management, conservation and protection.

Strategy 40: Educate natural resource professionals and promote management practices that maintain forest productivity and ecosystem services.

Strategy 41: Partner with State Parks, Green Mountain National Forest and other organizations to support forest-based recreational opportunities.

Goal 4: Maintain and enhance forest contribution to communities.

Strategy 42: Work with partners to encourage land use planning that maintains a working landscape.

Strategy 43: Promote and support the planning and management of urban forests at state, regional and local levels.

Strategy 44: Support local and regional efforts that encourage community forestry, economic development and strengthen land tenure.

Goal 5: Demonstrate exemplary forest management on state lands and encourage sustainable use across all landscapes.

Strategy 45: Implement forestry practices that demonstrate sustainable forest management.

Strategy 46: Expand educational opportunities on public lands.

Strategy 47: Utilize public lands as demonstration forests.

Desired Future Condition 5: *Legal, Institutional and Economic Framework*

Vermont has a legal, institutional and economic framework in place for forest conservation and sustainability

Overview

State policies must promote sustainability of Vermont's forests and reflect the needs of all forest owners while encouraging cooperation between all citizens of the state. Forestry statutes, rules and policies should provide for the sustainable management and protection of forest resources and provide the greatest environmental yield. To be successful, the Division of Forests is managed and operates in a sustainable manner that is respectful of the environment, its employees and the public. Within the Division, we will improve our understanding and monitor our actions in relationship with the principle of healthy forests.

Base Indicators of Forest Sustainability

- Level of adherence to forest management standards/guidelines.
- Number of Agency land management plans.
- Dollars spent on meeting our Desired Future Condition goals.
- Auditing of Division operations through survey of on job satisfaction.
- Number of violations of state forestry laws and regulations.
- Number of easement acres monitored annually.
- Acres enrolled in the UVA Program and third-party certification programs.

Issues and Threats

It is often difficult to promulgate state laws, policies and programs to promote sustainable forestry because of the perceived or real fears of erosion of property rights, loss of "traditional" uses or anticipated economic effects. State policies must promote the sustainability of Vermont's forests and reflect the needs of forest owners to meet their management objectives and public need. This is often a difficult balancing act between property rights and public welfare. Planning for state-owned and federal land should be comprehensive, interdisciplinary, and open to and representative of all Vermont citizens. Limited engagement of all citizens in the debate promotes imbalance and disinterest. A stable and equitable tax structure that encourages both retention and management of forests is necessary.

In light of the current economy, revenue streams are decreasing and shifting. This change has an impact on how the Division of Forests conducts business. The impacts will undoubtedly lead to changes in organizational structure and program delivery to focus on priorities while increasing efficiencies and effectiveness.

Goals and Strategies

Desired Future Condition 5 : *Legal, Institutional and Economic Framework*

Vermont has a legal, institutional and economic framework in place for forest conservation and sustainability

Goal 1: Maintain an organizational structure within the Division of Forests to support management, protection, conservation and enhancement of Vermont's forests.

Strategy 48: Ensure that all programs are consistent with its mission and our indicators are used to monitor progress towards maintaining healthy forests.

Strategy 49: Maintain infrastructure, staff and an organizational structure to achieve Desired Future Conditions.

Strategy 50: Enhance program management and program integration to improve efficiencies and effectiveness.

Strategy 51: Facilitate effective and enduring communications within the Division and with other state and federal agencies and organizations.

Strategy 52: Create and maintain an environment of professional development and continued learning.

Strategy 53: Encourage an organizational culture that rewards excellence, actively encourages teamwork and provides mentoring to achieve maximum job performance and job satisfaction.

Goal 2: Expand financial opportunities to support forest stewardship.

Strategy 54: Strengthen Division of Forests capacity to seek grant funding.

Strategy 55: Provide opportunities and incentives to accept private contributions.

Strategy 56: Support partners efforts to seek and maintain financial resources.

Strategy 57: Keep state legislature abreast of current financial status, program efforts, opportunities and challenges.

Strategy 58: Enhance financial collaboration with USDA Forest Service and Natural Resource Conservation Service, and others to fulfill Plan goals.

Goal 3: Strengthen, implement and enforce Vermont's forestry policies, rules and laws.

Strategy 59: Encourage a voluntary approach for attaining compliance.

Strategy 60: Support enforcement of Vermont's laws and regulations working within Vermont's legal system.

Strategy 61: Support an open, inclusive and deliberate process when assessing current and proposed legislation affecting forestry interests.

Goal 4: Encourage and support policies, programs and initiatives that assist private forest landowners in maintaining the working landscape.

Strategy 62: Continue to support and enhance participation in the Use Value Appraisal program as a stable tax equity program that promotes forest land retention and management.

Strategy 63: Encourage voluntary adoption and field application of best management practices for timber harvesting.

Strategy 64: Support forest landowners and the forest products industry on third-party certification and chain-of-custody marketing opportunities.

Strategy 65: Support and plan for cost-share and grant programs that assist forest landowners in management of the working forest.

Strategies Matrix

The following strategies matrix indentifies current Division programs, potential partners and resources needed to accomplish intended results. Relationship to the three national priorities and objectives is also referenced.

KEY

Resources Available/Needed:

GF - General Funds

FF - Federal Funds

IT - Inter-Departmental Transfer

NGO - Non-Governmental Organizational Support

PF - Private Funds

Division Programs:

FS - Forest Stewardship

UCF - Urban and Community Forestry

FH - Forest Health

FF - Forest Fire Protection

SL - State Lands Management

UM - Utilization and Markets

WF - Watershed Forestry/Clean & Clear

CE - Conservation Education

FL - Forest Legacy

LWCF - Land and Water Conservation (Funds)

National Priorities/Objectives:

1 – Conserve and manage working forest landscapes for multiple values and uses

- 1.1 - Identify and conserve high priority ecosystems and landscapes
- 1.2 - Actively and sustainably manage forests

2 – Protect forests from threats

- 2.1 - Restore fire-adapted lands and reduce wildfire impacts
- 2.2 - Identify, manage and reduce threats to forest health

3 – Enhance public benefits from trees and forests

- 3.1 - Protect and enhance water quality
- 3.2 - Improve air quality and conserve energy
- 3.3 - Assist communities in planning for and reducing forest health risks
- 3.4 - Maintain and enhance economic benefits and values of trees and forests
- 3.5 - Protect, conserve and enhance wildlife and fish habitat
- 3.6 - Connect people to trees and forests, and engage them in environmental stewardship activities
- 3.7 - Manage trees and forests to mitigate and adapt to global climate change

Partners:

AA	Agency of Agriculture, Food & Markets
AV	Audubon Vermont
AC	Agency of Commerce
AG	Attorney General's Office
AIV	Associated Industries of Vermont/Forest Products
ANR	Agency of Natural Resources
AOT	Agency of Transportation
APHIS	USDA, Animal and Plant Health Inspection Service
ASLA	Vermont Chapter, American Society of Landscape Architects
DEC	ANR, Department of Environmental Conservation
ED	Department of Education/Local School Districts
EE	Environmental Education Groups
FPA	Vermont Forest Products Association
FW	ANR, Department of Fish & Wildlife
GMNF	Green Mountain National Forest
LD	ANR, Department of Forests, Parks & Recreation, Lands Division
LT	Land Trusts
MU	Municipal Governments
NRCD	Natural Resource Conservation Districts
NRCS	USDA, Natural Resource Conservation Service
PS	Department of Public Service
RCD	Resource Conservation and Development Councils
RG	Recreation Groups
SAF	Society of American Foresters
SFI	Sustainable Forestry Initiative
SP	ANR, Department of Forests, Parks & Recreation, Parks Division
NASPF	US Forest Service, State & Private Forestry, Northeastern Area
TNC	The Nature Conservancy
TX	Department of Taxes, Property Valuation & Review
US	US Fish and Wildlife Service, US Park Service
USFS	US Forest Service, Research
UVM	University of Vermont & UVM Extension
VMC	Vermont Monitoring Cooperative
VAPDA	Vermont Association of Planning & Development Agencies
VNRC	Vermont Natural Resources Council
VNLA	Vermont Nursery and Landscape Association
VWMA	Vermont Wood Manufacturer's Association
VWA	Vermont Woodlands Association/Consulting Foresters Association of Vermont
WO	Watershed Organizations

Partner organizations are described under State Assessment DFC 5: Partnerships.

Desired Future Condition 1: Biological Diversity Conserve biological diversity across all landscapes				
Long-Term Strategy	**Programs that Contribute**	**Partners**	**Resources Needed to Implement**	**Supports National Objective**
Goal 1: Maintain a mix of forest structure and complexities across the landscape.				
1	FS, SL, FH, UCF, WF, UM, FL	NASPF, FW, NRCS, VWA, AV, TNC, LT, VAPDA, GMNF, ANR, US, SAF	GF, FF, IT, PF	1.1, 1.2, 2.2, 3.7
2	FS, UCF, WF, FL	NASPF, ANR, VNRC, AV, TNC, LT, VAPDA, GMNF, UVM, SAF, NRCS	GF, FF, NGO	1.1, 1.2, 3.1
Goal 2: Protect and conserve natural communities, genetic diversity, rare and endangered species, unique habitats, corridors and buffers.				
3	FH, FS, FL	FW, AV, TNC, NRCS, UVM,GMNF, VAPDA, LT	GF, FF, IT, NGO, PF	1.1, 3.5
4	FL, FS, SL, FH	FW, ANR, TNC, AB, LT, UVM, GMNF, VNLA, ASLA, NRCS	GF, FF, IT, NGO, PF	2.2, 3.5, 3.7
5	FL, FS, WF	FW, ANR, AV, NRCS, TNC, LT	GF, FF, IT, NGO	1.2, 3.5

Desired Future Condition 2: Forest Health and Productivity Maintain and enhance forest ecosystem health and productivity				
Long-Term Strategy	**Programs that Contribute**	**Partners**	**Resources Needed to Implement**	**Supports National Objective**
Goal 1: Identify trends in forest ecosystem health and productivity.				
6	FH	NASPF, FW, UVM, TNC, GMNF, SAF, AV, VMC	GF, FF, NGO	2.2, 3.6
7	FH	NASPF, AA, UVM, GMNF, APHIS, VMC	GF, FF, IT, NGO	2.2, 3.5, 3.6
Goal 2: Maintain productive capacity of forests.				
8	FS, SL, UM, FF, UCF, WF, FH	NASPF, FW, ANR, NRCS, VWA,FPA, LT, SAF,MU	GF,FF,IT,NGO,PF, FF	1.2, 2.1, 3.4, 3.7
9	FH, FS, SL, WF	FW,UVM,NRCS,GMNF, VWA, NRCD, RCD	GF, FF	2.2, 3.4
10	FH, FF, FS, UCF, SL	FW, ANR, NRCS, GMNF, VWA, SAF, VNLA	GF,FF,IT,NGO	2.1, 2.2, 3.7
11	FF, FH	NASPF, ANR, PS, GMNF, MU, RCD	GF, FF	2.1, 2.2, 3.3
Goal 3: Retain native flora and fauna across the landscape.				
12	FH, FS, UCF, SL	NASPF, FW, ANR, AA, TNC, GMNF, APHIS, ANLA, ALSA	GF, FF, IT, NGO	1.2, 2.2, 3.5, 3.6, 3.7
13	FH, FS, UCF, SL	NASPF, ANR, AA, TNC,	GF, FF, NGO	1.2, 2.2, 3.5, 3.6, 3.7

		VWA,GMNF, NRCS, MU, APHIS, VNLA, ALSA		
14	FW, FS	NASPF, FW, ANR, SAF, TNC, AV, UVM, VAPDA, VMC	GF, FF, NGO	1.1, 1.2, 2.2, 3.5

Desired Future Condition 3: Forest Products and Ecosystem Services Maintain and enhance forest contribution to ecosystem services				
Long-Term Strategy	**Programs that Contribute**	**Partners**	**Resources Needed to Implement**	**Supports National Objective**
Goal 1: Maintain and enhance the production of forest products.				
15	UM,FH	USFS, UVM, FPA, VWA, AIV, VMC	GF,FF, PF	3.4
16	UM,FS,SL	FPA, AIV, AC, VWA, GMNF, SAF, MU	GF, FF, NGO	3.4, 3.6
17	UM	USFS, UVM, FPA, AC	GF, FF	3.4
18	UM,FH,FS	NASPF, UVM, FPA, VWA, AIV, SAF, VWMA	GF, FF, NGO	3.4
Goal 2: Maintain and enhance water resources.				
19	WF, FS, UCF, UM, SL	SFP, ANR, DEC, NRCS, VWA, FPA, UVM, GMNF, SAF, RCD, FW	GF, FF, IT	2.2, 3.1
20	WF, UCF, FS	ANR, DEC, NRCS, AV APDA, AA, NRCD, RCD,MU, ALSA	GF, FF	3.1, 3.7
21	WF, FS, UCF	FW, ANR, DEC, NRCS, NRCD, ASLA	GF, FF, NGO, PF	2.2, 3.1
Goal 3: Maintain and enhance recreational opportunities.				
22	SL, FS, LWCF	LD, FW, SP, GMNF, VWA, RG, AOT	GF, FF, NGO, PF	1.2, 3.4, 3.5, 3.6
23	SL, FS, UCF	LD, FW, SP, GMNF, VWA, RG, AOT, MU, VAPDA	GF, FF, NGO, PF	1.2, 3.4, 3.5, 3.6

Goal 4: Maintain and enhance forest carbon.				
24	FH	USFS, ANR, UVM, SAF, VMC	GF, FF, PF	3.4, 3.7
25	FH, UM, FS, UCF	ANR, UVM, VWA, TNC, AV	GF, FF, NGO, PF	3.4, 3.7
Goal 5: Maintain and enhance air resources.				
26	FH	USFS, ANR, UVM, DEC, VMC	GF, FF	2.2, 3.2
27	FH, FS, UCF	USFS, ANR, UVM, DEC	GF, FF	2.2, 3.2
28	FH, FS	USFS, ANR, UVM, DEC, VMC	GF, FF	2.2, 3.2

Desired Future Condition 4: Land Ethic Maintain and enhance an ethic of respect for the land, sustainable use and exemplary management				
Long-Term Strategy	**Programs that Contribute**	**Partners**	**Resources Needed to Implement**	**Supports National Objective**
Goal 1: Encourage public understanding of forest systems.				
29	CE, FH, FS, UCF, SL, UM	NASPF, UVM, VWA, GMNF, FW, AV	GF, FF, NGO	3.6
30	CE, FH, FS, UCF, SL, UM	NASPF, UVM,VWA, SAF, NRCS	GF, FF, NGO	3.4, 3.6
Goal 2: Increase public awareness of the critical role trees and forests play in sustaining Vermont communities and residents.				
31	CE, UCF, FS	NASPF,UVM,VAPDA, ED, MU, ASLA	GF, FF, NGO	3.3, 3.4, 3.6
32	CE, SP, UCF, SL, UM, FH, WF, FF	NASPF,GMNF,UVM,VWA,FPA, ANR	GF, FF, NGO, PF	3.3, 3.4, 3.5, 3.6, 3.7
33	SE, SP, UCF, SL, UM, FS, WF, FF, FH	NASPF,UVM,NRCD,NRCS,VWA, FPA,GMNF, ED, SAF,SFI, AV	GF, FF, NGO, PF	3.3, 3.4, 3.5, 3.6, 3.7
34	CE, UCF, SL, UM, FS, WF	NASPF,GMNF,FW,NRCS,VWA, SAF, RCD, AV	GF, FF, NGO	1.2, 3.1, 3.2, 3.4, 3.5, 3.6, 3.7
35	FF, FH, CE	NASPF,GMNF,NRCD,MU	GF, FF	2.1, 3.3
Goal 3: Increase public understanding and the application of exemplary of forest management, conservation and protection.				
36	CE, SP, UCF, SL, FS, WF	NASPF, FW, UVM, VWA, FPA, SAF, AV	GF, FF, NGO, PF	1.2, 1.2, 3.4, 3.6
37	CE, FH, FS, UCF, UM, WF, SL	NASPF, VWA, UVM, AV, FW, SAF, ED	GF, FF, NGO	1.2, 3.4, 3.5, 3.6
38	FH, CE, FS, FF, SL, UM	NASPF, AA, UVM, VWA, TNC, ED, AV, VNLA, EE	GF, FF, NGO, PF	1.2, 2.1, 2.2, 3.3, 3.6, 3.7
39	CE, FS, UM, UCF, SL, WF, FF	NASPF, VWA, FPA, SP, SAF, ED, SFI, AV, VNLA	GF, FF, NGO, PF	1.2, 2.2, 3.4, 3.6
40	FS, FH, SL, UCF, UM, WF	NASPF, VWA, UVM, GMNF,	GF, FF, NGO, PF	1.2, 2.2, 3.4

		FPA, NRCS, SAF, SFI, AV, VNLA, ALSA		
41	CE, SP, SL, FS	GMNF, VWA, RO	GF, NGO, PF	3.4, 3.6
Goal 4: Maintain and enhance forest contribution to communities.				
42	FS,UCF,WF,UM	VNRC,VWA,FPA,NRCD, VAPDA, RCD, FW, SAF, AA, MU, ALSA	GF,FF,NGO	1.1, 1.2, 2.2
43	UCF, CE, FS	UVM, VWA, NASPF, VAPDA, DEC, MU, ALSA	GF,FF,PO	1.2, 2.2, 3.4, 3.5
44	FS, UCF, UM, CE	NASPF, VAPDA, VNRC, LT, RCD, MU	GF,FF,NGO	1.2, 3.6
Goal 5: Demonstrate exemplary forest management through state lands management and encourage sustainable use across all landscapes.				
45	SL, FH	FW, LD, GMNF, VWA, LT, SAF, NRCS, AV	GF, FF, IT, NGO	1.2, 3.4, 3.5, 3.7
46	SL, CE	FW, LD, SP, ANR, ED	GF, IT, PF, NGO	3.6
47	SL, FH, FS, UCF	NASPF, LD, FW, ANR	GF, IT, PF	1.2, 3.6

Desired Future Condition 5: Legal, Institutional and Economic Framework Vermont has a legal, institutional and economic framework in place for forest conservation and sustainability				
Long-Term Strategy	**Programs that Contribute**	**Partners**	**Resources Needed to Implement**	**Supports National Objective**
Goal 1: Maintain an organizational structure within the Division to support management, protection, conservation and enhancement of Vermont's forests.				
48	ALL	LD, SP	GF	ALL
49	"	ANR	"	"
50	"	LD, SP	"	"
51	"	ANR	"	"
52	"	ANR	"	"
53	"	ANR	"	"
Goal 2: Expand financial opportunities to support forest stewardship.				
54	ALL	NASPF, VWA	GF, FF	ALL
55	"	ANR	GF	"
56	"	VWA, AD, TNC, NRCD, VMC, NRCS	GF	"
57	"	ANR	GF	"
58	"	NASPF, GMNF	GF,S PF	"
Goal 3: Strengthen, implement and enforce Vermont's forestry policies, rules and laws.				
59	FS, FH, FF, UM, WF	ANR, AA, SFI	GF	ALL
60	FS, FH, FF, UM, WF	ANR, AG, SFI	GF	"
61	ALL	ANR	GF	"
Goal 4: Encourage and support policies, programs and initiatives that assist private forest landowners in maintaining the working landscape.				
62	FS, CE, UM, WF	ANR, AA, FW, VWA, FPR, LT, TX, MU	GF, NGO	1.2,3.4, 3.5, 3.6

63	FS, UM, WF, SL, FH	ANR, VWA, FPA, SAF	GF, NGO, PF	1.2, 2.2, 3.5
64	FS, UM, CE	ANR, UVM, VWA, FPA, AIV, LT, SAF	GF, NGO, PO	1.2, 3.4, 3.6, 3.7
65	FS	FW, NRCS, VWA, AIV, FPA, SAF, AV	GR, FF, PF	1.1, 1.2, 3.4, 3.5, 3.6

Table 2: Strategies Matrix.

Priority Areas and Issues

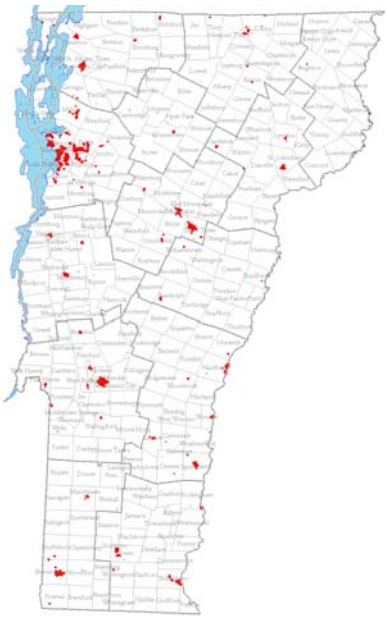
At the outset of the development of the **2010 Vermont Forest Resources Plan**, it was decided to classify the state into three broad landscape zones: Urban, Rural Residential and Rural. The classifications were based upon E911 housing point density data. E911 data supports the calculation of the number of houses per square kilometer of land area. From this analysis, average parcel sizes can be estimated. There is a direct correlation between housing density and average parcel size; the higher the housing density, the smaller the average parcel size. Using a landscape classification system based upon average parcel size allows us to evaluate benefits and strategies depending upon the intensity of landscape parcelizaton and predominat land use. The parcel size ranges in the three zones are:

- **Urban:** 0 – 5 acres
- **Rural Residential**: > 5 – 27 acres
- **Rural**: > 27 acres

The following is a general description of the three landscape zones along with a discussion of trends, issues and threats and values. At the end of the section is a summary of priority areas by landscape zone, as well as multi-state regional priority areas and priority issues.

Urban Landscape Zone

The Urban Landscape Zone (ULZ) designation is based on housing parcel sizes between 0 to 5 acres, (Map 1: Urban Landscape Zone).



Map 1: Urban Landscape Zone

The Urban Landscape Zone encompasses about 1.6% or 95,000 acres of Vermont's total land area, a relatively small amount by any state standards. Geographically, the Urban Landscape Zone is located primarily along the shores of Lake Champlain and the banks of the major rivers as historically these were the primary transportation corridors and development centers. The largest urban center is Burlington and its surrounding towns. The Burlington/South Burlington

Metropolitan Statistical Area (MSA) is home to approximately 170,000 people or 28% of Vermont's population (U.S. Census Bureau, 2000). Most other Vermont urban centers have populations below 10,000. The topography is gentle around the major lakes and flood plains but can vary in the river bank towns like Montpelier and Brattleboro. Soils are mostly silt and clay deposits and quite productive. Most urban expansion in the past 100 years has occurred on former agricultural lands.

Viewing the ULZ from above, one would quickly become aware of a mosaic of green space between the gray infrastructures of the streets, buildings and parking lots. The urban forest is the sum of street trees, residential trees, park trees and greenbelt vegetation; it includes trees on public and private land, in transportation and utility corridors and forests on watershed lands. Management of urban and community forests borrows principles from traditional forestry but relies on public policy to provide support to ensure sustainability.

Desirable attributes of sustainable urban and community forests vary among communities. The aesthetics, functions and management of community green space will ultimately depend on people, who determine which ecological functions and social benefits are desired and the scale to which these elements will be sustained. Most communities have parks, street trees, open space and greenways that were originally conceived to provide the community with amenities, without considering their potential to provide ecological services or their role in forming a networked infrastructure. Urban and community forestry, viewed as green infrastructure on a community scale, can improve the quality of life in Vermont's cities, towns and villages through comprehensive planning to connect, conserve, manage, enhance and enjoy the natural resources within them.

Stormwater runoff within urban areas has been identified as one of Vermont's major impacts on water quality and is now high on the state's environmental agenda (Vermont Clean and Clear Plan, 2009). Trees and forested areas within the ULZ can play an important role in mitigating stormwater runoff. Additionally, urban forests can be looked at as the first line of defense for climate change. Carbon storage by urban trees (9.25 kgC/m2 cover) and gross sequestration (0.3 kgC/m2 cover) may be greater than in forest stands due to a larger proportion of large trees in urban environments and relatively fast growth rates due to the more open urban forest structure (Nowak & Crane, 2002). An analysis by US Forest Service provides rough estimates of the multitude of forest benefits in the Urban Landscape Zone.

Vermont has an estimated 11.9 million urban or community land trees that provide (Nowak, et al., 2008):

- 2.3 million metric tons of carbon (C) stored ($52.4 million value)
- 75,000 metric tons/year of carbon(C) sequestered ($1.7 million value)
- 1,610 metric tons/year total pollution removal ($14.2 million value)

Specific pollution removal numbers are:

- 12 metric tons/year of carbon monoxide (CO) removed ($16,800 value)
- 164 metric tons/year nitrogen dioxide ($NO_{2)}$ removed ($1.6 million value)
- 985 metric tons/year of ozone O_3 removed ($9.8 million value)
- 40 metric tons/year of sulfur dioxide SO_2 removed ($97,500 value)
- 411 metric tons/year of particulate matter of ten micros or less PM_{10} removed ($2.7 million value)

To assist in targeting resources to Vermont communities in greatest need of urban tree canopy enhancement, the Division of Forests and the University of Vermont Spatial Analysis Lab conducted an assessment of the state that identifies communities that have less than average urban tree canopy (UTC) and greater than average population, urbanized area and impervious surface area. Once target UTC enhancement communities were identified, we overlaid Vermont's impaired watersheds. The highest priority communities include Burlington, South Burlington, Rutland and St. Albans due to their high UTC rating and the occurrence of stormwater impaired watersheds within their boundaries. Other high priority UTC communities include Barre City and Vergennes, (Map 39: Priority Areas for Urban Tree Canopy Enhancements).

To understand and effectively target increases in urban tree canopy locally, it is valuable to determine the existing amount and location of tree canopy, set goals for increasing canopy, develop a plan to reach those goals and then regularly monitor progress. However, more detailed UTC analysis is needed using high resolution imagery and local data layers such as parcel boundaries and land ownership. The Division of Forests has begun to complete these more accurate UTC assessments in partnership with the UVM Spatial Analysis Laboratory and the US Forest Service. So far, community level UTC assessments have been completed for Burlington, Rutland and St. Albans and are in process for Montpelier. UTC enhancement can be most efficiently realized by maximizing protection and maintenance in combination with new plantings and natural regeneration. The impacts of setting a UTC goal will likely include focusing or reallocating public agency resources (funds, staff, etc.) to enhance existing UTC areas and develop strategies to create cover in potential UTC areas on public land. On private

lands, a combination of education and outreach, landowner and redevelopment incentives, and refocusing of regulatory mechanisms to specifically achieve the objectives of the UTC goal will likely be required.

An analysis of Burlington's urban tree canopy (UTC) found that 2,648 acres of Burlington is covered by tree canopy (O'Neil-Dunne & Grove, 2008). This corresponds to 43% of the city's land area. An additional 36% (2,198 acres) of Burlington could conceivably be covered by UTC. The majority of Burlington's existing UTC is located in areas of residential land use. Residential land also contains most of the possible UTC. With metrics like these, the City has the information needed to work on meeting a newly established UTC goal of 50% put in place in their 2010 Climate Action Plan. For more detail on the community level UTC assessments visit: www.nrs.fs.fed.us/urban/utc/

Local efforts to plant and care for a community's urban tree canopy cover often begin with the vision of local government officials or local citizens. Ideally, the local government assumes the lead role in the overall management of a community forestry program. However, in Vermont, this leadership role often falls to community volunteers. Thus, strong educational outreach and technical assistance is needed to support their efforts. The Division's principal educational platform is an intensive training program called Stewardship of the Urban Landscape (SOUL). The course is designed to foster local urban forestry leaders that will help their community develop sustainable urban forestry programs. In 2010, eighty people participated in the program and are now involved in local UTC initiatives.

The US Forest Service identifies four base criteria needed to sustain local urban and community forestry programs. Annually, the Division of Forests tracks and reports on these elements. Communities that have all four elements are considered to be "managing" their urban forest resource; communities that have at least one but less than four of the elements are considered to be "developing." The four criteria are:

- *Management Plans:* Urban tree and forest management plans, developed from professionally-based resource assessments/inventories.
- *Professional Staffing:* Professional urban foresters/arborists.
- *Ordinances & Policies:* Local ordinances or policies aimed at the protection and sound management of urban trees and forests.

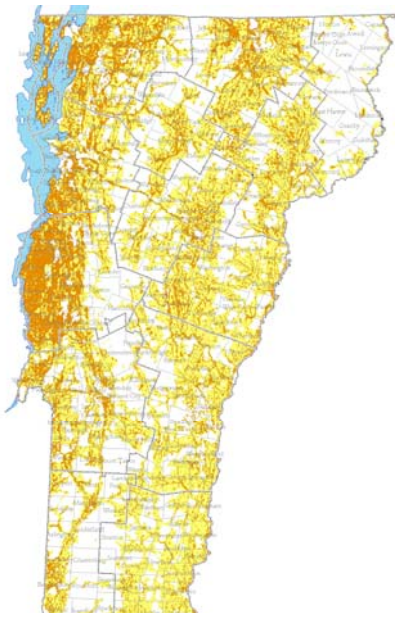
- *Advocacy/Advisory Organizations:* Active tree boards, commissions or nonprofit organizations established to advocate for local investment in urban forestry activities.

To help target our efforts to support communities reaching the 'managing' level, the Division of Forests took our Urban Tree Canopy Enhancement analysis, and highlighted the medium-high and medium communities and overlaid their current status in regards to the four base US Forest Service criteria, (Map 40: Urban and Community Forestry - Community Accomplishment Priorities). By referring to the two maps, we can begin to identify which communities are priorities for program development. For example, Colchester and Winooski are rated medium-high for UTC enhancement, have an impaired watershed within their boundaries and are not currently meeting all four base criteria. Thus, they would rank high for educational outreach and technical assistance to help them achieve 'managing' status.

Rural Residential Landscape Zone

The Rural Residential Landscape Zone (RRLZ) designation is based on housing parcel sizes between 5 to 27 acres, (Map 2: Rural Residential Landscape Zone).

The Rural Residential Landscape Zone totals about 3.5 million acres or about 59% of Vermont's land base. This is a combination of forested and agricultural lands most of which has been farmed within the past 120 years. It is where most Vermonters choose to live, in dispersed single homes and small tract developments. It contains most of the mid- and lower level streams and rivers, as well as the majority of roads and utility corridors.



Map 2: Rural Residential Landscape Zone

The RRLZ was divided into two land use categories for purposes of conducting the assessment: Non-Forested and Forested. Non-Forested lands in the RRLZ are lands less than 50% forested per km square, while Forested RRLZ lands are 50% or greater of the area in forest cover per km square.

Non-Forested Rural Residential Landscape Zone

The Non-Forested RRLZ occupies about 2.3 million acres or 39% of Vermont's total land area. Most lands are between 95' and 1,500' in elevation and contain the most productive farm and forest lands in the state (Map 16: Forest Productivity). Significant forest cover is scattered throughout this landscape in farm wood lots, vegetated strips around fields and along streams, non-tillable areas, wetland areas and forests on steeper slopes. The landscape characteristics of the Non-Forested category are best captured in the descriptions of the following Land Type Associations (LTA), (Map 5: Land Type Associations).

> ***Valley Floor Glacial Lake/Marine Plains:*** Fertile, moist soils developed primarily from clay and silt deposited in the Champlain Valley by glacial Lake Vermont and the Champlain Sea. The dominant natural vegetation is valley clay plain forest, with mesic maple-ash-hickory-oak forest on the shallow to bedrock inclusions, floodplain forest in the alluvial soil inclusions and a variety of wetland types in the organic soils inclusions. This LTA generally occurs below 600' elevation. At present, much of this LTA is in agricultural use.
>
> ***Hills and Foot Slopes:*** Transition areas between the valleys and the high ridges of the Green Mountains, 250' to 1,590'in elevation. Soils originated from glacial till and are in the frigid temperature regime. Typical soils are rocky sandy loams, generally shallower than soils in the valley bottoms with bedrock outcrops. Agriculture is much less common. In forested areas, softwood and mixed stands are common, with northern hardwoods tending to become purer as elevations increase.
>
> ***Rolling Low and Mid-Elevation Calcareous Metamorphic Hills:*** Elevations range from 520' to 2,490'. This LTA is made up predominantly of till-derived soils over meta-sedimentary rock, primarily on gentle slopes. Because of the carbonates in the bedrock and the till, soils tend to be enriched. This enrichment and gentle topography is more desirable for agriculture than other LTAs. Natural vegetation is dominated by northern hardwood forests of sugar maple, yellow birch and beech. In shallow to bedrock areas, wetter areas and lowlands, spruce-fir may be common, even dominant.

The Non-Forested lands contain the highest percentage of agricultural fields of any zone in the state. While the numbers of farms are declining in Vermont, the average farm acreage is increasing to gain efficiencies and is often over 500 acres. A high percentage

of farmland is enrolled in the Agricultural category of Vermont's Use Value Appraisal (UVA) program. Many of the agriculture lands have forested margins and woodlots that provide firewood, maple sap, sawlogs and wildlife habitat. However, as the number of farms continues to decline, land often reverts to forest cover and in many cases is developed into house lots.

Most non-agricultural parcels in this zone are held in small (> 5 acres) to medium (100 acre) private ownerships. Small forests can also provide "backyard" habitats and sustainable forest products even as development occurs if technical assistance and outreach remains available. Development pressures and high real estate land values will make protecting potential high value forest landscapes in the zone difficult. Tax incentive programs like UVA are even more important to provide assistance to landowners in the future. The areas under most pressure and likely to develop are shown on Map 9: Projected Housing Density Change. These lands will come under intense pressure for development when they enter the real estate market. This zone includes some conserved lands, predominantly easements through land trusts or held by the Vermont Department of Fish and Wildlife.

Threats from invasive species, both insects and plants can be high on lands close to human settlement, as non-native insects and diseases tend to be transported along corridors in more heavily populated areas. Stream corridors and wetlands are a priority landscape for wildlife habitat and for protecting water quality values.

Forested Rural Residential Landscape Zone

The Forested Rural Residential Landscape Zone (RRLZ) is generally located at 600' to 1,500' in elevation. At 1.2 million acres, this landscape represents 20% of Vermont's land base. Almost all the land in this category has a history of being cleared for agriculture, followed by abandonment and reversion to forests. The following LTAs best characterize this landscape, (Map 5: Land Type Associations).

> ***Hills and Foot Slopes*** (same characteristics as Non-Forest, but at higher elevations)
>
> ***Rolling Low and Mid-Elevation Calcareous Metamorphic Hills*** (same characteristics as Non-Forest, but at higher elevations)
>
> ***Temperate Hills of Southeastern Vermont:*** This LTA dominates the biophysical region. Soils are variable but mostly till-derived with soils fertility and vegetation

variable. The dominant cover types in the western section and on north and east facing slopes is northern hardwood. On south facing slopes, a mesic red oak-northern hardwood forest dominates, with hemlock present in cooler areas.

Dissected Low to Mid-Elevation Calcareous Metamorphic Hills: This LTA is a single block in Orange County (Connecticut River watershed) dominated by till-derived soils over meta-sedimentary rock on gentle to steep slopes. Elevations range from 472 to 2,424 feet. Natural vegetation ranges from northern hardwoods on the mid and upper areas, to spruce-fir and hemlock on the lowlands and shallow to bedrock areas.

The Forested RRLZ contains most of the highly productive forest lands in the state, (Map 16: Forest Productivity). It also includes the majority of forests tapped for maple syrup production. This landscape is dominated by small (5 to 100 acre) private forested land holdings interspersed with houses. This area has a high percentage of UVA enrollments supporting forested woodlots 25 acres and up. These parcels support the forest products industry by landowners' enrollment in the program which requires forest management practices. Vermont's UVA program has been effective in keeping forested lands forested, healthy and productive for more than 30 years. A small percentage of privately-owned, conserved land is scattered throughout the zone. Most of the conserved lands are properties with easements held by land trusts, municipal forests or small state land holdings.

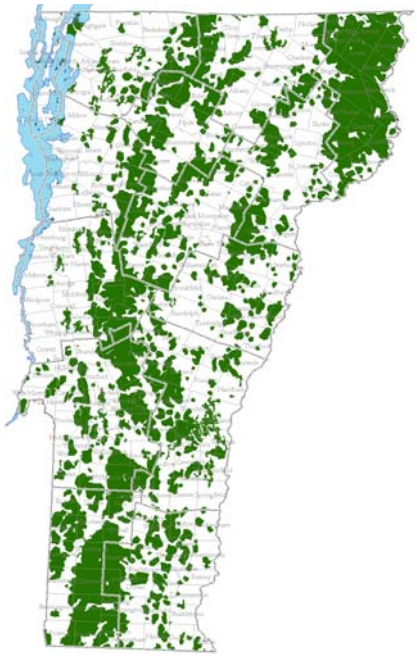
Many of the forests in this zone provide vital protection for public drinking water supplies through small streams that feed into larger rivers. The most important of these areas are identified on Map 35: Water Source Protection Areas. Privately-owned parcels of forested lands in this category are continually being sold or subdivided. As parcel size decreases, the ability to effectively manage these lands for forest values becomes more challenging. Houses and related development result in larger areas of impervious surfaces (roads, roofs, etc.), a major cause of stormwater runoff pollution into Vermont's waters. Planning for forested buffers and low impact development (LID) in developing areas is critical to managing runoff. Forested corridors along streams and wetlands play an important role in wildlife habitat as well. Because of the density of structures in close proximity to forest cover, this zone is also Vermont's highest risk to wildfire, (Map 32: Vermont Wildfire Risk Assessment).

Forests located in the Forested RRZ are at high risk from invasive species because of proximity to dispersal vectors and disturbed sites. The high number of landowners in

fragmented landscapes makes monitoring, evaluation and control of invasives difficult. Smaller parcels of forest land are also more vulnerable to over-browsing by deer because hunting opportunities become limited due to the small size of parcels and the increase in posting by landowners. This also limits opportunities for outdoor recreation. Inappropriate recreation activities may also increase due to the nearness to population centers. Conversely, the need for more trails and recreation areas increases as communities expand.

Rural Landscape Zone

The Rural Landscape Zone (RLZ) designation is based on housing parcel sizes greater than 27 acres, (Map 3: Rural Landscape Zone)



Map 3: Rural Landscape Zone

The Rural Landscape Zone is over 2.4 million acres or 40% of Vermont's 5.9 million acre land base. These lands are over 90% forested. Nearly all of Vermont's largest forested parcels are located in the zone. Agricultural and developed lands are rare.

The Rural Landscape Zone encompasses Vermont's landscapes not well suited to agriculture with higher elevations, and areas with steeper slopes and poorer soils. Evidence of failed "hill farms" from the 1800's are scattered throughout this zone and are witnessed in the form of stone walls, cellar holes and old town roads. By the early 1900's, there was a growing concern about the shortage of well-managed timberland and related problems of widespread forest fires and soil erosion. This led the state to begin obtaining large parcels of forest land. Later, the federal government established the Green Mountain National Forest and began acquiring large forest tracts. Today, these state and federal lands, along with large private holdings, particularly in northeastern Vermont, and lands conserved by private nonprofits, make up the majority of the Rural Landscape Zone. The following LTAs best characterize this landscape, (Map 5: Land Type Associations).

> ***Mountain Slopes:*** Located primarily in the Northern and Southern Green Mountains, elevations range up to 2,800' at the Massachusetts border, to about

2,035' at the Canadian border. Both glacial scouring and deposition occurred here, resulting in basal tills as parent material in most areas. Vegetation is primarily forest, dominated by northern hardwood.

Precambrian Plateau: This is a higher elevation equivalent of the Rolling Hills LTA, described in other regions. Elevations range between 1,300 and 2,600 feet with slopes less than 8%. The soil temperature regime is frigid. Soils most commonly have developed from basal tills and may be poorly drained. Due to the gentler terrain, some of these forests have a history of heavy industrial logging. Vegetation tends to be a mosaic of northern hardwood forest and lowland spruce-fir forest.

Upper Mountain Slopes Mountain Tops: Often referred to as the sub alpine zone, this LTA ranges from about 2,400 feet at its southern edge, to about 2,035 in the north. Landforms are likely to have been scoured by tie glaciers. Vegetation at the lower elevations is dominated by yellow birch-red spruce forest and at upper elevations by montane spruce-fir.

Well over 50% of the Rural Landscape Zone is presently owned by the State of Vermont or the federal government (Green Mountain National Forest, Silvio O. Conti National Wildlife Refuge). The remaining lands are medium to large privately-owned parcels, usually located around the perimeter of the state and federal lands. Because of state and federal ownerships, as well as the large acreage in permanent easement, the majority of the land in this zone is conserved. Although a significant portion of the private commercial timberland has changed hands in the past 10-15 years, existing easements preclude most forms of development. A high percentage of the private land holdings in the zone are enrolled in the UVA program.

These tracts, along with the public ownership, provide the core of Vermont's matrix forests. Matrix forests, or communities, dominate the landscape and form the background in which smaller scale communities occur (Thompson, et al., 2000). There are six matrix-forming natural communities in Vermont: montane spruce-fir forest, lowland spruce-fir forest, montane yellow birch-red spruce forest, spruce-fir-northern hardwood forest and northern hardwood forest.

While most lands in the RLZ do not score high for forest productivity based on soil or other site conditions, (Map 16: Forest Productivity), the stable nature of the ownership and long history of forest management make them very important to Vermont's forest

products industry. The state, federal and UVA lands must continue to provide the forest products that are necessary for maintaining a healthy forest products industry. Keeping these lands forested, productive and healthy is a top priority. The combination of a large conserved land base and high level of enrollment of private lands in UVA can assure that these lands continue to provide the full range of goods and services. Opportunities for participation in third party certification and carbon and ecosystem management programs can benefit both public and private lands and underscore the societal value of this landscape to produce ecosystem services on a sustainable basis.

Nearly all of the critical headwaters to Vermont's public water supplies and streams are located in the RLZ, (Map 36: Land Classification of Vermont Headwaters). Given the high percentage of forest cover and the relatively stable pattern of the land ownerships, these headwater areas will remain protected as forests into the foreseeable future. The monitoring and enforcement of Acceptable Management Practices for Maintaining Water Quality on Logging Jobs in Vermont (AMP's) and the state's Wetland Rules are tools for protecting the resource values of these areas.

The larger forested areas provide vital habitat for wildlife and are particularly critical to moose, bear and furbearer species. As part of their state Wildlife Action Plan, the Department of Fish and Wildlife recently completed a statewide assessment of the relative importance of habitat blocks and threats to these blocks. Many of these important forest blocks are in this zone.

The large tracts of land in the zone provide a myriad of outdoor recreational opportunities. They include Vermont's ski industry sites, Vermont's border-to-border hiking trail, the Long Trail which is also part of the Appalachian National Scenic Trail, much of the Vermont Association of Snow Travelers' statewide snowmobile network and a statewide cross-country ski trail network, the Catamount Trail. These areas also support local and regional hiking, horseback and biking trails, with more recreation corridor plans submitted each year. These lands provide quality hunting and fishing opportunities and serve as the backdrop for Vermont's famous fall foliage.

Because of the high percentage of conserved and UVA lands, and the high elevation and steeper slope characteristics of the land, development pressure in the zone is generally low. However, ski area expansion and continuing demands for trails of all types have the potential to impact critical habitats for deep forest wildlife species (Vermont Monitoring Cooperative, 2009). Companies that own commercial forest land, particularly those that are part of real estate investment trusts or timber investment management

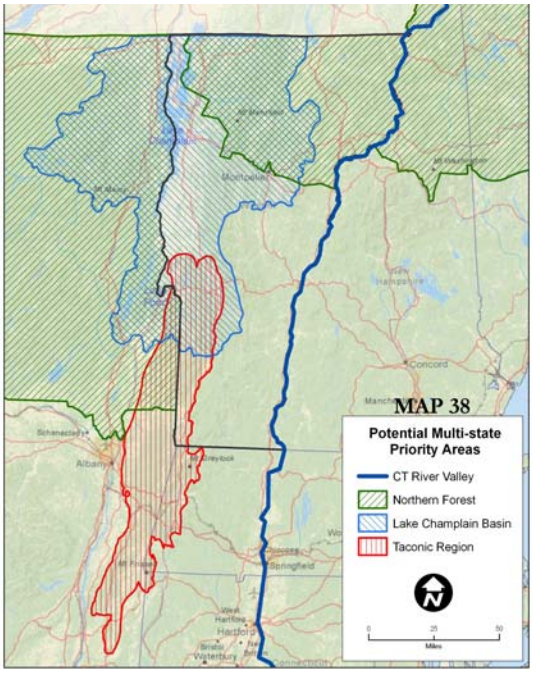
organizations, are affected by global, as well as local timber and real estate markets. This can affect land tenure and changing management goals.

Forest health concerns on large forested tracts include impacts from major invasive insect species, but also concerns related to native cyclic insect pests. These forests are the most vulnerable to anticipated global climate change and forest productivity issues related to past harvest applications and atmospheric pollutants, especially sites with low natural fertility or at higher elevations. Some of these forest areas are vulnerable to over-browsing by deer and moose which can lead to increased risk of regeneration failures and site competition from unwanted native and invasive plants.

Many of the resource values, issues or threats in the Rural Residential and Rural Landscape Zone are difficult to map on a statewide basis. As a result, we are unable to present a map of priority areas within the RRLZ and RLZ. More detailed analysis is available at a local scale and an example is shown on Map 41: Local Scale Priority Landscape, and will be used in defining specific activities and projects.

Multi-State Regional Landscape Priorities

The Vermont Department of Forests, Parks and Recreation has a long history of participation in multi-state forest resource projects. These projects have ranged from forest health efforts such as the North American Maple and the Spruce Budworm control projects, ecological mapping efforts such as the Biophysical Regions project, to participation in the four-state (ME, NH, VT, NY) economic development activities through the North East State Foresters Association (NEFA). All efforts have one thing in common, the need to cooperate across state boundaries to address a pressing regional need. It should also be noted that resource values and threats do not stop at our international border. Further assessments should include evaluating forest resources in neighboring Quebec, Canada and opportunities to collaborate collectively.



Map 38: Potential Multi-State Priority Areas

Looking forward, we have identified several broad categories of need that could benefit from a multi-state approach. These include issues relating to forest health and ecology, forest-based economy, ecological mapping and watershed planning, (Map 38: Potential Multi-State Priority Areas).

The following is a listing of Vermont's priority forest areas that span the region and, in some cases, the international border.

Northern Forest Lands (NFL) – About one third of Vermont lies within the planning area for NFL and includes some of the largest intact tracts of forest land, as well as some of Vermont's most impoverished communities. This area saw federal investment in the 1990's and was the impetus for the establishment of NEFA (North East State Foresters Association). Work to address region-wide efforts to support conservation, economic development and community infrastructure is needed. Currently, NEFA has joined forces with the rest of New England in a New England Governors initiative that includes a 'Keeping Forests as Forests' conservation and stewardship component.

Connecticut River Valley – This is one of the most at-risk areas of New England for forest fragmentation according to the US Forest Service publication 'Forest on the Edge.' Other issues include invasive species and land conversion. This area includes NH, VT, MA and CT. The US Fish & Wildlife Service is also engaged, through land conservation and management efforts within the Silvio O. Conte National Wildlife Refuge. Future needs include better pest detection and control, and more opportunities for landowner incentives for maintaining habitats and working landscapes.

Taconic Mountains – A significant percentage of Vermont's important natural communities and sites with rare and endangered species is within this area. Some of the area in Vermont is protected either by the Green Mountain National Forest or state lands and land conservation through private land trusts. Better pest detection and control, support for historic and recreation resources, and awareness of habitat issues including corridors between forest blocks, are needed. This area extends into VT, NY, MA and CT, which have designated portions of the Taconics for potential Forest Legacy areas. In addition, the GMNF extended its purchase boundary to include towns within the Taconic Range.

Lake Champlain Basin – This is a multi-state, multi-nation resource impacted by urban development and agricultural runoff. Challenges include maintaining tree canopy and watershed quality to reduce pollution and protect water quality. Vermont Governor's 'Clean and Clear' program has generated research, landowner education and incentives to improve water quality. The effort is being coordinated by the Lake Champlain Commission with membership in NY and Quebec.

State and Multi-State Regional Priority Issues

There are several priority issues that cross state borders and, by taking a regional approach, in addition with specific state efforts, will improve resource management and protection.

Invasive Species – Vermont is the latest state to experience invasive terrestrial plants and threats by three major invasive insects. Early detection, monitoring, coordinated regional responses and educational resources are needed, along with up-to-date recommendations to manage and eradicate invasive plants.

Water Quality – Maintaining forested watersheds is an issue that our sister states face, and we need to better understand the relationships between Vermont's water sources and the rest of the region. In Vermont, we must continue our efforts with AMPs and skidder bridges, and look to other states for innovative ways to protect water courses. Opportunities to learn from other municipal watershed organizations should be pursued.

Forest Habitats and Diversity – Understanding climate change, forest fragmentation, the browsing from wildlife on forest plants and invasive species are necessary to maintaining natural communities and critical habitats. Partnerships with Fish and Wildlife, GMNF, the University of Vermont and conservation groups throughout the region will help to direct these efforts.

Renewable Energy and Biomass – Utilizing wood biomass resources in a sustainable manner is one of the most important challenges we face. Aligning the demands with the resource as well as understanding the impacts on carbon budgets, air quality, forest soils and other resource values across the region will take careful planning, coordination and support.

Intergenerational Transfer of Land – Workshops, displays and other media have been employed in an educational effort with forest landowners. Needs include better financial and conservation planning tools. All states need to cooperate to link out-of-state landowners with resources both at home and in secondary residences.

Green Infrastructure – Green infrastructure strategies actively seek to understand, leverage and value the different ecological, social and economic functions provided by natural systems in order to guide more efficient and sustainable land use and development patterns. This is a relatively new concept with many lessons to learn and share. All states need to work together to market and transfer green infrastructure concepts and technologies.

Maintaining and Diversifying Markets – In the northern New England states where private land ownership is the norm, supporting private forest landowners is critical to the success of "Keeping Forests as Forests." Markets for forest products and ecosystem services are necessary to ensure that landowners can afford to hold and manage their forest land. Local and regional efforts to maintain and enhance markets for both traditional and non-traditional forest products and ecosystem services will be a key consideration in supporting private forest ownership.

Because many forestry issues are regional in nature and do not recognize political boundaries, multi-state approaches are often the most efficient way to address problems. However, multi-state projects can be difficult to coordinate and administer. A regional or federal entity needs to take the lead and find sufficient resources to ensure success. Many of these priority issues were also addressed under Vermont's Landscape Zone Priorities, with implementation at a state scale.

Priority Areas and Issues

Priority areas have been identified within each of the three Vermont landscape zones: Urban, Rural Residential and Rural. This approach draws upon the correlation that land use values, benefits and strategies vary depending upon the degree of parcelization and predominant land use. Multi-state regional areas, identified through a facilitated effort between the New England states and New York, are also listed, along with a list of priority issues that can and may be important throughout the state.

Urban Landscape Zone[4]

Priority Area 1: Communities with less than average urban tree canopy (UTC), and greater than average population and impervious surface area, (Map 39) .

Priority Area 2: Communities with stormwater impaired watersheds within their boundaries, (Map 39).

Priority Area 3: Communities with medium to medium-high UTC ranking not meeting the four base US Forest Service criteria for sustainable urban forestry programs: management plan, professional staffing, ordinances and policies, and advocacy/advisory organizations, (Map 40).

Priority Area 4: Communities with high UTC ranking and high susceptibility risk rating for invasive forest pests, (Map 39, Map 27 and Map 28).

Rural Residential Landscape Zone

Priority Area 5: Riparian areas and wetlands.

Priority Area 6: Rare and sensitive natural communities and habitats for threatened and endangered species.

Priority Area 7: Areas important for the protection of public water supplies, (Map 35).

Priority Area 8: Large forested blocks of land, (Map 10).

Priority Area 9: Forested lands at high risk to insect and disease attack, invasive plant infestation or regeneration failures, (Map 27, Map 28, Map 29 and Map 30).

Priority Area 10: Forest land eligible for UVA enrollment.

Priority Area 11: Forests providing significant wildlife habitats, including travel corridors.

[4] Due to high population density and the small parcel size of the Urban Landscape Zone, assistance in this zone will be targeted at the community/municipal scale.

Rural Landscape Zone

Priority Area 12: Lands identified as important wildlife corridors, feeding areas or wintering areas.

Priority Area 13: Riparian areas and wetlands.

Priority Area 14: Areas important for water source protection and recharge areas, (Map 35 and Map 36).

Priority Area 15: Forest land eligible for UVA enrollment.

Priority Area 16: Forests at risk from invasive or cyclic forest insects, plants and diseases, (Map 27, Map 28, Map 29 and Map 30).

Priority Area 17: Lands important in maintaining Vermont's statewide recreation trail networks.

Priority Area 18: Forest habitats at risk from atmospheric pollution or climate change factors, (Map 24, Map 31 and Map 32).

Multi-State Regional Landscapes

Priority Area 19: Northern Forest Lands, (Map 38).

Priority Area 20: Connecticut River Valley, (Map 38).

Priority Area 21: Taconic Mountains, (Map 38).

Priority Area 22: Lake Champlain Basin, (Map 38).

State and Multi-State Regional Issues

Issue 1: Prevention and control of invasive species.

Issue 2: Protecting water quality.

Issue 3: Maintaining and enhancing forest habitats and diversity.

Issue 4: Promoting sustainable renewable energy and biomass.

Issue 5: Assisting the intergenerational transfer of land.

Issue 6: Promoting green infrastructure.

Issue 7: Maintaining and enhancing forest markets.

Issue 8: Establishing and implementing Urban Tree Canopy (UTC) goals.

Issue 9: Maintaining existing forest cover.

State Forest Resource Assessment

Introduction

The primary objective of the State Forest Resource Assessment is to evaluate current forest conditions and identify priority forest areas and forest related issues for the purpose of focusing state and federal resources. State assessments and resource strategies are elements of State Forest Resources Plans required by the 2008 Farm Bill.

Federal guidance required that assessments be conducted using Geographic Information System (GIS) technology. Vermont relied on numerous sources to gather information spatially and worked with partners both within and outside the state who supplied spatial data used in the Assessment. The Appendix contains a complete package of all the maps referred to in the Assessment.

Desired Future Condition 1: *Biological Diversity*

Conserve biological diversity across all landscapes

Biological diversity encompasses the staggering "complexity of all life at all its levels of organization, from genetic variability within species, to species interactions, to the organization of species in larger landscape units" (Thompson, et al., 2000). Biodiversity is critical for the sustainability of Vermont's forests because it enables ecosystems to respond to external influences, to recover from disturbances and to support important ecological processes. All components of a given ecosystem are tied together in an intricate web, and alterations can have dramatic impacts on the entire system.

Ecological Mapping

Various levels of ecological mapping have been developed in Vermont to help identify areas with similar features. These maps are valuable planning tools to assist in managing Vermont's landscape.

Biophysical regions are large-scale ecological areas of similar climate, geology and vegetation, and human history, generally in units not smaller than 200,000 acres. Eight biophysical regions were identified in Vermont, five of which extend into neighboring states and the Province of Quebec, (Map 4: Biophysical Regions).

***Land Type Associations (*LTA)** are mapped in units between 500 and 10,000 acres. The boundaries are determined by elevation, soils and temperature. The LTA's in Vermont sort out into three broad categories: valley bottoms, mid-mountain slopes and mountain tops, (Map 5: Land Type Associations).

Natural communities are mapped at a small scale ranging from less than an acre in size (vernal pool) to over a thousand acres (northern hardwood matrix forest). In 2000, work in describing Vermont's natural communities was completed and resulted in the publication of *Wetland, Woodland, Wildland - A Guide to the Natural Communities of Vermont*. Natural communities are ranked as to their scarcity and sensitivity and this information is valuable in determining Vermont's priority landscapes in the Assessment. Natural communities are mapped on public land as part of the long-range management process. Certain natural communities of statewide significance are also mapped by consulting foresters for enrollment in Vermont's Use Value Appraisal (UVA) program. An example of state lands mapping of natural communities can be seen on the Groton

State Natural Communities Map:
www.vtfpr.org/lands/groton/2008NaturalCommunities.pdf

Forested Land Area

The area covered by forest in Vermont is shown in Figure 1, covering the time period from 1948 through 2008 (USDA Forest Service Forest Inventory and Analysis, Northern Research Station, 2008). The two categories of measurement used are from the US Forest Service, Forest Inventory and Analysis (FIA) data. The first category, "Forest land," either currently has tree cover or used to have tree cover and is expected to see that cover restored. This category includes otherwise productive forest areas, including wilderness designation, urban forests and natural areas that are not available for harvest. The second category, "Timberland," is productive forest land that is available for harvest. Understandably, the forest land acreage is higher than the timberland figures. Forested acres have been increasing over the second half of the 1900's, (Map 6: Percent Forested and Map 7: Forest Cover Types). It should be noted that timberland acreage can be unavailable for actual timber harvesting due to landowner objectives, topographical constraints and accessibility.

Since the 1997 forest inventory, the trend of increased forested acreage has flattened out and decreased slightly. Any additional acres of forest land are usually attributed to the abandonment of agricultural land. Those acres can have high ecological value as they are often in places where forests are important for wildlife corridors, serve as important portions of watersheds and riparian zones, and align with the Urban Landscape Zone. Forest inventory data also fails to capture all the urban forest resources that do not meet stocking levels, but these trees, riparian corridors and small forest patches contribute to the ecological, social and economic sustainability of Vermont's communities. Statewide, urban land in Vermont has an estimated 5.5 million trees and a tree canopy cover of 38% (Nowak, et al., 2008).

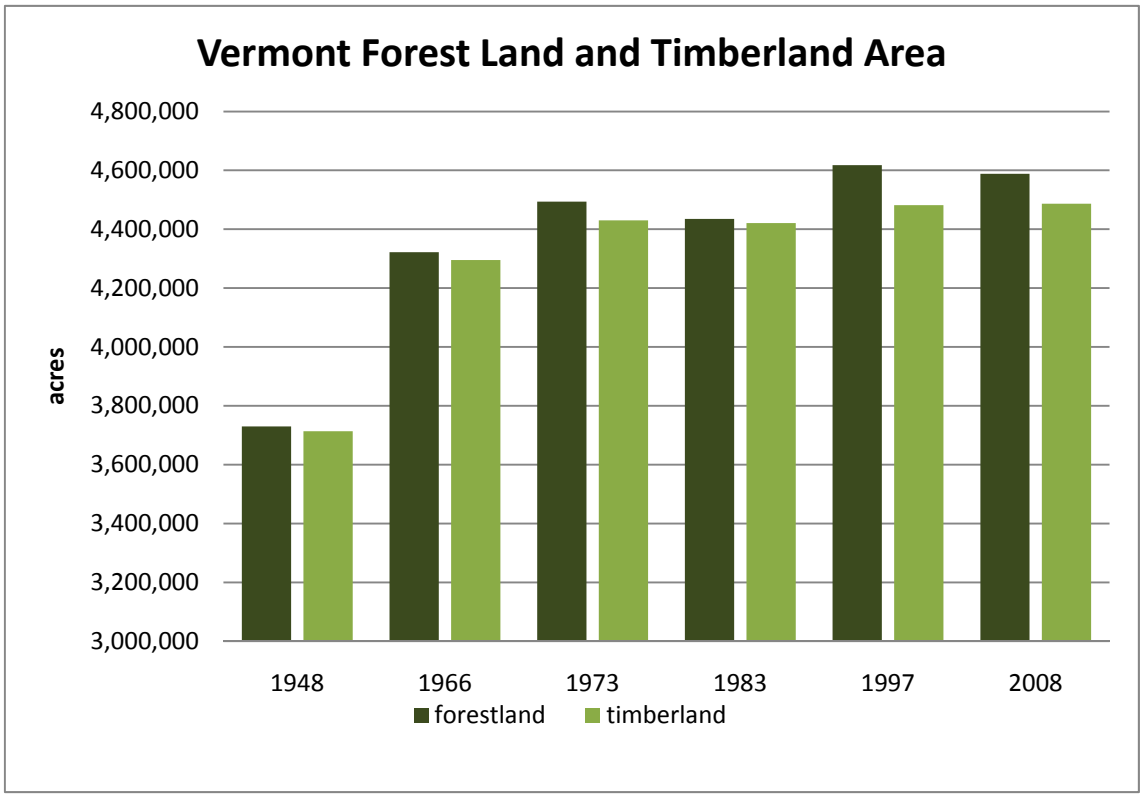


Figure 1: Vermont Forest Land and Timberland. *Source:* National Forest Inventory and Analysis Database, 2008

Species Composition and Distribution

The distribution of tree species in Vermont was obtained from FIA, (Map 8: Distributions of Vermont Tree Species), (National Forest Inventory and Analysis Database, 2008). This information is modeled from the 1996 inventory and shows the relative importance of 12 tree species in Vermont.

The following two charts (Figure 2 and Figure 3) show species composition as percent of total trees for softwoods and hardwoods, respectively. All softwood species show an overall decrease in percent of total trees between 1983 and 2008 except for fir. The decrease in hemlock, cedar, white pine and spruce was less than 2%. Balsam fir increased 1% between 1983 and 2008.

For hardwoods, the relative proportion of sugar maple decreased in both periods (1983-1997 and 1997-2008) from 19% to 16%. The proportion of beech increased from 11% to 16%. Changes in other species have ranged from 1-2%.

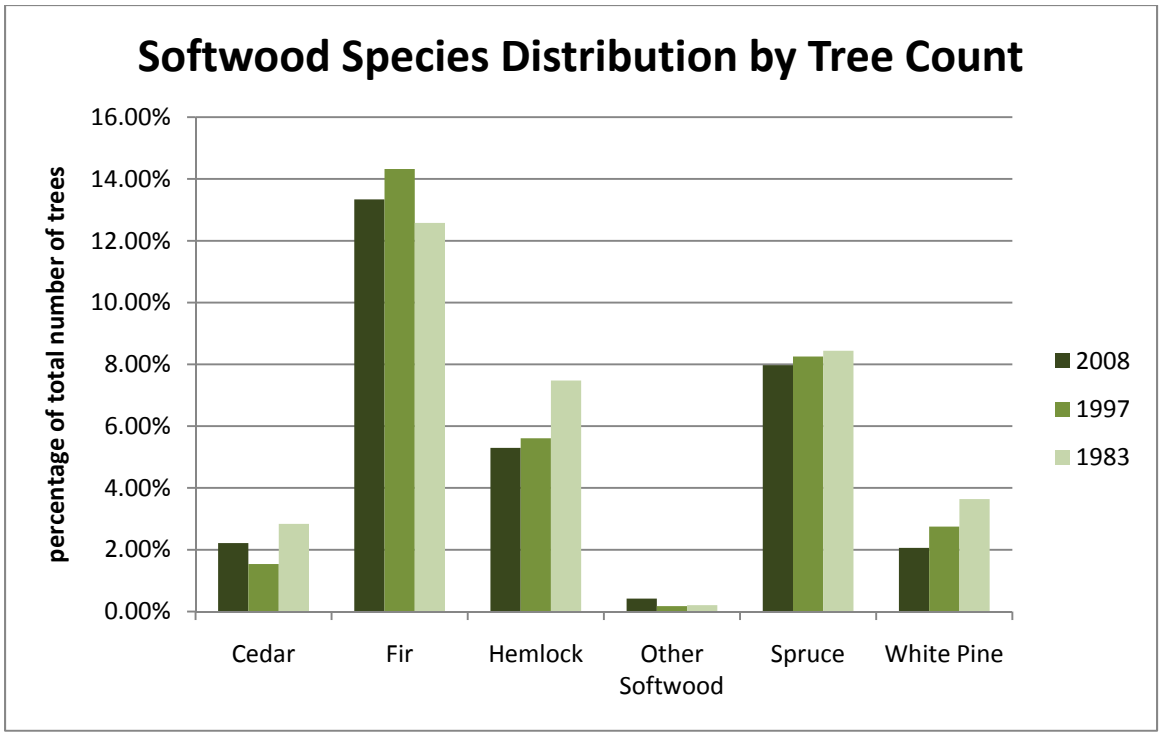


Figure 2: Softwood Species Distribution by Tree Count. *Source:* National Forest Inventory and Analysis Database, 2008

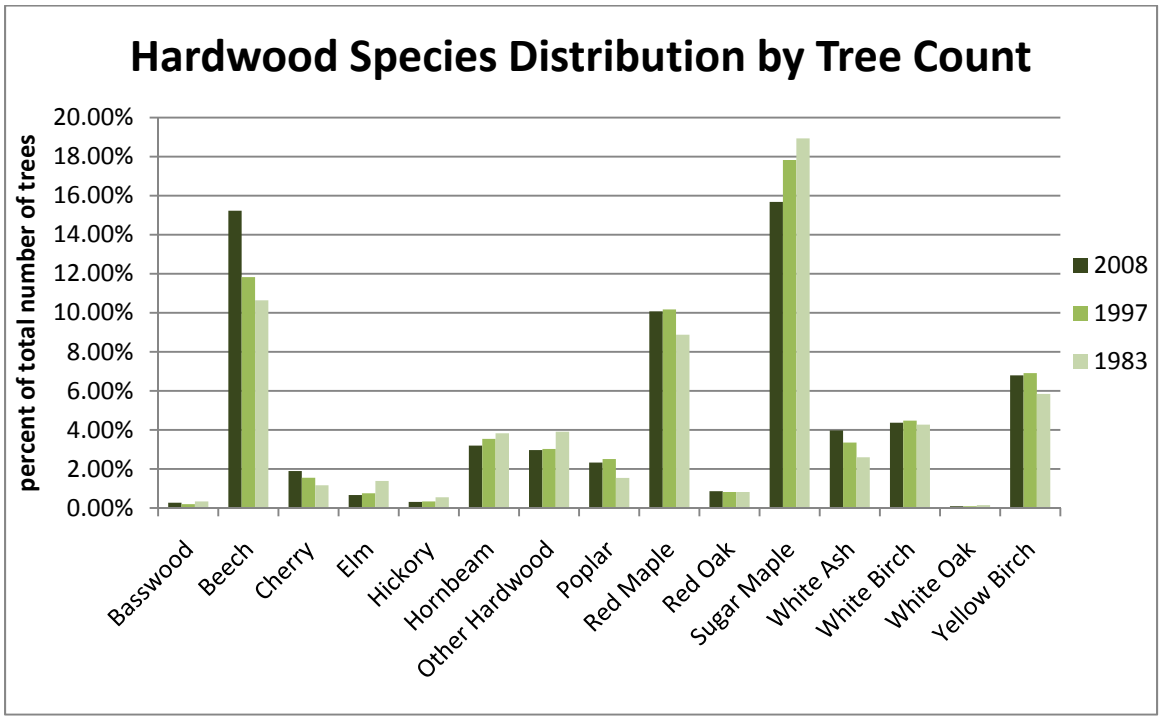


Figure 3: Hardwood Species Distribution by Tree Count. *Source:* National Forest Inventory and Analysis Database, 2008

In the past, changes in tree species composition were monitored to keep track of the relative proportions of selected commercially preferred and less preferred species. Sugar and red maple are examples of the former and latter. It is now recognized that biodiversity is a major component in maintaining healthy, resilient forests and is connected to forest sustainability, wildlife habitat quality and forest health. In the coming years, it will become more important to monitor overall species composition to detect forest changes due to climate change and other disturbances. In order for this monitoring to be useful, better techniques for interpreting the existing data will be needed.

Habitats

The abundance of forested land in Vermont provides a wide variety of habitat for wildlife. In 2001, the US Congress required each state to produce a Wildlife Action Plan to help direct federal funding and, in 2005, Vermont's Wildlife Action Plan was completed. In Vermont, the emphasis is on a statewide, science based all-species conservation strategy. Detailed species assessment reports were prepared for 144 vertebrates and 191 invertebrates, which included descriptions of the habitats and landscapes used by these species. Twenty-two major categories of threats to wildlife were identified; the top six threats were habitat loss, impacts of roads and trails, pollutants and sedimentation, invasive species, climate change, and data gaps and information needs (Vermont Department of Fish and Wildlife, 2005) .

The Vermont Wildlife Action Plan is not represented spatially. The plan addresses important wildlife habitats but does not identify where they are located. The Vermont Department of Fish and Wildlife (FW) recently undertook several projects to identify important wildlife travel corridors and large habitat blocks, and evaluate the threats to these wildlife habitats. An interactive map is also being developed by FW to assist natural resource professionals. Unfortunately, these products are not available at this time. However, we worked closely with FW to ensure that strategies, when developed, promote both our plan and the Vermont Wildlife Action Plan.

Over the past 20 years, FW has produced several specific species suitable habitat maps that range from deer wintering habitat to Indiana bat habitat. Because these maps are produced for use at the local scale, they were not included in the series of Assessment maps. However, they are very important for use in identifying locally important priority areas. Natural heritage sites have been carefully documented and mapped but the locations are not widely publicized in an effort to protect them. In addition, most are

small and not capable of being mapped on a statewide scale. For more information visit: www.vtfishandwildlife.com/wildlife_nongame.cfm

Common Flora and Fauna

One of the most important roles of our forest land is as a matrix that supports a wide array of common flora and fauna. As an example, Vermont's forests provide breeding habitat to over 70 different neo-tropical birds. However, many common species are in decline or threatened by a variety of causes. Population levels of wood thrush and the Canada warbler have declined at rates of 63% and 55% respectively (Audubon Vermont, 2010). In addition, there are emerging threats to some of our common trees; hemlocks are threatened by hemlock woolly adelgid, ash by emerald ash borer and butternuts by Butternut canker disease, to name a few. Regardless of whether these threats are caused by specific exotic pests moving into the state or are the results of forest conversion outside of Vermont, how we manage these common species will greatly influence the future. Better monitoring of Vermont's common flora and fauna, and developing strategies such as maintaining forest blocks across the landscape, will help preserve our diverse forest ecosystem. Landowner outreach including Audubon Vermont's 'Foresters for the Birds' program, along with habitat assessments and educational efforts to increase public awareness on threats to flora and fauna are important.

Population Growth, Parcelization, Fragmentation and Development

Vermont remains the second least populated state in the country and the third most rural (U.S. Census Bureau, 2000). In 2000, 608,827 residents lived in Vermont, an increase of nearly 8.2% from 1990. It is predicted that the population growth rate is likely to increase and that by 2030, Vermont will have an additional one hundred thousand residents, (Map 9: Projected Housing Density Change). The urban areas of the state will need to continue to plan for an accelerated population growth. In addition, many of the rural communities, especially in the Rural Residential Landscape Zone, will be confronted with population increases and the pressures associated with rapid development. Grand Isle County or the towns more commonly referred to as the Champlain Islands, are experiencing population growth. The county's population at the 2000 census increased 30% from 1990. Other rural areas are facing similar population growth rates. Lamoille County experienced an increase of 18% from 1990 to 2000.

Planning for the additional one hundred thousand Vermont residents depends on where they will reside. Since 2000, there have been approximately 1,400 new households

annually or an average annual growth rate of 0.6% (Vermont Housing Finance Agency, 2009). The percentage of developed land also continues to increase as a result of increased residential and commercial development, and construction of second homes which is mostly related to the ski industry.

Eighty six percent (3.8 million acres) of Vermont's forests are privately-owned, leaving 14% owned by public entities (USDA Forest Service Forest Inventory and Analysis, Northern Research Station, 2008). From 1983-2008, the number of forest landowners owning 1-9 acres more than doubled resulting in increased land parcelization. Land parcelization presents a significant challenge to Vermont's natural resource managers who strive to accommodate individual landowner's management objectives and values while trying to manage beyond property boundaries to maintain the overall sustainability of the region's entire forest ecosystem. Roads, impervious surfaces and scattered developments are further fragmenting forests and creating smaller forest patches. The combination of parcelization and fragmentation poses a serious threat to the overall ecological integrity of Vermont's native landscape.

Land conversion of farms and forests from 1982 to 1997 reveals an increase of 74,800 acres of land developed for building sites (Bolduc, et al., 2008). Of these, an estimated 31%, or 23,450 acres, came from agricultural land, whereas an estimated 68%, or nearly 51,000 acres, came from forest land. Estimates from the Natural Resource Conservation Service's Natural Resource Inventory reveal that developed land in Vermont, not including land in rural transportation uses, increased from 158,900 acres in 1982 to about 254,200 acres by 2003, a significant increase of 60% over two decades; far outpacing Vermont's population growth (Figure 4). With pressures from development, parcelization and fragmentation, the management of Vermont's forests for long-term sustainability will become progressively more challenging and necessary.

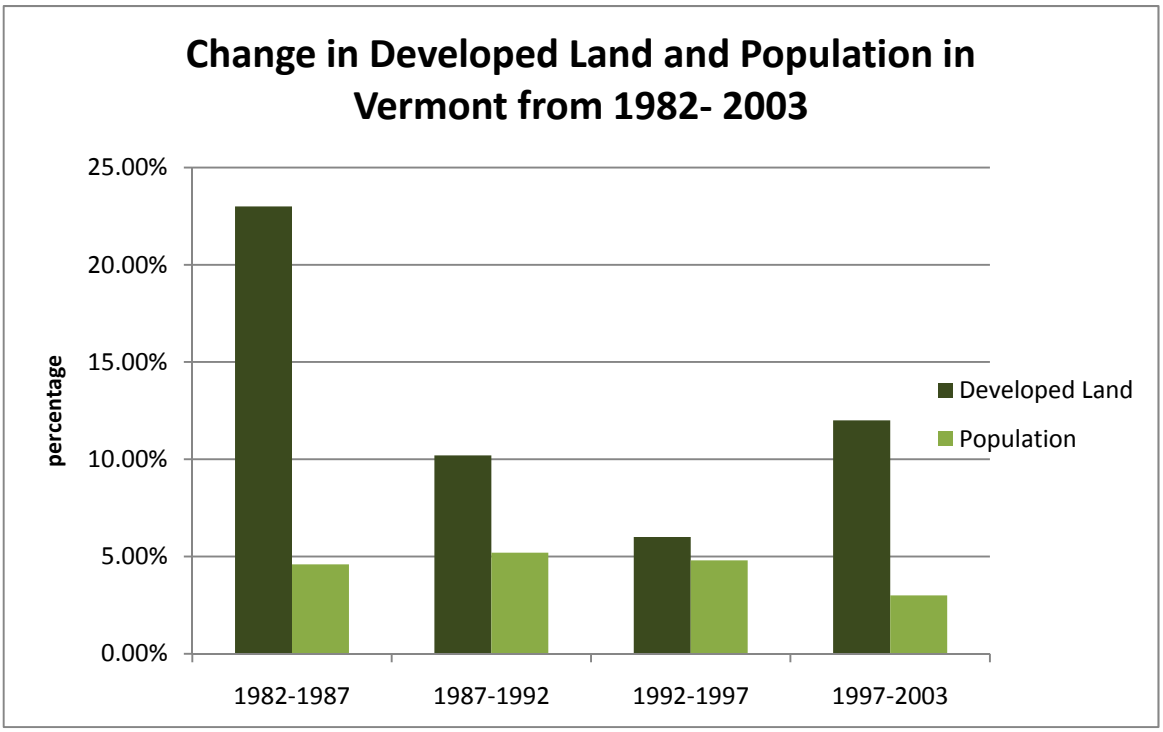


Figure 4: Change in Developed Land and Population in Vermont from 1982 - 2003. *Source: Bolduc & Kessel. Vermont in Transition, 2008*

Forest Legacy and Land Conservation

The Forest Legacy Program (FLP) is a partnership between participating states and the US Forest Service to identify and protect environmentally important privately-owned forest lands from conversion to non-forest uses. FLP acquisitions focus on conservation easements or fee purchases.

The Forest Legacy Program requires each state to select areas where the most valuable forest lands face the greatest threats (Forest Legacy Areas), determine criteria for selecting projects for possible funding, and solicit and receive input from the public. The FLP also requires an Assessment of Need (AON) to focus federal investment on priority landscapes. In Vermont, three resource values were identified in the assessment; in descending order of importance they include: size of forest block, productivity of soils and ecological resource richness, (Map 10: Forest Legacy: Analysis of Need - DRAFT), (Vermont Department of Forests, Parks and Recreation, 2009). It should be noted that these criteria were very similar to the ones used to produce the Department of Fish and Wildlife's Habitat Blocks Ranked for Conservation Value. These two separate analysis projects identified many of the same high priority landscapes and are a key component in our Assessment and identification of priority landscapes.

The AON map connects all of the scattered high scoring areas into one zone. The map represents the area in which potential Forest Legacy parcels should be considered for conservation, and encompasses 2.6 million acres or about 44% of Vermont's total acreage. Although strategies promoting land conservation are identified, Vermont's AON, pending final approval from the US Forest Service, will be the guiding document for Vermont's Forest Legacy Program.

In 2009, Vermont had a total of 368,000 acres under conservation easements. Reports from the University of Vermont Spatial Analysis Laboratory indicate that approximately 1.3 million acres or 22% of Vermont's landscape is under some form of permanent conservation, (Map 11: Conserved Lands and Map 12: Percent of Land Area Conserved by Town). This represents a success story in the efforts to keep forests forested. With success comes responsibility, however, easement monitoring and stewardship assistance have become an increased burden on personnel time. Cooperation with local conservation organizations will be critical in the coming years to ensure legal obligations are being met.

Use Value Appraisal

Concerns that high property taxes were forcing forest and agricultural landowners to sell to developers, Vermont passed the Use Value Appraisal Law in 1978. Now commonly referred to as UVA or Current Use, the program allows landowners with 25 or more acres to apply for a reduction in the assessed value of their eligible acreage from an assessment based on the standard fair market value, to an assessment based on the "use value," or a value based on what the land could produce for timber or agriculture. In exchange for this tax stabilization, forest landowners agree not to develop the land and submit a forest management plan to the state for approval.

The program has proven very popular and, as of 2009, there are over 11,000 forest land parcels enrolled. This represents over 1.5 million acres or about 30% of all the eligible private forest land in Vermont, (Map 13: Percent of Town Acres Enrolled in UVA, Map 14: UVA Average Parcel Size by Town, and Map 15: Forest UVA Parcels for Washington County).

Recent amendments to Vermont's UVA program allow for enrollment of significant habitats without the primary purpose of timber production. The criteria used to identify significant wildlife habitats include, but are not limited to: deer wintering areas; concentrated areas of American beech, oak and cherry; bat habitats; vernal pools; wildlife corridors; heron rookeries; and certain natural communities of statewide

significance. Identifying and mapping the habitats will primarily be conducted by resource professionals with assistance from agency staff. Forest management in these areas is based on Agency guidelines.

Use Value Appraisal is Vermont's most successful forestry and conservation program in its ability to maintain a large percentage of forest lands forested. This program also compliments the goals and purpose of the Forest Stewardship Program. The Department's county foresters spend roughly 75% of their time administering both programs. The UVA program may serve as the basis for Vermont's landscape scale stewardship planning in the future. Maintaining support for state policy that recognizes the importance of Vermont's 'working landscape' will be critical as the state continues to weather economic downturns.

Desired Future Condition 2: *Forest Health and Productivity*

Maintain and enhance forest ecosystem health and productivity

Healthy forests are ecosystems that possess the long-term capacity for self-renewal of their ecological productivity, diversity and complexity (ANR Sustainable Forestry Task Force Report, October, 2007). Normal climate variability and natural disturbances may disrupt this capacity in the short-term. Changes outside the historical range may threaten long-term forest health. The ecological health of forests is essential if they are to meet social needs.

Forest Productivity

The productive capacity of forest soils, (Map 16: Forest Productivity) limits ecological productivity, and may determine forest recovery or decline, (Map 23: Areas of Forest Decline Over 10 Years), following disturbance. Forest soils are a product of mineralogy, soil evolution and land use history. Acid deposition further modifies soil characteristics. Forest management techniques can influence future site productivity, (Map 24: Forest Sensitivity to Acid Deposition).

Sulfur and nitrogen deposition continue to exceed the critical acidity load for 30% of Vermont forest land (Miller, E. 2005). Soil nutrients, retained organic matter, sequestered carbon, (Map 25: Above Ground Forest Carbon (Live Tree) and Map 26: Forest Soil Organic Carbon) should be considerations in determining sustainable harvesting levels. Acceptable management practices for logging, and other watershed protection strategies, help conserve soil productivity and reduce erosion. Work is necessary to develop management recommendations that consider nutrient depletion when harvesting on acid sensitive sites and monitoring changes in forest soil nutrition. Affected states, including Vermont, need to continue to press for reduction in acid forming emissions.

One measure of forest productivity is the volume of trees, expressed as cubic feet, board feet, cords or tons. The FIA data uses cubic foot volume as a consistent, product-neutral measure that can be converted to other product specific measures. Volume, or inventory, is meaningful when looked at in combination with net growth. Tree volume in Vermont has increased, with the highest rate of increase occurring between 1983 and 1997 (Figure 5). The change from 1997 to 2008, though still positive, shows a slower rate of increase. The rate of change can vary depending on a variety of factors, including weather, past volumes harvested, forest age and relative density of trees.

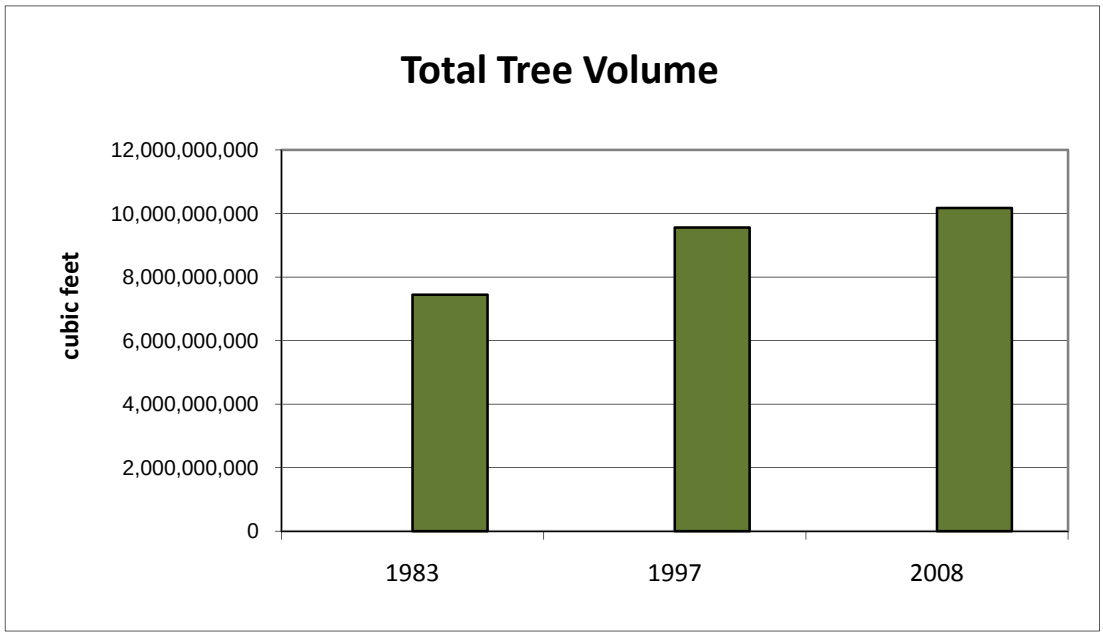


Figure 5: Total Tree Volume. *Source:* National Forest Inventory and Analysis Database, 2008

Tree Mortality Volume (Figure 6) is presented over the same time period using a different volume scale. Volume lost to mortality was roughly 5,000,000 cubic feet between 1983 and 1997. That measure increased to nearly 10,000,000 between 1997 and 2008. This may account for the decline in net growth. "Removals" is a measurement term that includes the volume of timber harvested annually and the volume of trees on land categorized as unavailable for harvest (USDA Forest Service Forest Inventory and Analysis, Northern Research Station, 2008). Decreases in the available land base can occur due to land use change resulting from development, conversion to agriculture or from change in land use designation such as wilderness or natural area. Figure 7 summarizes the annual removals by volume for the time period from 1983 to 2008. The data does not allow a distinction to be made between volume of harvest and volume associated with land use change. This change is similar between 1983 to 1997 and 1997 to 2008. Priorities include working with partners to identify locations, characteristics

and probable cause(s) for increased mortality observed in the current FIA data, especially as it relates to future forest productivity.

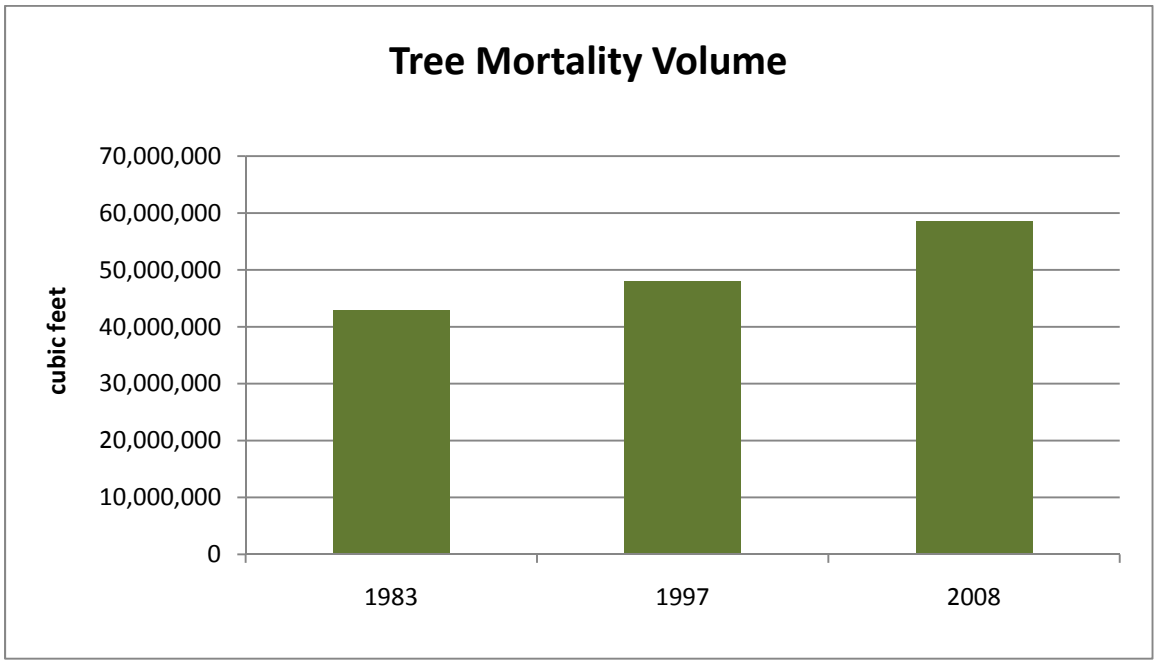


Figure 6: Tree Mortality Volume. *Source:* National Forest Inventory and Analysis Database, 2008

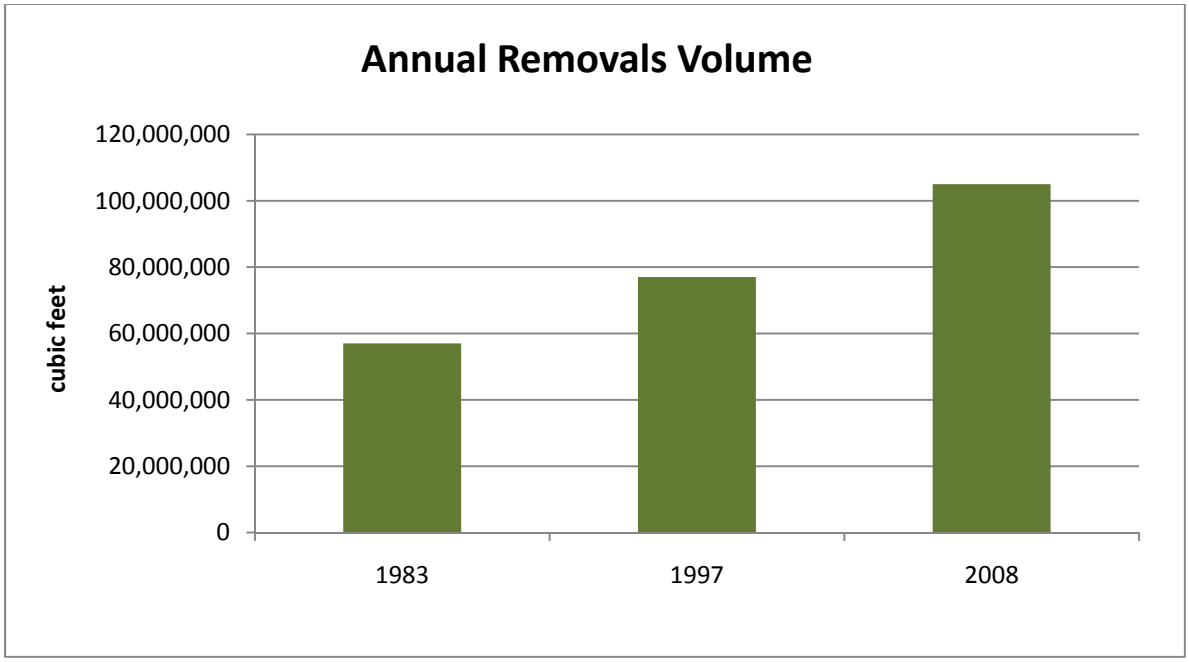


Figure 7. Annual Removals Volume. *Source:* National Forest Inventory and Analysis Database, 2008

Non-Native Invasive Species

Non-native invasive species cause irreversible impacts on tree health and biodiversity. Three non-native insects which currently threaten Vermont are the emerald ash borer, Asian longhorned beetle and hemlock wooly adelgid. Areas of potential risk have been mapped based on locations of host species and likelihood of insect introductions (USDA Forest Service, Forest Health Technology Enterprise Team, 2010), (Map 27: Susceptibility Potential for Emerald Ash Borer, Map 28: Susceptibility Potential for Asian Longhorned Beetle, and Map 29: Susceptibility Potential for Hemlock Woolly Adelgid). Only hemlock wooly adelgid is currently present in the state; emerald ash borer and Asian longhorned beetle are within fifty miles of Vermont's border. Over half of the trees in Vermont are host species of one of these three insects. A number of exotic insects and diseases, such as beech bark disease, butternut canker and gypsy moth, are already established statewide. Other potentially threatening pests have been introduced to the continent, but have not been found in Vermont. Conserving genetic diversity within native host species increases potential resiliency in light of invasive pests and other anthropogenic stresses. To address non-native invasive species, we need to prevent new introductions through common pathways such as firewood, nursery stock and other non-local products; prepare for new invasions by planning and preserving germplasm; work with partners to develop tools for detecting, identifying, evaluating and managing invasive pests; and respond rapidly if infestations are detected.

Invasive plants in Vermont have also been shown to play a role in regeneration failures of native tree species, (Map 30: Non-native Invasive Plant Occurrence). They successfully out-compete native plants and aggressively respond to disturbances that open forest canopies or disturb soils (Collier & Vankat; Fagen & Peart, 2004; and Webster, Jenkins & Jose, 2006). Invasive plant growth can lead to loss of native flora and fauna. We have little comprehensive information on the distribution of terrestrial invasives in forest land. There are limited means for control, but many landowners are looking for both technical and financial support.

Climate Change

Climate change may have gradual and long-term impacts on forests (U.S. Geological Survey, 2009). It is probable that the changing climate will affect biodiversity, productivity, forest structure and ecosystem services. There will be initial short-term impacts as forests try to adapt to environmental change and long-term impacts as a new forest evolves. Currently, scientists in Vermont are detecting changes in forest species distribution in high elevation spruce-fir forests (Beckage, et al., 2008). Predicting future

changes is complex, making it difficult to develop new forest management strategies. Planning for climate change will require working with local and regional partners. A short-term goal will be an assessment of forest vulnerability and the development of a climate change adaptation plan. Mapping locations that might serve as potential refugia for spruce-fir forests will assist discussions on possible management strategies that prolong the survival of these forest ecosystems in Vermont, (Map 31: Potential Climate Change Refugia).

Acid Deposition

Acid deposition threats to forest sustainability are generally accepted. Although impacts can affect all parts of the forest system (i.e., increased winter injury on red spruce trees), soil productivity is of particular concern to forest health. Acid deposition can increase leaching of valuable soil nutrients making them unavailable for tree growth (Driscoll, Lawrence, et al., 2001). Of particular concern are calcium depletion and aluminum toxicity; both have been shown to adversely affect sugar maple growth (Long, et al., 2009). A recent international project requested by the New England Governors and Eastern Canadian Premiers mapped forest sensitivity to acid deposition providing a tool to develop Vermont-specific guidelines to inform forest planning (Miller, E., 2005), (Map 24: Forest Sensitivity to Acid Deposition).

Natural Disturbances

Natural disturbances, such as native insects and diseases and extreme weather events, have always had impacts on forest dynamics, forest products and services. Human activities can directly affect forest health and sustainability, including planting monoculture or certain harvesting practices. Inadvertent introductions of exotic pests or creation of habitat that favors undesirable species are also disturbance issues for forests on different levels. Managing for natural disturbances includes continuing monitoring activities to map disturbances annually, (Map 23: Areas of Forest Decline Over 10 Years) diagnosing forest health problems, surveying changes to native and exotic pest populations, working with partners to develop management tools that reduce long-term forest health impacts, and providing education and outreach to landowners, foresters and other groups to promote forest health goals.

Forest Health Management

Forest health management involves a variety of strategies. Appropriate response focuses resources where they are most likely to protect forest health. This depends on access to information from local observations, other regions, historical records and

current research; it requires collaboration between government organizations, landowners and other groups; and it requires evaluation of potential impact. Because forest health issues don't recognize political boundaries, a coordinated regional approach is critical to address them on a landscape scale. The most effective strategies to protect priority landscapes may be undertaken far from these priority areas.

Flexibility is needed to respond to emerging situations that threaten forest health. Monitoring changes in tree crown condition may be early indicators of unidentified damage causing agents. Diagnostic follow-up may require specialized skills, including entomology and pathology expertise. More information is needed to guide management strategies in many areas. Integrated methods can be supplemented by direct control, such as suppression and eradication, when necessary, to prevent imminent damage.

Wildland fire does not pose a serious threat to Vermont forests, but the state does have fire seasons in the spring and fall, (Map 32: Vermont Wildfire Risk Assessment).The majority of wildland fires occurs in April and May, and usually involves small grass fires that escape homeowner's control.

While forest fires have historically impacted forest health and productivity, the discontinuance of clearing and burning forest land for conversion to agriculture and improvements in fire suppression technology have greatly reduced the occurrence of large wildland fires. Wildland fire concern in recent times has focused on risk to homes nestled in wooded areas (Wildland-Urban Interface). On a small scale, the State of Vermont uses prescribed fire to maintain early successional forest habitats and promote regeneration of species favoring disturbance on state-owned lands.

The Division of Forests works with local Regional Planning Commissions to implement Community Wildfire Protection Plans (CWPP's). Two plans have been prepared to date, (Map 33: Community Wildfire Protection Plans in the Northeast). These plans assist certain towns in identifying and mitigating wildland fire risk within their community. One of the methods of reducing wildland fire risk is through prescribed burning to reduce hazardous fuels. The Division of Forests provides formal prescribed burn plans and on-site support when the prescribed burns are accomplished.

The Division administers the Town Forest Fire Warden program which requires all towns within the state to have an appointed fire warden. Division fire personnel develop and provide training for municipal and volunteer fire fighters in wildland fire suppression.

The Division's fire personnel are not first responders to wildland fires, but are available on request for on-site technical support and specialized equipment. Our forest fire program focuses on prevention, fire awareness and fire fighter safety. In cooperation with the National Weather Service, the Division provides fire weather data to federal, state and local officials.

Vermont does contribute to regional and national fire control efforts. Annually, state personnel attend fireline safety refreshers and work capacity tests to become qualified wildland firefighters. Vermont is a member of the Northeastern Forest Fire Protection Commission (COMPACT) and each year qualified fire fighters are available to respond to interagency requests for support.

Desired Future Condition 3: *Forest Products and Ecosystem Services*

Maintain and enhance forest contribution to ecosystem services

Vermont's forests have ecological, economical and social value. Benefits people obtain from forest ecosystems help sustain and fulfill human life. Vermont's working landscape supports a forest products industry estimated to generate over 1 billion dollars annually in the state and helps private forest landowners cover ownership costs. Our clean air and water are in large part due to the filtering effects of trees above and below ground. Forests provide food, fresh water, fuel and fiber. They support functions such as maintaining soil fertility, cycling of nutrients (carbon sequestration & air pollution filtering) and providing habitat for plant and animal life. Forests reduce the effects from climate (drought), weather (flooding, strong winds) and insect and disease problems (natural controls). Forests represent a part of our lives that we value for education, aesthetics, rural forest-based economy, recreation, tourism and cultural heritage.

Wood for Energy

As regional pulpwood demand declined over the past decade, opportunities for marketing lower grade wood became increasingly difficult. The one bright spot during this period has been an increase in demand for wood for energy. A recent study of residential firewood consumption shows an increase from 275,000 cords per year in 1997 to 315,000 cords per year in 2008 (Vermont Department of Forests, Parks and Recreation and Department of Public Service, 2009). Increase in demand for wood fuel has also come from growth in institutional and commercial use. Between 1983 and 2008, 35 schools in Vermont converted from fossil fuels to the use of wood chips for heating. These successes, combined with the high cost of alternative fuels, have many speculating that there will be a substantial increase in the demand for wood fuel in the next 10 years.

Some projections have been made regarding the sustainability of Vermont's forest to meet this new anticipated demand for wood for energy (Biomass Energy Resource Center). These projections range from as little as 400,000 green tons (over and above current harvest levels) to as much as 2.4 million green tons per year. It needs to be noted that estimates like these are intended to address energy development potential more from a statewide policy perspective rather than offering detailed information suited to project development.

The capacity to sustain increased wood supply for energy production may be additionally constrained by external factors including the number of loggers employed, limits on combustion emissions and the capacity of Vermont's forests to grow fiber.

Wood Product Manufacturing

Vermont's forest products economy is not just a local economy, but part of a regional and world economy. Vermont sawlogs and other primary forest products such as wood chips are sold and processed all over the northeast, and secondary wood products from Vermont are sold around the world.

As of the beginning of 2010, the sawmill industry in Vermont is entering its eighth consecutive year of economic challenges. This contributed to a slow but steady decline in the number of sawmills operating in the state. A major decline in construction as well as a major recession starting in late 2008 has caused further contraction in this sector. From 2004 through the middle of 2007, poor logging weather limited log supply while keeping log prices high.

Figure 8 shows the number of commercial sawmills operating in Vermont from 1983 to 2008 (Vermont Department of Forests, Parks and Recreation, 2008). As the number of sawmills decline, there is a point where the number becomes too small to adequately provide the market diversity that foresters and landowners require to be able to market forest products. A broad range of forest products business sizes and specialties is key to exemplary forest management.

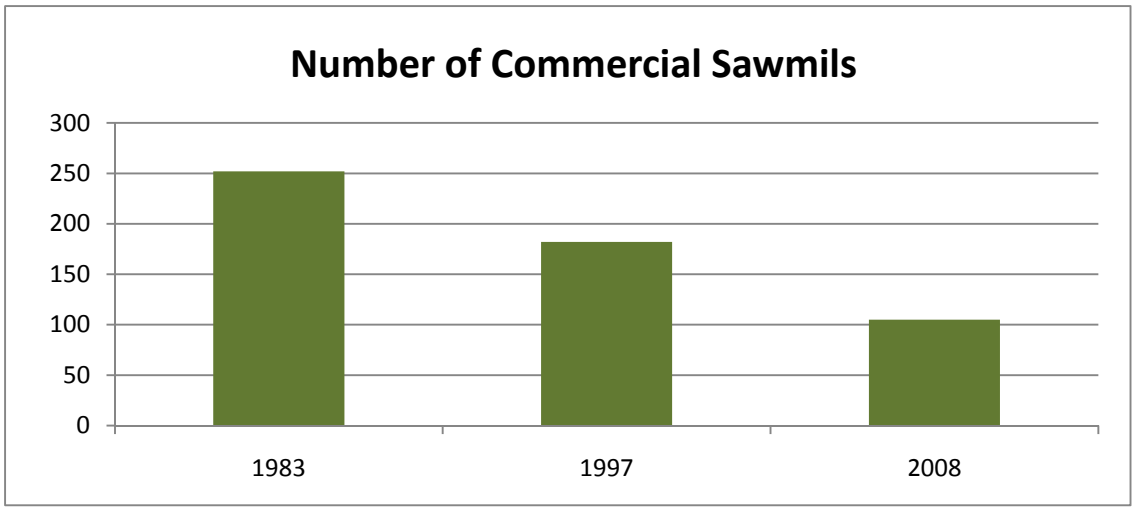


Figure 8. Number of Commercial Sawmills. *Source: Vermont Department of Forests, Parks and Recreation, Division of Forests, Annual Harvest Report, 2008.*

It is widely recognized that the further the distance sawlogs must travel to a mill, the lower diversity in species and quality accepted by the mills. This makes sense since the cost of harvesting and transporting logs is the same regardless of quality of any given log. As transport distance goes up, so does cost, reducing the profit margin for marginal species and grades. An adequate number of sawmills throughout a region plays a very important role in supporting quality forest management in Vermont's diverse forest.

Vermont's secondary wood product manufacturing sector has also declined in the past few years. The closure of Vermont Tubbs and Ethan Allen's furniture manufacturing operations have been the most significant large-scale company losses, while several others have scaled back production substantially. Over the past ten years, the manufacturing sector has developed two associations and an industry-wide marketing council in partnership with the Division of Forests. Vermont WoodNet and Vermont Wood Manufacturing Association now represent a majority of wood product companies. The Guild of Vermont Furniture Makers adds the high-end of furniture to the list. These three associations collaborate with Vermont Woodlands Association, Vermont Forest Products Association and Consulting Foresters Association of Vermont, through the Vermont Wood Products Marketing Council, to promote the Vermont brand and to work on specific marketing projects.

Timber Harvesting

Most forest land in Vermont is privately-owned by individual landowners who occasionally sell their standing trees to the forest products industry as "stumpage." In 2008, an estimated total sale of stumpage earned by Vermont landowners was about $22 million (Vermont Current Use Advisory Board, 2010).

Figure 9 provides information on the harvest of forest products in Vermont during 2008, the most recent year for which data are available. During that year, 89.2 million board feet (178,464 cords) of hardwood sawlogs and 83.9 million board feet (167,742 cords) of softwood sawlogs were harvested from Vermont's forests, totaling 173.1 million board feet (346,206 cords). Vermont's pulpwood harvest was 145,218 cords. The biomass chip harvest totaled 231,817 green tons (92,727 cords). These chips are used primarily as fuel in wood to energy facilities but are also in demand for wood pellet production, composting and mulch.

Figure 9 also shows export, import and processed volumes for the respective products. Import and export volumes for residential firewood are not known, though some trade in each direction is recognized. All pulpwood harvested in Vermont is shipped out of

state for further processing into pulp and paper. Although the state is host to paper making businesses, none have pulpwood conversion capability. The historic condition of higher volume of softwood log exports than hardwood is shown, as is the reverse relationship for log imports.

Residential firewood harvest volume is estimated to be 315,000 cords for the year. This is the largest volume by product category. It is important to note that it is often the case that a single tree yields a variety of products: sawlog, pulpwood, biomass chips or firewood. In future harvest trend assessments, it may be useful to express volumes in tons rather than cords. Although a cord is generally understandable to a general audience, measuring harvest and inventory in tons can provide a more accurate accounting, especially if more whole tree utilization occurs.

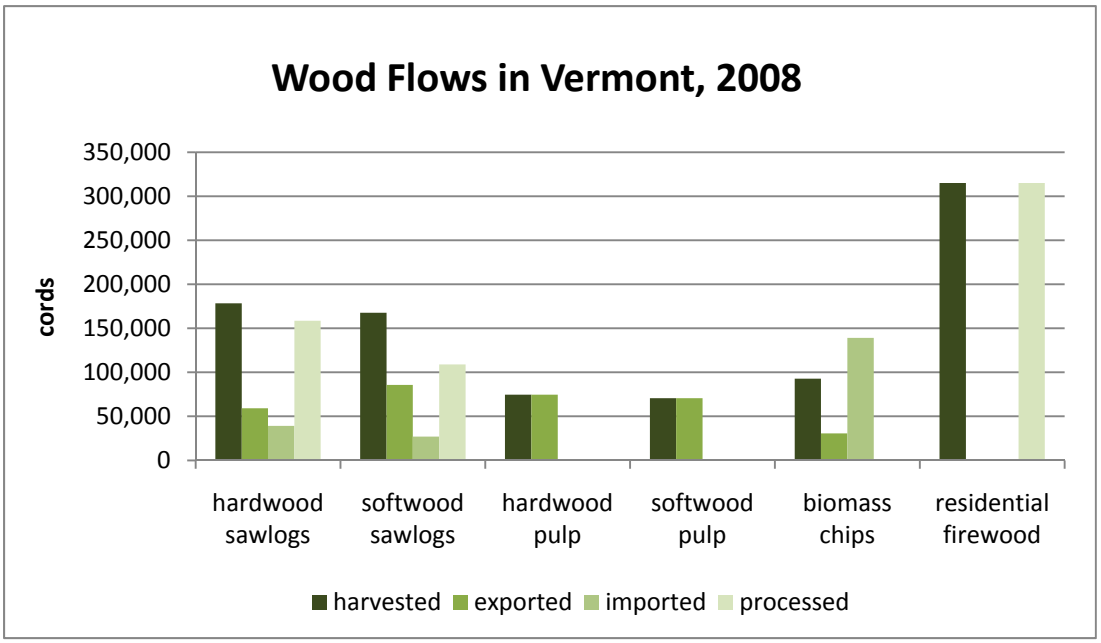


Figure 9. Wood Flows in Vermont, 2008. *Source: Vermont Department of Forests, Parks and Recreation, Division of Forests, Annual Harvest Report, 2008.*

Cultural and Non-Timber Forest Products

Interest in non-timber forest products is increasing rapidly. These include medicinal and herbal products such as ginseng and golden seal; decorative products including holiday greenery and vines; edible products such as shitake mushrooms and various nuts; to specialty products such as brown ash for basketry. Forest landowners should be encouraged to manage these resources sustainably.

Vermont is the nation's leading maple syrup producer with operations distributed around the state in small family businesses with a handful of large operations (New

England Agriculture Statistics, 2009). Vermont maple syrup production in 2009 was 920,000 gallons, the highest production since 1944, and an increase of 30% from 2008. Modern sugarmakers rely upon vacuum and tubing sap distribution, reverse osmosis sugar concentration and super-efficient evaporation systems. 'Sugaring season' still remains a quintessential Vermont tradition.

The Vermont Christmas tree industry has also been increasing production. In 2007, 168,206 trees were harvested, an 11% increase from 2002 (USDA Agricultural Statistics Service). An estimated 255 tree farmers benefit from growing Christmas trees in the state.

Recreation

Forest-based outdoor recreation is a major component of Vermont's economy. Popular winter outdoor sports include downhill and cross-country skiing, snowmobiling, dog sledding, ice climbing and snowshoeing. In 2007-2008, Vermont logged over 4.3 million skier visits (Vermont Ski Area Association, 2009), among the highest in the US. Vermont has 35,000 registered snowmobilers in 138 clubs around the state (Vermont Association of Snowmobile Travelers). Summer and fall activities include hiking, camping, hunting and fishing, mountain biking, bird watching and geocaching.

Outdoor recreation continues to grow in popularity in Vermont. Over the past 20 years, there has been a shift in the types of outdoor activities people are participating in, away from pursuits such as hiking, towards more specialized activities. There is an increased demand for trails to meet the wide variety of activities. Public land managers are finding it difficult to maintain recreational trails and structures due to increased and diversified use. Maintaining Vermont's recreational opportunities will be a challenge for the future.

Statewide trail organizations such as the Green Mountain Club, Vermont Association of Snow Travelers, the Vermont Mountain Bike Association, Vermont Horse Council, Catamount Trail Association and the Vermont All-Terrain Sportsmen's Association work with state and federal agencies to coordinate and promote their activities. Their primary purpose is to manage a statewide trail network, which relies on the use of both public and private lands. Maintained recreational trails in Vermont total over 8,100 miles (Vermont Department of Forests, Parks and Recreation, 2010) and only made possible by the cooperation between federal, state and private landowners

Wildlife-based activities including hunting, fishing, trapping, viewing and photography are important cultural elements of life in Vermont. Based on a 2001 survey of residents involved in wildlife-based activities, Vermont ranked second only to Alaska in participation by residents. A national survey conducted by the US Fish and Wildlife Service in 2006 found that 41% of Vermont residents hunted. The US Fish and Wildlife Service estimated in 2006 that wildlife-based activities contributed over $383 million dollars to Vermont's economy. This same survey indicates that over 545,000 residents and non-residents participated in wildlife-based activities in 2006. Clearly, fish and wildlife resources, and the lands and waters that support them, are critically important to the quality of life for those who live in and visit Vermont.

The Vermont Fish and Wildlife Department owns 85 Wildlife Management Areas, numerous riparian properties and over 170 fishing/boating access areas statewide totaling nearly 130,000 acres. These lands play a critical role in the Department's ability to achieve its mission and in supporting the public's quality of life in terms of maintaining connections to the land. Management of these areas emphasizes the conservation of fish and wildlife, and their habitats, and the properties provide important public access and opportunities for hunting, fishing, trapping and other fish and wildlife-based activities.

Carbon Sequestration and Storage

Climate change represents both a challenge to forest sustainability and an opportunity to highlight the value of forests and forest products in providing temporary mitigation of greenhouse gas emissions through carbon sequestration and storage. Vermont's greenhouse gas emissions in 2005 were estimated at 9.07 MMtCO2e[5] (Governor's Commission on Climate Change Report, October, 2007). Carbon storage in forests and wood products was estimated at 9.0 MMTCO2e, which contributes significantly to reduce total greenhouse gas emissions. To reduce Vermont's emissions to 1990 levels by 2028 requires an increasing role for forest sequestration. Protection of forests with high carbon storage, (Map 25: Above Ground Carbon (Live Tree) and Map 26 Forest Soil Carbon), and implementation of forest management strategies that increase carbon sequestration and storage in forests with low carbon are needed to reach 1990 emissions targets. Yet pressures from forest conversions, harvesting for wood energy, infestations of non-native destructive pests or changes in private or public land management can alter the extent of forest mitigation of greenhouse gases. In urban forests, increasing canopy cover not only expands sequestration possibilities, but can

[5] Million metric tons carbon dioxide equivalent.

change air temperatures leading to reduced energy needs for heating and cooling buildings (Carbon Storage and Sequestation by Urban Trees in the USA, 2002).

Air Quality

It is well established that tree and forest canopies cleanse air by filtering air borne pollutants. Trees sequester many pollutants from the atmosphere, including nitrogen dioxide (NO_2), sulfur dioxide (SO_2), ozone (O_3), carbon monoxide (CO) and particulate matter of ten microns or less (PM_{10}). Air pollution removal by urban forests in one city, Washington DC, was calculated at 878,000 pounds per year (Nowak & Crane, 2002). At the same time, the release of volatile organic compounds from trees can influence the production of ground level ozone. Air quality monitoring shows that Vermont has made improvements in sulfur dioxide pollution and the state is currently within national standards for criteria pollutants. However, our state is still affected by poor visibility on summer days, acid deposition on sensitive forests, ozone injury on sensitive plants and increasing atmospheric carbon dioxide (U.S. Environmental Protection Agency). Currently, Vermont towns and cities are working to increase urban canopy cover to reduce stormwater flow, mediate air temperatures, mitigate carbon emissions and filter air pollutants.

Water Quality

Impaired Waters from Nonpoint Source Pollution

Pursuant to Section 303(d) of the federal Clean Water Act, seventeen of Vermont's waterways are listed as "impaired" primarily due to urban stormwater runoff, (Map 39: Priority Areas for Urban Tree Canopy Enhancements). Three watersheds are impaired due to ski area development. Once a waterway is listed as impaired, it is scheduled for the development of a Total Maximum Daily Load (TMDL) target. A TMDL is an EPA approved target which attempts to limit and allocate discharge loads among the various dischargers to impaired waters in order to assure attainment with water quality standards.

The Lake Champlain phosphorus TMDL was prepared jointly by Vermont and New York, and was finalized in 2002. Nonpoint Source Pollution (NPS) contributes about 90% of the total phosphorus load to Lake Champlain (Lake Champlain Basin Program, 2010). A 2007 report for the Lake Champlain Basin Program (LCBP) estimated the contribution of NPS phosphorus from major land use types: Agricultural Land (38%), Urban and Other Developed Land (46%) and Forest Land (15% phosphorus). The TMDL included a Vermont-specific implementation plan describing a suite of action items and attendant

funding needs to reduce the phosphorus load delivered annually to Lake Champlain. The TMDL led to Vermont's Clean and Clear Action Plan in 2003. The plan's goal is to accelerate the reduction of phosphorus pollution in Lake Champlain and reducing related pollutants in waters statewide (Vermont Clean and Clear Plan, 2009).

While millions of dollars have been spent on the clean-up effort of Lake Champlain over the past 20 years, positive results have been slow in coming. The Lake Champlain Basin encompasses the towns with the highest growth rates in Vermont and with this development comes more stormwater runoff and reduced forest canopy cover, (Map 34: Vermont Major Watersheds). Improving green infrastructure and low impact development practices will help to minimize stormwater runoff. The Champlain Basin also has the highest percentage of farm land in the state which is another major contributor to phosphorous pollution. Unlike the growth in urban areas, the trend in agriculture is declining as Vermont farms are struggling to stay in business. With this decline in agriculture, comes an opportunity to restore forested riparian areas, wetlands and bottomland hardwoods in the Champlain Basin. A major challenge that Vermonters face in protecting these ecologically valuable lands is the threat of land conversion for development.

A 2007 report for the LCBP estimated that 8-15% of the total nonpoint source phosphorus load delivered to Lake Champlain comes from forest land. Work continues statewide to accelerate the implementation of practices to protect water quality during timber harvesting operations. Stream crossings used during harvesting have been a particular area of concern in eliminating discharges of sediment. With forests covering more than 4.6 million acres and representing 78% of Vermont's total land base (National Forest Inventory and Analysis Database, 2008), forestry continues to be an area worthy of efforts to reduce sedimentation and phosphorus loading to state waters.

Public Drinking Water Supplies

In order to protect public drinking water supplies, public water systems[6] in Vermont are required to develop Source Protection Areas (SPAs), (Map 35: Water Source Protection Areas) and subsequently, Source Protection Plans after the State Water Supply Division has approved the SPA. State rules regulate activities within SPAs. SPAs are considered in the development of forest management plans on both state and federal land in Vermont and with statewide emergency response plans.

[6] Vermont Public Water System is a water supply that provides drinking water to the public and has at least 15 service connections or serves an average of at least 25 individuals for at least 60 days a year (Vermont Department of Environmental Conservation Water Supply Rule, 2005).

In Vermont, public water supply systems are divided into three categories: surface water, ground water and ground water under the influence of surface water. Drinking water sources are identified and the corresponding recharge area or source protection area is mapped or delineated. Table 3 depicts the number of users of public water systems by water source (Vermont Department of Environmental Conservation, Water Supply, 2010). A public water system has the potential of serving a customer more than once. For example, someone may get water at home from the same public water system that serves that person's workplace. Both public and private sources of groundwater (wells and springs) serve the majority of Vermont households. However, public surface water systems tend to serve major urban areas where populations are concentrated and multiple uses are occurring; domestic, industrial and commercial.

Vermont Public Water Supply Systems

Water Source	Population Total	Number of Systems	Source Protection Area (Acres)
Ground Water Under Influence of Surface Water	1,845	6	176,206
Ground Water	219,532	563	
Surface Water	248,355	39	240,082
Totals	469,732	608	416,288

Table 3. Vermont Public Water Supply Systems. *Source: Vermont Department of Environmental Conservation, Water Supply, 2010*

Historically, Vermonters have benefited from an abundance of high-quality drinking water. Protection of this resource is becoming more difficult as development pressure and competing land uses threaten both water quantity and quality, (Map 36: Land Classification of Vermont Headwaters). The price that Vermonters pay for protection of drinking water sources continues to rise (Agency of Natural Resouces, 2002).

Private Forests and Drinking Water

The US Forest Service, State and Private Forestry publication "Forests, Water and People," identified private forests in the Northeast and Midwest that are most important for drinking water supply and most in need of protection from development pressure (Barnes, et al., 2009). Nine layers of GIS data were combined to produce four indices of watershed importance for drinking water supplies and the need for private

forest management to protect those supplies. The four indices are: mean ability to produce clean water for watersheds; important watersheds for drinking water; private forests in important watersheds; and development pressure on private forests in important watersheds.

The results of the analysis indicate that Vermont ranks high in the ability to produce clean water. The analysis also indicates that forest land serves an important role in providing clean drinking water to consumers. Looking to the future, the major area of concern for Vermont is projected development pressure in the Winooski and Middle Connecticut watersheds, and the potential impact that it could have on water quality and water supply, (Map 37: Development Pressure on Private Forests in Drinking Water Supply Watersheds). These watersheds deserve the highest priority for protection and conservation to protect public drinking water supplies. Maintaining forest cover by assisting private forest landowners in meeting their management objectives and stabilizing land ownership costs are critical to maintaining Vermont's clean water.

Stream Crossings on Logging Jobs

The US Forest Service - Northeastern Area, Best Management Practices (BMP) Protocol: "Monitoring Implementation and Effectiveness for Protection of Water Resources" was conducted in Vermont in 2004. The assessment revealed that culverts, along with ford crossings, are the most commonly used structures to cross streams. Of the 94 stream crossings examined, fords were installed on 23 crossings; culverts on 26 crossings; and bridges on 14 crossings. Stream crossing structures had been removed on the other 31 stream crossings (Figure 10). Thirty-seven percent showed evidence of sedimentation. Characteristics of improperly installed crossings include: passage barriers for fish, amphibians and macro invertebrates; bank instability from inadequate compaction and excessive slopes; alteration of stream flow; inadequate maintenance; and premature failure often proceeded by prolonged erosion.

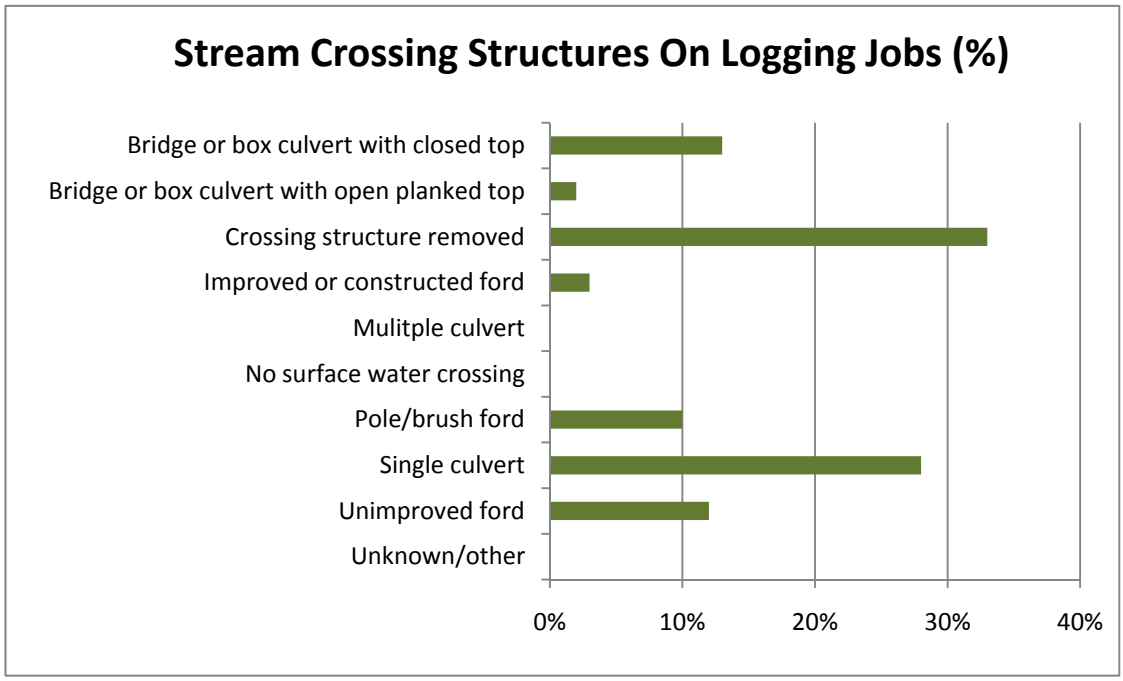


Figure 10. Stream Crossing Structures on Logging Jobs (n=94). *Source: The U.S. Forest Service - Northeastern Area, Best Management Practices (BMP) Protocol*

The results of that assessment revealed that stream crossing practices on logging operations is still an area of concern for sedimentation as well as aquatic organism passage. In addressing this concern, the Division has launched the *Portable Skidder Bridge Initiative* to promote better stream crossing practices. The goals of this initiative are to: inform loggers, landowners and foresters about the benefits of using portable skidder bridges through information and education; offer programs that provide loggers access to portable skidder bridges; and assist businesses in the fabrication and sale of portable skidder bridges.

Riparian Buffers

Much of the land adjacent to streams and rivers in Vermont has been deforested over the past 200 years to accommodate the development of roads and railways, residential and commercial development and agriculture. The loss of streamside trees and shrubs – also called riparian buffers – has resulted in lasting ecological and economical impacts throughout Vermont's watersheds. Healthy, well-vegetated riparian buffers are essential to good water quality and aquatic habitat. The re-establishment of buffers through planting trees is one of the most effective ways to improve water quality, reduce erosion and flood damage, and maintain healthy fisheries in our waterways.

For the past several years, a major effort has been underway in Vermont to restore forested buffers along rivers and streams. Much of this work has been targeted on agricultural land and is being accomplished through the Conservation Reserve

Enhancement Program (CREP). At the close of the 2009 fiscal year, total CREP enrollment reached 2,162.7 acres, which can be estimated to cover over 357 miles of streambank assuming average buffer widths of 25´ for grass and 35´ for trees (Vermont Clean and Clear Plan, 2009).

The Vermont League of Cities and Towns (VLCT) Water Quality Coordinator works with towns primarily in the Lake Champlain Basin providing technical assistance to support water quality enhancements to town zoning regulations and other municipal ordinances. In 2007, the VLCT developed a Model Riparian Buffer Ordinance for towns to consider in zoning for water quality protection. Based on an evaluation of the most current town zoning or other applicable regulations, 29 out of the 136 towns in the Lake Champlain Basin are considered to have fully met criteria for having "good" local regulations in place for water quality protection.

Riparian Buffer Guidelines were developed and adopted by the Agency of Natural Resources in 2005. The guidelines direct Agency staff in developing buffer recommendations for Vermont's land use law (Act 250) jurisdictional projects and other processes using the applicable Act 250 criteria, including public utility projects that are reviewed and permitted by the Vermont Public Service Board.

Buffer protection on timber harvesting operations is provided for in Vermont's "Acceptable Management Practices (AMP) for Maintaining Water Quality on Logging Jobs." Specific AMP guidelines regarding stream buffers call for keeping logging equipment 25 feet away from streams to prevent ground disturbance. Within buffer strips, only light thinning or selection harvests are suggested to provide shade for minimizing stream temperature fluctuations. Buffer width is determined by percent slope, starting at 50 feet for slopes up to 10 percent.

Desired Future Condition 4: *Land Ethic*

Maintain and enhance an ethic of respect for the land, sustainable use and exemplary management

Land ethic is appreciating the value of the land and understanding and accepting responsibility for our impacts on a finite, non-renewable resource. To help foster a responsible land ethic, we must first know who has an impact on the land and in what ways: who owns, lives and uses Vermont's forest? We need to understand the programs, both public and private, that are developed to encourage public awareness, involvement and stewardship activities. Measuring how effective our collective efforts are on cultivating a strong land ethic will help us to evaluate and adapt. And finally, we, the Division of Forests, must serve as role models on the lands that we manage.

Ownership of Forest Land

Public lands in Vermont falls into three broad categories: federal, state and municipal. As of 2009, Vermont's 892,894 total acres of public land includes 445,933 acres of federal lands, 396,296 acres of state lands and 50,665 acres of municipal lands, (Figure 11 and Map 11: Conserved Lands).

Figure 11. Forest Land Ownership in Vermont. Source: *Vermont Department of Forests, Parks and Recreation*

While there are significant differences in the management styles and land management emphasis, all public lands share similar concerns. The trend best summarizing the concerns is an increasing public demand at a time of decreasing management resources. In Vermont, the public has taken an interest in how public lands are managed. There is a desire to have a say in how resources are allocated with assurance that management is sustainable. Concerns relating to timber harvesting on federal land are commonplace. Allocating financial and personnel resources is perhaps the land manager's biggest challenge. Traditional interests such as timber harvesting are perceived to be competing with a wilderness experience, wildlife and water advocates, and recreational users.

Timber management still remains a priority on public lands. Approximately 2 million board feet and 3.9 million board feet are harvested annually from state land and the Green Mountain National Forest respectively. These volumes are below the 'allowable cut'[7] and 'allowable sale quantity (ASQ)'[8] from both agencies in terms of sustainability, and reflect resource constraints of public land managers and competing interests from public land users.

The Agency of Natural Resources (ANR) holds easements on over 140,000 acres of privately-managed forest land. ANR is responsible for monitoring the properties to assure continued compliance with the easement conditions and provide stewardship assistance to the landowners. Many of these landowners are relatively new to the full suite of stewardship opportunities and nearly all of them are new to managing land with conservation easements. All can benefit from training aimed at understanding easement restrictions and learning about sustainable forest management practices.

Private woodland ownership currently covers 3,864,000 acres of the total acres of timberland in the state (86%) (USDA Forest Service Forest Inventory and Analysis, Northern Research Station, 2008). Although this is the largest single category of ownership, private landowners don't represent a consensus of management goals, objectives or practices.

[7] The maximum volume of wood that can be harvested from a specified area within a specified time period. An amount up to this volume is allowed to be harvested through a legal or statutory authority which has enforcement capability.

[8] The amount of timber that may be sold within a certain time period from an area of suitable land.

The number of parcels has grown from 61,900 parcels in 1983 to 88,000 in 2008, (Figure 12) (USDA Forest Service Forest Inventory and Analysis, Northern Research Station, 2008). This is a rate of increase of a little over 1,000 new parcels per year. It is clearly shown in Figure 12 that the growth occurred in the smallest parcel size categories: 1-9 acres and 10-19 acres. The total acres in private ownership have declined from 3,992,600 acres in 1983 to 3,864,000 in 2006.

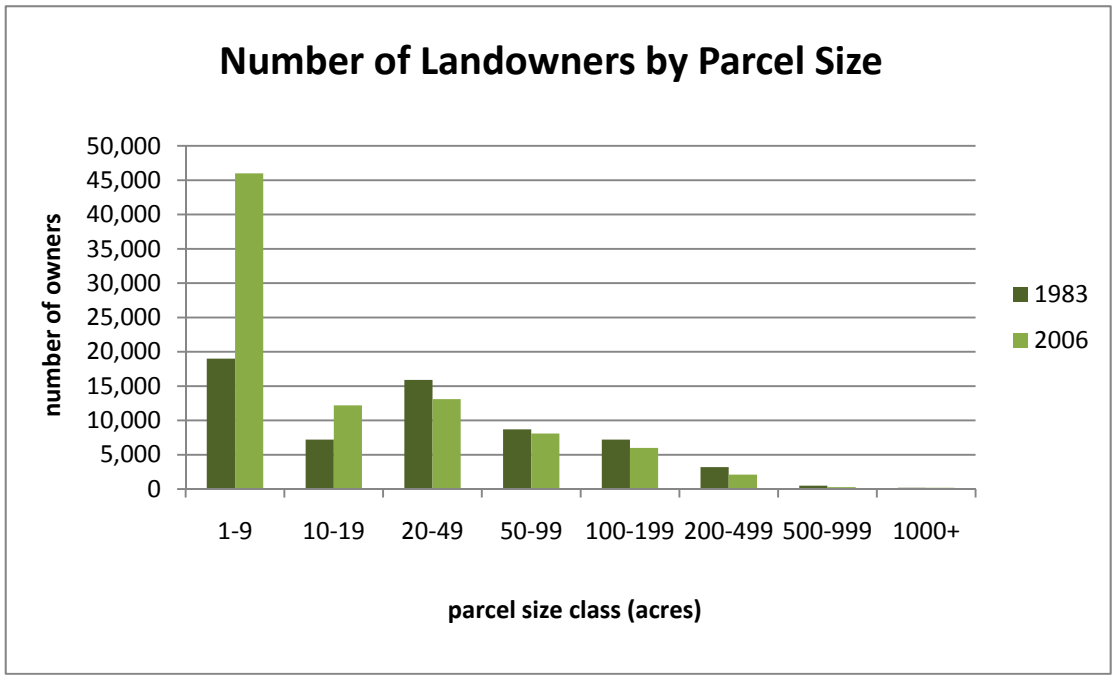


Figure 12. Number of Landowners by Parcel Size. *Source: National Wood Owner Survey Database, USDA Forest Service Inventory and Analysis, 2008*

The private ownership of land in our society is often associated with personal wealth rather than with responsibility or opportunity for provision of ecological benefits or services for communities. Many of our tax and local service policies fail to value natural landscapes. They tend to treat forest woodlot management activities as a hobby, providing clear disincentives to maintaining large blocks of private forest land for timber, watershed or habitat values. This is especially true near developing areas where water quality, outdoor recreation and habitat linkages are needed the most. Vermont is fortunate to have the UVA tax program that allows managed forest land to be taxed at a rate comparable to the value of its use rather than the value if it were developed.

The forest products economy is primarily dependent on private forest land for its fiber supply. A constantly changing and aging landowner population and increasing subdivision of forested lands are current issues that affect wood availability. As woodlot parcels get subdivided, the resulting smaller parcels make it more difficult to profitably harvest timber on a parcel by parcel basis. As the landowner population changes, there

is an increasing number of owners who are not aware of the role that timber harvesting plays in forest stewardship.

Intergenerational transfer of forest land presents a particular challenge to both forest landowners and forest managers and planners. Without prior estate plans, properties transferred after the death of an owner are often taxed at high levels. Many people leave property to more than one heir, which spreads out the tax burden, but often forces the sale or subdivision of assets to achieve equity in transfer and to pay the taxes.

Even when an elderly forest landowner wishes to pass on an intact forest, it is difficult if the heir has no time for, interest in or does not live near the managed property. Most attorneys practicing estate law do not present clients with options regarding land protection unless it is specifically requested by the client. A study done in 2004 found that forest landowners aged 65 or older controlled 44% of the nation's forests. Nearly half of this forest was controlled by an owner 75 years of age or older (Butler & Leatherberry, 2004). In 1983, 25% of private woodland owners were under 45 years old, 53% were between the ages of 45 and 64, and 22% were older than 65. In 2008, 16% of landowners were under 45, 59% were between 45 and 64, and 25% were older than 65 (USDA Forest Service Forest Inventory and Analysis, Northern Research Station, 2008). Given the amount of forest land that may turn over in the next decade, lands controlled by older forest landowners are at the highest risk for development unless legal planning for transfer has been done in advance.

State Lands Management

The Vermont Agency of Natural Resources owns approximately 350,000 acres of land in 200 towns across Vermont with parcels ranging in size from several acres to several thousand acres. These lands are managed for a variety of conservation purposes including recreation, wildlife habitat, timber management and flood water flowage.

Lands owned by the Departments of Forests, Parks and Recreation and Fish and Wildlife are managed under the guidance of long-range management plans. The development of these comprehensive plans is based on multi-resource inventory data including an assessment of natural communities, wildlife habitat, timber, recreation and historic resources. The ANR Land Management Classification is applied to shape and communicate the implementation of management activities for the planning period. Each planning effort includes public outreach. Long-range management plans may address just a single state forest or wildlife management area, or may be several parcels combined into a management unit.

Timber and vegetation management contributes to the maintenance and enhancement of biodiversity; production of a variety of forest products at a sustainable level; improvement of forest health conditions; management of quality habitat; enhancement of scenic beauty; control of invasive exotic species; and the demonstration of sound forest management practices.

Regeneration of Vermont's forests generally occurs naturally as a result of the timber management process. As trees are removed and gaps created, new trees grow from on-site seed sources. Planting, while part of Vermont's early forest history, is not common practice following harvest and generally only occurs to meet very specific objectives (e.g. enhancement of sensitive natural communities, restoration of riparian buffers). Pilot projects to facilitate adaptation to climate change suggest that alternate forest regeneration methods may need to be considered in the future.

The Department of Forests, Parks and Recreation has sold personal road-side firewood lots on state forest lands since the 1970's. A limited number of firewood lots are made available by a lottery system in each region of the state. Demand fluctuates with the price of fuel. Over the past two years, the Division of Forests has been partnering with the Vermont Agency of Human Resources in a program referred to as the Wood Warms Initiative to supply firewood from state timber sales to low income Vermonters.

State lands are owned and managed to meet a variety of goals and objectives and are seldom managed to maximize any one goal. As such, timber growth exceeds harvest. It is expected that scheduled harvests from state lands will increase over the next few years as state budget constraints direct more utilization of forest receipts for management activities.

State land has supported an active timber management program for many years that has contributed to local, state and regional economies. Other activities occurring on state land also contribute economically including hiking, tourism, hunting, fishing, trapping, snowmobiling and cross-country skiing.

Federal Lands Management

Green Mountain National Forest

The Green Mountain National Forest (GMNF), established is 1932, encompasses more than 400,000 acres in southwestern and central Vermont, forming the largest contiguous public land area in the state. In 2006, the Forest Service completed the

Green Mountain Land and Resource Management Plan which describes the role of the GMNF in managing for multiple-use purposes. Although the Forest Service will continue to manage these lands for multiple-use purposes, they will strive to emphasize the following uses and interests seeking to provide benefits for people today, with an eye towards coming trends so as to maintain options and opportunities for future generations: conducting management activities in a manner that perpetuates an abundance of clean water and the maintenance of productive soils; assuring lands are well suited to trail-based activities in backcountry settings; enhancing wildlife and plant habitat conditions; focusing on producing high-quality, high-value forest products; actively contributing towards sustaining the character of Vermont's rural landscape, fostering vibrant local communities and economies; serving as a model of ecological and science-based forest stewardship; and playing an increasingly important educational role (Green Mountain Land and Resource Management Plan, 2006).

Activities that are guided by the 2006 Forest Plan have impacts to both state and private forest lands within the region. The traditional Forest Service role of managing the Green Mountain National Forest for multiple–use and other purposes compliments many of the stewardship goals created by the Department of Forests, Parks and Recreation for state and private forest land in Vermont.

The Department worked closely with the Green Mountain National Forest staff to support development of the 2006 Forest Plan and will continue to partner with the Forest Service with plan implementation by: actively participating in environmental assessments for management activities throughout the forest, cooperating with the Forest Service on land acquisition within the purchase boundary and occasionally assisting with management activities on the national forest land when mutually beneficial to both organizations.

Silvio O. Conte Fish and Wildlife Refuge

In 1991, Congress passed the Silvio O. Conte National Fish and Wildlife Refuge Act. The act authorized the U.S. Fish and Wildlife Service (FWS) to establish a national fish and wildlife refuge to protect the diversity and abundance of native species within the Connecticut River watershed. In 1997, Champion International Corporation announced that it would sell approximately 132,000 acres of land in Essex County, Vermont. A nonprofit conservation organization, The Conservation Fund, successfully bid on the property and subsequently passed it along to agencies and a timber company. Because the Nulhegan Basin was identified as a Special Focus Area for the Refuge, the FWS was offered ownership of 26,000 acres within the Basin. The purchase of this area by the

FWS in 1999 marked the establishment of the Nulhegan Basin Division of the Silvio O. Conte National Fish and Wildlife Refuge. The Vermont Agency of Natural Resources acquired about 22,000 acres adjacent to the Basin to form the West Mountain Wildlife Management Area. Essex Timber Company (a private timber company) purchased the remaining 84,000 acres that surrounds the federal and state properties, subject to protective easements that restrict future development and encourage sound and sustainable forestry practices. The combination of ownerships and easements on the 132,000 acres will provide long-term conservation of important wetland and upland wildlife habitats as well as preserve traditional uses of the land.

The Department of Forests, Parks and Recreation has worked as a partner with FWS on the Silvio O. Conte Refuge. The Department is interested in continuing to develop a working partnership through the Silvio O. Conte Comprehensive Conservation Plan that is presently being developed.

Marsh-Billings-Rockefeller National Historical Park

In 1992, the Marsh-Billings-Rockefeller National Historical Park was created by an act of Congress after being donated by Laurance and Mary Rockefeller. It is administered by National Park Service as a national historical park. The Rockefeller estate and 650 acres of forest land known as the Mount Tom Forest was the boyhood home of George Perkins Marsh, one of America's first conservationists and later home of Fredrick Billings, conservationist, railroad builder, philanthropist and pioneer in reforestation and scientific farm management.

Since its creation, the Park's educational projects and activities have enhanced and enriched public discussion about land and cultural stewardship in the region. The forest management plan prepared for the Mount Tom Forest and implemented by Park staff has demonstrated how commonly held public values are enhanced by forest stewardship. It also compliments the Division's vision of encouraging high quality stewardship of Vermont's privately-owned natural resources by managing forests for sustainable use, providing opportunities for compatible outdoor recreation, and furnishing natural resource information and education to the public.

Public Awareness and Technical Assistance

The core of Vermont's forest stewardship efforts for the past five decades has been the 'County Forester Program.' Arguably the best known state employees in our rural counties, the County Forester (CF) has always been the point of contact for cost-share

information, Use Value Appraisal tax advice/application, and assistance on a variety of forestry issues for landowners and consulting foresters. The CF is conveniently located within the region and available for field days and garden clubs, as well as landowner workshops and field inspections. They coordinate with state Fish and Wildlife biologists to provide landowner outreach on habitat management and conservation. Nearly all CF's have served as Tree Farm inspectors and all have some involvement in municipal forestry. The burgeoning responsibilities of Vermont's UVA program have in recent years limited CF's time for outreach, but they remain the principle support for Vermont's private and municipal forests. Other Division staff has strong outreach in specific program areas including urban and community forestry, tree diagnostic services, forest health monitoring, fire protection, wood utilization and watershed forestry.

Public awareness is critical in protecting forest health. Educational campaigns, such as 'Don't Move Firewood' and 'Buy Local,' help prevent the spread of invasive species. An informed public is also our primary early detection tool. All North American infestations of Asian longhorned beetle, and most of emerald ash borer locations, have been detected by members of the public. In Vermont, trained volunteers assist with surveys for hemlock woolly adelgid, invasive plants and other pests. Early detection allows for a broader range of management strategies. In Vermont, hemlock woolly adelgid has been introduced at least four times on live nursery trees. None of these introductions resulted in an established infestation, because, in each case, the insects were detected before they had spread.

Our state urban and community forestry program has a strong outreach component using such tools as an e-newsletter and a listserv. Since much of the planting and care of municipal trees and forests falls on the shoulders of community volunteers, the program has instituted a volunteer training program called Stewardship of the Urban Landscape (SOUL). The program's goal is to educate citizens about the importance of trees and their care, and build a cadre of tree steward leaders in the state who bring to their community the skills needed to manage their forest resources. The program uses innovative technology such as interactive television and an online blackboard classroom to increase participation and engagement. Enrollment is up over 400% since 2005.

The Division makes use of the holiday of Arbor Day to perpetuate a message of the importance of trees. Each year, over 6,000 of Vermont's youth participate in one of the various Arbor Day offerings from receiving a free tree seedling to plant to participating in a fifth grade poster contest about urban forests.

Effective delivery of information and education is linked to accessibility and visibility. An interactive web-based program called "ACORN" was developed at University of Massachusetts to help landowners map their property and keep in touch with local experts, programs and funding opportunities. This project included two counties in southern Vermont and has proven to be an efficient way to deliver a suite of information, particularly to out-of-state landowners. Other avenues to market forest stewardship include a new initiative offering direct peer-to-peer contacts for new landowners; mailings to landowners enrolled in UVA for short, direct messages; television and radio media, limited mostly to public service announcements and events; and print media which has been very successful with our partners such as The Vermont Woodland Association's newsletter and Northern Woodlands Magazine with a circulation of over 15,000 throughout New England.

The most effective tools for outreach are technical service providers who can give landowners advice, training and referrals. Outside of state and federal personnel, consulting foresters, private professionals who earn their living managing forest land for woodland owners, offer a full range of forest and wildlife management services, including inventory, planning, design and oversight of management operations. They frequently represent landowners in timber sales by selecting and marketing timber and other forest products, and overseeing harvests and restoration. They charge for their services, either on a per diem basis or as a percentage of the gross income received from wood product sales which they oversee.

Town Forest Fire Warden System

For over 100 years, the Town Forest Fire Warden system in Vermont has been effective in fire suppression and fire prevention. Town forest fire wardens regulate open burning in their towns through issuing "Permits to Kindle Fire," educating the town residents about safe open burning practices, and maintaining relationships with their local fire departments. Town forest fire wardens are the local points of contact for questions and concerns about open burning, enforcing forest fire laws and promoting the safe and reasonable use of fire by the residents of their towns.

The Division of Forests provides annual training to the Town Forest Fire Wardens to keep them up-to-date on the latest methods, technologies and trends in wildland fire. Town forest fire wardens are equipped by the state with all the materials needed to promote fire prevention and safe burning. By law, they are in charge of wildland fire suppression, and often call upon the state for technical assistance and specialized equipment.

Public Participation

Participation of the public in planning and managing Vermont's forests comes at many different levels. State, federal and municipal governments all have well-developed avenues for notifying and collecting input from citizens on management plans, strategies and directions.

The Division of Forests has two standing advisory committees; the Vermont Urban and Community Forestry Council and the Vermont Forest Stewardship Committee (VFSC). These two groups provide advice and guidance on program development, implementation and accomplishments. The VFSC serves as the ranking body for the Forest Legacy Program, and were engaged during the development and review of the state assessment and resource strategies.

Public Involvement on Public Lands Management

State Lands

Public participation and input is an important component of the long-range management planning process for state land. Planning and state land parcel information is made available to the public in an understandable format at advertised meetings held at convenient times and locations. Public comment is taken as advice and the Agency of Natural Resources makes every effort to include suggestions that are compatible with the ANR and its departments' missions; compatible with ANR lands management principles and goals, and which are fiscally realistic.

The level of public process varies dependent upon several factors including the significance of the resources; legal complexities; potential for user conflicts; parcel size; and degree to which any proposed management results in significant land use change. The public is notified at the beginning of the planning process through a variety of ways (e.g. press releases, Department website, and direct mailings). The number of public meetings scheduled and the degree to which focus groups or other means to gather public comment are used is dependent upon the complexity of the parcel and the issues raised during the planning process. Meeting format also varies and can include open houses and presentations followed by questions and answers. A comment period is extended beyond the public meeting to give ample time for response. In some cases, a summary of comments is compiled and included in the final plan.

Municipal Lands

Vermont has a community governance system based on towns. Each Vermont town that is incorporated has a Selectboard of duly elected citizens with various other town committees and boards that make recommendations on aspects of town business. Many communities have a Conservation Commission, Tree Board or Planning Commission that oversees local ordinances related to street trees and/or the acquisition and management of town forests. There are specific rules for "warning" citizens of various rule changes, public meetings or plan activities. Each town holds a town-wide meeting in March at which time issues are voted on by the populace. There are also opportunities for special meetings on single issues. Citizens can participate at designated meetings or can collect signatures to call meetings. On many issues, citizens can meet directly with the Selectboard to discuss concerns or present petitions. Communities vary in how they engage the public on issues related to forest planning on municipal lands, but Selectboards are contacted by the state about planning and management issues on state-owned lands in their towns and are important stakeholders. Engaging citizens in land use decisions at the local level promotes the understanding of community benefits and a stewardship ethic. By statute, municipalities can request state assistance in the management of the land they own. A significant number of town, municipal and community forests that have active management use the services of the Division's County Foresters.

Federal Lands - Green Mountain National Forest

Public Involvement is important and required in the development of both a Forest Plan and the projects that will implement that Forest Plan. The National Forest Management Act requires the Forest Service to establish procedures to give the federal, state, and local governments and the public adequate notice and an opportunity to comment upon the formulation of Forest Plans. The National Environmental Policy Act regulations (40 CFR 1500.2(d)) require federal agencies to "encourage and facilitate public involvement in decisions which affect the quality of the human environment. During the development of the 2006 GMNF Forest Plan, the GMNF staff conducted extensive public involvement. Over 70 meetings were held to provide other agencies, municipalities, stakeholders and individuals opportunities to be involved with the development of the Forest Plan at all stages. The meetings were designed to provide information to the public on existing conditions of resources as well as to give the public an opportunity to provide input on the future management of

the GMNF. All the information available at public meetings was also made available on the GMNF website and the public was encouraged to provide comments via email or other means throughout the revision process. Public involvement continues with the development of site specific projects designed to implement the 2006 Forest Plan. Projects are designed in collaboration with stakeholders, other state and federal agencies, and interested citizens most often from the communities where the projects will occur.

The actual on-the ground implementation of many of the GMNF's projects also depends on public participation in the form of partnerships. Numerous organizations work with GMNF staff to maintain roads, trails and historic sites, conduct inventories and research, and create wildlife habitats. This level of public involvement is crucial in providing services and opportunities for public enjoyment on the GMNF.

Forest Certification

Forest certification is another tool to enhance sustainable use and promote exemplary management. There are three main forest certification programs within Vermont: Forest Stewardship Council (FSC), Sustainable Forestry Initiative (SFI) and Tree Farm (ATFS). All are third party audit systems that use different standards. In addition to forest certification, all three claim to provide or have access to third party chain-of-custody certification which is necessary for finished products to carry indication of certification.

Forest certification efforts are limited in Vermont, in part by the lack of large forest properties. Certification entails an initial entry cost as well as periodic audit costs for the landowner. Larger properties are better able to bear these costs because of the greater likelihood of some level of annual harvesting. A legislatively-mandated study investigating the feasibility of third party certification for state land concluded that lack of financial resources precluded the ability to pursue state land certification at this time.

Chain-of-custody certification is equally challenging by the relative lack of certified forest products and what has been a very slow growth in demand for certified wood products. In Vermont, four sawmills and ten wood product manufacturing companies currently participate in chain-of-custody protocols with one or more of the certification systems. About 50 percent of wood product businesses use at least some volume of certified raw material, including those that are chain-of-custody certified. All report that

a scarcity of certified wood supply and/or certified wood demand represents a problem. However, wood product manufacturers report that as demand for wood products recovers from the current depressed state, they expect that certification will play a much larger role in consumer preference. 'Buy Local' is a consumer interest that is expanding beyond food and agricultural products and into the forest economy.

Desired Future Condition 5: *Legal, Institutional and Economic Framework*

Vermont has a legal, institutional and economic framework in place for forest conservation and sustainability

To uphold the views and values society holds towards Vermont's forests, a legal, institutional and economic framework needs to be in place to support the conservation and sustainable management of our forests. This recognizes that conditions and processes beyond the forest play a large role. Policies and guidelines need an enabling institutional environment for their formulation and implementation. The legislation provides the regulatory and fiscal instruments needed to achieve policy objectives. Institutions also provide the human and technical capacities needed to implement activities and programs for sustainable, healthy forests. Evaluation of these policy and institutional frameworks is a necessary component for the assessment of forest sustainability.

Vermont has long history of an open and collaborative governmental structure. Cooperation among forest landowners, the public and government fosters confidence and ongoing, productive involvement by all of society in developing and implementing public policy.

To fulfill our mission, the Division of Forests will continue to work, as we have for more than a century, for the wise management of Vermont's forests. While periodic internal assessment and reorganizations will always be necessary, increased efficiencies can no longer compensate for continual reductions in staff and funding. A major commitment to our programs, through the provision of adequate funding, must be realized.

The Department of Forests, Parks and Recreation has broad authorities granted for assessments, policy development and management. Found primarily in Title 10, several different chapters address powers and authorities. We have statutory authority to carry out an assessment of the state's forest resources and to develop a plan to guide the Department in fulfilling program responsibilities. The Forest Resources Plan is one source for reporting that assessment and meets the intent of V.S.A. Title 10, Chapter 73, Section 2225, which authorized the Department to: "*carry out a detailed inventory and analysis of the forest resource," which "thereafter shall be the basis for planning programs and their administration by the Department for the conservation, management and development of Vermont's forest resources."*

In 1951, the Vermont Legislature enacted into law a policy that states: *"the forests, timberlands, woodlands and soil and recreational resources of the state are hereby declared to be in the public interest* (Title 10, Chapter 83, Section 2601)." Continuing in Section 2601; *"It is the policy of the state to encourage economic management of its forests and woodlands, to maintain, conserve and improve its soil resources and to control forest pests to the end that forest benefits, including maple sugar production, are preserved for its people, floods and soil erosion are alleviated, hazards of forest fires are lessened, its natural beauty is preserved, its wildlife protected, the development of its recreational interest is encouraged, the fertility and productivity of its soil are maintained, the impairment of its dams and reservoirs is prevented, its tax base is protected and the health, safety and general welfare of its people are sustained and promoted."*

Sub-section (b) of Section 2601 charges the Department to: *"implement the policies of this chapter by assisting forest landowners and lumber operators in the cutting and marketing of forest growth, encouraging cooperation between forest owners, lumber operators and the State of Vermont in the practice of conservation and management of forest lands, managing, promoting and protecting the multiple use of publicly-owned forest and parks lands; planning, constructing, developing, operating and maintaining a system of state parks…"*

Forestry Division Staff

The Division of Forests greatest asset has always been its staff. A professional and dedicated workforce supported by management is critical in a climate of declining revenues. From a peak in the 1980's of 80 employees, the Division now has 54 full-time employees. According to the 'Fiscal Year 2009 State of Vermont Workforce Report,' the Department of Forests, Parks and Recreation (FPR) has the highest average length of service (18.7 years). The average age for FPR is 49.2 years old. This ranks' 7th in Vermont State Government at the departmental level. FPR currently has 19% of its classified workforce eligible for retirement; 24 employees have retired since 2005. In five years, the number of FPR employees eligible for retirement will nearly double to 40%. The loss of institutional memory due to retirements is a concern. Maintaining the Division's commitment of employees and teamwork is essential to meeting future challenges.

Economic Framework

The Division's annual budget is currently 5.4 million dollars which includes: 67% general funds, 21% federal funds (excluding Forest Legacy Program acquisitions), 9% special

funds and 3% inter-departmental transfers. The percent of the Division's budget comprised of federal funds has shifted over the past eight years from a high of 26.5% to a low of 21%. These shifts are a result of variable revenues from state and federal sources. The general fund contribution to the Division's budget has been declining over the past three fiscal years for an overall decrease of 8%.

Personnel costs make up roughly 95% of expenditures. The second largest expenditure is grants. These range from small, one-time expenditures to larger on-going commitments. As a result, decreasing revenues have led to the inability to backfill after retirement and reduction of some grant amounts. We have attempted to increase revenues through some fee-for-service work to other public agencies and retention of revenues generated from the sale of forest products from state land. Additional revenue enhancements are needed. The Strategies Matrix on page 32 lists the financial resources needed to accomplish the goals of this plan.

Inter-Agency/Government Cooperation

The Division of Forests works closely with many departments within state government as well as several federal agencies. An integrated approach, drawing upon many disciplines, guides our programs and supports other efforts on behalf of Vermont's forests and our relationships with them. The specific departments/agencies the Division works with are listed under partners on page 111.

Use Value Appraisal

The cornerstone for the Use Value Appraisal (UVA) program is the requirement that each parcel submit a management plan. The management plan must meet acceptable silvicultural standards recommended by the Division of Forests. Properties are periodically inspected for compliance and management plans are updated every 10 years. If a landowner decides to leave the program or is found in non-compliance, they pay a penalty based on a percentage of fair market value of the 'developed' portion. Enrolling in UVA places a lien on the property that stays with the land if it is sold or changes hands.

Vermont's county foresters are the primary contact with forest landowners and landowner organizations. Without the expertise of county foresters to guide landowners towards natural resource professionals, many would be limited in access to management assistance. These efforts compliment the purpose of the Forest Stewardship Program and are administered in unison.

Vermont Association of Planning and Development (VAPDA), through individual Regional Planning Commissions, provide an assessment of forest resources and strategies to maintain working forest landscapes and protection of significant resources, and are included in regional plans. Regional plans could serve as landscape-scale plans for Vermont's Forest Stewardship Program and be referenced to in landowner UVA plans.

Cost-Share Opportunities

Private forest landowners often rely on federal and state funding. Cost-share programs administered through the Natural Resource Conservation Service (NRCS) are important to augment management costs for non-commercial activities. The Division of Forests participates on the NRCS State Technical Committee, and the Director of Forests and State Conservationist are collaborating on several landscape scale projects. Most notably is the 'Keeping Forests as Forests' initiative within New England and supported by the NE Governors. Funding through Environmental Quality Incentives Program (EQIP) and Wildlife Habitat Enhancement Program (WHIP) cost-share programs should be maintained and enhanced, and efforts made to engage Vermont's consulting foresters in promoting cost-share options for forest landowners.

Regulatory Protection of Forest Water Resources

There are various state rules and regulations aimed at protecting the function that forests provide for water quality, reducing the risk of nonpoint source (NPS) pollution associated with logging, maintaining physical functions of streams and protecting wetlands, aquatic systems and riparian habitats.

Acceptable Management Practices

In 1986, the Vermont Legislature passed amendments to Vermont's Water Quality Statutes Title 10 V.S.A., Chapter 47: Water Pollution Control. The amendments declared that "it is the policy of the state to seek over the long-term to upgrade the quality of waters and to reduce existing risks to water quality." The revised state law requires permits for discharges of "any waste, substance or material into the waters of the state." However, individual permits are not required for any discharges that inadvertently result from logging operations if responsible management practices are followed to protect water quality. "Acceptable Management Practices (AMP's) For Maintaining Water Quality on Logging Jobs in Vermont" were developed and adopted as rules to

Vermont's water quality statutes and became effective on August 15, 1987. The AMP's are intended to prevent any mud, petroleum products and woody debris (logging slash) from entering waters of the state.

Two-hundred sixty-one AMP cases were investigated by the Division of Forests' staff from 1999 through 2009 and revealed evidence of a discharge. These cases have been examined in detail to pinpoint sources of discharges on timber harvesting operations. The results are depicted in Figure 13 and shows that the majority of discharges are associated with stream crossings, practices associated with working within the buffer and skid trails. This is important information for tailoring logger training and education programs in Vermont.

Figure 13. AMP Cases, Source of Discharge (%). *Source: Vermont Department of Forests, Parks and Recreation, Division of Forests, 2009*

Since adoption of the AMPs, the Division has worked with representatives from the Vermont forest industry and the Department of Environmental Conservation Compliance and Enforcement Division to reduce the number and severity of water quality violations resulting from timber harvesting operations. There continues to be a high level of cooperation and voluntary compliance among loggers and landowners to bring operations into compliance with Vermont's water quality statutes. Logger training, through Vermont's Logger Education to

Advance Professionalism (LEAP) Program, has provided Forest Water Quality and AMP workshops on a regular basis to assist loggers.

There is no apparent upward or downward trend in the number of AMP cases investigated. However, anecdotal information from staff investigating AMP cases indicates that water quality violations are becoming less severe. AMP reports submitted by FPR staff for 1999 to present indicate that the number of cases investigated ranged from a low of 29 during 2007 to a high of 49 during 2000 and 2008. The numbers vary due to many variables such as amount and distribution of annual rainfall, number and timing of timber harvesting operations, market conditions.

Act 250

Act 250, Vermont's land use law, was enacted in 1970 and is now forty years old. Recognized nationally as a landmark land use regulation, ten criteria were developed to minimize environmental impact from development. Four of those criteria address the protection of soil and water resources: (1) Water and Air Pollution, (2) Water Supply, (3) Impact on Existing Water Supplies and (4) Soil Erosion. Headwaters are defined and protected under this state statute. Headwaters are predominantly forested and can generally be considered as pristine. Because headwater streams have a significant influence on downstream river processes, it's important to direct protection and conservation efforts to maintain and enhance forest cover in these watersheds, (Map 36: Land Classification of Vermont Headwaters).

Wetland Rules

In 1986, the Vermont Legislature passed the Vermont Wetlands Act, which mandated the adoption of rules that would identify and protect significant wetlands and their associated buffers. In February of 1990, the Vermont Wetland Rules became effective. Under these rules, silvicultural activities are allowed without prior review. However, there are certain conditions that apply to timber harvesting operations that occur in mapped wetlands. Violations of Vermont's Wetland Rules from timber harvesting activities are few. Logger training, through Vermont's Logger Education to Advance Professionalism (LEAP) Program, has provided Forest Water Quality and Wetlands workshops on a regular basis to help loggers comply with Vermont's Wetland Rules (Water Resources Board, 2001).

Stream Alteration Permits

A review and permit is required for any stream crossing (culverts, bridges or at-grade fords) when the drainage area above the crossing encompasses a minimum of ten square miles; and the project requires fill or earthwork construction involving ten cubic yards or more to construct and/or maintain the crossing.

A review and stream crossing approval is also required for permanent stream crossing structures (excludes at-grade fords) where the drainage area is greater than one square mile but less than ten square miles (Vermont Department of Environmental Conservation 401 Certification of the amended Section 404 Vermont General Permit GP#58).

Quarantines

The Vermont Agency of Agriculture, the USDA Animal and Plant Health Service and the Division of Forests cooperate on emerging forest pest needs and the necessity of imposing quarantines. Quarantines can be established at the federal or state level and are meant to restrict the movement, sale and distribution of designated plant pests and regulated articles from infested to uninfested areas. Vermont's list of quarantined forest pests is included under Title 6, Chapter 84, §1034. Current forest-related quarantines include four state regulated forest pests: hemlock woolly adelgid, pine shoot beetle, Scleroderris canker and noxious weeds. Three federally regulated pests that have not been found to occur in Vermont are: Asian longhorned beetle, sudden oak death and the emerald ash borer. Two additional federally regulated pests are present in Vermont: gypsy moth and Japanese beetle. Details of these quarantines are posted on the Agency of Agriculture's website: www.vermontagriculture.com/ARMES/plantindustry/PlantandPestQuarantines.html. A recently developed Vermont Invasive Forest Pest Action Plan indentifies roles and responsibilities of the Agency of Agriculture, the Department of Forest, Parks and Recreation and the University of Vermont in forest pest control.

Heavy Cut Law

In 1997, the Vermont Legislature passed H.536 (Act 15), known as Vermont's "Heavy Cut" law. This law was enacted to monitor and regulate heavy cutting/clear-cutting being done in the state. Title 10, Chapter 83, §2625 states that a "heavy cut" is a harvest leaving a residual stocking level of acceptable growing stock below the C-line as defined by the United States Department of Agriculture, US Forest Service silvicultural stocking guides for the applicable timber type. This act requires landowners who intend to

conduct a "heavy cut" of 40 acres or more, on land owned or controlled by the landowner, to file a notice of intent to cut.

The act exempts the following: (1) heavy cuts intended to carry out agricultural conversions that will result in land in agricultural production within five years; (2) heavy cuts to carry out a conversion regulated by Act 250 or the public service board; and (3) heavy cuts consistent with an approved forest management plan under the Use Value Appraisal program, consistent with an approved chip harvesting plan or consistent with any other plan approved under other department rules. Results to date of applications approved and acreage approved for heavy cutting are depicted in Figure 14.

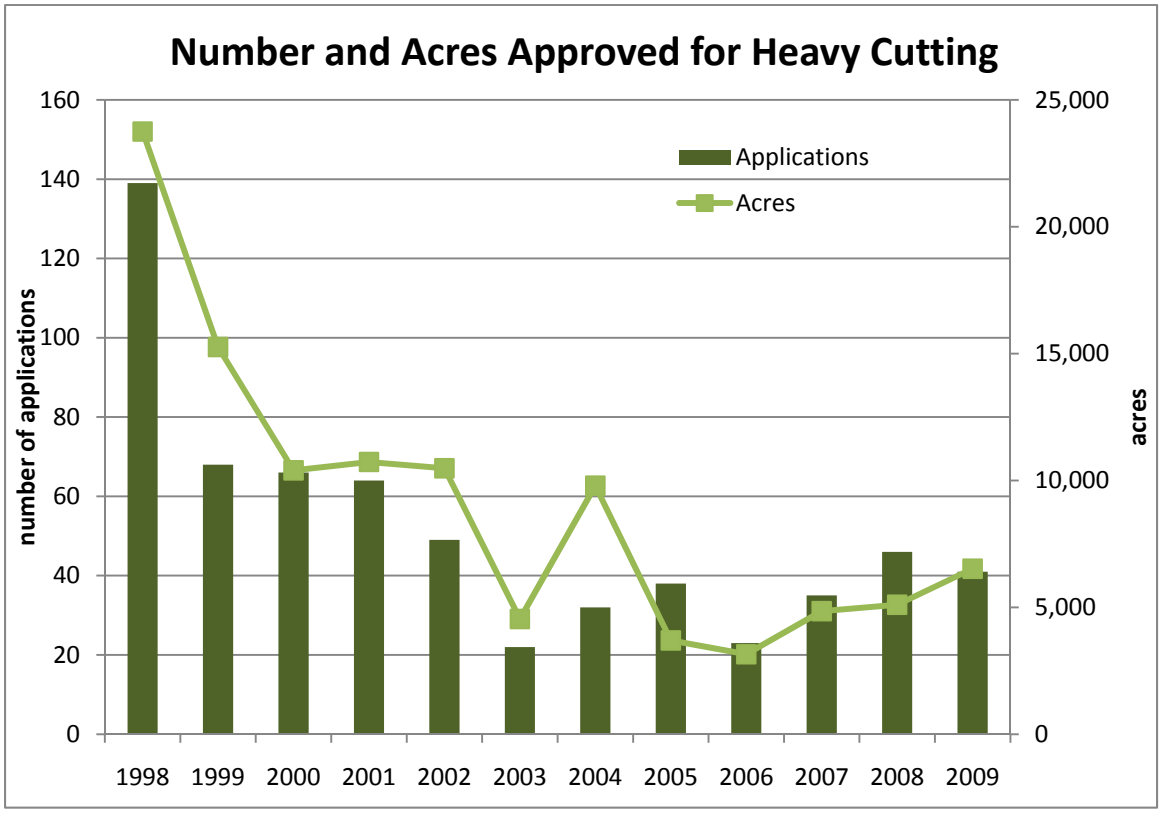


Figure 14. Number and Acres Approved for Heavy Cutting. *Source: Vermont Department of Forests, Parks and Recreation, Division of Forests, 2009*

Shortly after the law went into effect, the state experienced a severe ice-storm in 1998 that caused extensive damage to some areas of Vermont's forests. Salvage operations were conducted for the next several years in response to the damage inflicted. Much of the approved heavy cutting that occurred from 1998 through 2002 reflects timber harvesting operations designed for salvaging damaged forest stands. Since then, activity has leveled off. Most of the approved heavy cuts are exemptions where the landowner

has a forest management plan in effect that has been approved by the Department of Forests, Parks and Recreation.

Forest Practices

Interest in a statewide forest practices act circulate on an infrequent basis. Current concerns on forest sustainability, particularly related to potential increase in biomass harvesting, has lead to some interest in developing procurement standards. Voluntary compliance with acceptable management practices, logger and landowner education and enforcement of current regulations continue to serve the state well.

Partnerships

Vermont landowners have access to a variety of other tools and resources through partner organizations. Key organizations in Vermont that work cooperatively with the Division of Forests are included here and listed in Appendix A: Planning Process Summary if they were involved in the development of the plan. Initials in parenthesis after partners names, indicates key to organizations listed as partners in the Strategies Matrix starting on page 32.

> ***Agency of Agriculture (AA):*** Administers programs and develops policies and procedures for regulating and managing the state's agricultural land, products and livestock.
>
> ***Agency of Commerce (AC):*** An MOA with the Agency helps the Division coordinate economic development and marketing within the forest products sector and the rest of Vermont's manufacturing sectors.
>
> ***American Society of Landscape Architects – Vermont Chapter (ASLA)****:* Professional association representing landscape architects. They promote the profession and advance the practice through advocacy, education, communication and fellowship. In the 2010 legislative session, licensure of landscape architects was enacted in the state.
>
> ***Associated Industries of Vermont (AIV):*** The Forestry Policy Task Force group of this organization addresses statewide policies affecting the industry and also serves as the state coordinator for the national Sustainable Forestry Initiative (SFI).

Audubon Vermont (AV): Affiliated with National Audubon Society, they are involved in environmental education, research and advocacy. With the assistance of a Forest Service Redesign grant, they have an initiative called 'Foresters for the Birds.' The program provides education and technical assistance to manage forest lands for bird habitats. The program is proving to be an excellent mechanism to bring forest landowners with an interest in birds into being active forest stewards.

***Center for Northern Woodlands Education*:** A nonprofit organization that uses media to encourage a culture of stewardship. A high quality quarterly subscription magazine, 'Northern Woodlands,' includes articles related to programs and technical assistance, website and other publications on forest and wildlife issues.

Connecticut River Joint Commission: Established in Vermont, New Hampshire and Massachusetts in the 1980's. The commission advises the three Governors in developing policies to guide growth and development across the Connecticut River.

Conservation Commissions: Local municipal commissions work to sustain their important natural and cultural resources. Statewide umbrella organization is the Association of Vermont Conservation Commission. They offer educational, networking and financial support to local commissions.

Department of Fish and Wildlife (FW): Responsible for managing and protecting the state's fish and wildlife resources through protecting habitats, implementing species management plans, educating the public, performing research, enforcing fish and wildlife regulations, and managing wildlife management areas.

Land Trusts (LT): Vermont is fortunate to have non-profit land trusts at the forefront of developing stewardship programs that incorporate landowner education into conservation easement monitoring. The largest of these is the Vermont Land Trust. All such organizations work to identify and protect important agricultural, forest and habitat lands in Vermont; and provide outreach to landowners on land protection, estate planning tools and easements.

Logger Education to Advance Professionalism: Supported by the Division of Forests, UVM Extension and the forest products industry, the program provides education on forest ecology, forest management systems and training in safety and techniques for tree felling and logging.

Marsh-Billings-Rockefeller National Historical Park (US): Created in 1992 after being donated by Laurence and Mary Rockefeller, the 650 acre park is an excellent example on long-term forest stewardship.

Natural Resource Conservation Districts (NRCD): A statewide network of local units of government responsible for helping landowners with conservation practices and offer workshops, projects and demonstrations on a variety of natural resource topics. NRCD's often make trees and wildlife shrubs available for planting. The Bennington County NRCD sponsors the "Sustainable Forest Consortium" providing educational programs on forest topics**.**

Northern VT and George Aiken Resource Conservation and Development Councils (RCD): Affiliated with NRCS, they sponsor the "Forestry Letter Series" in some Vermont counties, provide outreach to youth on natural resources, and outreach on specific forestry topics, including watershed protection. They also partner with the Division on the Portable Skidder Bridge Program.

Recreation Groups (RG): Numerous recreational organizations, both statewide and regional, coordinate recreation opportunities and maintain miles of recreational trails throughout the state. Statewide organizations include: Catamount Trail Association (CTA), Green Mountain Club (GMC), Vermont All Terrain Vehicle Sportsman Association (VASA), Vermont Association of Snow Travelers (VAST) and Vermont Mountain Bike Association (VMBA).

Silvio O. Conte National Fish & Wildlife Refuge (US): Established in 1991 to promote conservation of the abundance and diversity of native plants and animals, and their habitats on 7.2 million acres in the Connecticut River Watershed in Connecticut, Massachusetts, Vermont and New Hampshire. The US Fish and Wildlife Agency owns 26,000 acres in the Nulhegan Basin in northeastern VT.

Society of American Foresters (SAF)**:** Educational, outreach and policy services to professional foresters in Vermont with limited outreach to landowners. The

Green Mountain Division serves Vermont and represents many of the practicing foresters in the state. They sponsor continuing education credits and serve as Vermont's only forester certification effort.

The Nature Conservancy (TNC): In addition to preserving natural communities and features through acquisition and conservation, TNC provides educational and outreach efforts on the natural world. Specific interests in Vermont include invasive plants.

Third Party Certifiers: There are a number of national third party certifiers of forest sustainability operating in Vermont. Sustainable Forestry Initiative (SFI) is an industry-based program, while Forest Sustainability Council (SFC) is accepted and sponsored by a broad array of environmental organizations including Smartwood and Rain Forest Alliance. All have forest management certification and chain-of-custody programs.

Tree Farm: A program of the American Forest Foundation with chapters in every state, Tree Farm promotes forest management on private forest land. TF also has a third party certification program. In Vermont, the program is managed by Vermont Woodland Association.

University of Vermont, Cooperative Extension (UVM): Provides University of Vermont-based information and can draw on the expertise of the Rubenstein School of the Environment and Natural Resources. Extension's Natural Resources branch offers periodic workshops, short courses and produces a variety of educational publications on forest management, maple, and urban and community forestry.

US Department of Interior – Fish and Wildlife Service (US): Provides technical expertise in fish and wildlife conservation and management, enhancing interagency cooperation and partnerships between federal, state and local partners, and manages the Silvio O. Conti and Missisquoi National Wildlife Refuges.

USDA – Farm Services Agency: Provides cost-sharing to primarily agriculture producers for such programs as soil conservation and water quality improvements. The Conservation Reserves Enhancement Program (CREP) and

Biomass Crop assistance Program provide opportunities toward forestry interests.

USDA – Forest Service (NASPF, USFS): Comprised of three separate and distinct units. Research and Development provides valuable resource assessments through Forest Inventory and Analysis (FIA), as well as academic and applied research in a variety of forestry fields. State and Private Forestry provides technical assistance to landowners and resource managers, primarily through partnering with state forestry agencies, to help sustain the nation's forests and communities. Finally, the National Forest System manages almost 200 million acres of forests and grasslands. Within Vermont, the over 400,000 acre Green Mountain National Forest is managed out of offices in Rutland, Manchester, Rochester and Middlebury.

USDA - Natural Resource Conservation Service (NRCS)**:** Once thought of as only supporting farmers, NRCS offers a variety of financial incentives to woodland owners who are engaged in conservation activities. Some programs offer annual payments for conservation use, others offer one-time, up-front payments for conservation easements, and others fund the cost to implement activities prescribed in forest management plans. Environmental Quality Incentive Program (EQIP) and Wildlife Habitat Incentive Program (WHIP) are two cost-share programs of value to Vermont forest landowners. The State Forester serves on the NRCS Technical Team which oversees cost-share programs, while a State Conservationist also participants on the Vermont Forest Stewardship Committee, thus ensuring coordination between these two agencies.

Vermont Association of Planning and Development (VAPDA): Regional Planning Commissions provide land-use planning technical assistance and guidance to local municipalities.

Vermont Coverts: Member organization that offers training and peer support on wildlife management techniques on private lands.

Vermont Family Forests: A nonprofit organization that promotes and educates about ecological community-based forestry practices.

Vermont Forest Products Association (FPA): Member association representing the full array of the forest products industry – loggers, truckers, foresters,

sawmill, and secondary manufacturers. Association advocates for the forest products industries and sponsors member training and educational programs.

Vermont Natural Resource Council (VNRC): A private nonprofit environmental education and advocacy organization, working to promote the wise use of Vermont's natural resources. They are engaged in lobbying, research and educational work on a variety of issues including forestry.

Vermont Nursery and Landscape Association (VNLA): Professional organization for the horticultural industry in Vermont. They support Vermont's green industry professionals through programming and certification, and promoting greater public awareness of green industry products and services in the state.

Vermont Wood Manufacturers Association (VWMA): Represents nearly 120 primary and secondary processors and related businesses statewide. They work to support the industry in Vermont and promote its long-term viability by expanding members' presence in the marketplace, ensuring a sustainable supply of raw materials, increasing workforce skill and acting as responsible employers and community members.

***Vermont Woodlands Association (VWA)*:** Member organization that provides advocacy, training and peer support for landowners and foresters, regular newsletters and updates on legislation. They administer Vermont's Tree Farm Program and Association of Consulting Foresters. Tree Farm offers third party certification for members.

***Watershed Organizations (WO)*:** Vermont has over a dozen watershed associations, some of which participate in projects related to forest resources.

Woodland Owners Association: Member organization for Windham County landowners and managers offering educational workshops, a newsletter, peer contacts and referrals.

Appendix

Appendix A: Planning Process Summary

The 2010 Vermont Forest Resources Plan is designed to serve as a broad overview for planning future activities while meeting the requirements outlined in the 2008 Farm Bill. The Plan was prepared in the context of the Division of Forests long-term mission, while reflecting the vision articulated in the last comprehensive plan, The Vermont Forest Resources Plan - 'A Forest That Works for All,' completed in 1999.

In an effort to include as many perspectives as possible, the Division adopted a participatory process that engaged stakeholders early on. This included reaching out to individuals and groups during the assessment phase, building upon public input associated with past planning efforts and providing opportunities to comment on the draft plan.

Stakeholder involvement in the 2010 Vermont Forest Resources Plan has been ongoing from the start of the process. The methodology used was to establish one-on-one contact with key resource partners up front and keep them informed and involved throughout the process.

These stakeholders included:

- The Vermont Fish & Wildlife Department
- Vermont Department of Environmental Conservation
- Natural Resource Conservation Service, State Technical Committee
- The Vermont Natural Resources Council
- The Vermont Forest Roundtable (this organization has members representing all major forest conservation organizations)
- The Vermont State Geologist
- Green Mountain National Forest
- Vermont Forest Stewardship Committee
- The Vermont Land Trust
- The Lake Champlain Basin Technical Committee
- The Green Mountain Club

- Vermont Urban and Community Forestry Council

Given the very short time-frame we had to work with, the goal was to give stakeholders background information about the process we would be using and encourage them to participate according to their interest. It was critical during the assessment phase to reach out to these groups as we identified resource issues and threats.

Another key element during the planning process was the review and integration of associated plans and planning efforts. A number of plans were reviewed and used as a basis for both the assessment and strategy phase of this Plan. They included, among others:

- Department of Fish and Wildlife, Wildlife Action Plan
- Department of Forests, Parks and Recreation, 1999 Vermont Forest Resources Plan
- Department of Forests, Parks and Recreation, Forest Legacy Assessment of Need
- Department of Forests, Parks and Recreation, Urban and Community Forestry Action Plan
- Agency of Natural Resources, Forest Sustainability Report
- Green Mountain National Forest, 2006 Forest Plan
- Vermont Governor's Climate Change Report (Climate Action Plan), 2007
- Vermont's Community Wildfire Protection Plans

Forestry Division staff were engaged in the process as well. Program managers were involved through the development of the assessment and identification of strategies. Field staff and managers were also given the opportunity to comment on the draft Plan, ensuring that current program activities and new initiatives addressed resource needs.

Once a draft plan was prepared, stakeholder meetings were held. The Forestry Roundtable represents the major environmental and conservation organizations within the state. In addition to this group, we also met with the key organizations within the forest products sector. We met with the Vermont Forest Stewardship Committee and provided an opportunity for incorporating their recommendations. Finally, the draft Plan was posted on the Department website and an email sent out to key stakeholders within Vermont requesting feedback.

Although the Division has met all required planning standards, we recognize that, as this is the first attempt at a five-year plan under guidelines provided by the US Forest

Service, the amount of public involvement for this effort is not to the level we and the public would desire. We will compensate for this deficiency with outreach during the implementation phase and the next iteration of the Plan.

Appendix B: Maps

The following maps come from a variety of sources. Most maps include an abstract that details the data sources, purpose and originator. Background into their use and function is located where the maps are individually referenced in the Assessment.

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MAP 8: DISTRIBUTIONS OF VERMONT TREE SPECIES XIII
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MAP 20: FOREST PRODUCTIVITY INPUT LAYER: LANDFORMS XXV
MAP 21: FOREST PRODUCTIVITY INPUT LAYER: SLOPE XXVI
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MAP 30: NON-NATIVE INVASIVE PLANT OCCURRENCE XXXV
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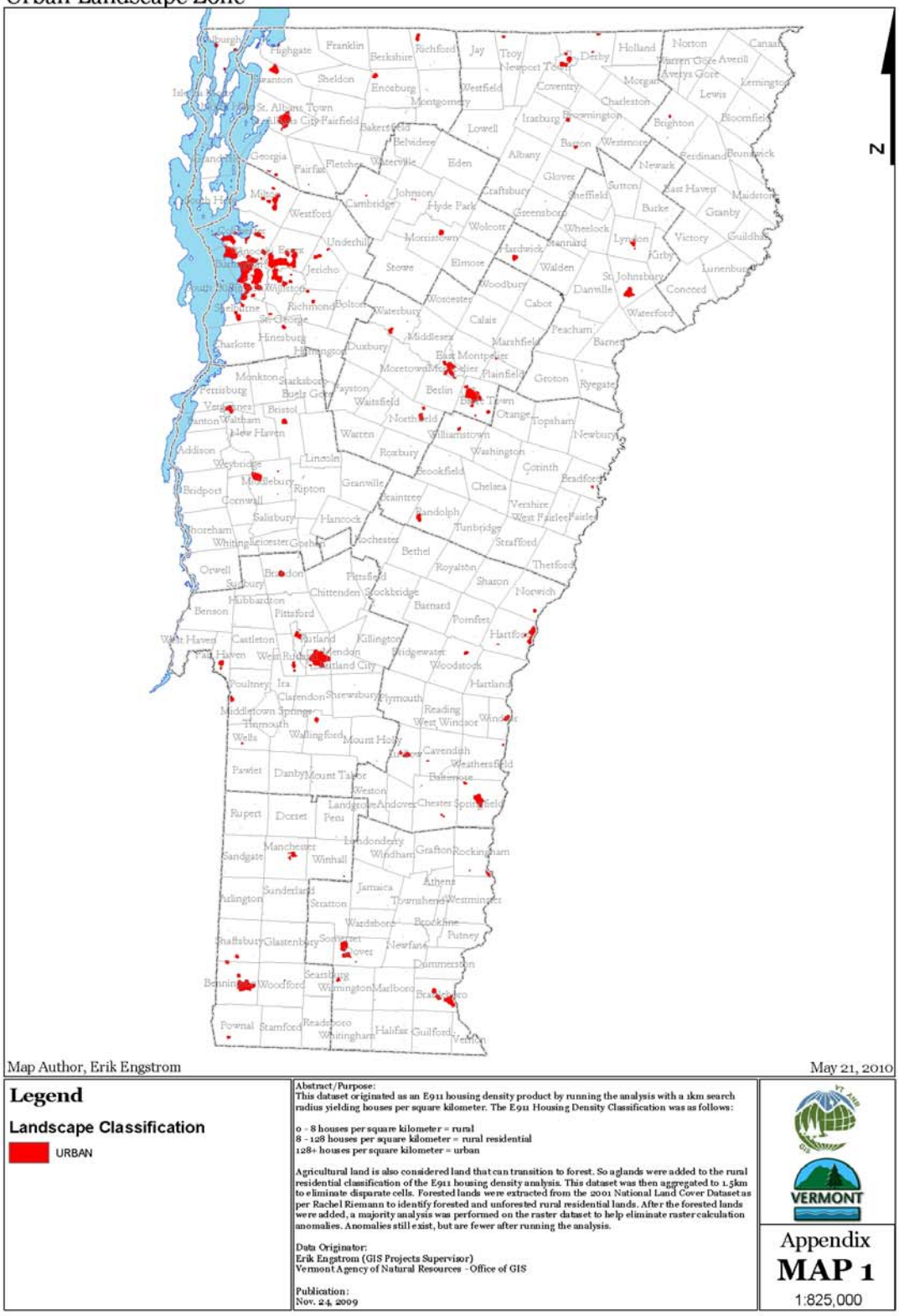
MAP 38: POTENTIAL MULTI-STATE PRIORITY AREAS XLIII
MAP 39: PRIORITY AREAS FOR URBAN TREE CANOPY ENHANCEMENTS XLIV
MAP 40: URBAN AND COMMUNITY FORESTRY - COMMUNITY ACCOMPLISHMENT PRIORITIES XLV
MAP 41: LOCAL SCALE PRIORITY LANDSCAPE XLVI

2010 Vermont Forest Resource Plan

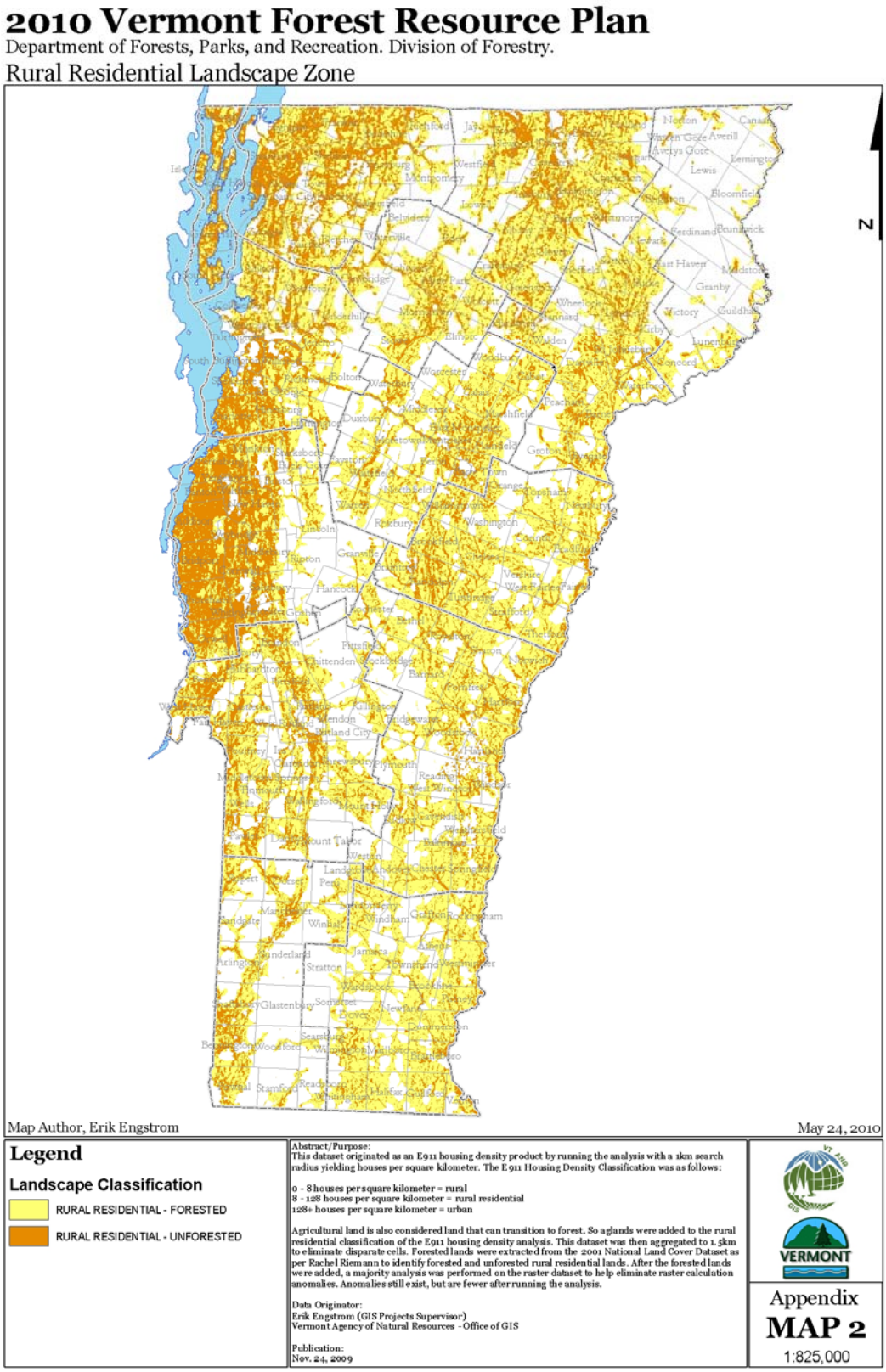
Department of Forests, Parks, and Recreation. Division of Forestry.

Urban Landscape Zone



Map 1: Urban Landscape Zone

Links to text: Urban Landscape Zone



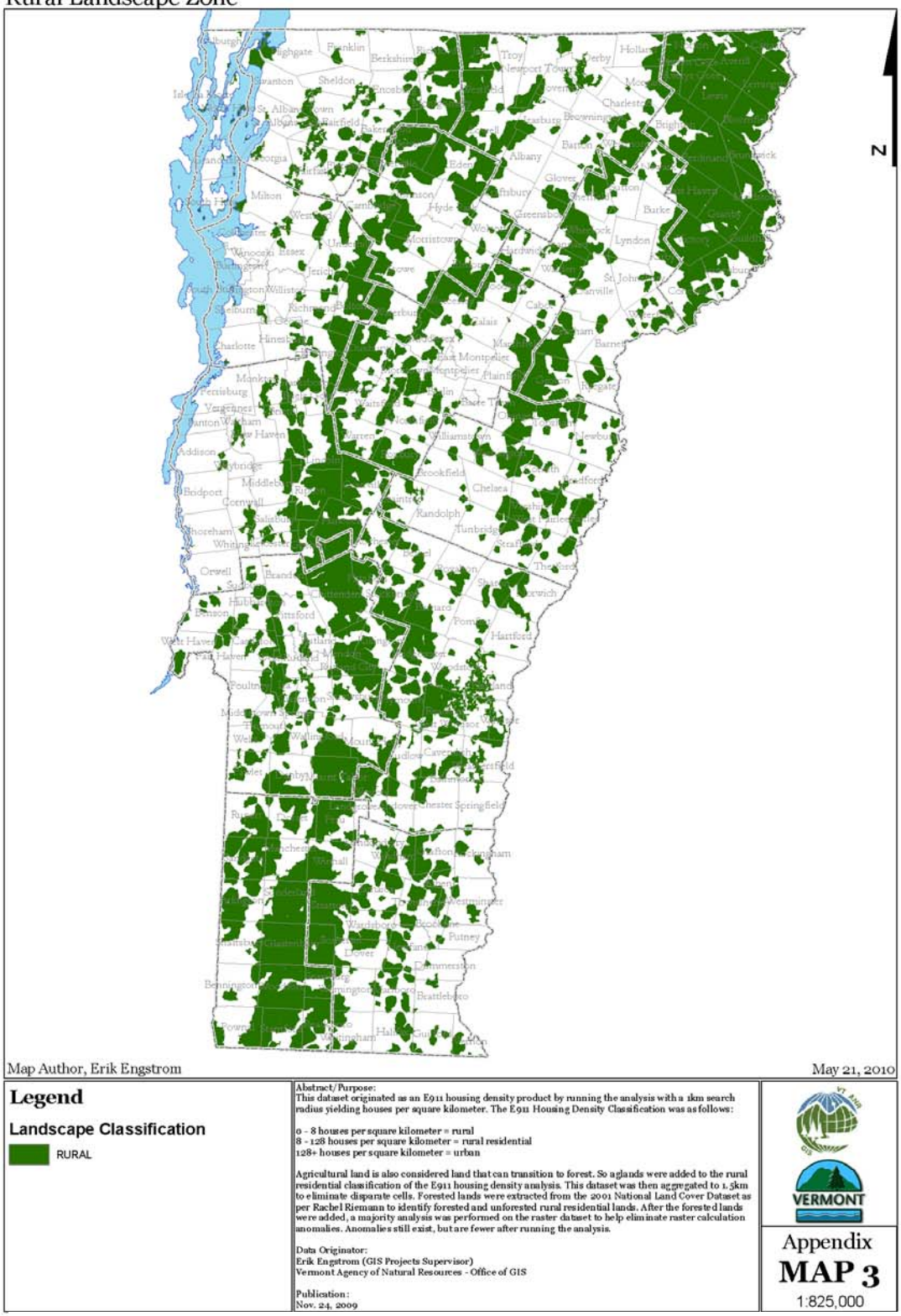
Map 2: Rural Residential Landscape Zone

Links to text: Rural Residential Landscape Zone

2010 Vermont Forest Resource Plan

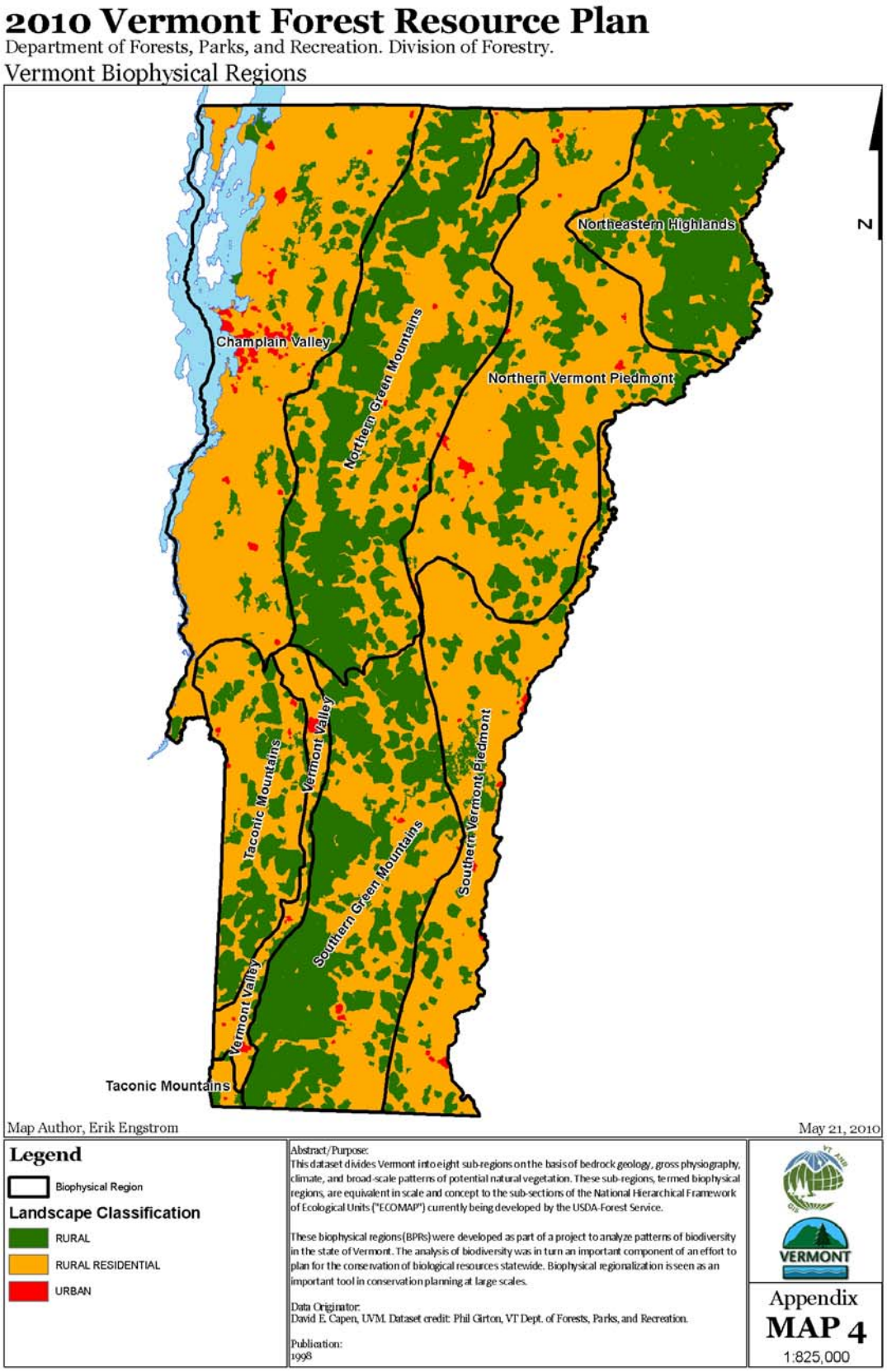
Department of Forests, Parks, and Recreation. Division of Forestry.

Rural Landscape Zone



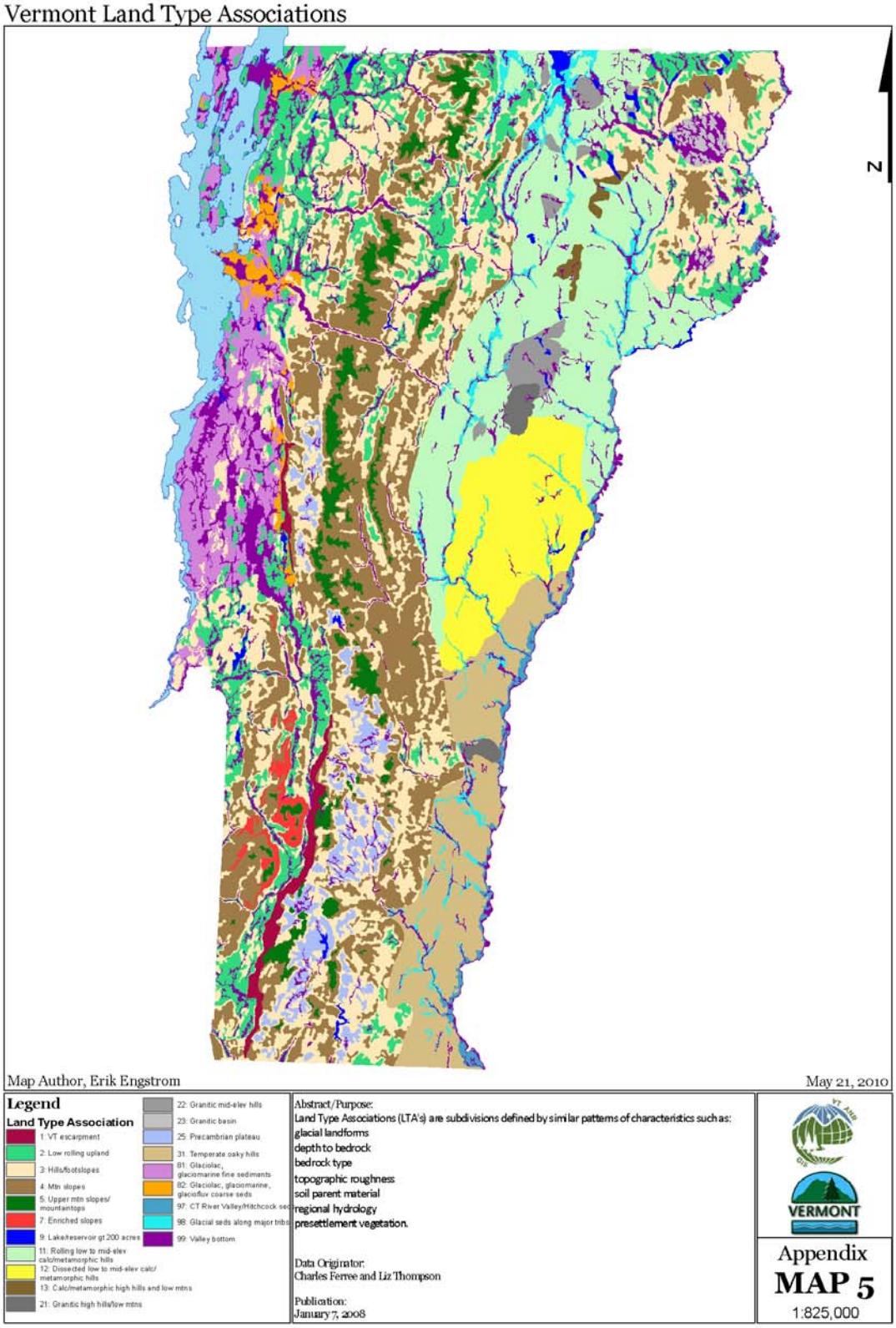
Map 3: Rural Landscape Zone

Links to text: Rural Landscape Zone



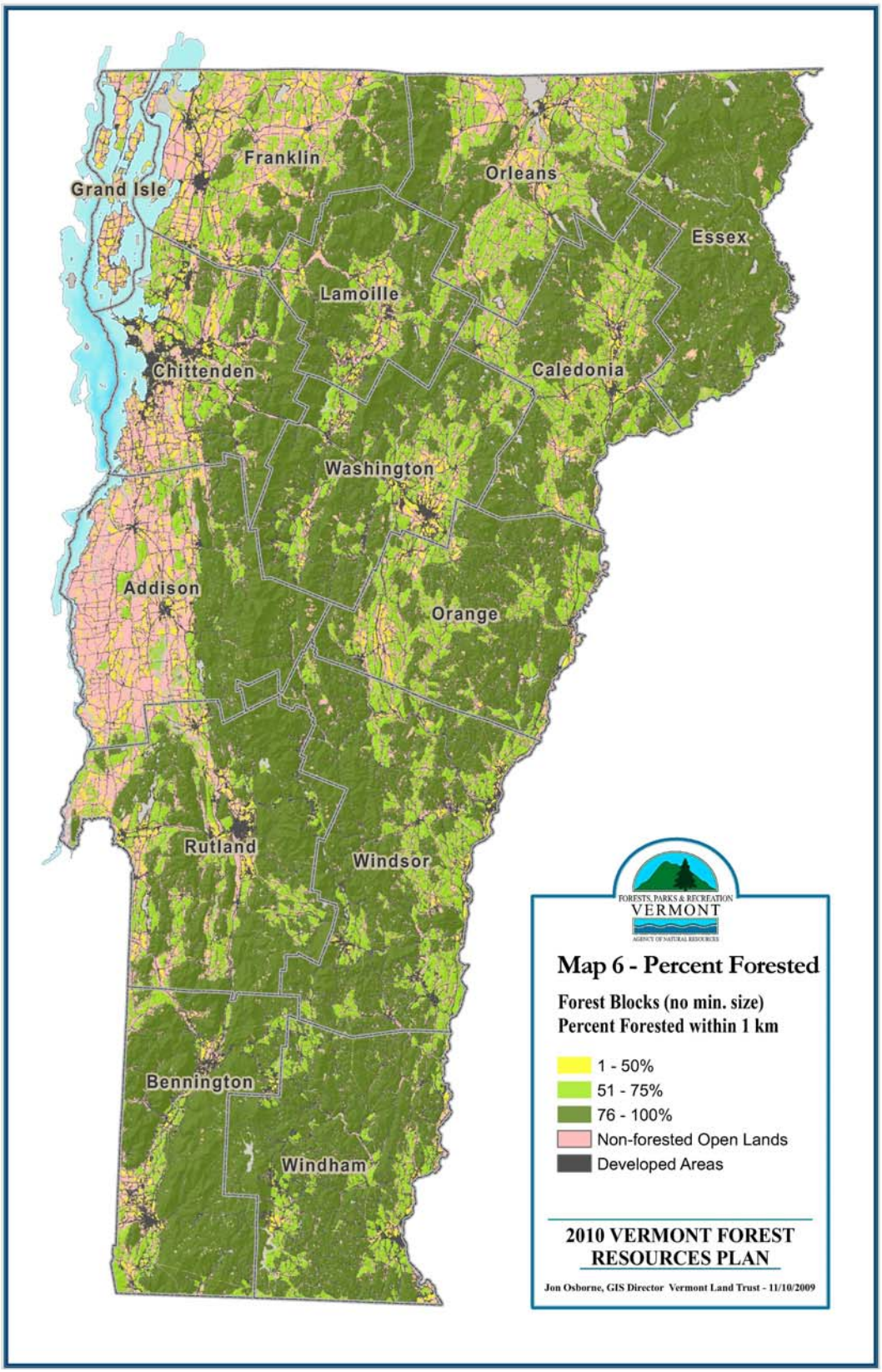
Map 4: Biophysical Regions

Links to text: Ecological Mapping



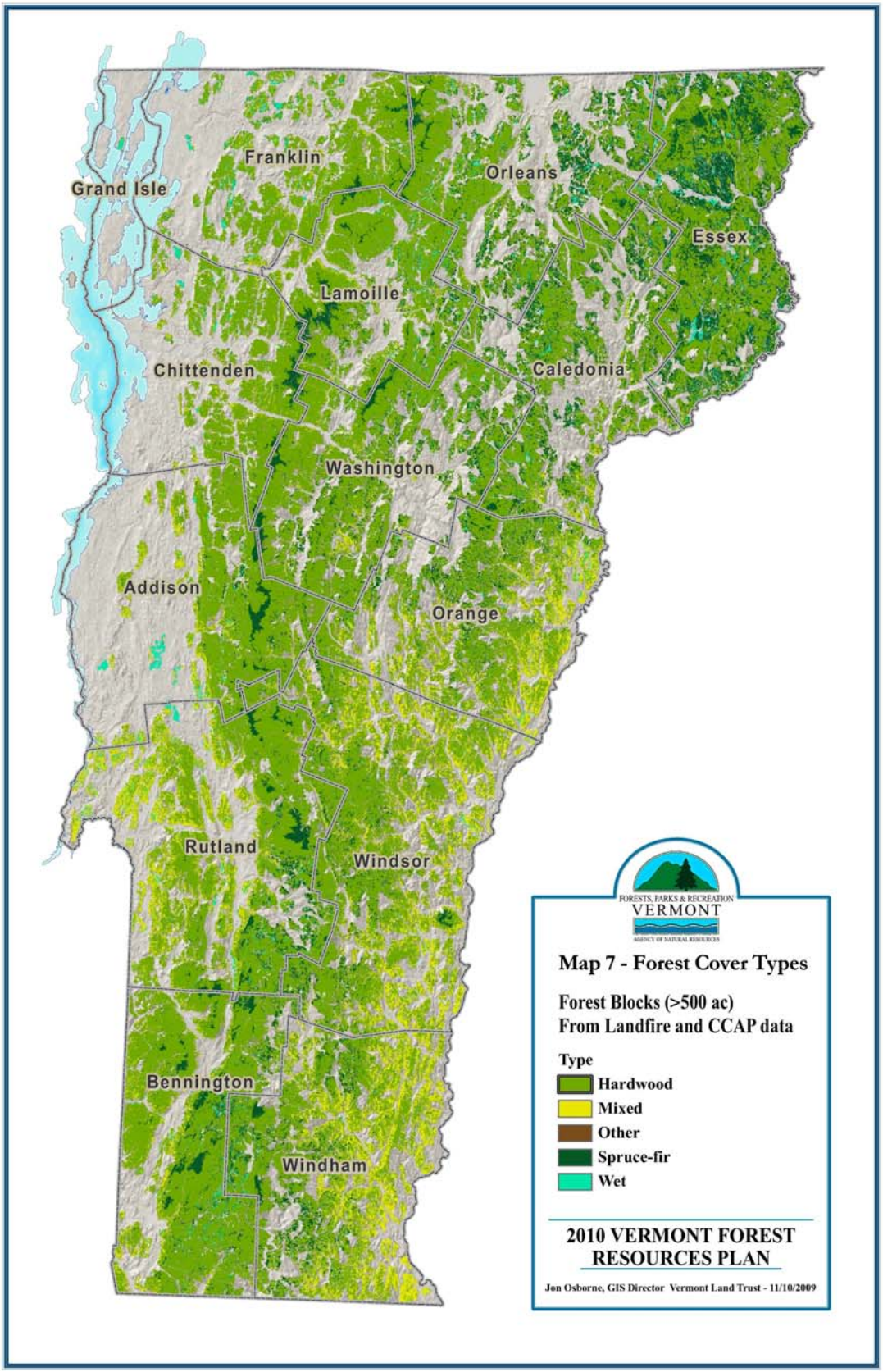
Map 5: Land Type Associations

Links to text: Rural Residential Landscape Zone, Rural Landscape Zone, Ecological Mapping



Map 6: Percent Forested

Links to text: Forested Land Area



Map 7: Forest Cover Types

Links to text: Forested Land Area

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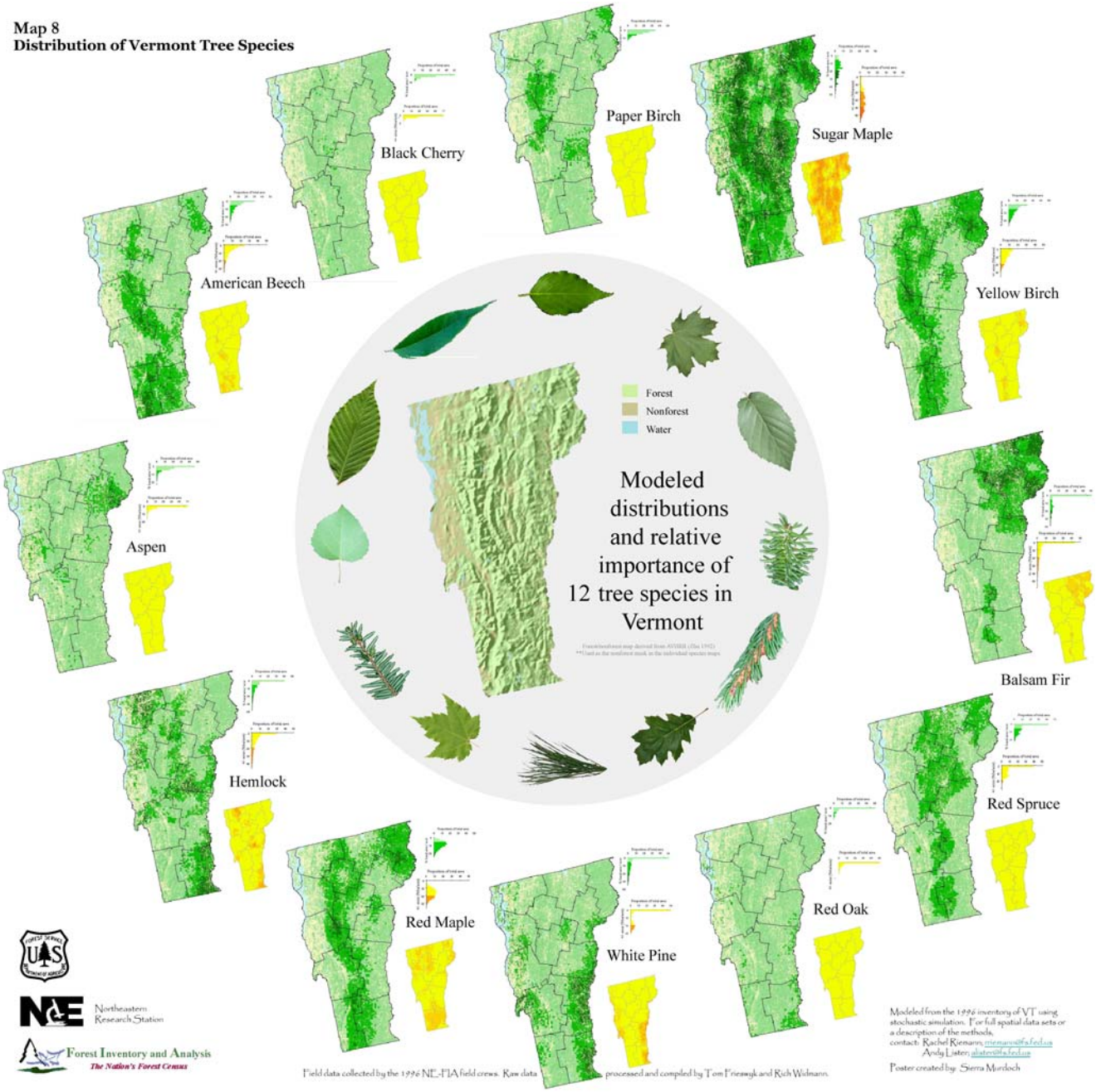
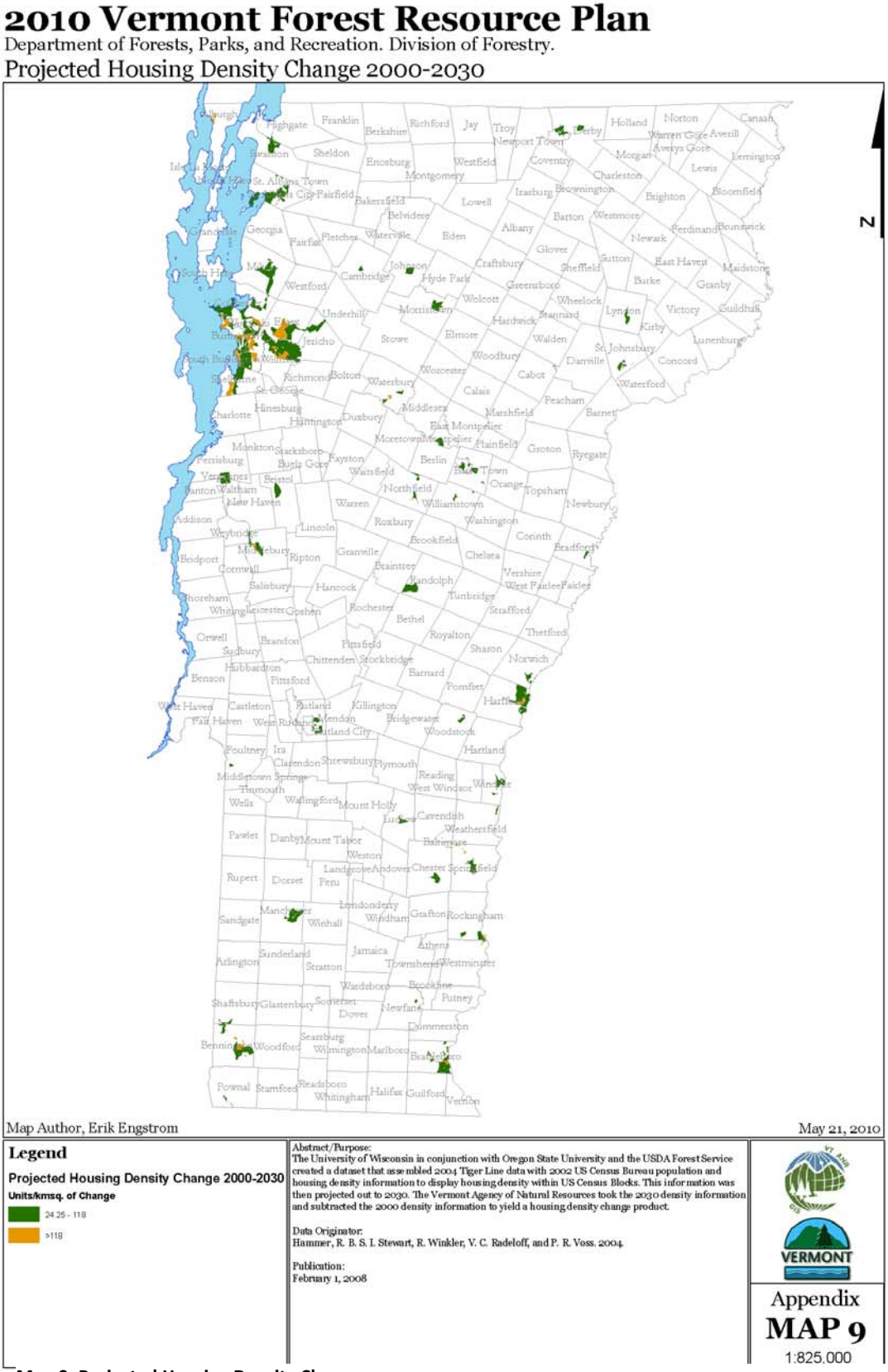
Department of Forests, Parks, and Recreation. Division of Forestry.



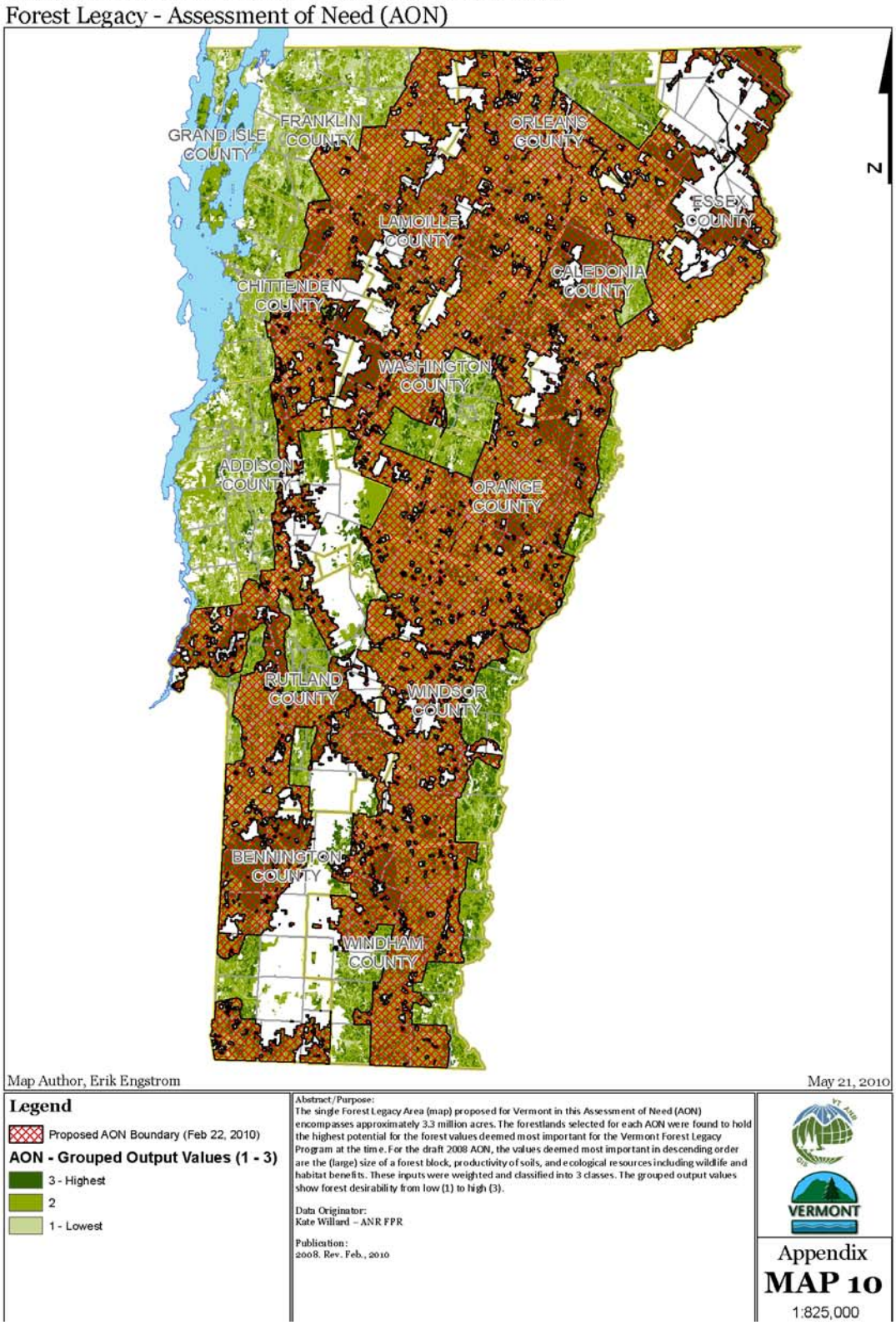
Map 8: Distributions of Vermont Tree Species

Links to text: Species Composition and Distribution



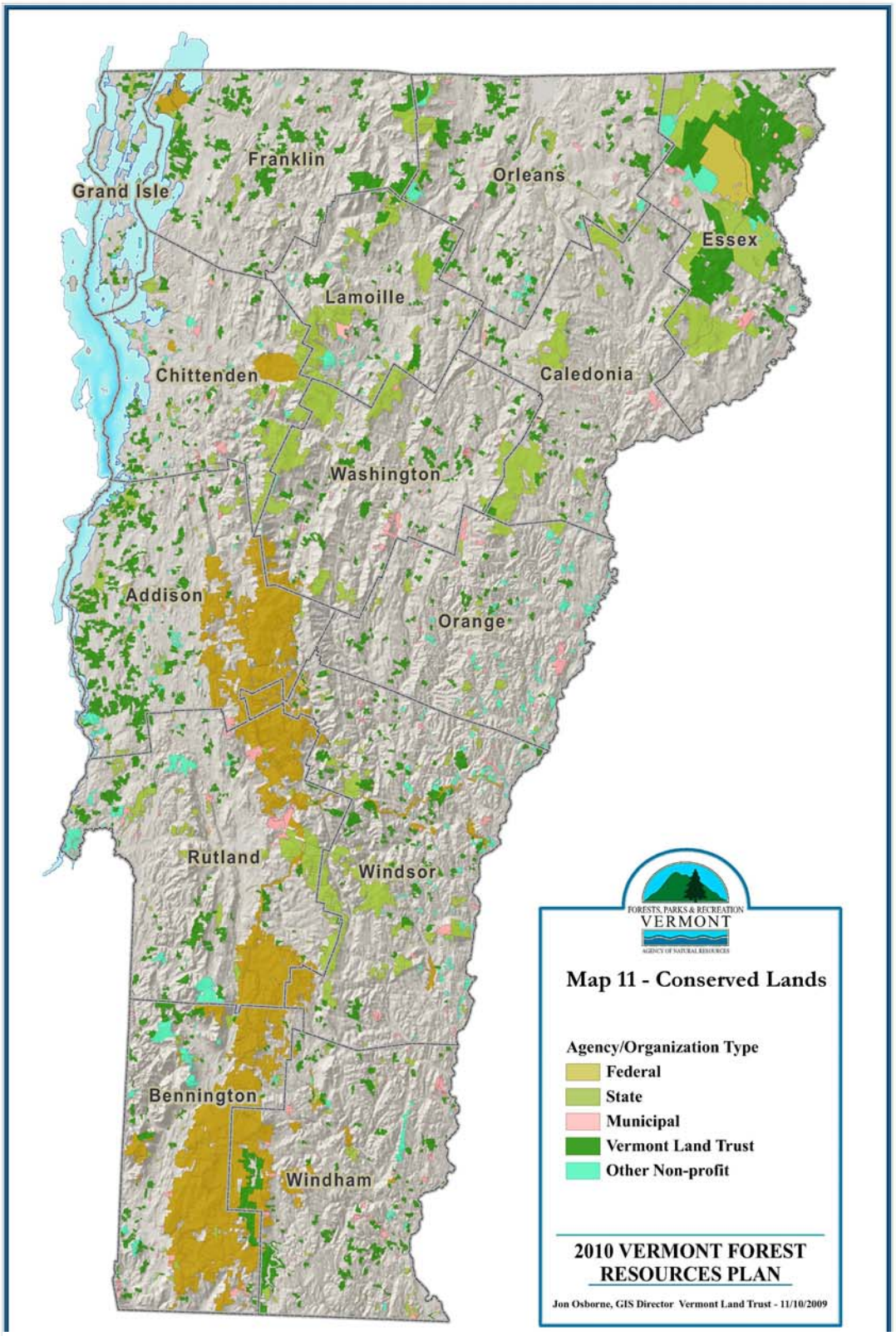
Map 9: Projected Housing Density Change

Links to text: Rural Residential Landscape Zone, Population Growth, Parcelization, Fragmentation and Development



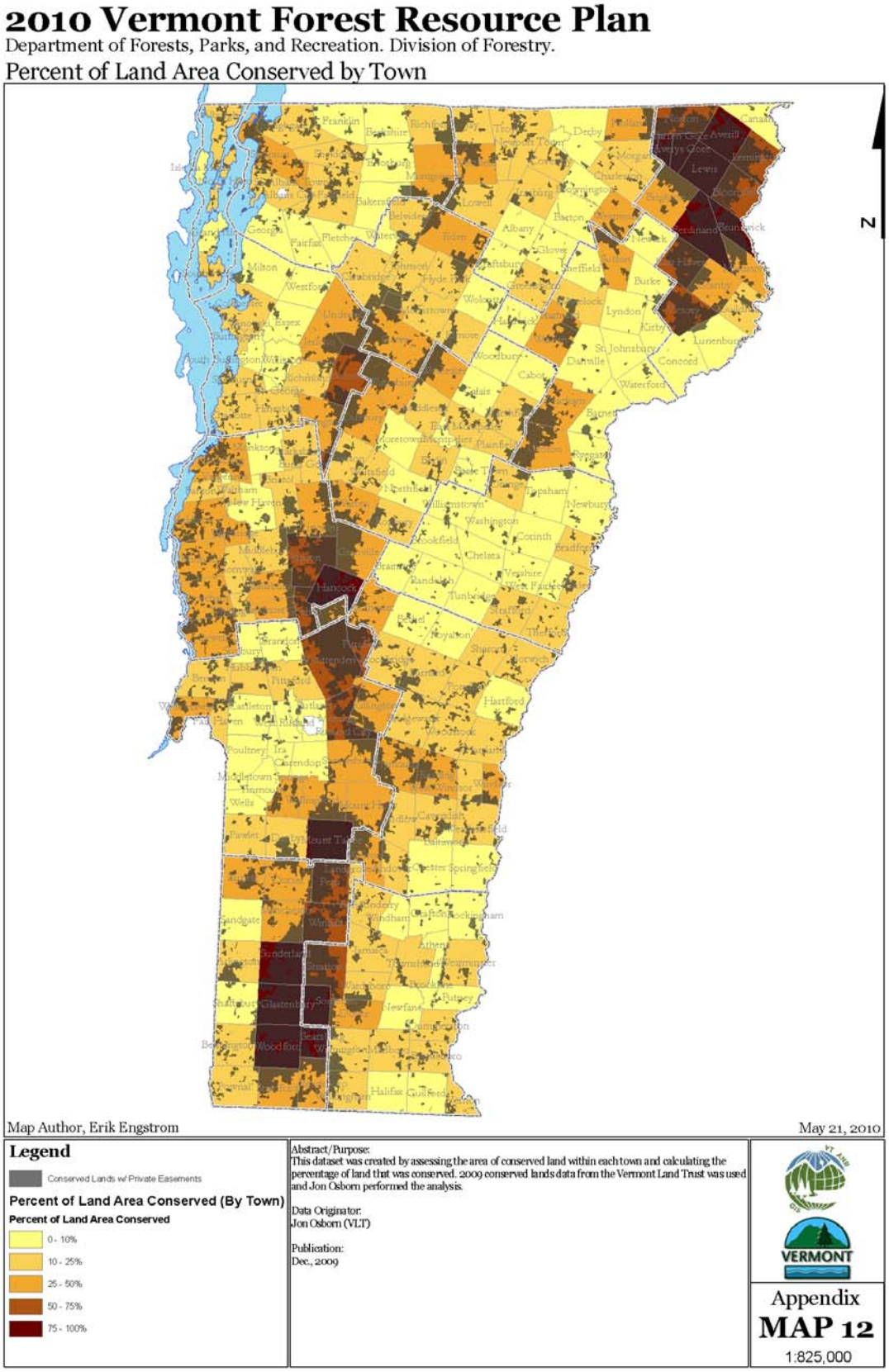
Map 10: Forest Legacy: Analysis of Need - DRAFT– February, 2010.

Link to text: Priority Areas and Issues, Forest Legacy and Land Conservation



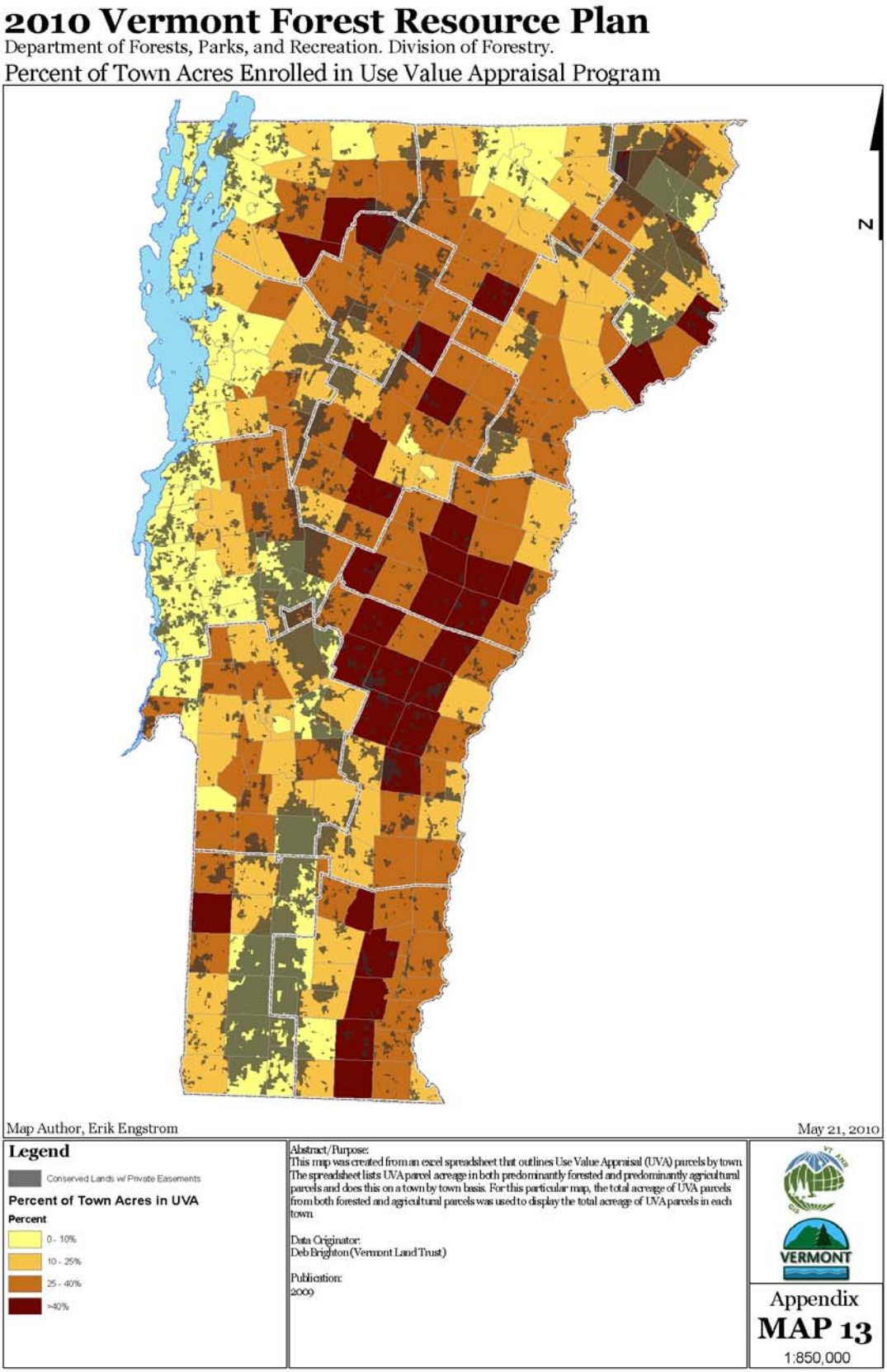
Map 11: Conserved Lands

Links to text: Forest Legacy and Land Conservation, Ownership of Forest Land



Map 12: Percent of Land Area Conserved by Town

Links to text: Forest Legacy and Land Conservation



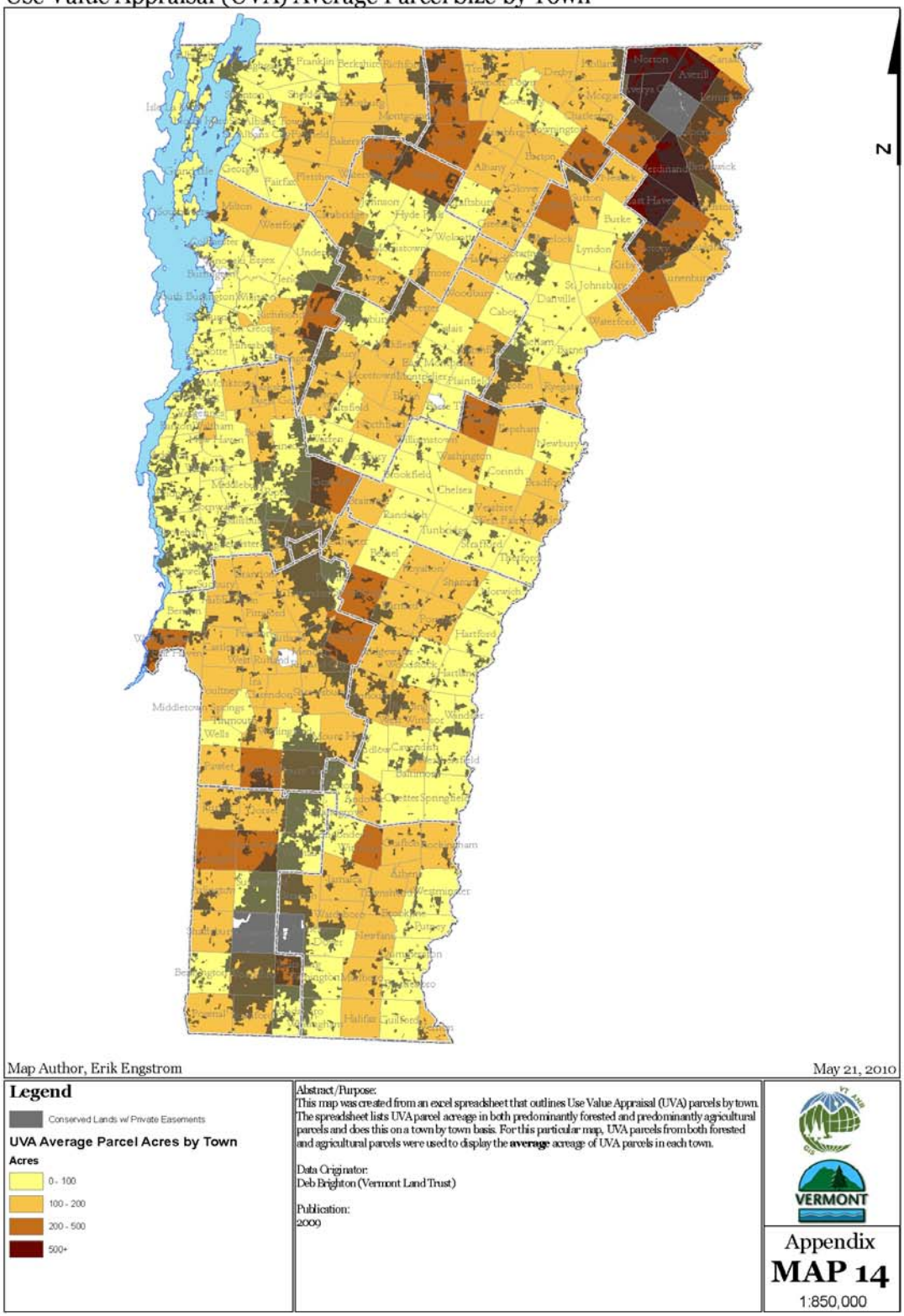
Map 13: Percent of Town Acres Enrolled in UVA

Links to text: Rural Residential Landscape Zone, Rural Landscape Zone, Use Value Appraisal

2010 Vermont Forest Resource Plan

Department of Forests, Parks, and Recreation. Division of Forestry.

Use Value Appraisal (UVA) Average Parcel Size by Town



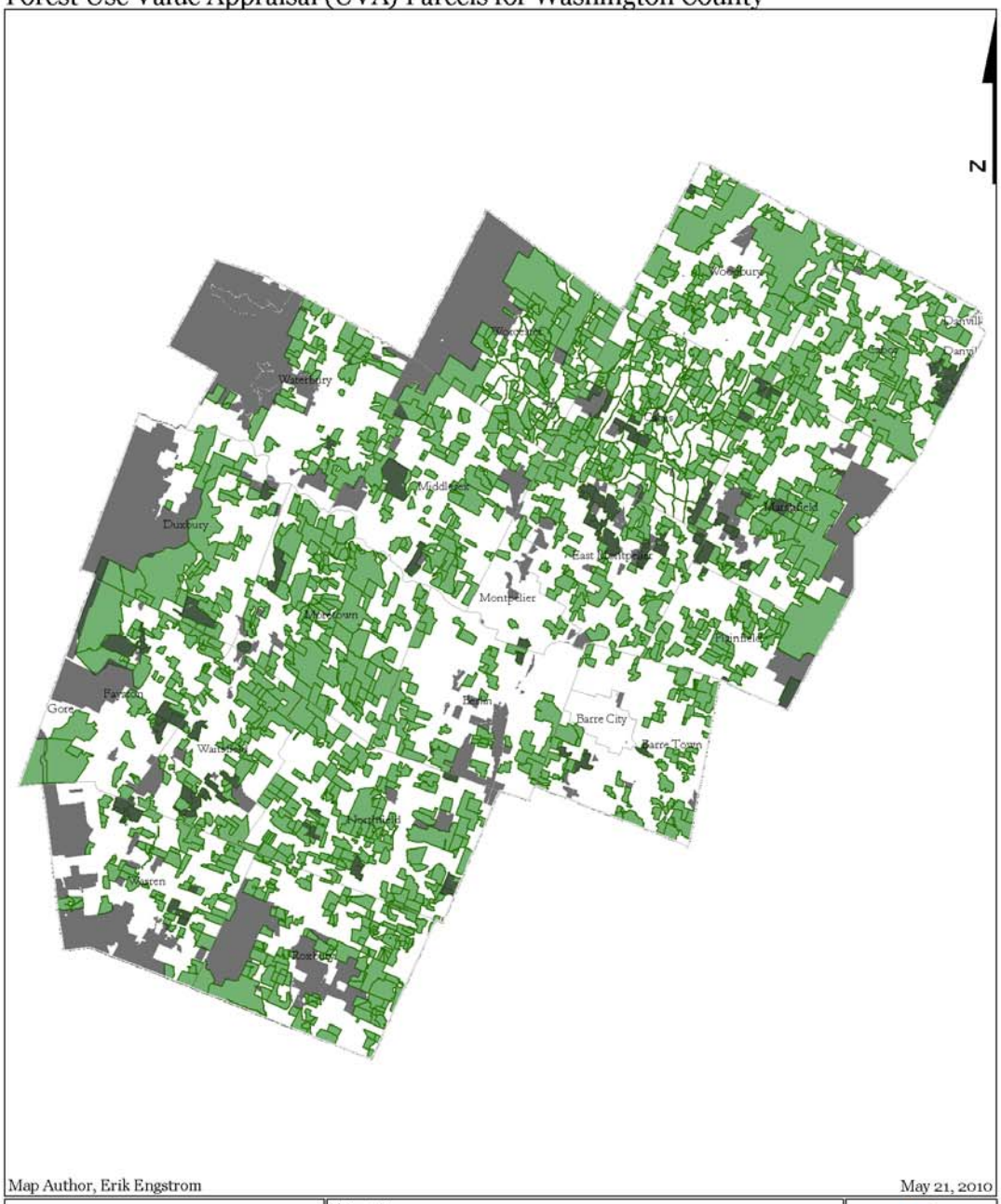
Map 14: UVA Average Parcel Size by Town

Links to text: Rural Residential Landscape Zone, Rural Landscape Zone, Use Value Appraisal

2010 Vermont Forest Resource Plan

Department of Forests, Parks, and Recreation. Division of Forestry.

Forest Use Value Appraisal (UVA) Parcels for Washington County



Map Author, Erik Engstrom

May 21, 2010

Legend

- Washington County
- Conserved Lands w/ Private Easements
- Forest Use Value Appraisal Parcels

Abstract/Purpose:
This dataset is the product of Use Value Appraisal (UVA) mapping for Washington County.

Data Originator:
Russ Barrett (ANR – Forests, Parks, and Recreation)

Publication:
2009

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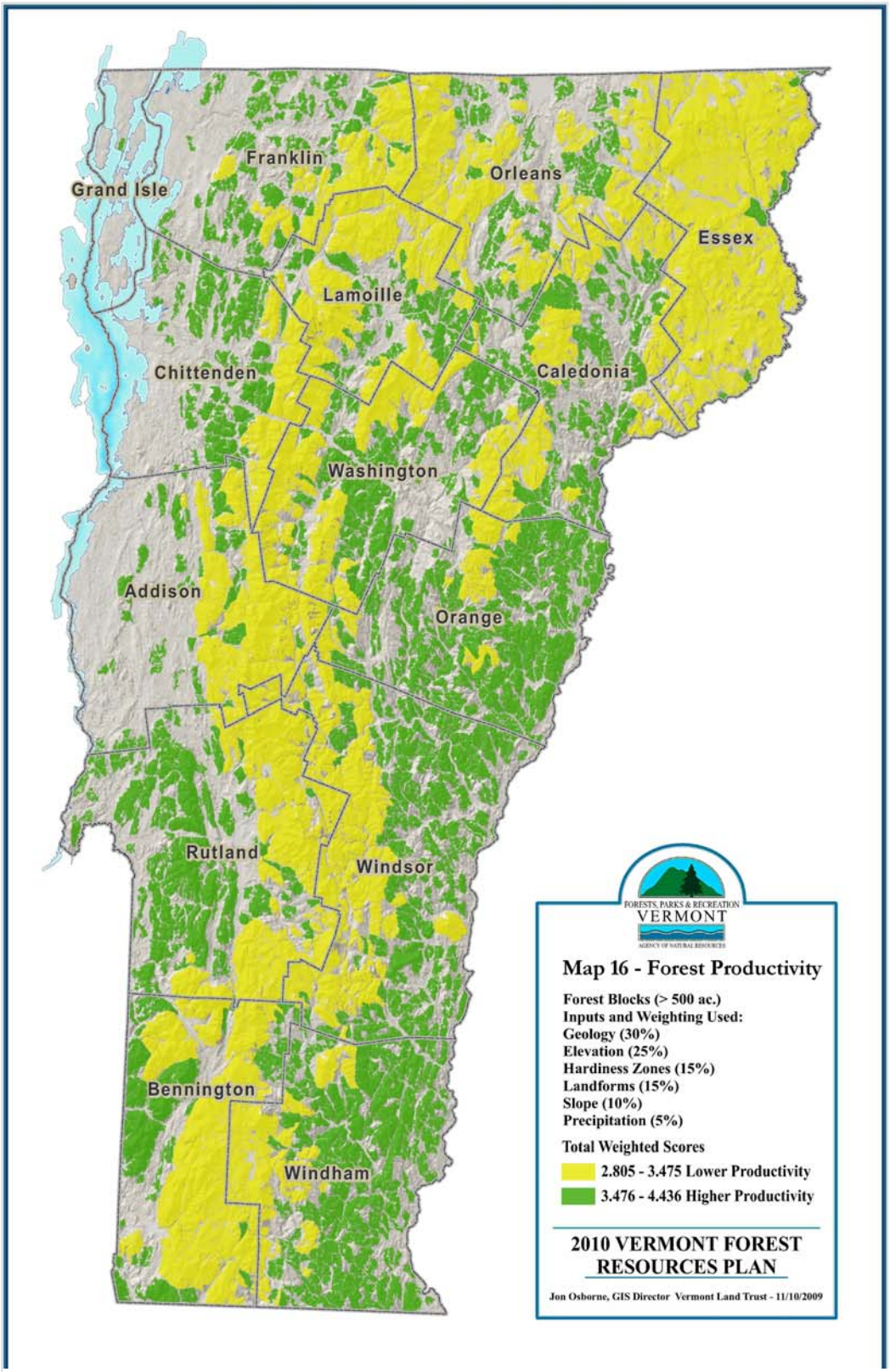
Appendix
MAP 15
1:225,000

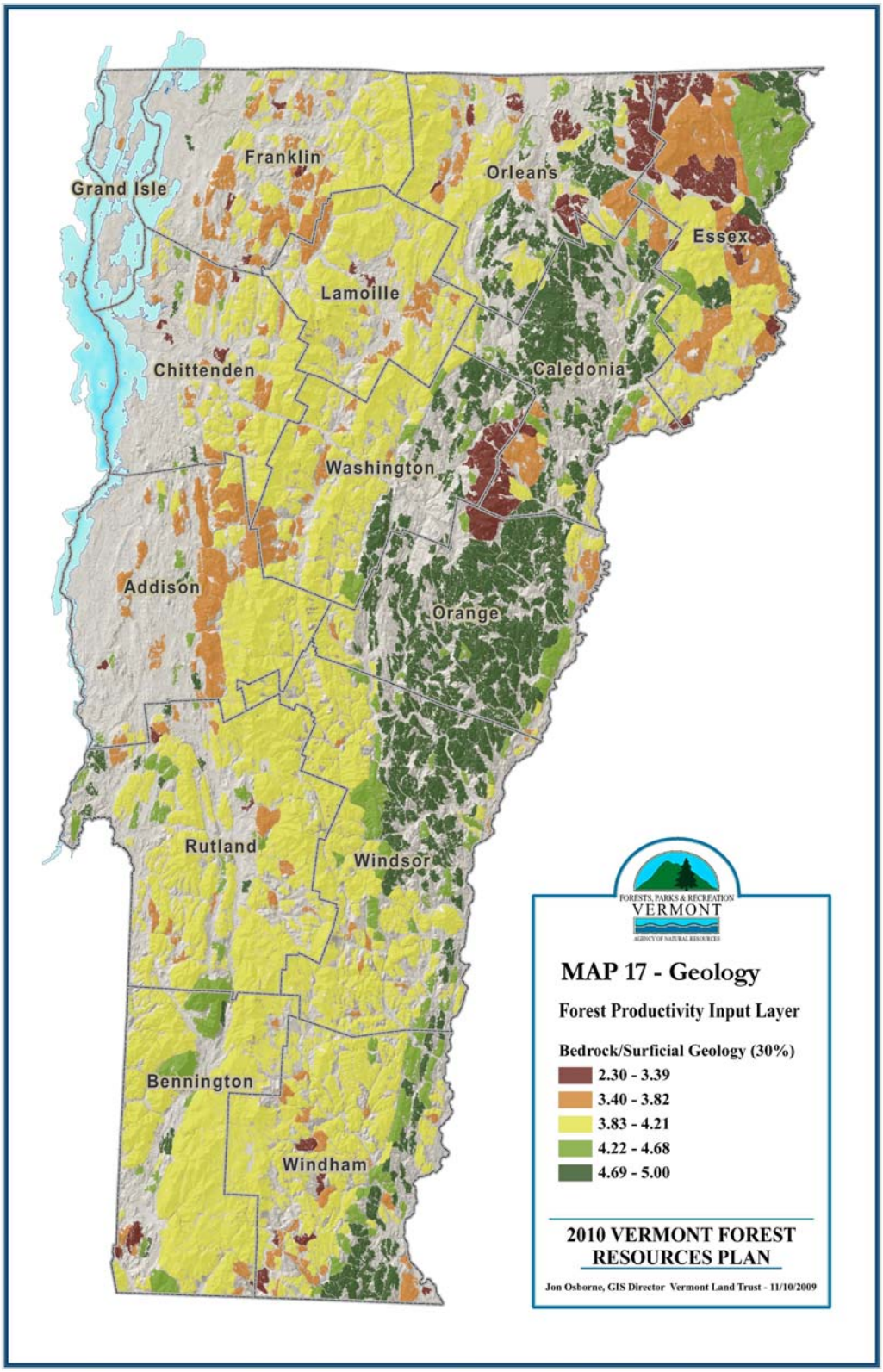
Map 15: Forest UVA Parcels for Washington County

Links to text: Use Value Appraisal

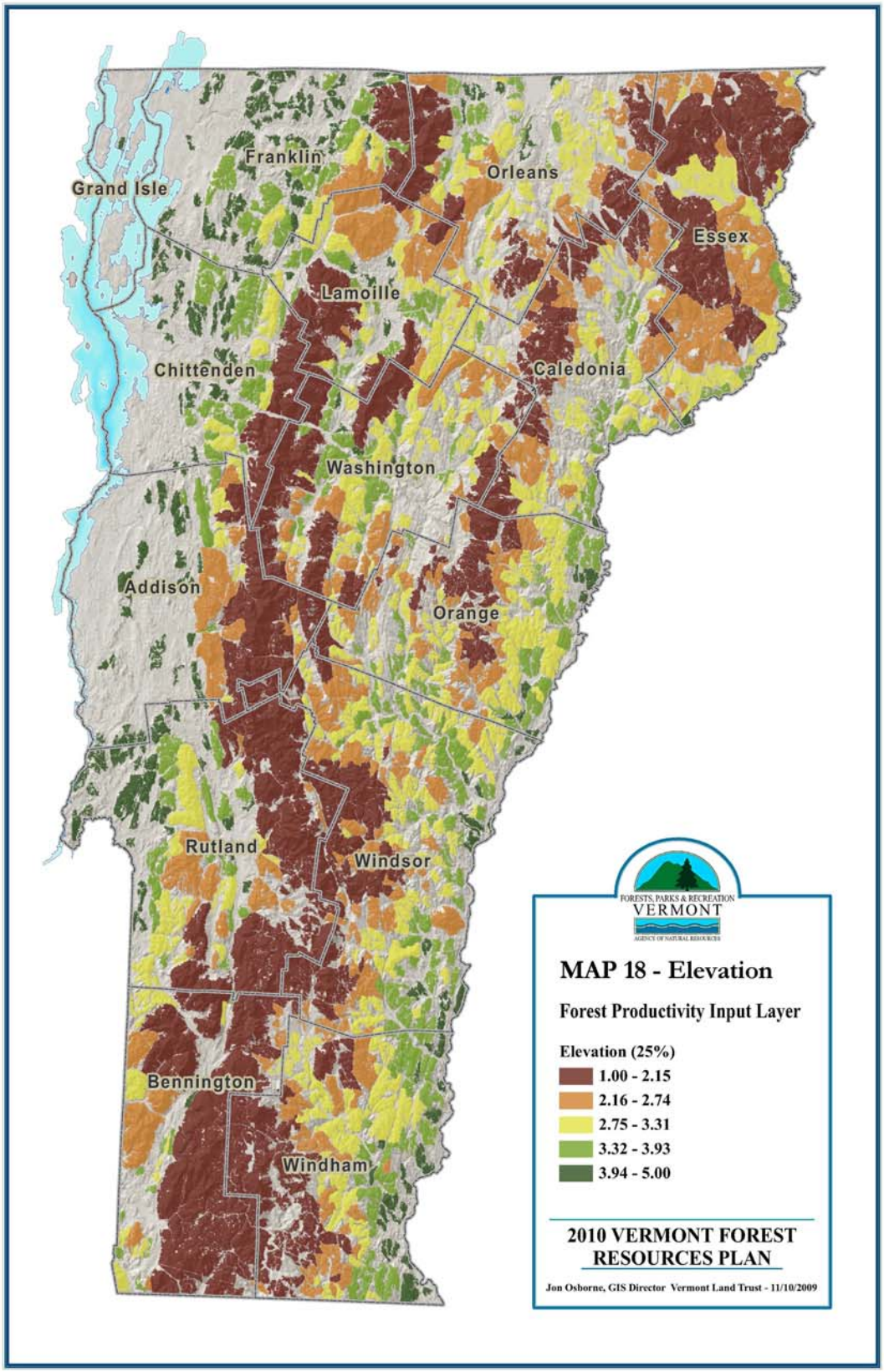


Map 16: Forest Productivity

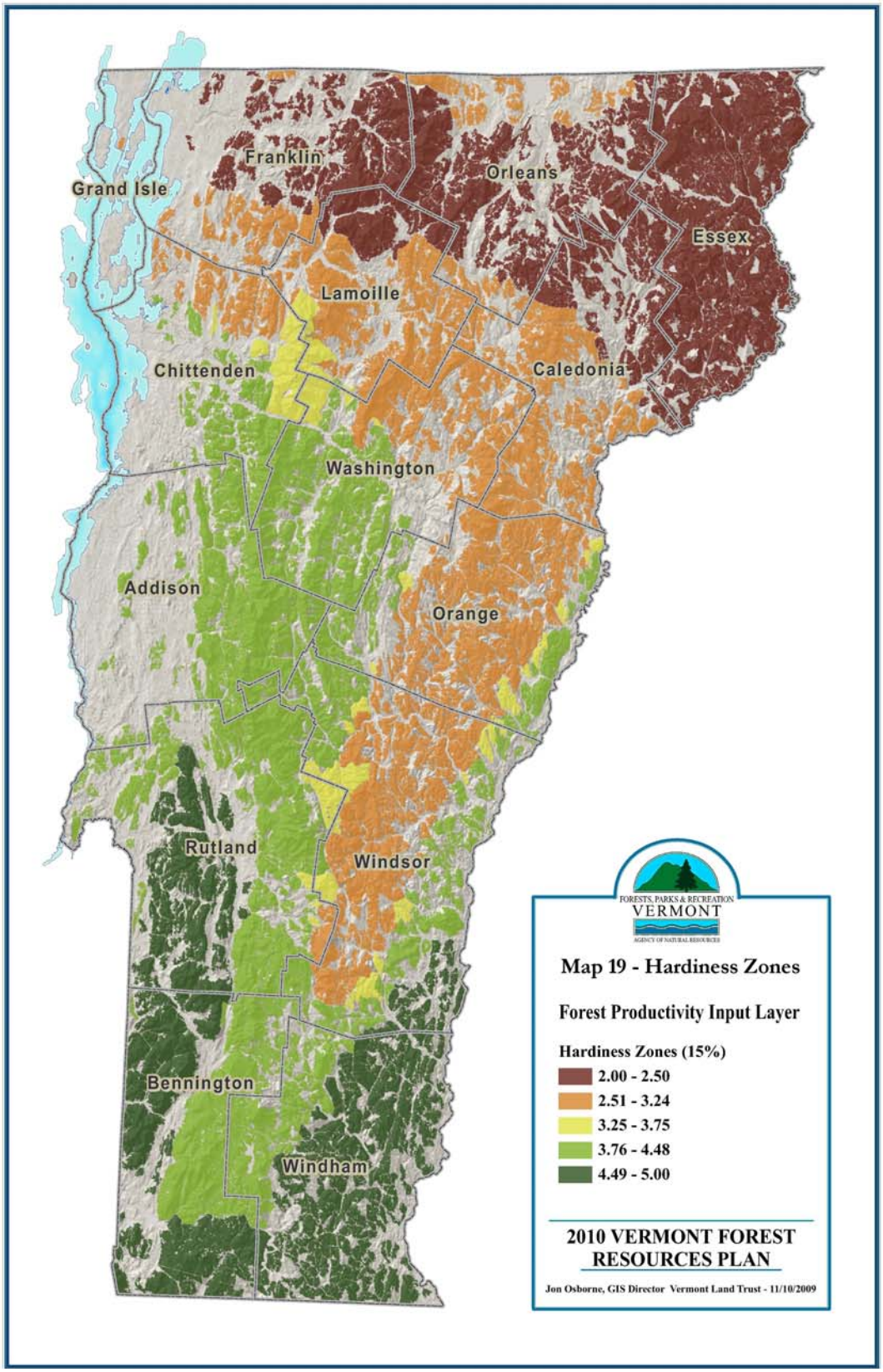
Links to text: Rural Residential Landscape Zone, Rural Landscape Zone, Forest Productivity



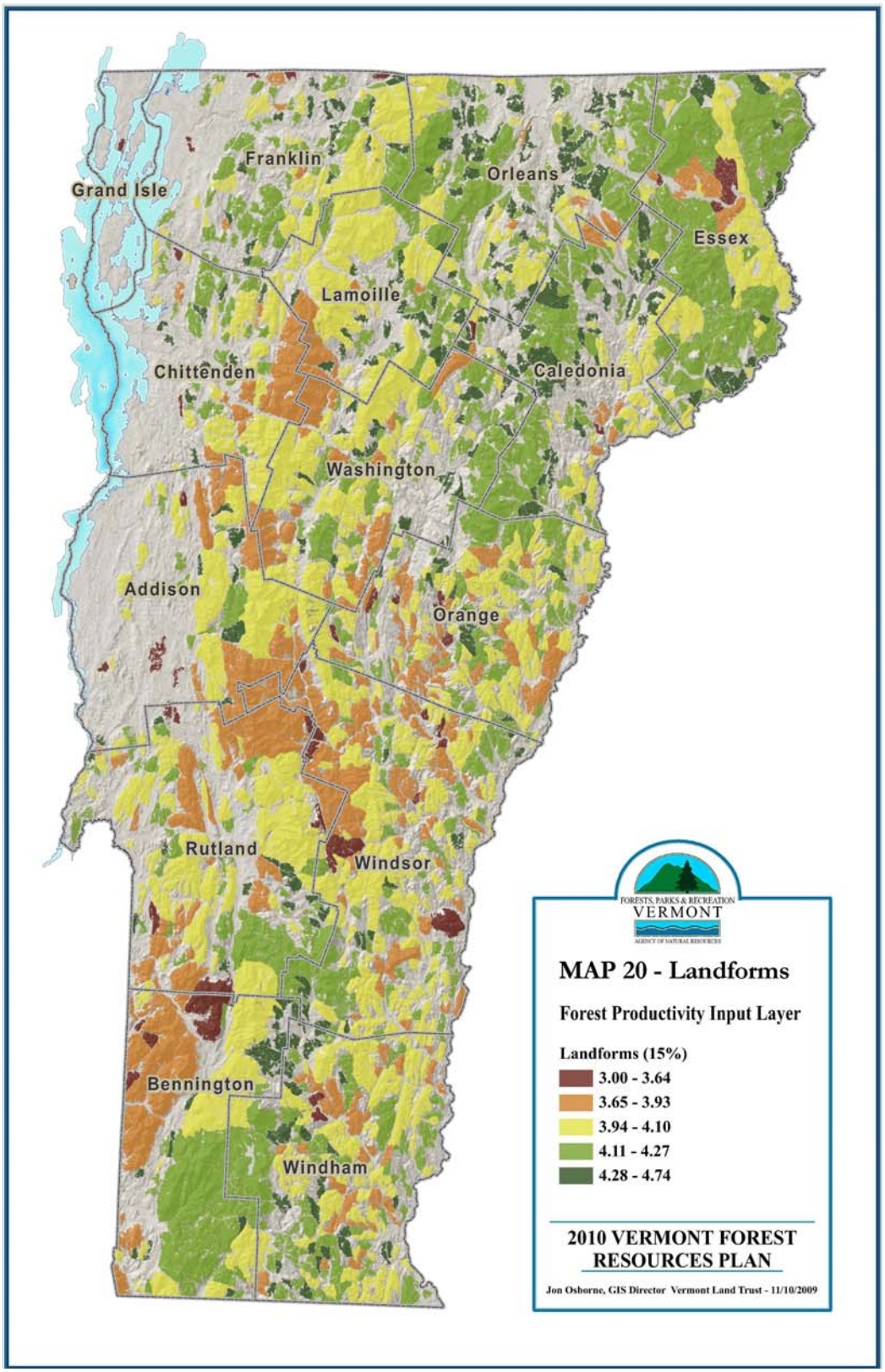
Map 17: Forest Productivity Input Layer: Geology



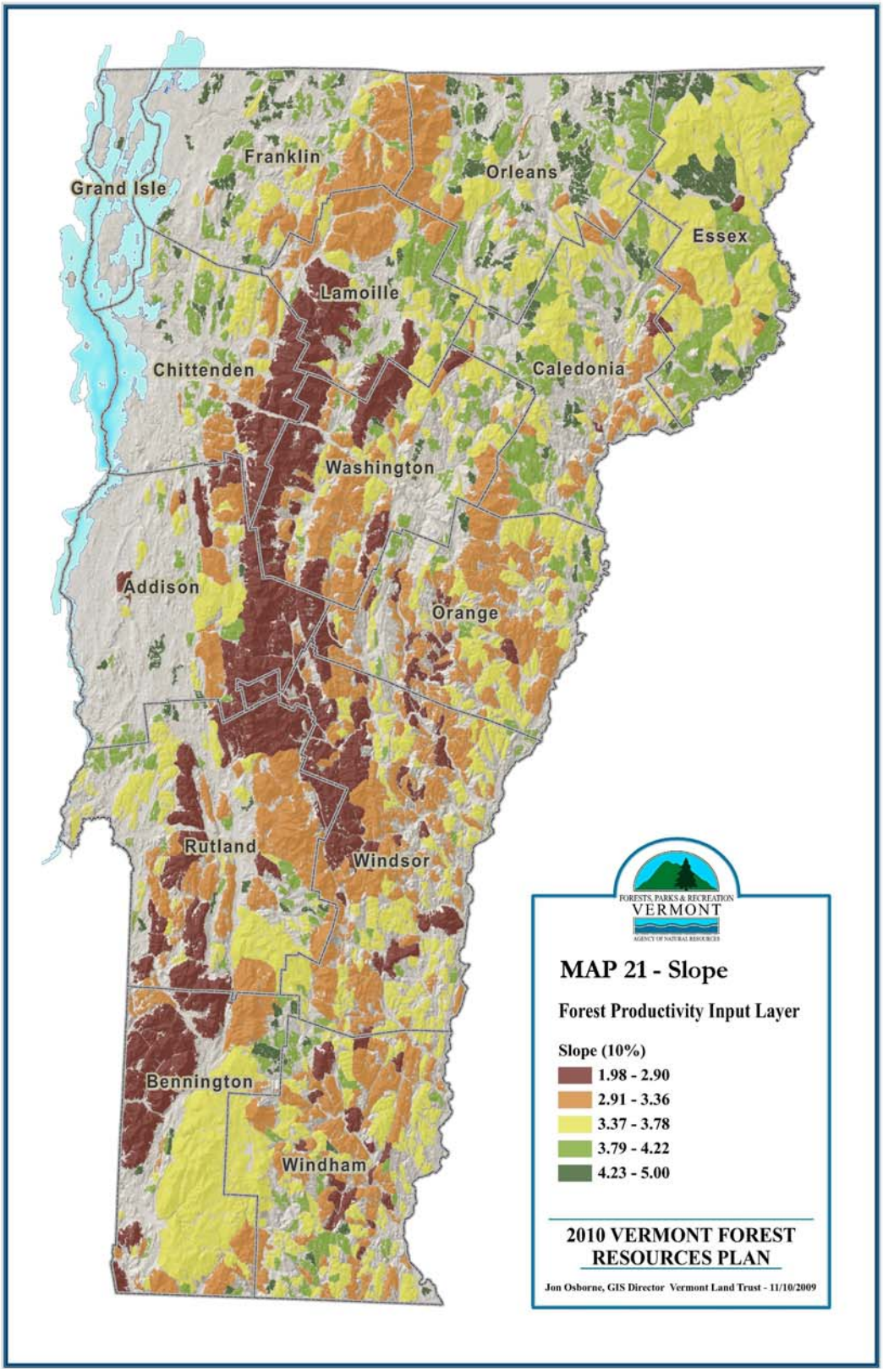
Map 18: Forest Productivity Input Layer: Elevation



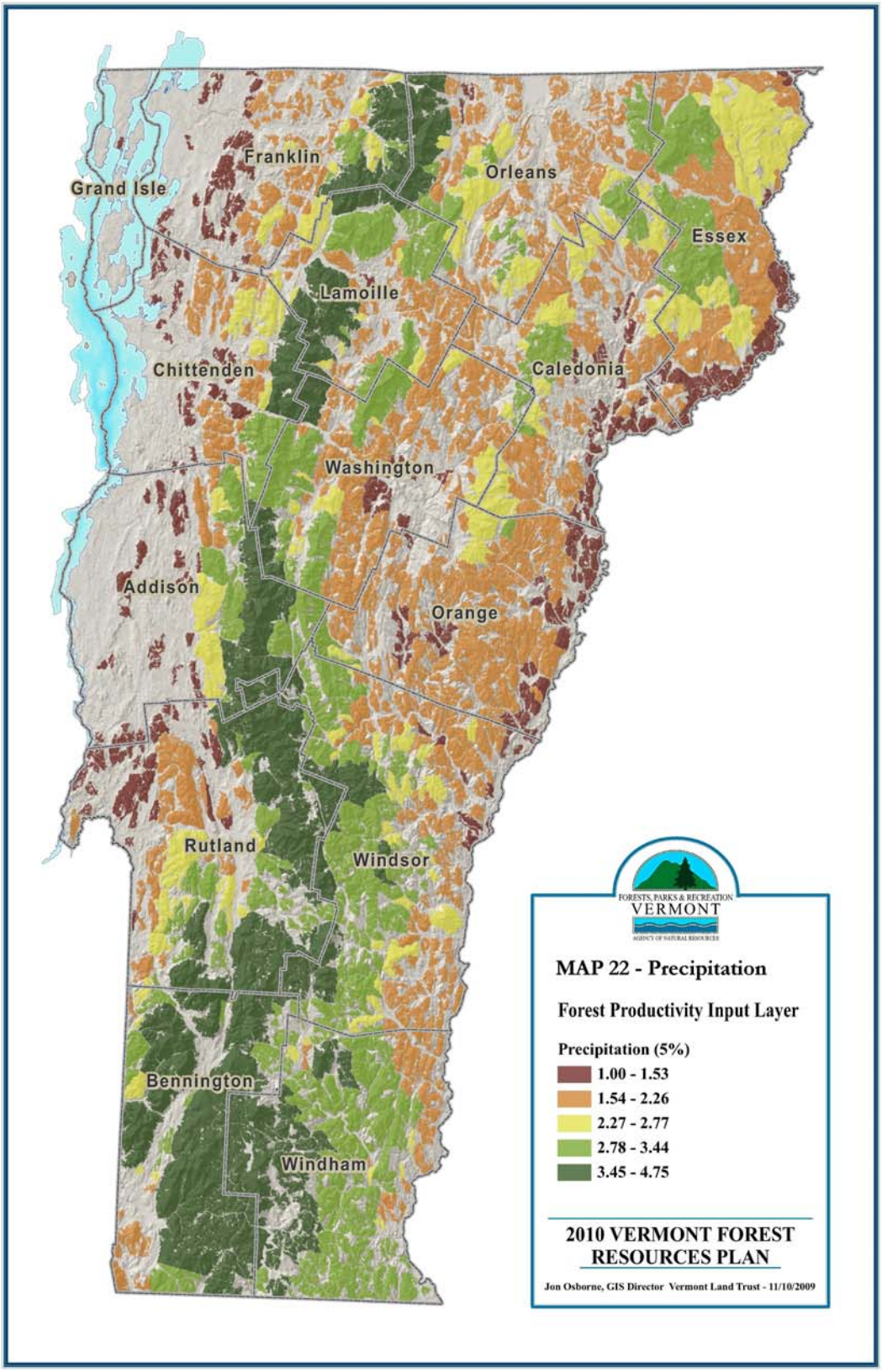
Map 19: Forest Productivity Input Layer: Hardiness Zones



Map 20: Forest Productivity Input Layer: Landforms



Map 21: Forest Productivity Input Layer: Slope

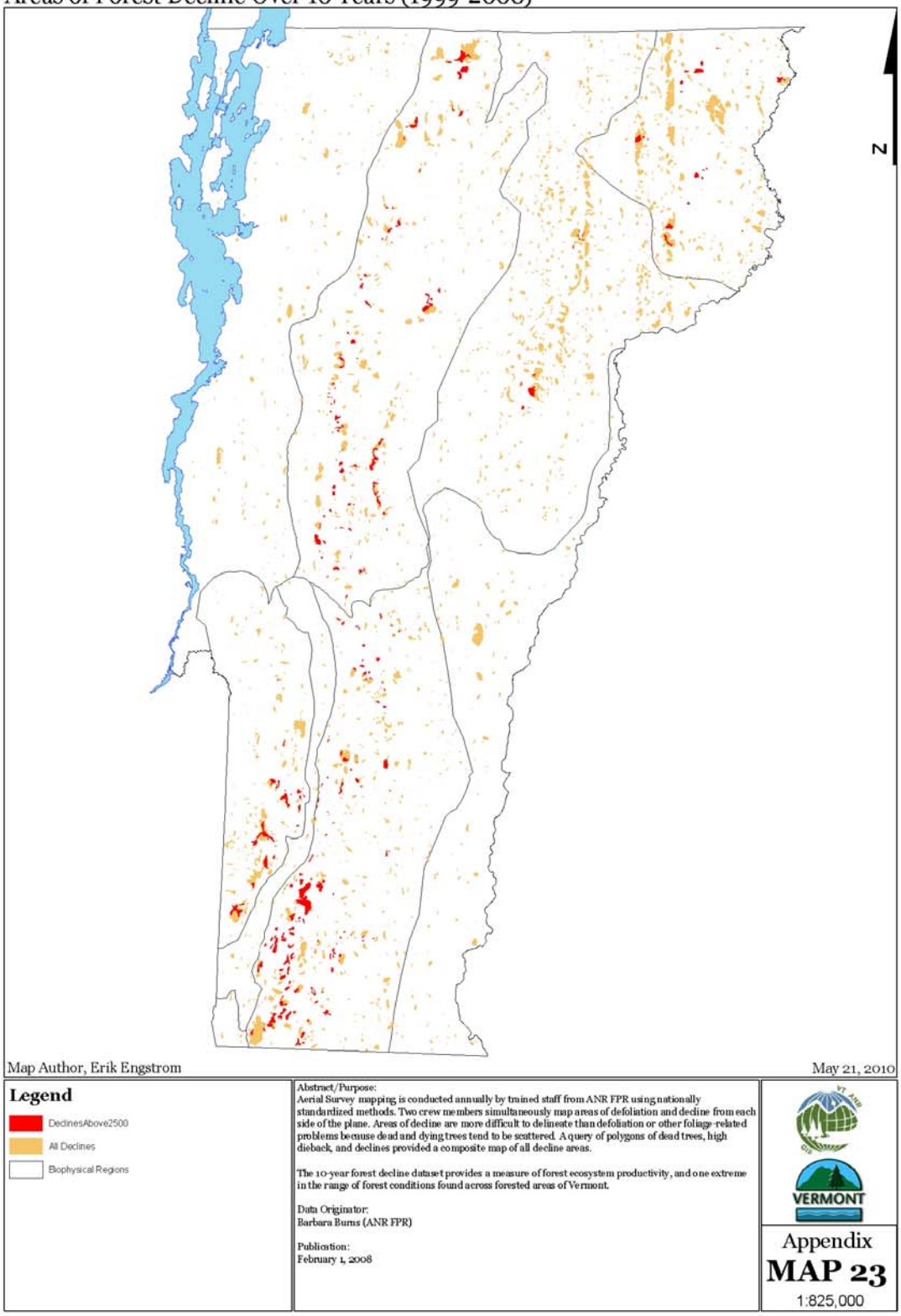


Map 22: Forest Productivity Input Layer: Precipitation

2010 Vermont Forest Resource Plan

Department of Forests, Parks, and Recreation. Division of Forestry.

Areas of Forest Decline Over 10 Years (1999-2008)



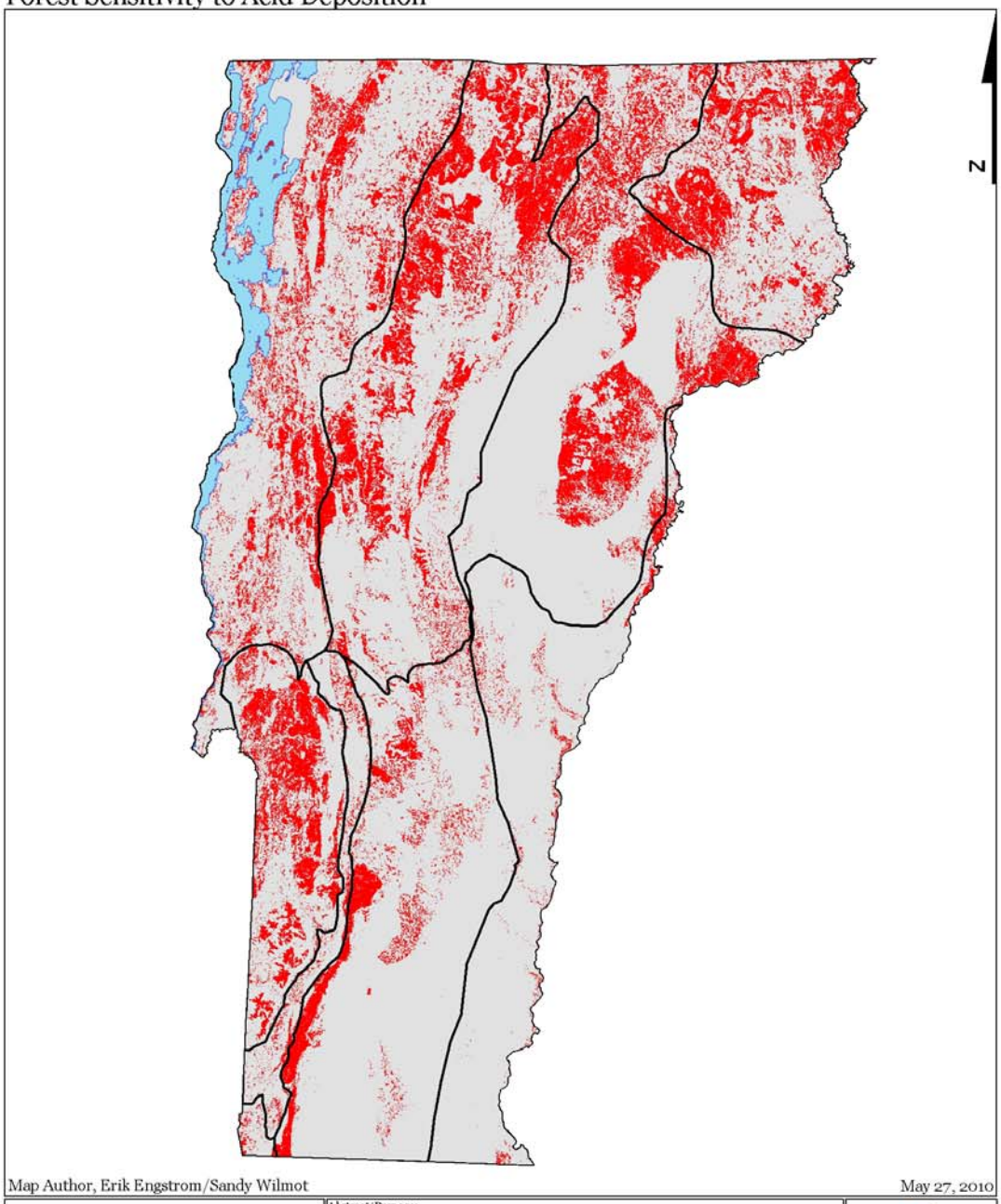
Map 23: Areas of Forest Decline Over 10 Years

Links to text: Forest Productivity, Natural Disturbances

2010 Vermont Forest Resource Plan

Department of Forests, Parks, and Recreation. Division of Forestry.

Forest Sensitivity to Acid Deposition



Map Author, Erik Engstrom/Sandy Wilmot

May 27, 2010

Legend

- Biophysical Regions
- Low Sensitivity
- High Sensitivity

Abstract/Purpose:
Forest health and productivity are dependent on soil fertility, which can be compromised due to acid deposition leaching. This map captures current understanding of areas where forest health may be compromised due to acid deposition effects.

This modeling approach used an ecological assessment of acceptable levels of deposition based on a steady-state, ecosystem mass balance for nutrient cations (NEG/ECPFMG, 2001). The *critical load* of sulfur + nitrogen, which is the level of deposition below which no harmful ecological effects occur in a forest ecosystem, was developed first, using forest nutrient demand associated with growth after harvest, and soil mineral weathering rates. Then a *deposition index* was calculated to reflect the difference between the critical load and current deposition and is used to identify sensitive forest ecosystems. This map provides the results of the "deposition index", those areas highly sensitive to acid deposition. More details can be found in the online report: http://www.ecosystems-research.com/fmi/NH-Forest-Mapping-Report-2005-12-15.pdf

Data Originator:
Eric Miller, Ecosystems-research, Inc

Publication:
Dec. 15, 2005

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Appendix
MAP 24
1:850,000

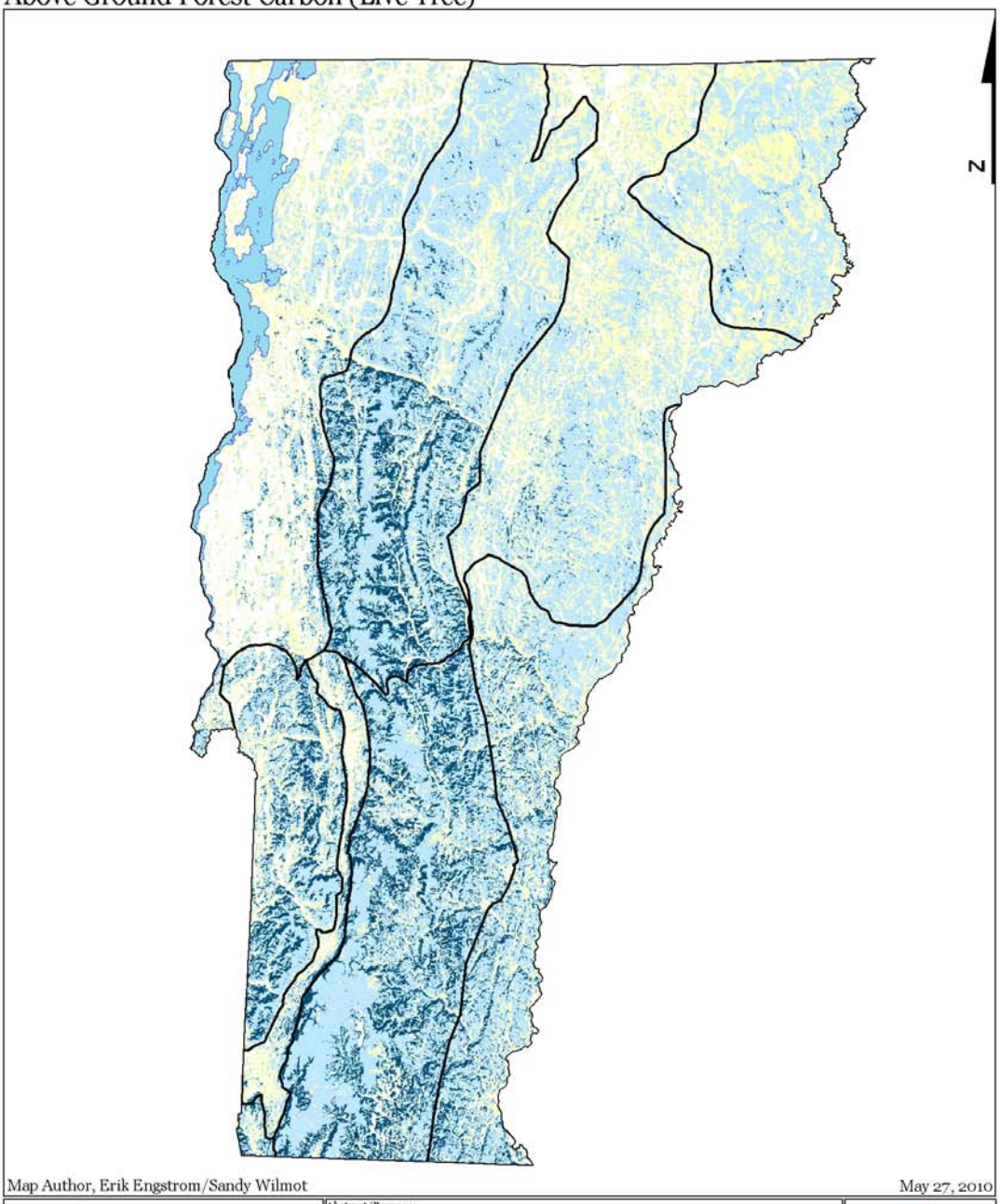
Map 24: Forest Sensitivity to Acid Deposition

Links to text: Priority Areas and Issues, Forest Productivity, Acid Deposition

2010 Vermont Forest Resource Plan

Department of Forests, Parks, and Recreation. Division of Forestry.

Above Ground Forest Carbon (Live Tree)



Map Author, Erik Engstrom/Sandy Wilmot

May 27, 2010

Legend

Biophysical Regions

Above Ground Forest Carbon (Live Tree)

0

Low

Medium

High

Abstract/Purpose:
Forest carbon sequestration and storage are important factors in accomplishing Vermont's targeted goals for greenhouse gas reductions (Gov. Climate Change Commission Report, 2007). This map will be used to aid in the development of strategies to increase the role of forests in mitigating GHG, such as identifying areas of high carbon storage where conservation measures can be used, as well as areas of low carbon storage where forest management may improve above ground storage.

Data Originator:
Woods Hole Research Center
Project funded under NASA's Terrestrial Ecology Program and titled "The National Biomass and Carbon Dataset 2000 (NBCD 2000): A High Spatial Resolution Baseline to Reduce Uncertainty in Carbon Accounting and Flux Modeling."

Publication:
2000

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Appendix
MAP 25
1:850,000

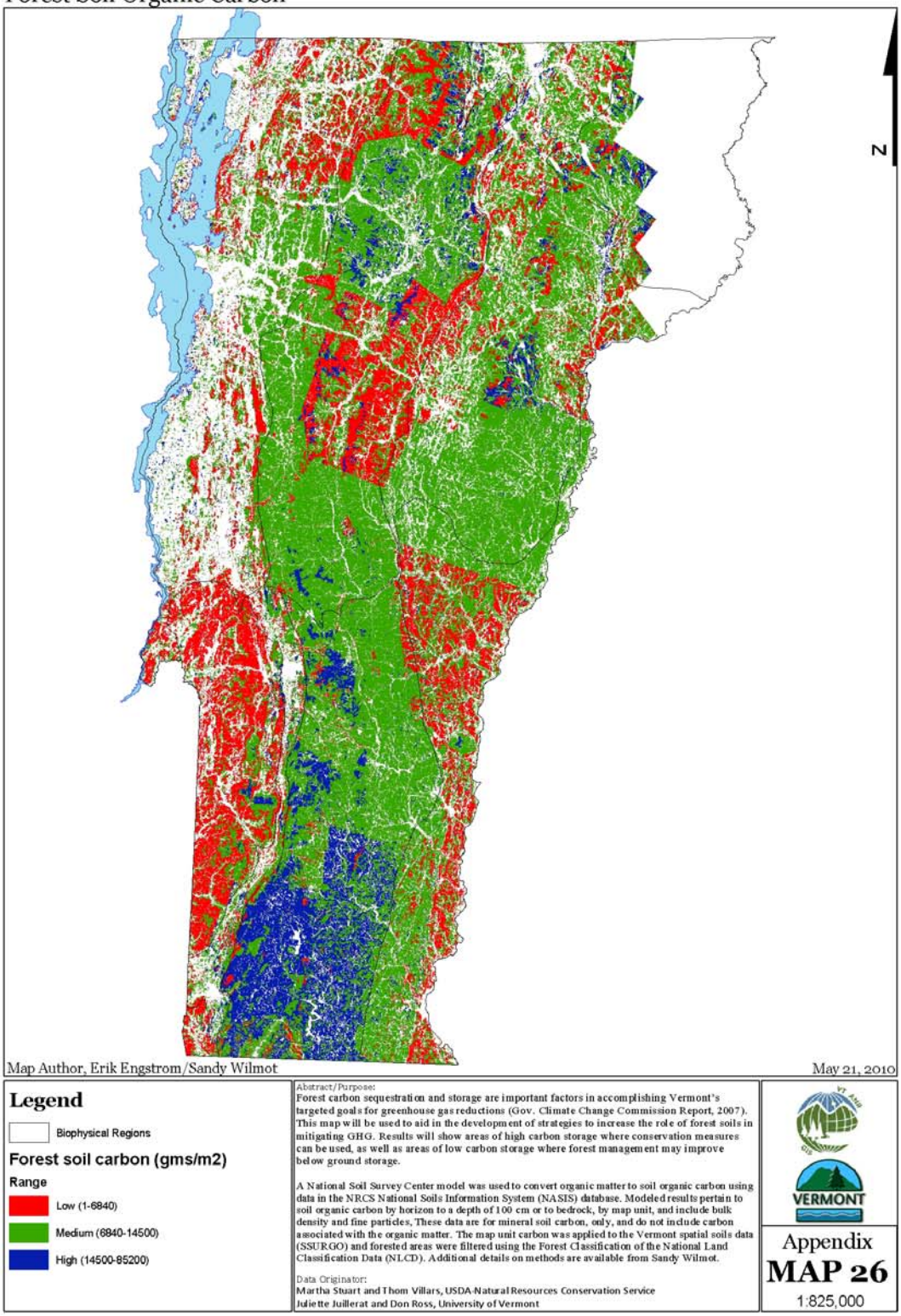
Map 25: Above Ground Forest Carbon (Live Tree)

Links to text: Forest Productivity, Climate Change, Carbon Sequestration and Storage

2010 Vermont Forest Resource Plan

Department of Forests, Parks, and Recreation. Division of Forestry.

Forest Soil Organic Carbon



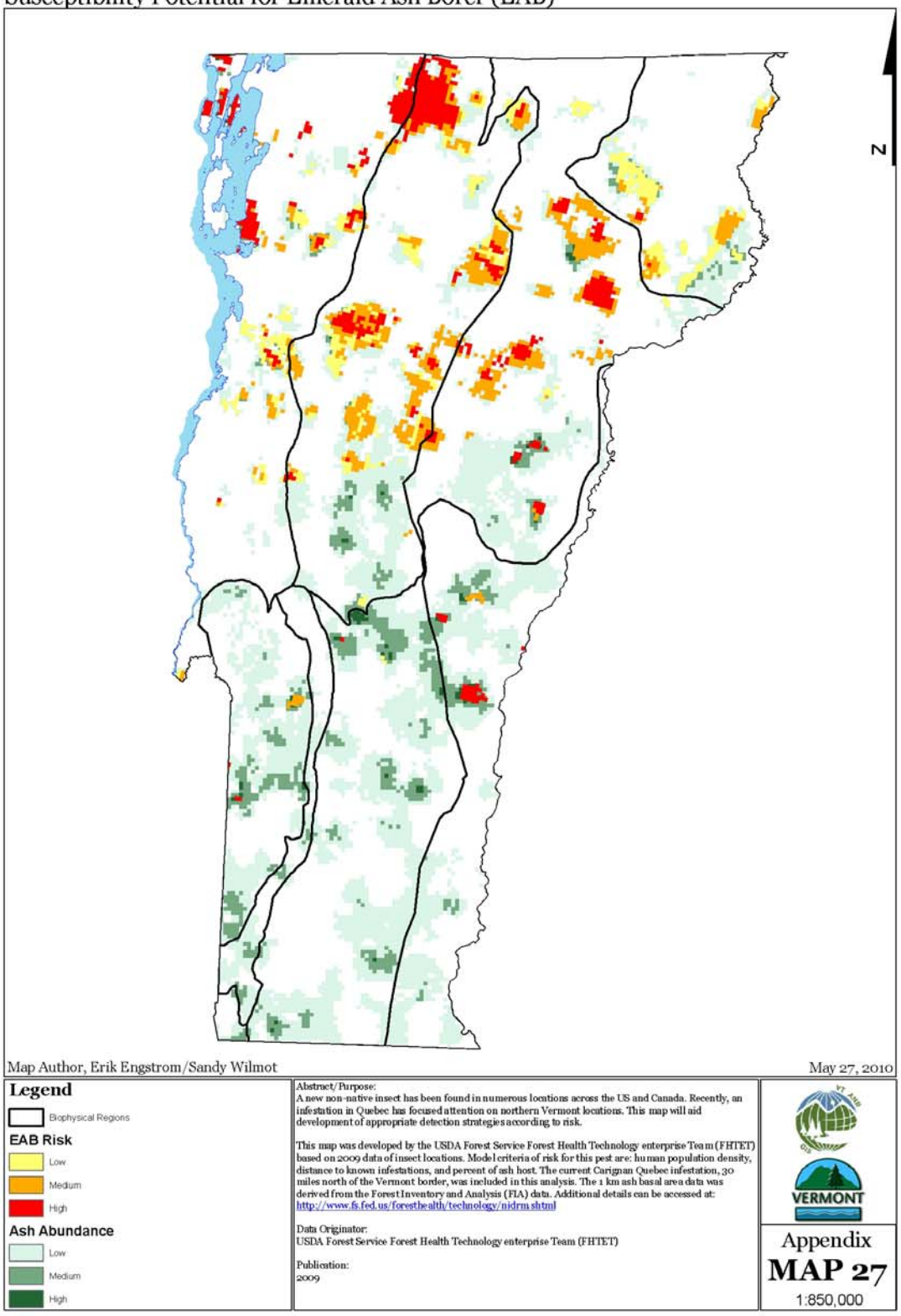
Map 26: Forest Soil Organic Carbon

Links to text: Forest Productivity, Climate Change, Carbon Sequestration and Storage

2010 Vermont Forest Resource Plan

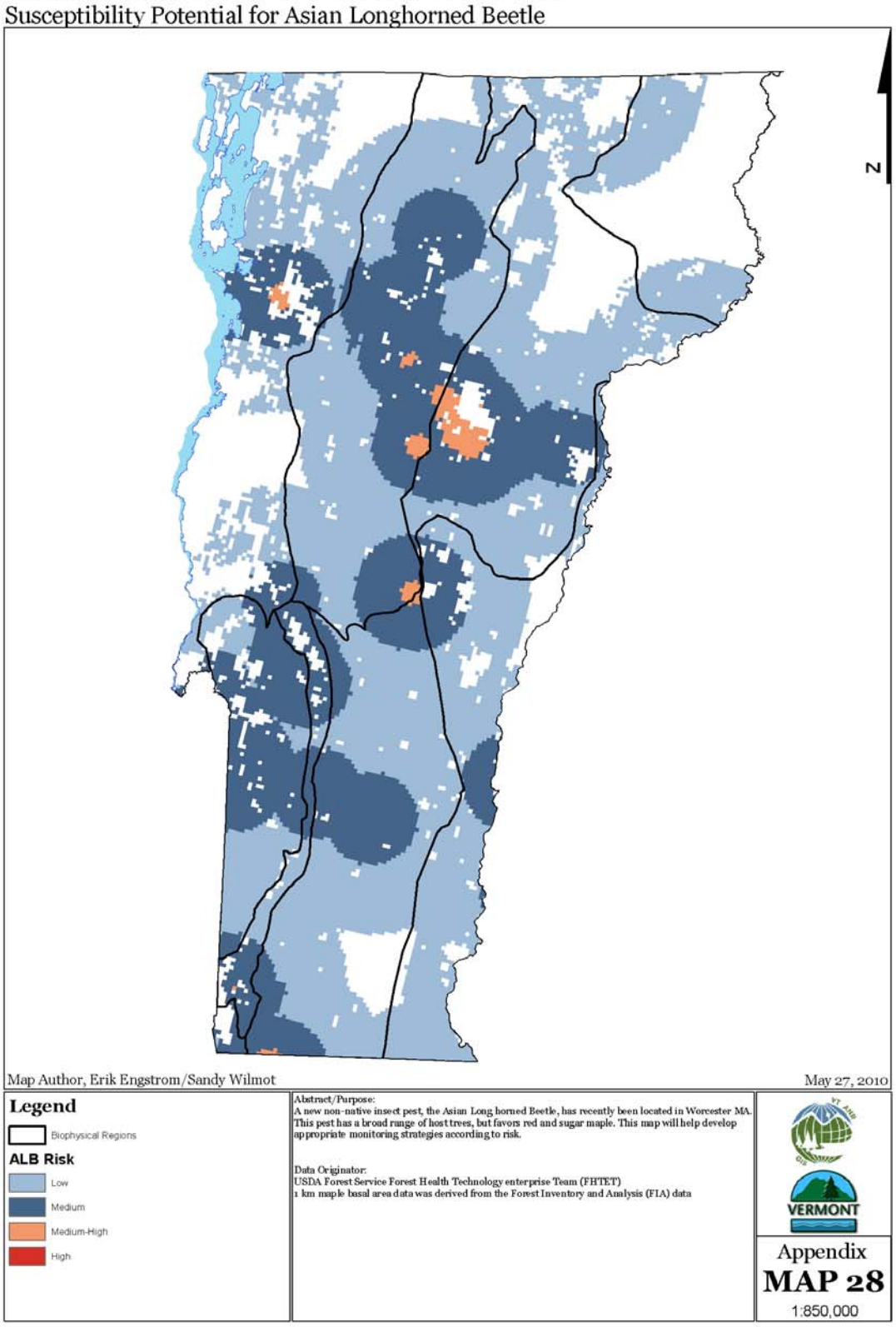
Department of Forests, Parks, and Recreation. Division of Forestry.

Susceptibility Potential for Emerald Ash Borer (EAB)



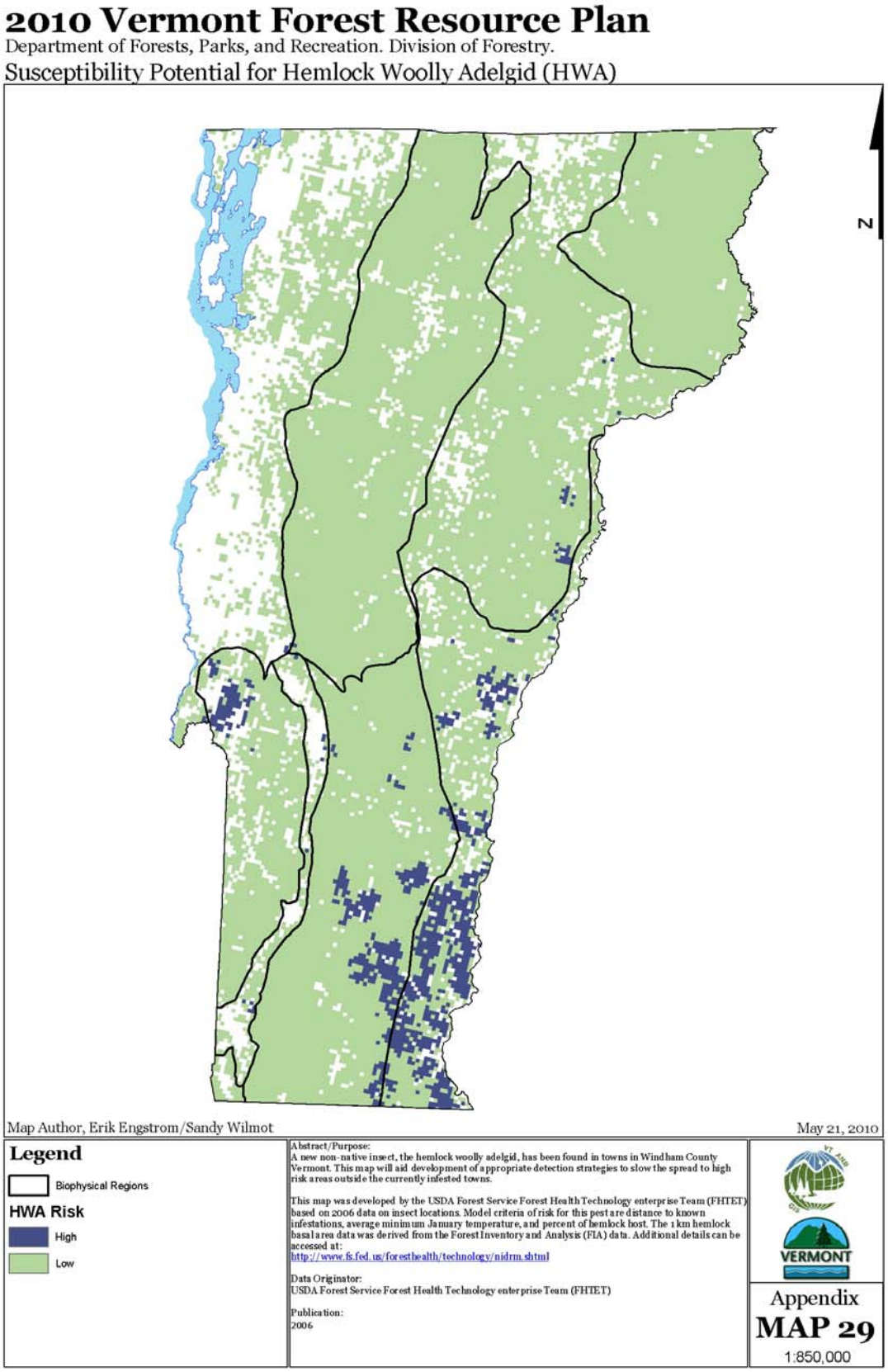
Map 27: Susceptibility Potential for Emerald Ash Borer

Links to text: Priority Areas and Issues, Non-Native Invasive Species



Map 28: Susceptibility Potential for Asian Longhorned Beetle

Links to text: Priority Areas and Issues, Non-Native Invasive Species



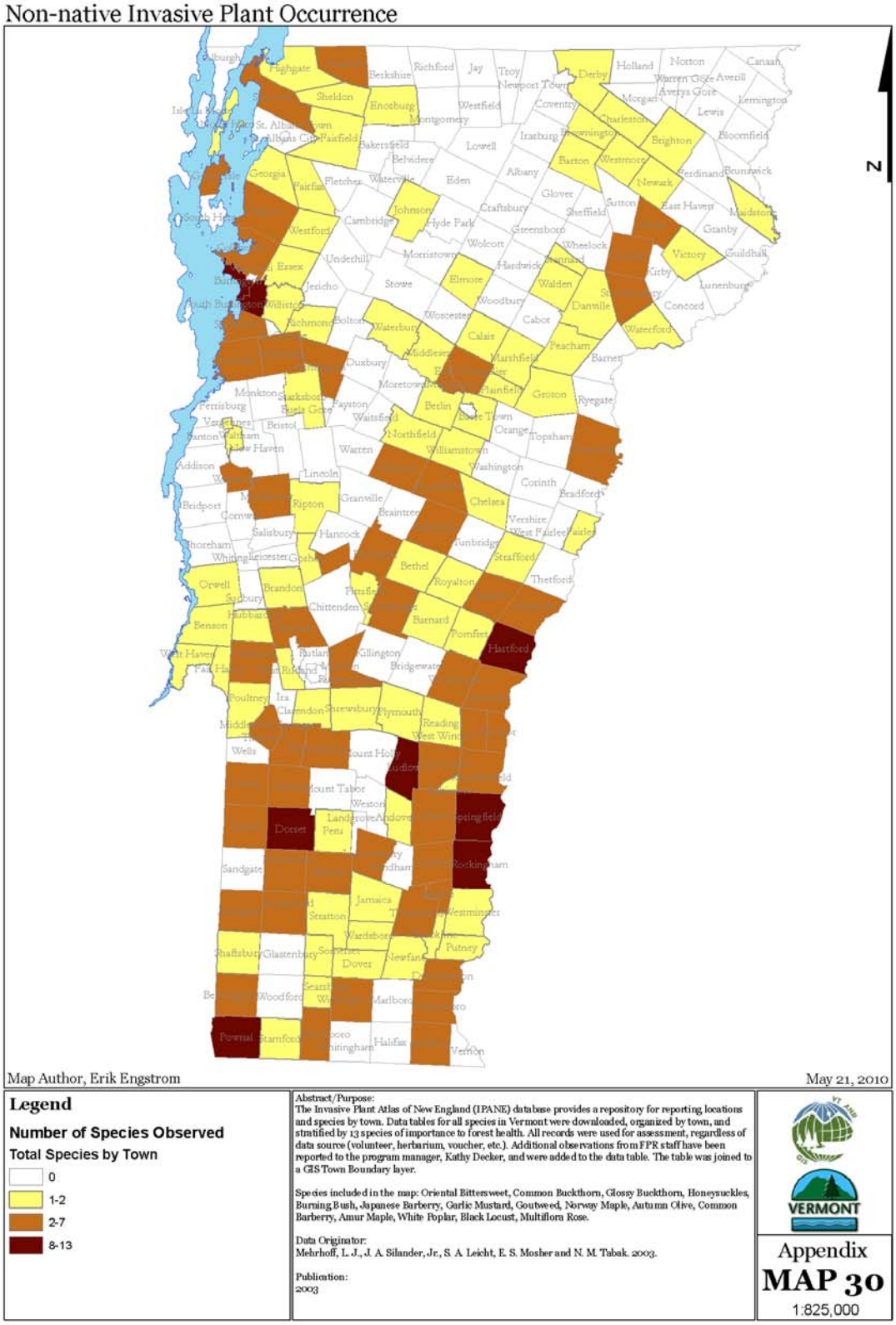
Map 29: Susceptibility Potential for Hemlock Woolly Adelgid

Links to text: Priority Areas and Issues, Non-Native Invasive Species

2010 Vermont Forest Resource Plan

Department of Forests, Parks, and Recreation. Division of Forestry.

Non-native Invasive Plant Occurrence



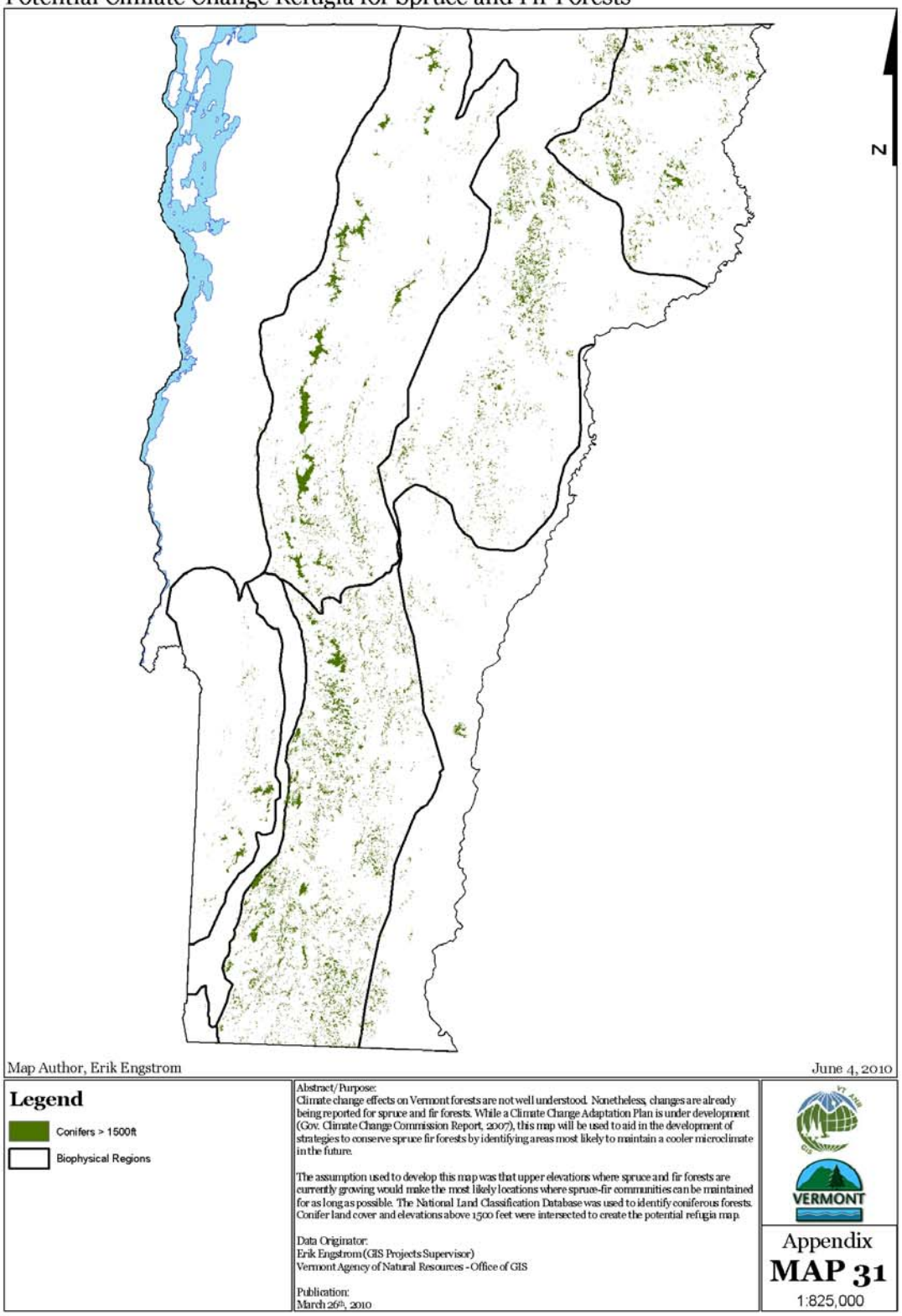
Map 30: Non-native Invasive Plant Occurrence

Links to text: Priority Areas and Issues, Non-Native Invasive Species

2010 Vermont Forest Resource Plan

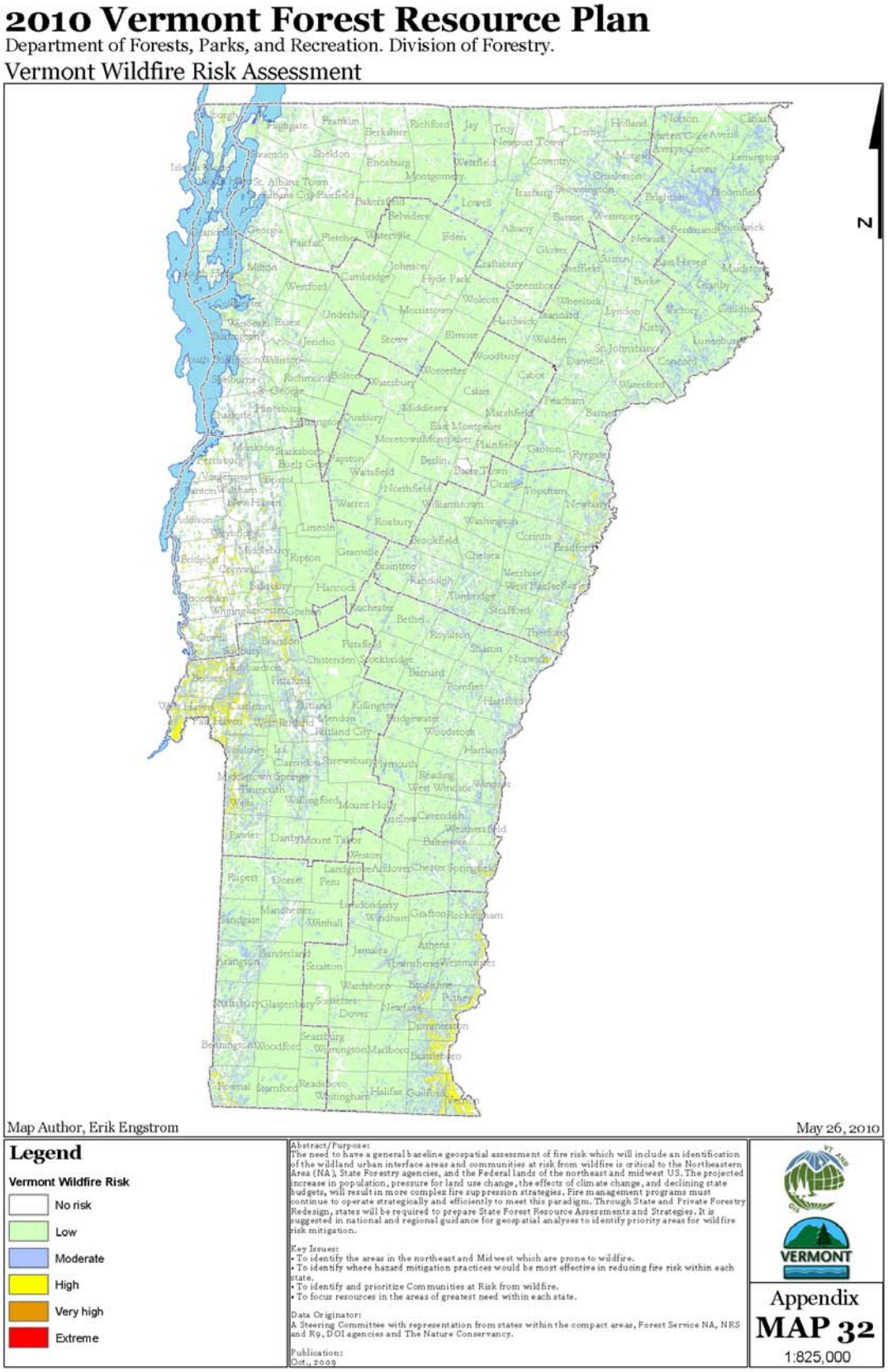
Department of Forests, Parks, and Recreation. Division of Forestry.

Potential Climate Change Refugia for Spruce and Fir Forests



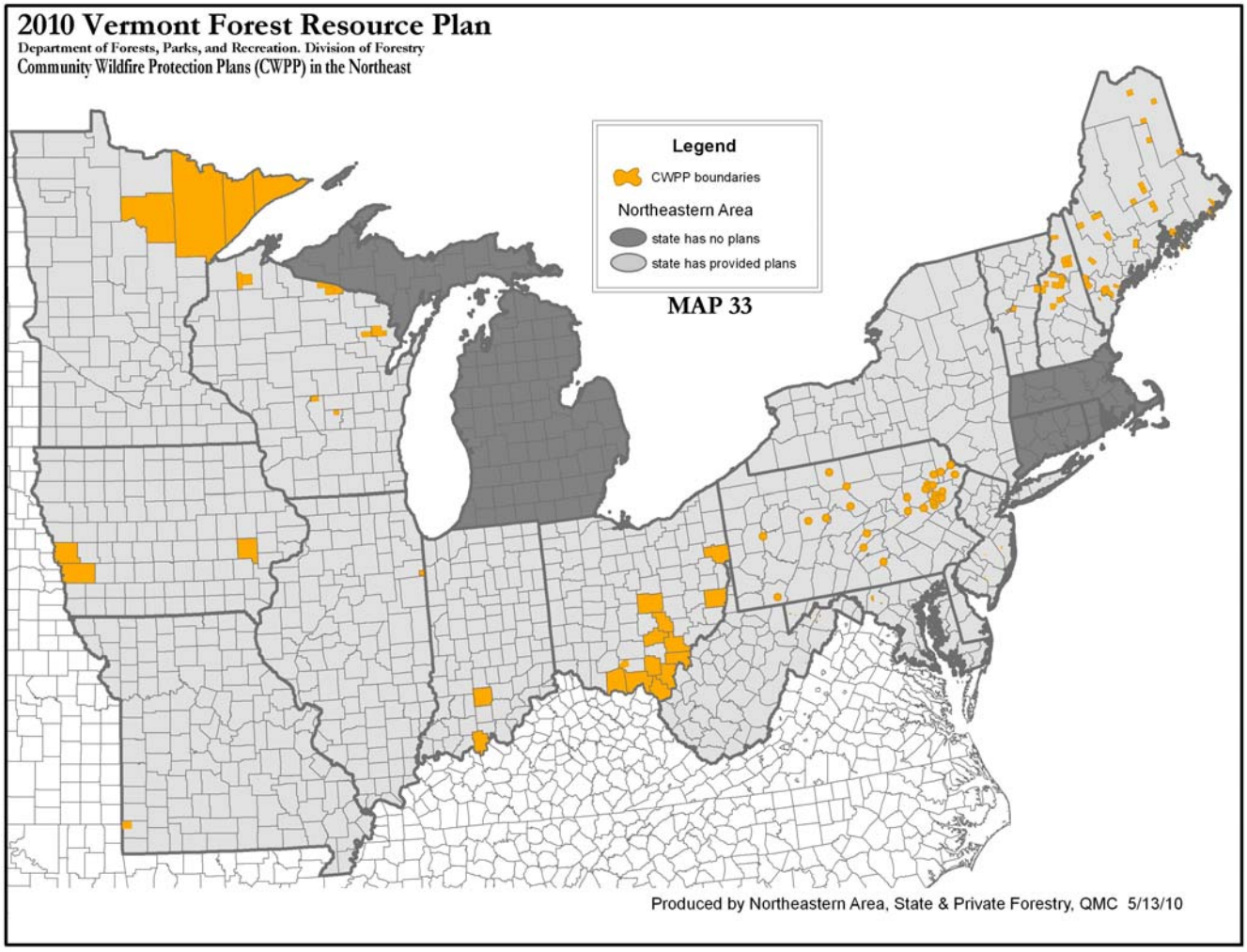
Map 31: Potential Climate Change Refugia

Links to text: Priority Areas and Issues, Climate Change, Carbon Sequestration and Storage



Map 32: Vermont Wildfire Risk Assessment

Links to text: Priority Areas and Issues, Forest Health Management



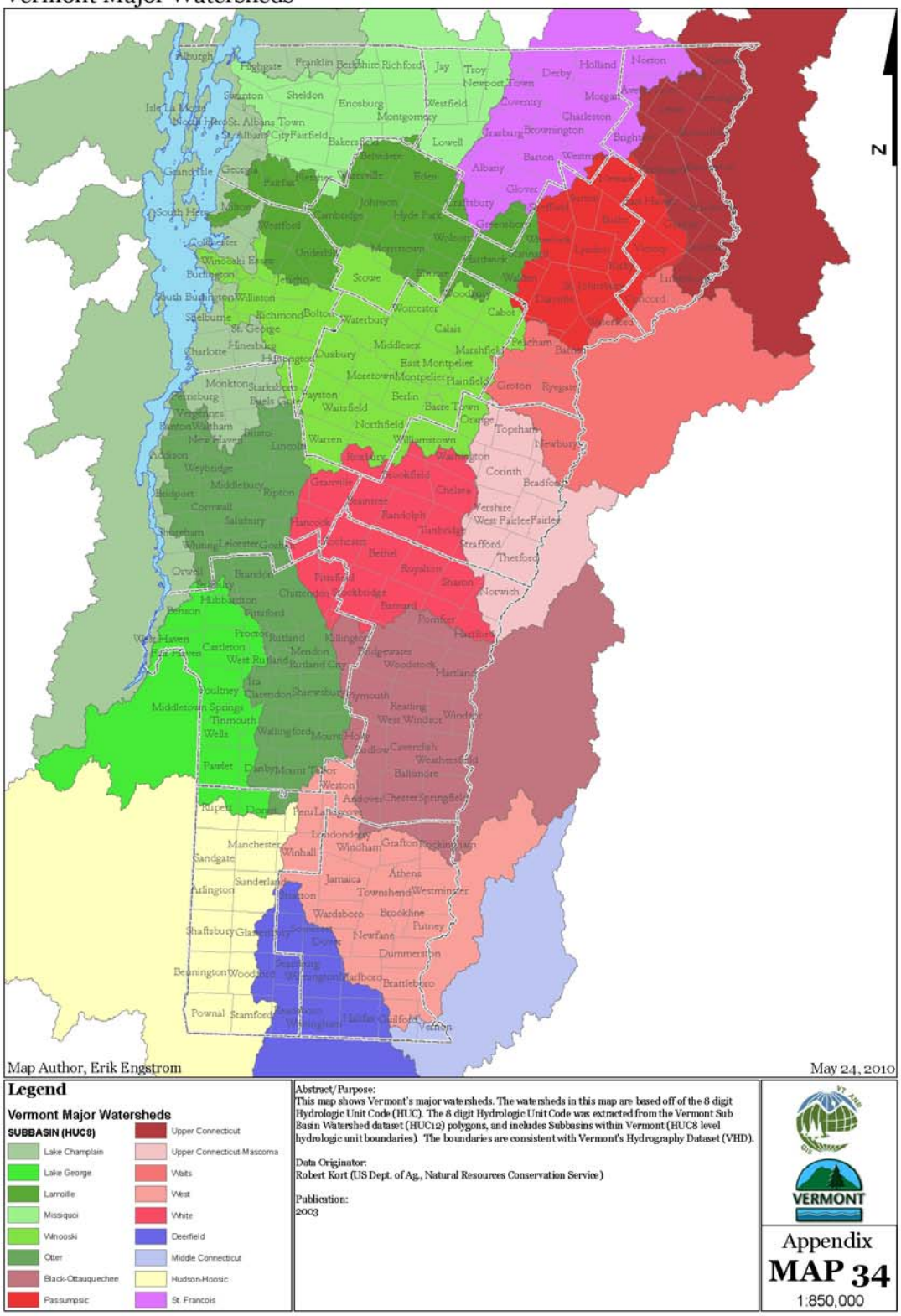
Map 33: Community Wildfire Protection Plans in the Northeast

Links to text: Forest Health Management

2010 Vermont Forest Resource Plan

Department of Forests, Parks, and Recreation. Division of Forestry.

Vermont Major Watersheds



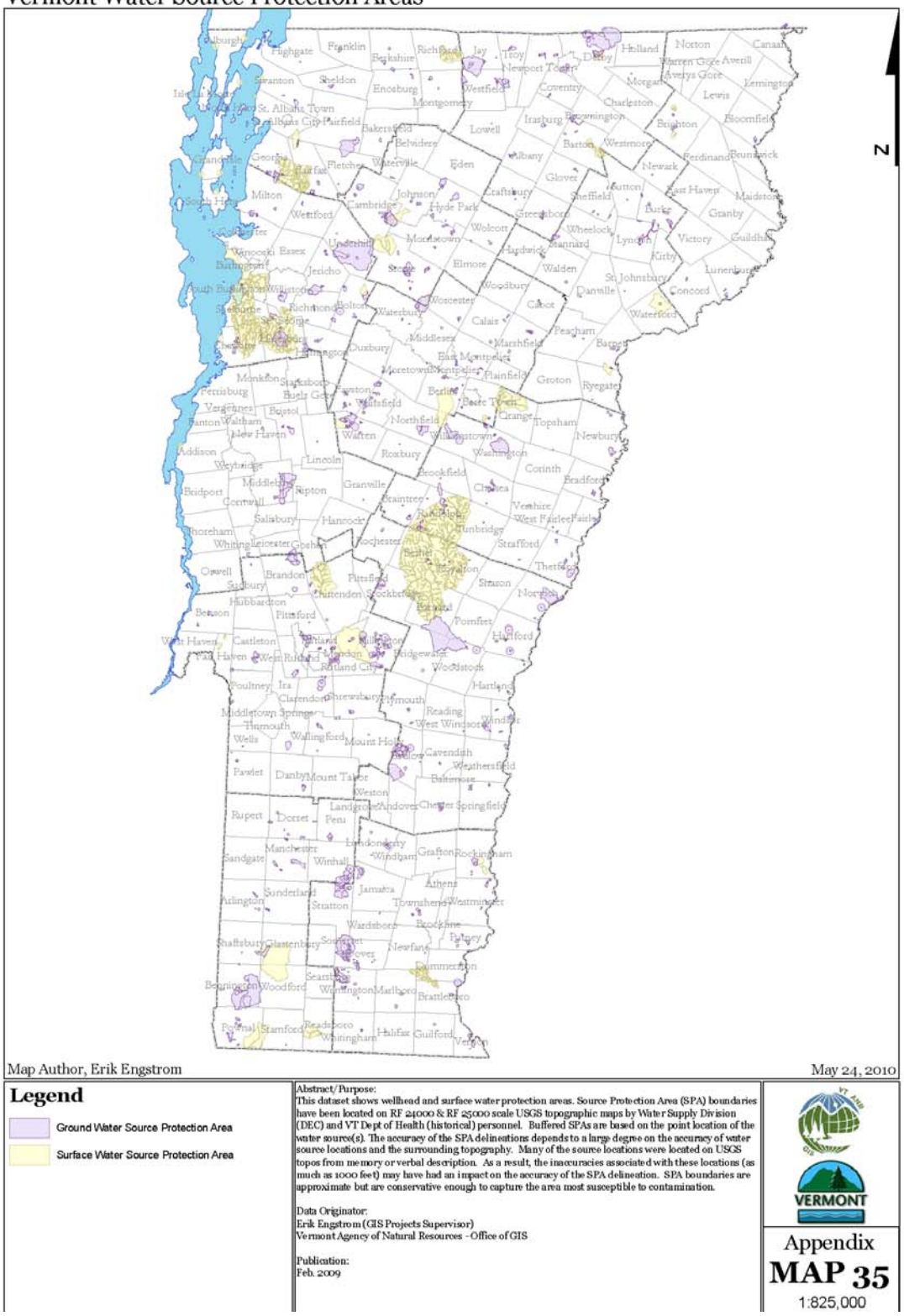
Map 34: Vermont Major Watersheds

Links to text: Water Quality

2010 Vermont Forest Resource Plan

Department of Forests, Parks, and Recreation. Division of Forestry.

Vermont Water Source Protection Areas



Map 35: Water Source Protection Areas

Links to text: Rural Residential Landscape Zone, Priority Areas and Issues, Water Quality

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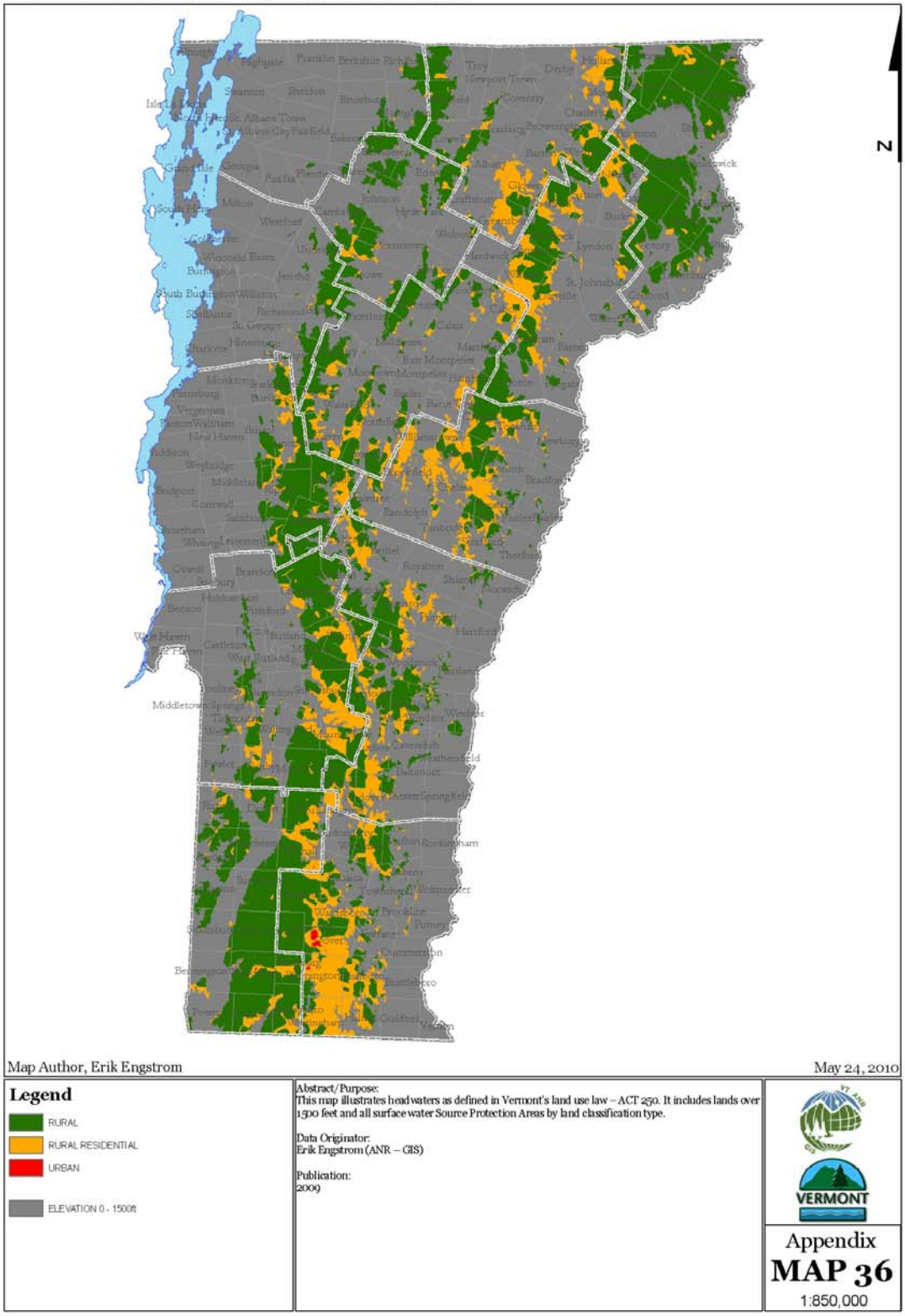
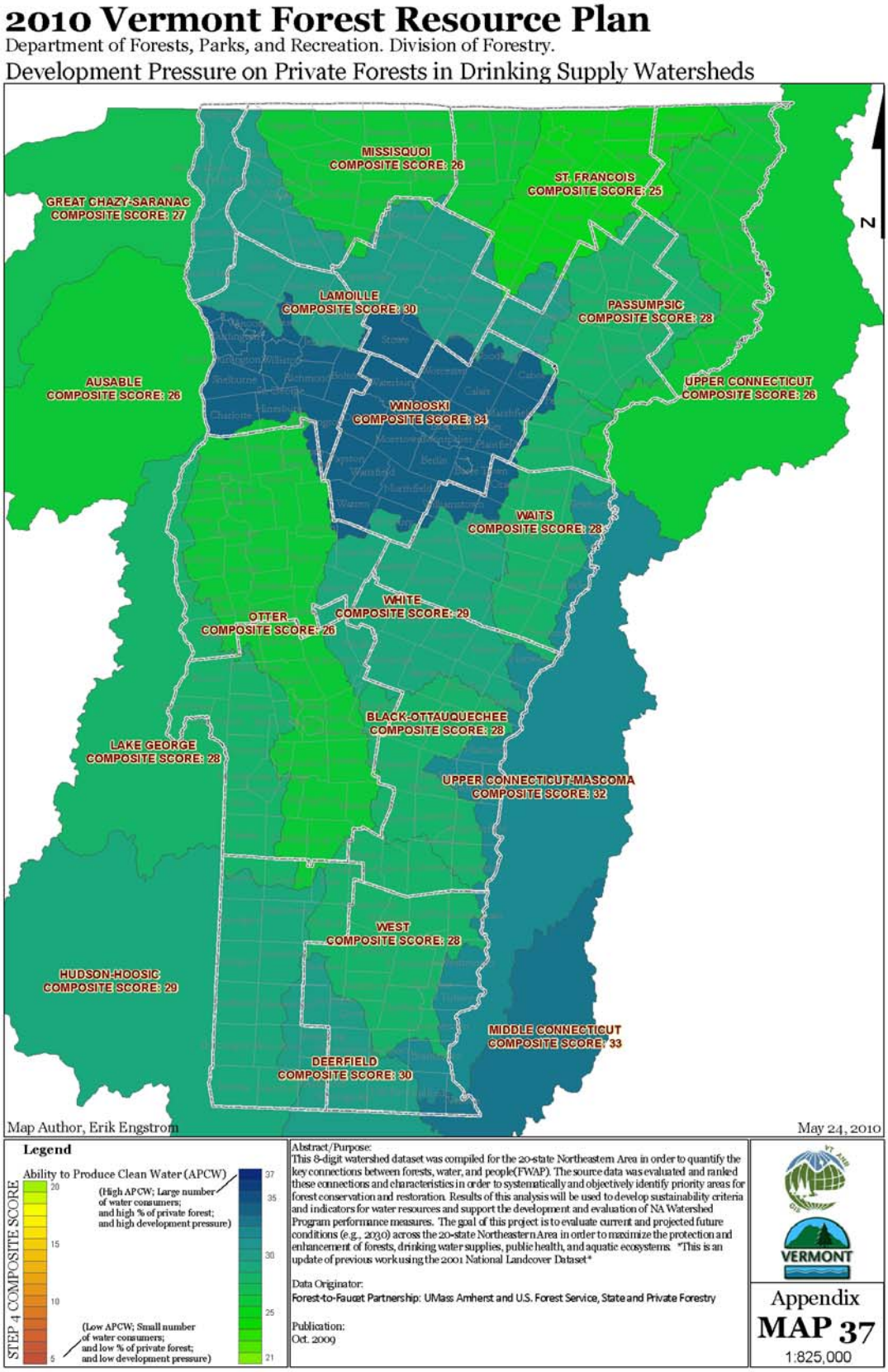
Land Classification of Vermont Headwaters



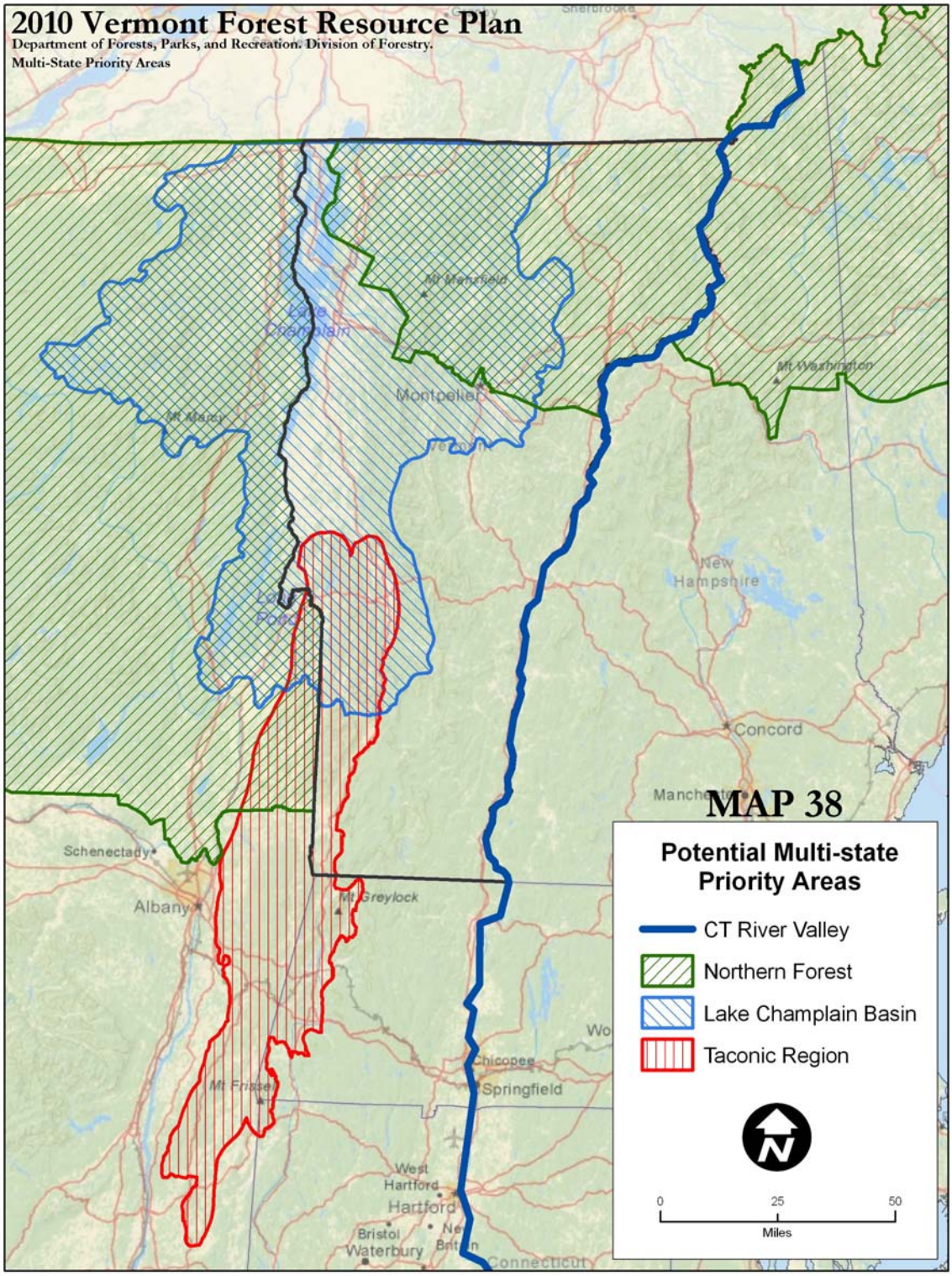
Map 36: Land Classification of Vermont Headwaters

Links to text: Rural Landscape Zone, Priority Areas and Issues, Water Quality, Regulatory Protection of Forest Water Resources



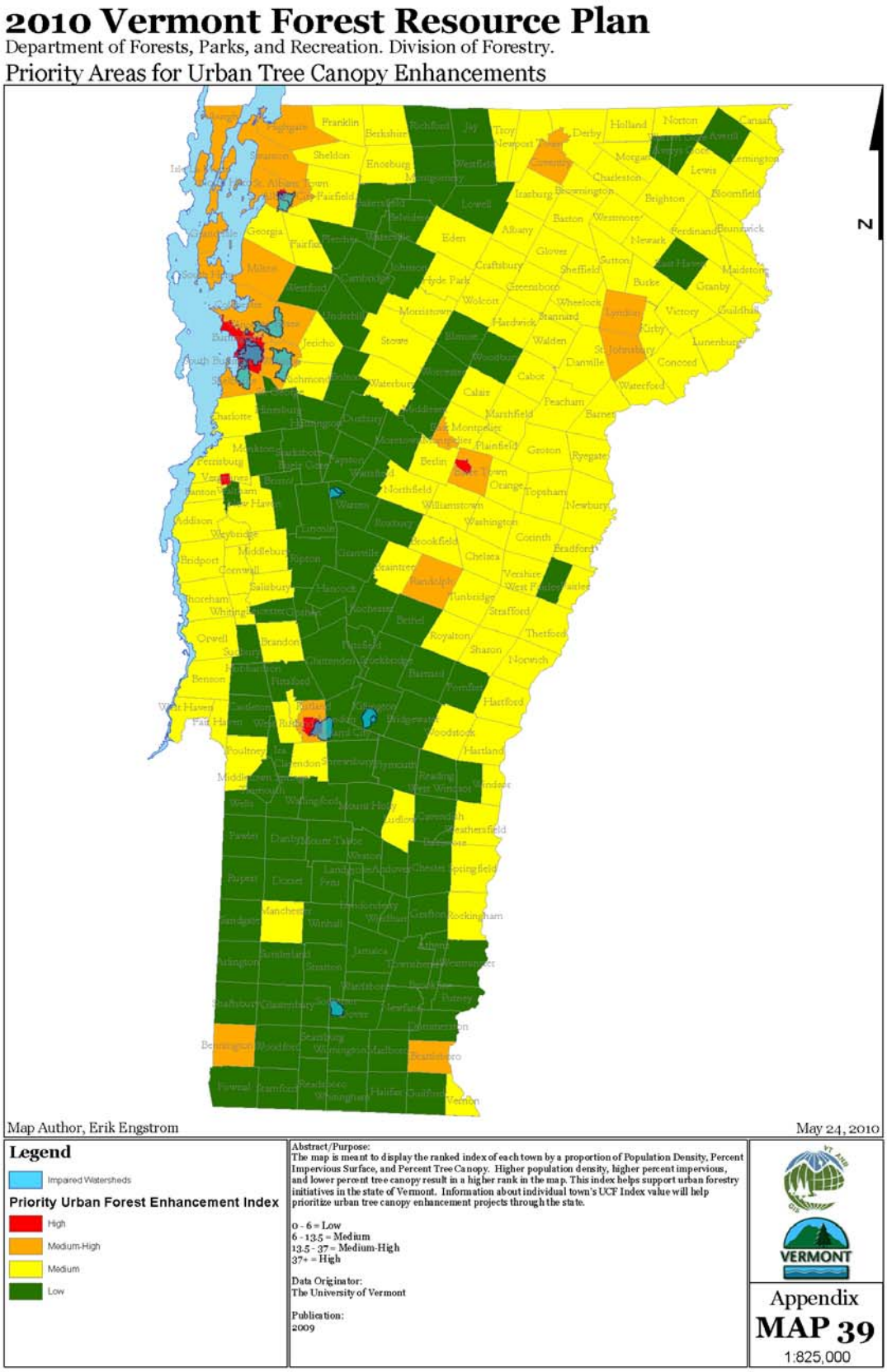
Map 37: Development Pressure on Private Forests in Drinking Water Supply Watersheds

Links to text: Water Quality



Map 38: Potential Multi-State Priority Areas

Links to text: Priority Areas and Issues, Multi-State Regional Landscape Priorities



Map 39: Priority Areas for Urban Tree Canopy Enhancements

Links to text: Urban Landscape Zone, Priority Areas and Issues, Water Quality

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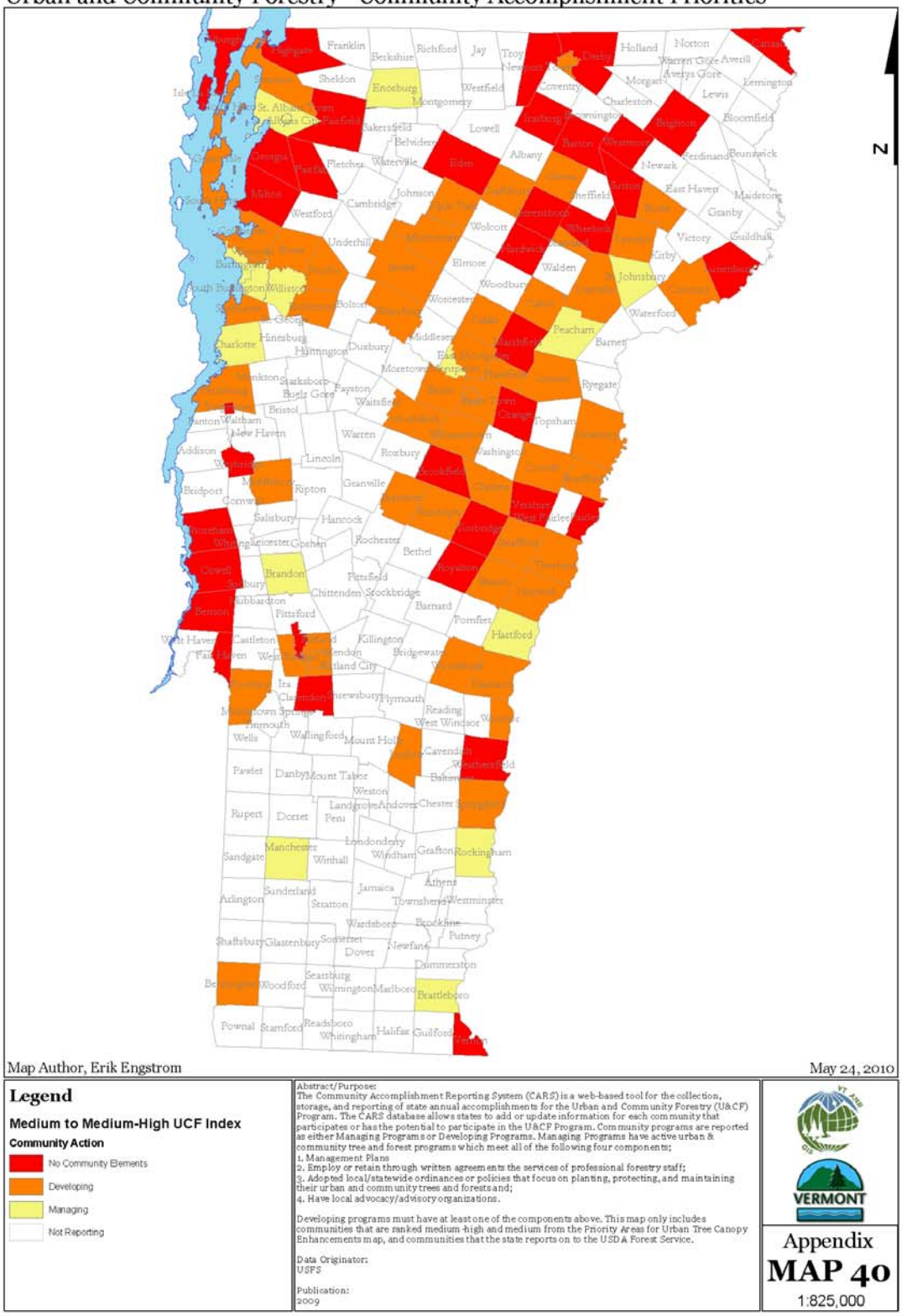
Urban and Community Forestry - Community Accomplishment Priorities



Map 40: Urban and Community Forestry - Community Accomplishment Priorities

Links to text: Urban Landscape Zone, Priority Areas and Issues

Map 41: Local Scale Priority Landscape

Links to text: Rural Landscape Zone

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