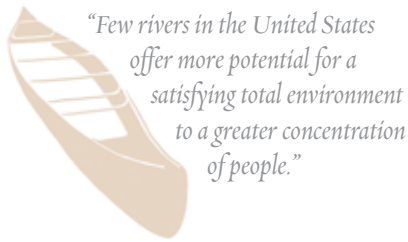


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CONSERVING THE HEART OF NEW ENGLAND

THE CONNECTICUT RIVER WATERSHED



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LAND



CONSERVING LAND
FOR PEOPLE

*The Trust for Public Land conserves land for people to enjoy
as parks, gardens, and other natural places, ensuring livable
communities for generations to come.*

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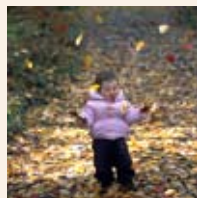
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CONSERVING THE HEART OF NEW ENGLAND



THE TRUST *for* PUBLIC LAND

CONSERVING LAND FOR PEOPLE

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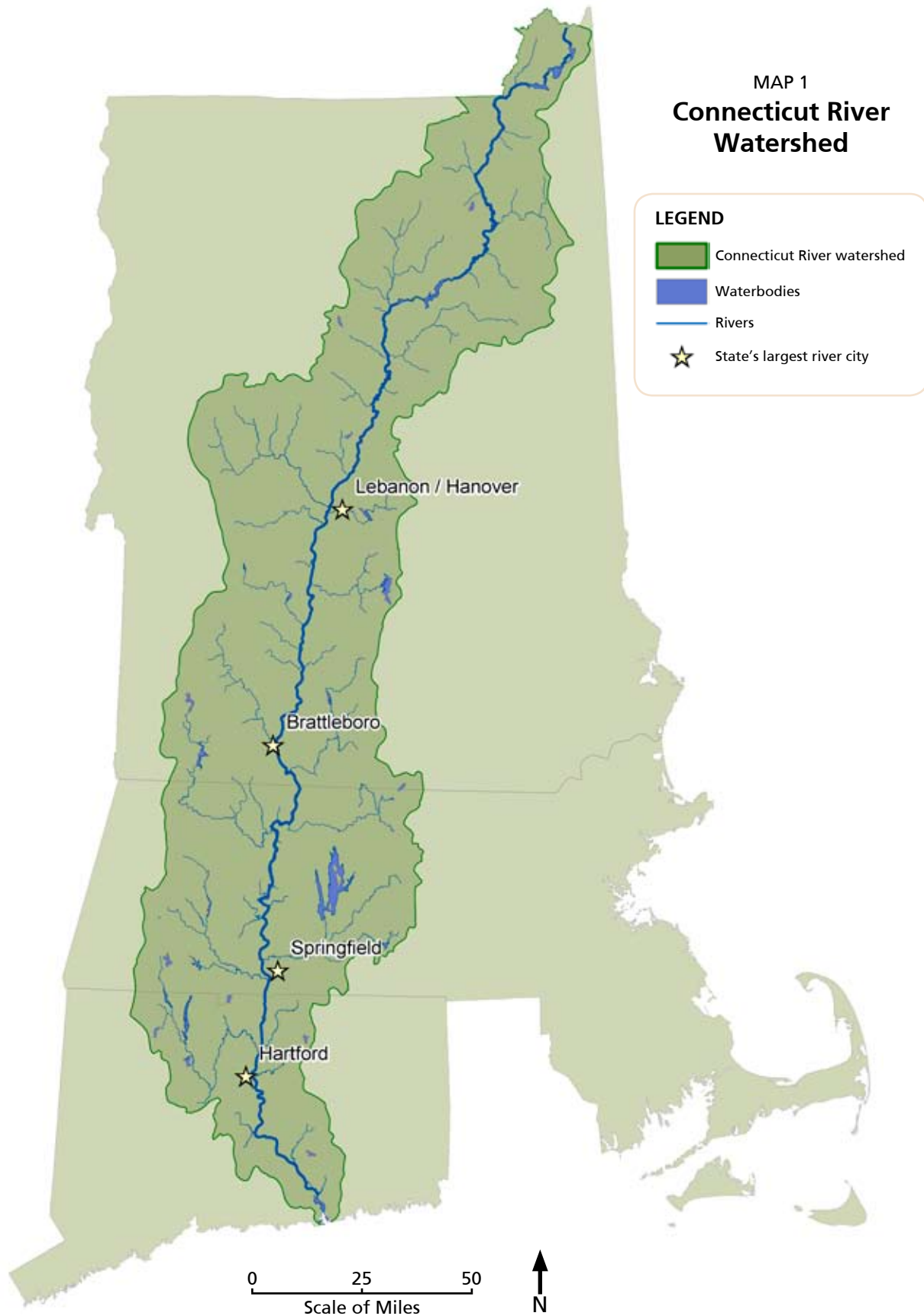
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MAP 1
Connecticut River Watershed



FOREWORD AND ACKNOWLEDGMENTS

The Trust for Public Land would like to thank the trustees and staff of the Emily Hall Tremain Foundation, as well as the Educational Foundation of America, the Northeast Utilities System, and the United Technologies Corporation, for generous support of TPL's Connecticut River Program and this report. We are also grateful to the people and organizations—too numerous to mention here—who contributed data, analysis, ideas, writing, and feedback to the report.

As TPL's New England region considered multi-state initiatives through which we could become more proactive in our land conservation work, the Connecticut River quickly rose to the top of the list. The River drains almost one sixth of New England and a third of the land mass of the four states through which it flows. It encompasses a spectacular diversity of landscapes, each with a character that is both locally unique and consistent with our sense of New England as a whole. The connection between land and people is strong: forests and farms still dominate the landscape, wildlife abounds, and it is a multi-faceted tourist and recreation destination.

Unfortunately, the landscape is undergoing changes that make it a little less unique and appealing with each passing decade. Some change is inevitable, some best handled through other means, and some best prevented by conserving those lands that help us maintain our identity and quality of life. TPL's Connecticut River Program seeks to play a key role in defining and meeting the land conservation needs of the watershed, for a wide range of purposes that make life better for future generations. To

us, that means engaging at the state, regional, and federal levels to identify priority resources and increase the funding available to protect them. It also means sitting at kitchen tables and town halls, helping to accomplish local goals that make the region a better place.

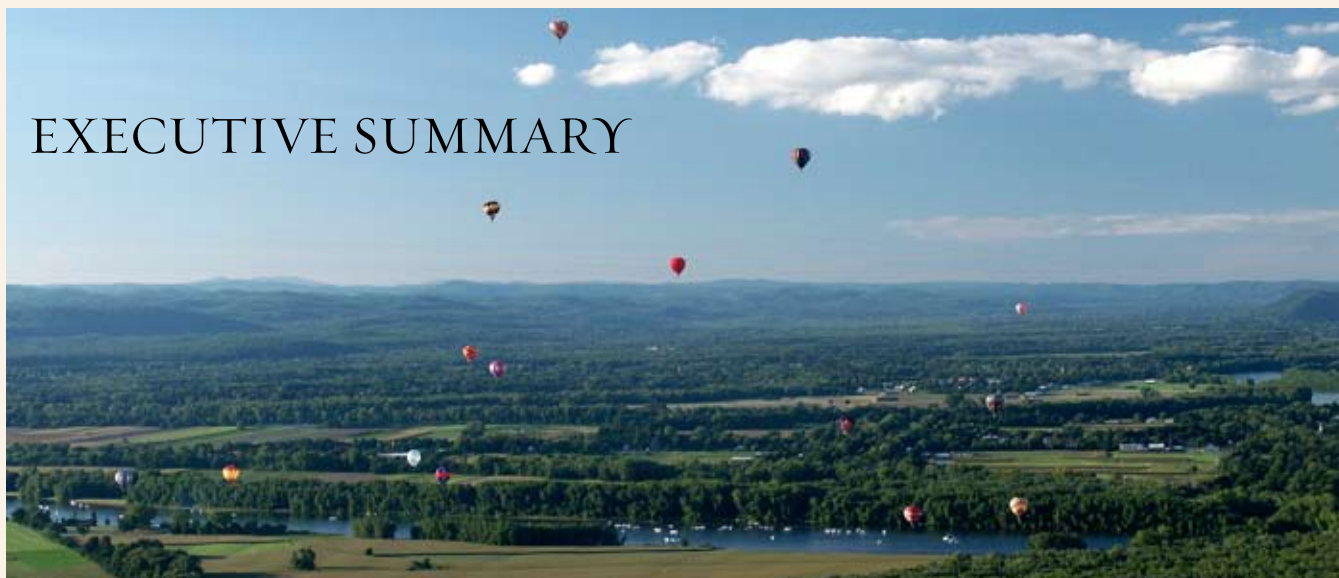
Whether we are protecting 171,000 acres in the Connecticut Lakes or a four-acre urban farm in Holyoke, our organization is designed to depend on partnership. We look forward to continuing and expanding our work with the individuals, communities, agencies, organizations, and elected officials who share our vision of a vibrant and healthy Connecticut River watershed for generations to come. We hope this report will prove an informative and useful starting point for regional discussions about the role of land conservation in reaching these goals River-wide. As relative newcomers to the watershed's big picture, we dedicate this report to the many organizations whose hard work and passion over many years have made the River—and the land that sustains and defines it—a New England treasure worthy of protection.



Whitney Hatch
New England Regional Director



Clem Clay
Connecticut River Program Director



EXECUTIVE SUMMARY

Hot air balloons over the Connecticut River. John Body

The Connecticut River is New England's great river and one of only 14 designated American Heritage Rivers. It winds 410 miles from the Canadian border through New Hampshire, Vermont, Massachusetts, and Connecticut, joining the sea at Long Island Sound. The River is central to the story of this nation's birth and its early political, agricultural, economic, and industrial development. The watershed—the 7.2 million acre area from which water flows to the Connecticut River—provides recreational opportunities, destinations, wild places, and working lands critical to New England's identity. The land also produces more measurable benefits: revenues and jobs, food and forest products, and ecological goods and services. Yet, much of what we treasure about the watershed could be lost in years or decades as cities struggle and rural areas receive an unwelcome makeover.

Resources

Farms: The deep, fertile soils near the mainstem of the River and along sections of major tributaries make up some of the nation's most productive farmland. These farms are New England's breadbasket—they can produce high yields of vegetable, nursery, and other high value crops, as well as corn and other more common crops. Beyond these fertile valleys, the character of the landscape is enhanced by the classic New England patchwork of farm and forest; the average farm is half wooded and most open land is devoted to pasture, hay, and feedstock that support the dairy business. The security of the watershed's farm landscape is threatened by economic challenges to farm viability, the failure of federal farm policy to address New

England agriculture's needs, and the rising value of land for residential and other development. Only 11 percent of prime farmed soils and 16 percent of other farmland are currently protected. American Farmland Trust and many local groups agree that farmland loss in the watershed is an urgent problem—more than a quarter of the farmland in the watershed was lost between 1982 and 2002, and watershed counties accounted for 45 percent of New England's net loss of farmland between 1997 and 2002.

Working Forests: The Connecticut River watershed is nearly 80 percent forested, an extraordinary number considering that it may have been as much as 80 percent cleared in the mid-19th century. Nearly one third of the forestland is within roadless blocks of more than 1,000 acres that permit more economically efficient forestry operations. The watershed contains high quality timberland and is stocked with nearly twice as much timber volume per acre as the average New England forest. More than 31 percent of all forestland in the watershed is protected from development. But despite tremendous conservation victories that ensure sustainable harvests and jobs, the watershed's forests remain threatened. The US Forest Service "Forests on the Edge" study ranked portions of the watershed among the top 20 areas in the nation with high development threat and high rates of private forest ownership.

Water: The Connecticut River provides 70 percent of the annual freshwater input to Long Island Sound, and the quality of that water is important to every creature along its path. Since the passage of the Clean Water Act in 1972,

both wildlife and humans using the River have benefited immeasurably from reductions in point source pollution and combined sewer overflows. As farms and forests are sold for housing, the challenge of managing nonpoint-source pollution from lawns and impervious surfaces such as rooftops and roadways becomes more complex. Land conservation, especially in combination with good management practices, can be a boon. In addition to clean water for wildlife and recreation, the Connecticut River watershed supplies its own residents and a nearly equal number in the Boston area with drinking water. In the states where data is available, only 32 percent of land important to protecting drinking water supplies has been protected thus far and protecting the remaining lands is a regional priority.

Habitat: Among the thousands of species that inhabit the Connecticut River watershed are 10 federally threatened or endangered species. The Connecticut River and its tributaries support most of the known viable populations of the federally endangered dwarf wedgemussel. The Silvio O. Conte National Fish and Wildlife Refuge is the only multi-state, watershed-wide refuge in the US Fish and Wildlife Refuge system. The Nature Conservancy has designated the estuary portion of the watershed as one of the Last Great Places on Earth and runs a Connecticut River Program dedicated to preserving and restoring critical habitats. Primarily due to the efforts of state and federal agencies, 29 percent of the 1.3 million acres of priority fish and wildlife habitat identified in our analysis are protected, but many species have inadequate protected habitat to ensure long-term viability in their natural range.

Land For People: River access, trails, historic and archaeological sites, tourist destinations, scenic views and byways, and other special places are essential to the Connecticut River's identity and tourist economy. A tremendous wealth of people-centered resources—many integrally connected to land that is not fully protected—is well documented throughout the River's basin. Their potential loss, and the diminishing opportunity to create new parks and recreational opportunities where people need them, lends urgency to the task of defining and achieving land conservation goals.

Threat

In total, 23 percent of the watershed's 7.2 million acres are protected through public ownership or private conservation easements. Eleven percent of the landscape is

developed for commercial or residential purposes, but this number increased by 31 percent from 1982 to 1997. The affordability and accessibility of the Connecticut River valley give it a high potential for economic development, and rapid growth is expected in the Interstate-91 corridor. Even with only moderate population growth of 6.6 percent expected between 2000 and 2020, exurban sprawl will convert a projected 323,000 acres from rural to exurban density. If current trends continue unabated, the River's landscapes will become less distinctive, the long term costs of sprawl will be paid from public coffers, habitats will be degraded, food and fiber production will diminish, and the quality of water for people, animals, and Long Island Sound will worsen.

Conserving the Heart of New England

The Connecticut River watershed is a reflection of all of New England. It has a wide variety of landscapes with deep importance to regional and local culture, a high proportion of privately owned land, a strong tradition of municipal home rule, and few mechanisms for implementing large scale landscape planning. Despite its central location, the watershed is distinguished by its overall low population density, its large number of small towns, and its disproportionately high share of the green infrastructure found in the four river states. Green infrastructure, simply put, includes the lands that ensure clean water and air, diverse habitats, land-based jobs, recreation, and beauty. The watershed exports food, fiber, water, energy, recreational opportunities, and other benefits of this rich infrastructure, but lacks the political and economic clout to adequately protect the land that provides them.

Conserving land is a non-controversial way of ensuring that private landowners are willing partners and that the public receives permanent benefits in return for strategic green infrastructure investments. Along with dozens of local, state, and national organizations, TPL has spent decades demonstrating that the needs of people can be aligned with the tenets of conservation by protecting important landscapes. Any regional land conservation initiative must take a very long view, respect the need for economic vitality, and help towns and cities achieve locally defined goals. Citizens, organizations, agencies, and elected officials each have important roles to play. We should act and invest wisely now to ensure that New England's principal river and heartland are among the great legacies of stewardship that we leave to future generations of Americans.



Sea kayaks near the mouth of the Connecticut River. Jerry and Marcy Monkman



INTRODUCTION

Take a map of New England and draw the boundaries of a cohesive natural system that captures at least a little of nearly everything the region has to offer. If you have done your job well, you have drawn the boundaries of the Connecticut River watershed. The River and its 38 main tributaries drain 41 percent of Vermont, a third of New Hampshire, a third of Massachusetts, and almost a third of Connecticut. A New England icon, the Connecticut River is the six-state region's longest river (410 miles), drains its largest watershed (7.2 million acres), and is arguably its most significant natural resource. Its water sustains terrestrial and aquatic ecosystems, farms, industry, and the domestic water needs of 2.3 million watershed residents and a similar number in the Boston area.¹ The Connecticut River supplies nearly five trillion gallons of water to Long Island Sound each year, approximately 70 percent of that body's freshwater.²

The watershed captures the essence of New England, not just because it drains nearly one sixth of the region's land, but also because of its historical importance and because it encompasses so many permutations of classic New England landscapes and lifestyles: Northern Forest communities intimately connected to their coniferous landscape; tight-knit riverfront farming villages rich in prime soils; hardscrabble hill towns dominated by working forests, pastures, and orchards; tidal communities full of coastal culture; college towns bustling with energy; and two of New England's largest cities. It is no wonder that the Connecticut is one of just 14 American Heritage Rivers, a designation achieved through community effort and "the characteristics of the natural, economic, agricultural, scenic, historic, cultural, or recreational resources of the river that render it distinctive or unique."³

This report presents an overview of the environmental, economic, cultural, recreational, and historic value of the watershed's land, as well as a look at the risks these natural assets face from projected housing development. It considers the role that land conservation plays in enhancing quality of life and natural systems, and it argues that existing efforts to conserve land will be greatly enhanced by a region-wide perspective and a coordinated effort to develop and fund a vision for land protection across this great landscape.



A farm on Indian Stream in Pittsburg, New Hampshire, a short distance from the Connecticut River. Jerry and Marcy Monkman



A BRIEF HISTORY OF THE RIVER

"The story of the Connecticut River and the Valley of the Connecticut is so mingled with the history of the country, and particularly the formative periods, that in the proper telling of it much of history must also be related."

-Edwin Bacon, *The Connecticut River and the Valley of the Connecticut*. 1906.

Throughout its history, the Connecticut River has been New England's central artery, shaping travel, land use, and development. This section offers a short and selective review of events that have shaped the landscape and culture of the watershed.

GEOLOGY

The Connecticut River has not always been here, but its origins can be found 400 million years ago, during the formation and subsequent breakup of the super-continent Pangaea. As land masses floating on their tectonic plates collided, much of New England was added to North America, a process known as the Taconic orogeny. This mountain-building event was followed by the Acadian orogeny, which pushed the northern Appalachian mountain ranges into existence and added much of the New England coast, along with most of present-day Africa. Approximately 50 million years after Pangaea's completion, the single land mass pulled apart as tectonic plates drifted toward their present locations. Much of New England east of the Connecticut River nearly joined Africa and Europe on their journey, but the Connecticut Valley rift ultimately aborted, leaving behind the Eastern Border Fault from southern New Hampshire to New Haven, Connecticut.

Sediment from the once-tall surrounding mountains eroded into this channel, dinosaurs roamed the tropical plain (leaving now-famous footprints), lava flows injected hard igneous rock into the mix, uplift and erosion battled one another, leaving only the hardest materials exposed above the sediments, and glaciers scraped and shaped the land. Through all this tumult, the rift valley provided the path of least resistance through which waters from the highlands could drain to the sea. New England's early geologic history is extraordinarily complex and is key to understanding the distinctive features that make spe-



Harvard Forest Dioramas of the presettlement forest and the height of agriculture capture the striking transformation of New England's landscape. John Green; Courtesy of Fisher Museum, Harvard Forest, Petersham, MA.

cial places of the Green Mountains, White Mountains, Berkshires, Central Massachusetts Plateau, and the Connecticut hills that enclose the Connecticut River, as well as the traprock ridges and monadnocks that are signature features of the valley floor.

Between 25,000 and 18,000 years ago, glaciers a mile thick sculpted the landscape. As the ice melted 18,000 to 13,000 years ago, natural dams formed the enormous Lake Hitchcock, which stretched from present-day Rocky Hill, Connecticut, to Bath, New Hampshire, and far up many tributaries. With a legacy of rich and terraced lakebed and alluvial soils, this piece of geologic history left a strong imprint on the region's landscape and identity.⁴

NATIVE PEOPLES

Native Americans populated the region as the Wisconsin Glacier retreated and Lake Hitchcock finally drained (11,000 to 12,000 years ago). For millennia, people hunted land mammals and relied upon the River for its abundant fish. With the adoption of agriculture and other land management practices in the last 2,000 years, some groups established settlements near the River's arable floodplain soils. The River sometimes served as a territorial boundary among regional tribes (primarily tribes connected with the Abenaki, Iroquois, and Algonquian Nations), but also as a gathering and trading center and sometimes a battleground where territory was contested. The River's name is derived from "Quinnetukut" and similar words in various Algonquian dialects, all translated as "long tidal river" in recognition of the ocean's influence on water levels as far as 60 miles upriver from Long Island Sound.

Early European contact was dominated by the fur trade, an era that endured far longer in the northern watershed than in the south, where conflicts over land emerged within decades. Europeans generally traded for the land they settled, but tribes probably believed they had retained usufructary rights (hunting, fishing, perhaps farming), while the settlers' view of land ownership was far more exclusive. The number and landscape impact of settlers was clearly something the native peoples, who had long maintained a relatively low population density, could not have anticipated. European disease had perhaps the most devastating effect in the end, but war played a substantial role. Western Massachusetts was the locus of much of the conflict, including British raids on natives at Turner's Falls and significant events of King Philip's War (1675/6), the raid on Deerfield and subsequent upriver journey to Montreal (1704), and the Seven Years' War (1754-1763). The latter war culminated in the opening of the northern watershed to increased settlement as British American colonists defeated the French and Indian alliance.⁵

IMMIGRANTS SETTLING THE LAND

The resources offered by the River—including prime farmland, fish, waterpower, and a means of transporting goods—ensured that the valley was settled before the hills.⁶

The Valley Floor: Dutch traders were the first Europeans to explore the southern portion of the Connecticut River valley, beginning in 1614. They were more intent on the fur trade than on farming and settlement. French explorers and traders entered the region from the Saint

Lawrence and Champlain valleys around the same time. They established no settlements or forts and did not become very familiar with the upper River region, but did develop important ties with resident Abenaki that strongly influenced development of the upper watershed for the subsequent 150 years. Dutch presence was eclipsed as the Connecticut River valley in Massachusetts and Connecticut emerged as the first western frontier for the British colonists beginning in the 1630s. Early towns—Wethersfield, Hartford, Hadley, Deerfield, and others—followed a “village nucleus” template characterized by common grazing lands (now town commons) surrounded by homes on modest lots. The homes varied in size and quality, but the lots themselves were designed to be of equal value. Additional lots of cropland were located nearby and allotted based on family size; collective agreements to manage these resources, from mandatory fence-mending duties to shepherds on the town payroll, were adapted from English custom or devised anew to meet community needs.

Rich in resources and always engaged in export, these early communities were nonetheless largely focused on collective survival and betterment. While colonial expansion northward was delayed well into the 18th century by hostilities between colonists and Native Americans, a distinct culture developed in the southern half of the valley, including a backlash against the relaxation of Puritanical values that occurred in the eastern coastal communities. Many valley farmers accumulated considerable wealth due to superior soils and access to markets, and especially to the rise of the tobacco trade. As new generations were born and others immigrated to the valley, the original equitable allotment of holdings gave way to greater diversity in land holdings and means of livelihood. Millers, sawyers, broommakers, distillers, and others added to the wealth provided by the land with specialized and efficient operations producing marketable items for local use and export.

Uphill and Upriver: As the desire for land, wood, and independence increased, a new generation of settlers established hill towns that differed in character from those in the valley. The nuclear village gave way to a town plan that acknowledged the primacy of dispersed individual

Early settlement patterns along the Connecticut River continue to shape today's towns, as farms and communities remain near the river and development remains sparse in nearby hilltowns. This photo is from the upper Pioneer Valley near Northfield, Massachusetts.

This and all other aerial photographs used in this report are provided courtesy of USDA's National Agricultural Imagery Program.





Early log drive on the Connecticut River near Hanover, New Hampshire. Courtesy of Bondcliff Books, from "Log Drives on the Connecticut River"

homesteads, while retaining some elements of a town center, usually centered on a church. Following British victory in the French and Indian Wars in 1763, colonists rapidly pushed northward up the River valley and into the surrounding hills. In the half-century preceding the end of the Revolutionary War, portions of the watershed were contested by New York, Massachusetts, New Hampshire, and the Green Mountain Boys, who held their constitutional convention on the River in Windsor to gain the support of valley residents for Vermont's independence. Meanwhile, tensions between the colonies and the crown increased, in part over the King's insistence on reserving mast logs of over 24 inches in diameter for himself, an edict that was widely flouted by colonists who rip-sawed boards to a width of 23.5 inches to avoid detection.

In 1811, William Jarvis imported hundreds of Merino sheep—a breed that produced excellent long-staple wool but had been unavailable outside Spain—from the Royal Spanish flock to his Connecticut River farm at Weathersfield, Vermont. Soon Merinos by the millions had populated the countryside of the northern watershed. Exporting sheep, wool, logs, potash, herbal essences, and much more, resourceful pioneers cleared the vast majority of the region's forests before and after achieving independence. Except for perishable milk products, farming in these hills was, however, not to prove competitive with farming farther west once continental train service was established.

The sons and daughters of New England pioneers eventually departed in large numbers for the Civil War or with hopes of better economic opportunity in nearby cities, the Midwest, and beyond. The returning forest and new sawmill technology enabled fewer people to manage more land. Resourceful young people became one of the countryside's top exports. Those who remained inhabited far-apart village centers surrounded by regrowing forests, and farms with stone walls surrounding the best pasture and cropland. Persistent and creative, these families became the mainstays of the majority of towns in the watershed that, even today, have fewer than 2,000 residents.

BUILDING INFRASTRUCTURE

The legacy of human impact on the New England landscape from the mid 19th century through the late 20th century is not just the soft imprint of romantic stone walls and historic homes of earlier eras, but the hard infrastructure of a growing economy: steel rails, brick mill buildings, concrete dams, asphalt highways, and streets underlain by sewer and runoff channels.

Transportation by Water and Land: The Connecticut was the first major American river developed for transportation.⁷ Access to markets in Boston, the southern colonies, the Caribbean, and Europe made the lower

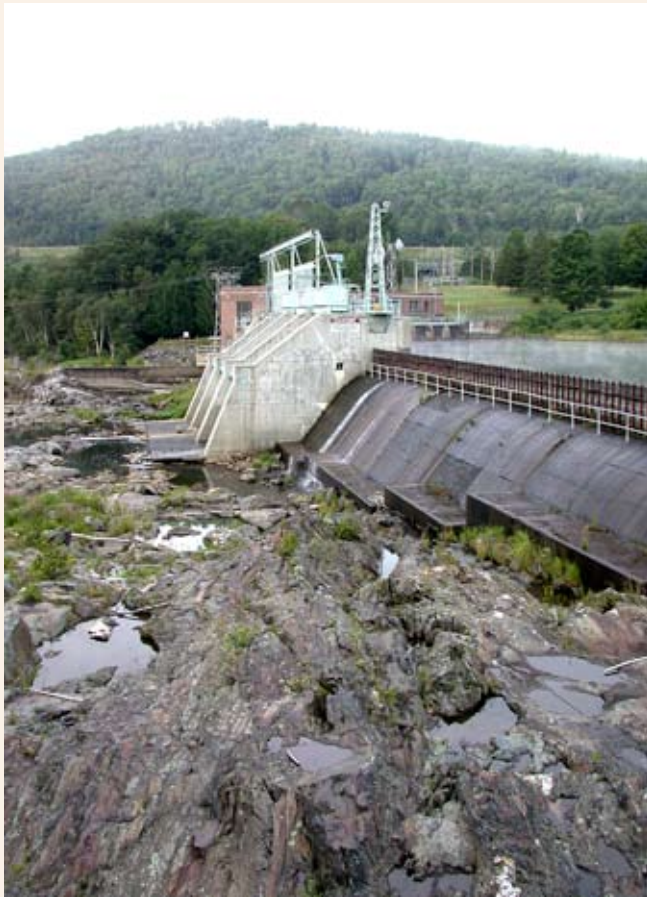
Connecticut Valley an export region from its earliest days. Merchants who controlled both land and trade in the lower River accumulated wealth, some gaining entry to the elite group known as the “River Gods.” Log drives down the River linked even the most northern reaches of the watershed to ports in Hartford and Middletown. Locks and canals at several falls eventually opened the majority of the River to passengers and goods traveling up and downstream. However, with Saybrook at the River’s mouth unable to meet the requirements of a deep-sea port, New Haven became the preferred terminus for southbound transport beyond Hartford, first via the Farmington Canal and later the railroads. The River valley’s low elevation, moderate grade, and population centers made it a natural site for a north-south railroad. With rail construction in the 19th century, the River quickly faded in importance for transportation. Interstate-91 followed suit a century later. In both cases, the most traveled route beyond White River Junction was through the Green Mountains to Burlington, rather than into the remote Northeast Kingdom.

Yankee Industry: The Connecticut River valley and nearby New Haven are legendary for their “American system of manufacturing” using interchangeable parts. Yankee ingenuity spawned precision manufacturing in arms, machine tools, and other metal products. The River and its major tributaries provided the power, while able and educated workers provided the resourcefulness and creativity. Many of these workers were raised on farms that had become less viable or had less need for labor. Industry absorbed a labor force that could not be sustained by the countryside, providing munitions critical to the Union victory in the Civil War.⁸ However, it also treated the River as a dumping ground for waste, a trend that began to reverse with the 1972 passage of the Clean Water Act.

The Power of Water: Without power tapped directly from the Connecticut River and its tributaries, urban manufacturing centers in the watershed might never have become leaders of the Industrial Revolution. Entering the 20th century, the River powered the growing demand for electricity, a more portable source of energy that reduced the competitive advantages of industries on the River.

The Holyoke Dam and the Holyoke Power Canals were monumental civil engineering feats that powered the booming industries in Holyoke and municipal electrical needs. Much of the industrial infrastructure is now aged and crumbling, but Holyoke and other towns are looking to revitalize their riverfronts.





McIndoe Falls Dam, one of the ten hydroelectric dams on the Connecticut River's mainstem. Ethan Nedeau

Between 1900 and 1957, 16 hydroelectric dams were built on the mainstem, Deerfield River, and other tributaries. They primarily exported power and included Moore Dam, New England's single largest electric power development based on a natural resource.⁹ The River has become less important as a direct source of manufacturing power, but electrical power remains a critical resource generated and exported by the region.¹⁰ Another is drinking water, most notably that of the Quabbin reservoir, constructed in the World War II era to supply water to more than 2 million eastern Massachusetts residents. Following severe floods in the 1930s, the US Army Corps of Engineers built flood control dams throughout the watershed, 17 of which are still in use. Dams afforded many benefits, but also impeded anadromous fish, such as Atlantic salmon, shad, and short-nose sturgeon, from reaching their spawning habitat.¹¹

Map 2 depicts key elements of built infrastructure that represent both a legacy of four centuries of settlement and a predictor of future developments. These fixtures of the landscape have changed our lives, and frequently bettered them, even as they have caused environmental harm.

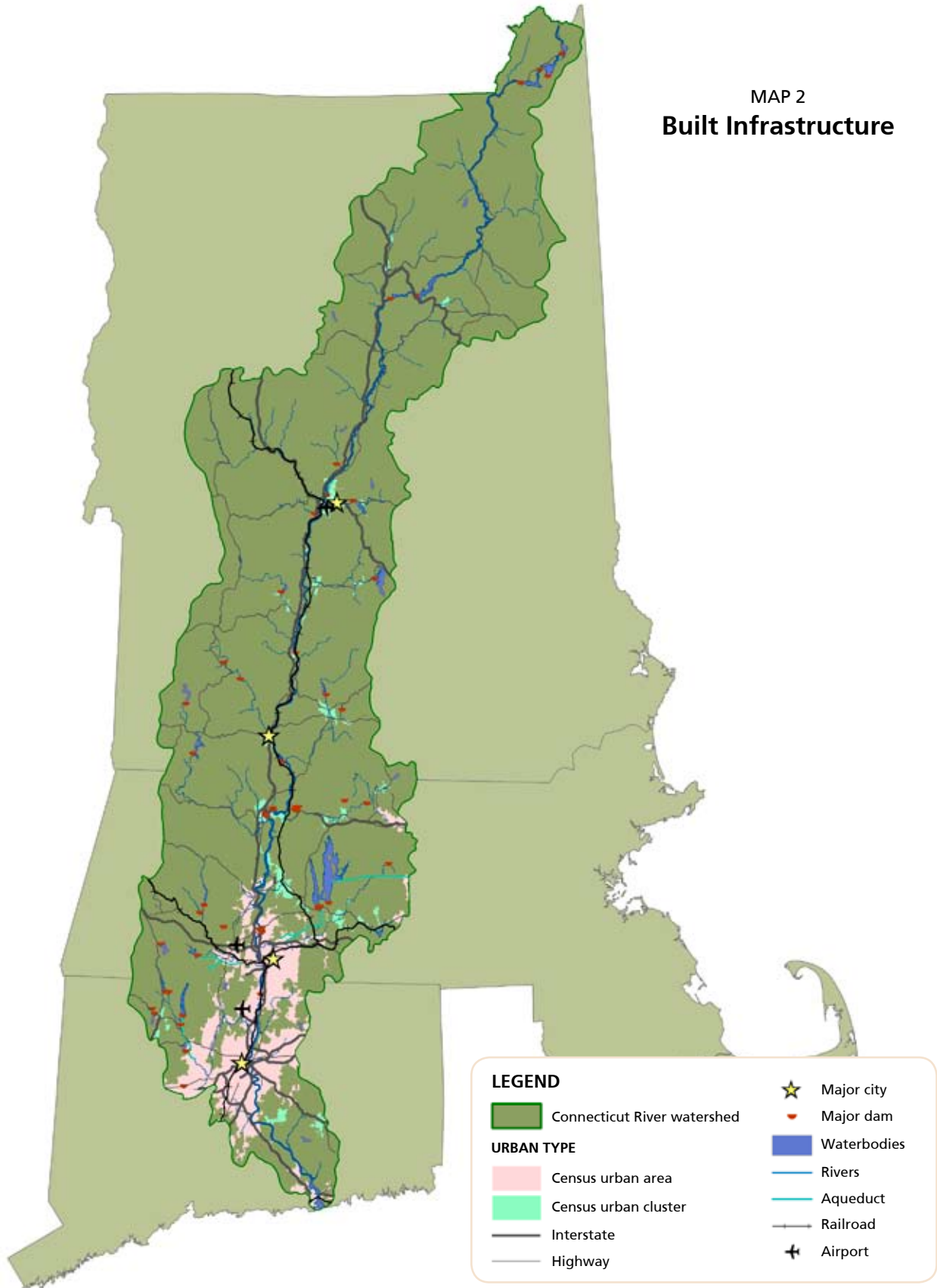
A CENTURY AND MORE OF CONSERVATION

Forest clearing and regrowth, dams, railroads, highways, population growth, and industrial pollution transformed the Connecticut River watershed from the mid-17th onward. Most of these changes were driven by the economic exigencies of changing technology and markets. To varying degrees, states and towns responded to the impacts of those changes to protect public interests. The historical record is peppered with examples of towns giving or taking land use rights and financial incentives to better align private action with the public good. From banning the export of wood from Hatfield to subsidizing mulberry tree plantings to encourage the fledgling silk industry, proactive intervention in the private market is a Connecticut River and New England tradition.¹² The New England town meeting and tradition of "home rule" derived from an independent, community-oriented spirit that was suspicious of outside control but committed to local betterment.

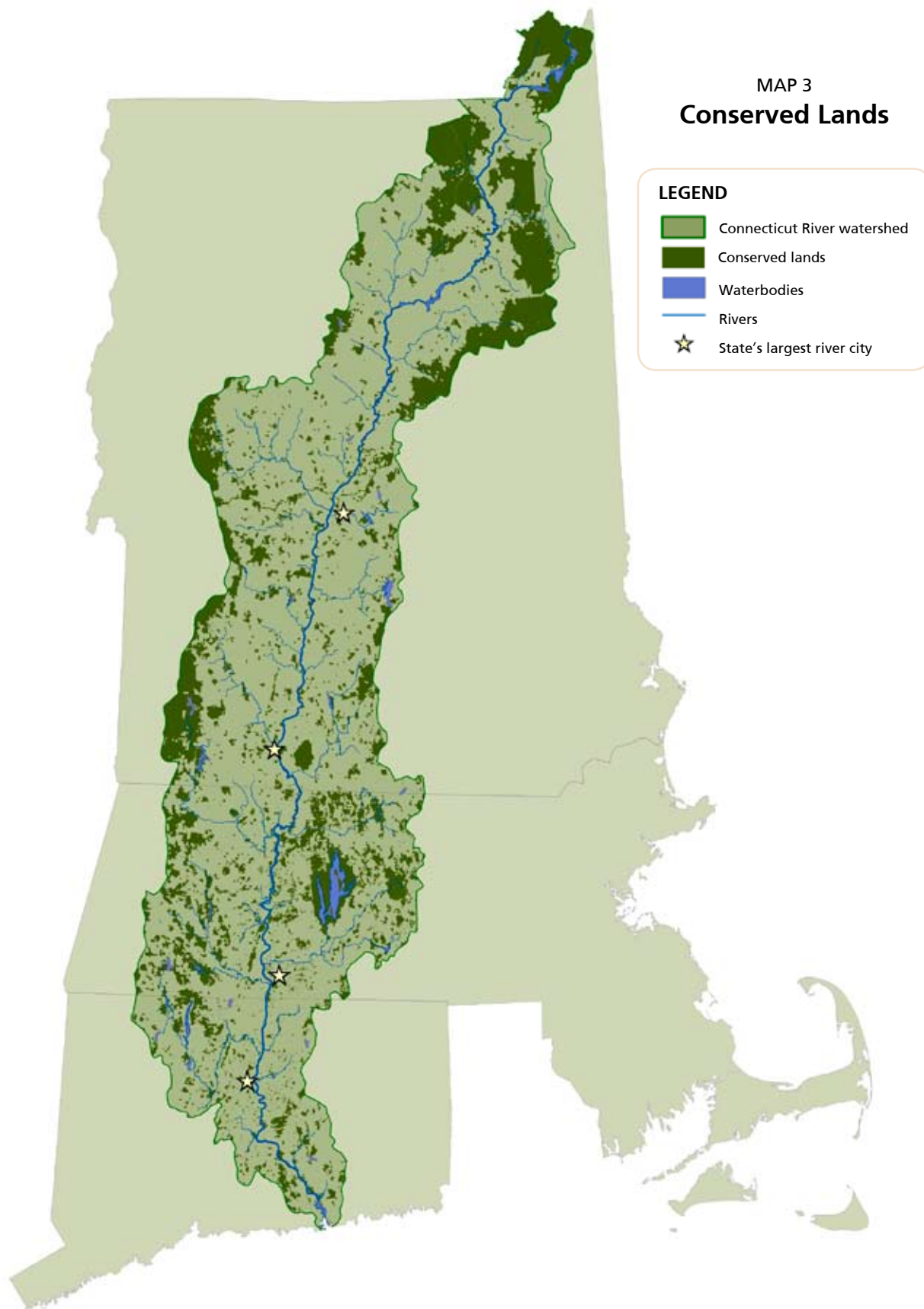
Land protection emerged in New England as a public response to these market-driven landscape changes, and to the rapacious harvest of second growth timber that took place in the late 19th and early 20th centuries. Unlike in the West, an ethic of private and public responsibility to safeguard the landscape's public benefits evolved in New England in a context of private ownership, often in numerous small holdings. Despite the challenging ownership patterns and a strong belief in local control and private land rights, New England produced the first regional conservation organization (The Appalachian Mountain Club, 1876), and many of the earliest and most influential voices for conservation (Thoreau, Olmsted, and many more). Notably, New England led the nation in land trust formation (The Trustees of Public Reservations in Massachusetts, 1891; The Connecticut Forest and Park Association, 1895; The Society for the Protection of New Hampshire Forests, 1901). Organizations dedicated to the Connecticut River and its tributaries emerged later; those with multi-state reach include the Connecticut River Watershed Council (1952) and the Connecticut River Joint Commissions (VT/NH, 1989).¹³ These groups focus on water quality, fish passage, tourism, recreation, and more; they are important partners in ensuring that land protection serves widely valued purposes.

The accomplishments of these visionary pioneers and advocates are jewels of the New England landscape. From Bushnell Park in Hartford to the White and Green Mountain National Forests, the region's people reap incalculable annual returns on these early investments in natu-

MAP 2
Built Infrastructure



MAP 3
Conserved Lands



ral capital. Map 3 depicts conserved land in dark green: 1.68 million acres have been conserved, more than 23 percent of the watershed. Approximately 325,000 acres are in National Forests, with the remainder in a combination of other public ownership (local, state, or other federal) and private ownership with easements protecting key public values of the property. The vast majority of protected land is forested, and much of it is available for sustainable harvest and recreation.¹⁴ Currently farmed land comprises 7.8 percent of protected land, and 23 percent falls within state and federal priority habitat areas or in riparian buffer zones.

These are accomplishments for which the many agencies, organizations, and communities who worked to save this open space can be proud. TPL is thrilled to have played a role in over 50 conservation transactions in the watershed, all in partnership with highly effective non-profit and public organizations. But there is clearly room for building on those successes and protecting more of this landscape—nearly 4.75 million acres (more than two thirds of the total watershed area) remain undeveloped and unprotected. In TPL's analysis of projected housing density, 440,000 acres are identified as being subject to particularly high threat. While there needs to be ample room for economic development and housing, those of us who believe the Connecticut River watershed's lands and communities are a special part of New England's heritage must identify and work to protect those lands that we value most before our landscape loses its distinctive character. The following two sections take a region-wide look at one important threat to the watershed, and at some of the important resources that should be protected.

Portions of the Connecticut River are highly dynamic, continually carving into the land and depositing sediments further downstream, such as this striking portion of the river near Maidstone, Vermont. Aerial photographs clearly show old oxbows where the river once flowed and gives a unique perspective on the ephemeral nature of riverside lands.





Young corn in the view of the Mount Holyoke Range, Hadley, Massachusetts. Jerry and Marcy Monkman



CHANGES IN THE LANDSCAPE

The Connecticut River watershed contains two of New England's six largest cities, but is distinguished by its overall low population density. In its four states, the watershed occupies 32 percent of the land, but is home to just 20 percent of the population. Comparing towns in the four states, the average watershed town is less than half as populous as the average town outside the watershed in these states. More than half of watershed towns have fewer than 2,000 residents, while more than half of towns outside the watershed are home to more than 6,000 residents.

In 2000, the Connecticut River watershed's population stood at approximately 2.3 million. By 2020, that number will grow by 150,000 individuals, a 6.6 percent increase. More importantly, those people will occupy more space on average than they have in the past and will have a disproportionate impact on the landscape. In 1999, the New England regional administrator of the US Environmental Protection Agency declared sprawl the greatest environmental threat to our region,¹⁵ and there is little evidence to suggest that the situation has improved. While many other trends are important to address, for this report's purposes the universal threat to the watershed's green infrastructure today is the consumption of farms and forests for new residential housing.¹⁶ The location, quantity, and density of housing affects all of the resources discussed in this report. Perceptions are important, too: when local housing density increases substantially, people feel that their community is changing. As journalists with the New England Futures project put it, "standard zoning and exurban development are eating away at the innards of New England's character and way of life."¹⁷

The New England scenes we cherish are largely a product of past economic activity. For the first three centuries of European settlement, the watershed's landscape was shaped by people who were aware of their dependence on land and water, even if they were not always good stewards. Today, imported food and forest products demonstrate the competitive advantages of other regions and nations, making it difficult for those who have long lived off the wealth of the land to continue this tradition here. Large forest tracts are often owned by corporations that respond to shareholder pressures and a global market-



Some of the finest remaining grasslands in the Connecticut River Valley are threatened by development. Clem Clay

place, rather than loyalty to present and future generations of loggers. Highways, cars, planes, and the Internet permit new attitudes toward place and mobility. Even as jobs are scarce or pay poorly for most, land prices in attractive locales often escalate beyond the reach of a new generation of locals, and the aging generation sees its land base as its primary resource for retirement. At the same time, the New England Business Council and New England Futures Network have identified the Connecticut River corridor along I-91 as a top site for new business development, presenting both opportunities and challenges for the region.¹⁸ Today's economic forces require a reassessment of what it will take to retain a landscape that feels like home.

The threat is often equated with population growth, but the increase in residents is quite modest and does not tell the whole story.¹⁹ A strong trend toward inhabiting larger homes and yards in less dense areas means that even static population in the watershed would lead to increased land consumption, as well as increased demand for water. Many New Englanders are familiar with the super-sizing of the new American home; they only have to observe new construction projects in their communities. The cumulative effect of a four- or five-bedroom house with a three-car garage on a large lot becoming the standard, however, is not as obvious to the casual observer. But it is significant. For example, population in the watershed grew just eight

percent (175,000 residents) between 1980 and 2000,²⁰ but developed land area in the watershed increased by 31 percent (180,000 acres) during the shorter period from 1982 to 1997.²¹ The demographics are complex, but the result is simple—land is being rapidly consumed because of increases in population and modern settlement patterns that place fewer homes in cities and town centers and more in less dense areas. These patterns, if unchecked, will transform not just how the watershed looks, but how it functions—culturally, economically, and ecologically.

Maps 4 and 5 highlight areas where the overall density of Census tracts has moved, and will continue to move, from rural to exurban, from exurban to suburban, or from suburban to urban between 1960 and 2020. Later in the report, the areas of projected change from 2000 to 2020 (Map 5) are overlaid with various natural resources to highlight places where these changes may have the greatest impact. Each resource is threatened in unique ways, but this geographic distribution of future housing density change serves as a useful proxy for overall threat to all resources region-wide.

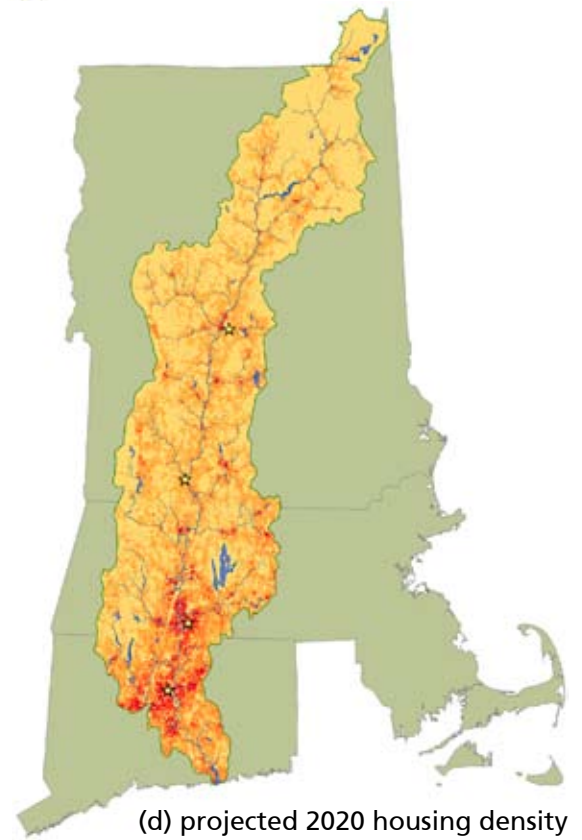
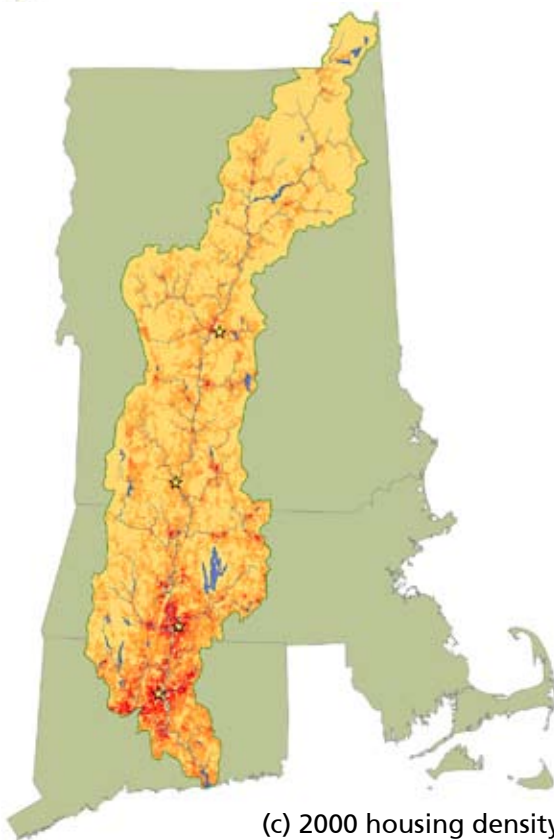
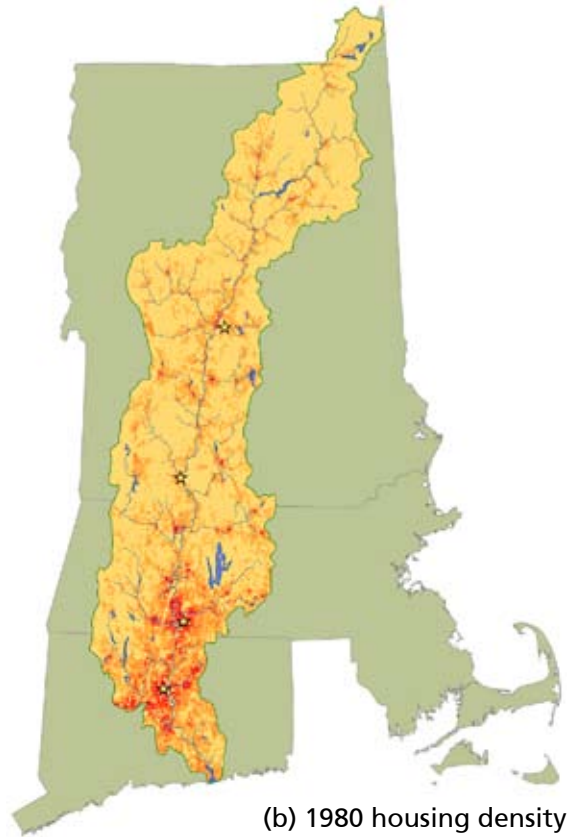
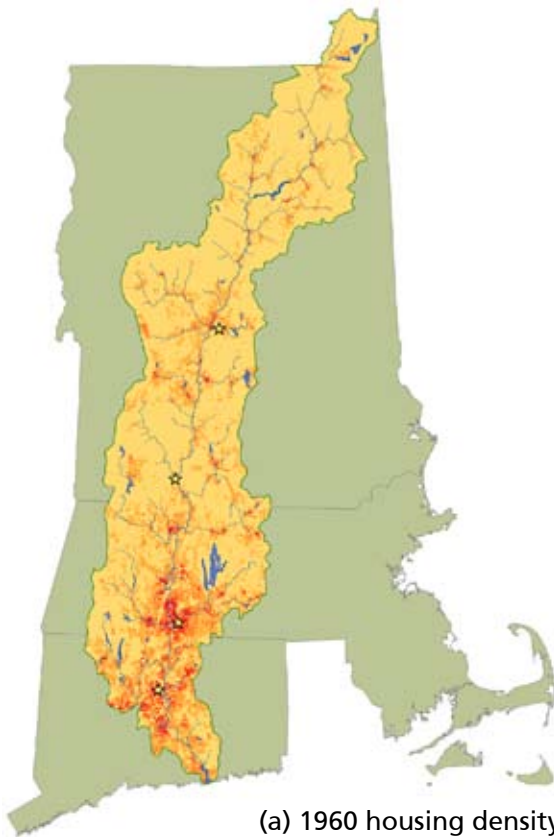
The maps illustrate that while there are notable clusters of growth, change is occurring in a dispersed pattern across the watershed's many landscapes. New Hampshire stands out as the state with the greatest projected population increase, even on the quieter western side of the state. The following table shows the proportion of land crossing into each density category by 2020, dramatically illustrating the predominance of exurbanization when the measure is acres rather than people.

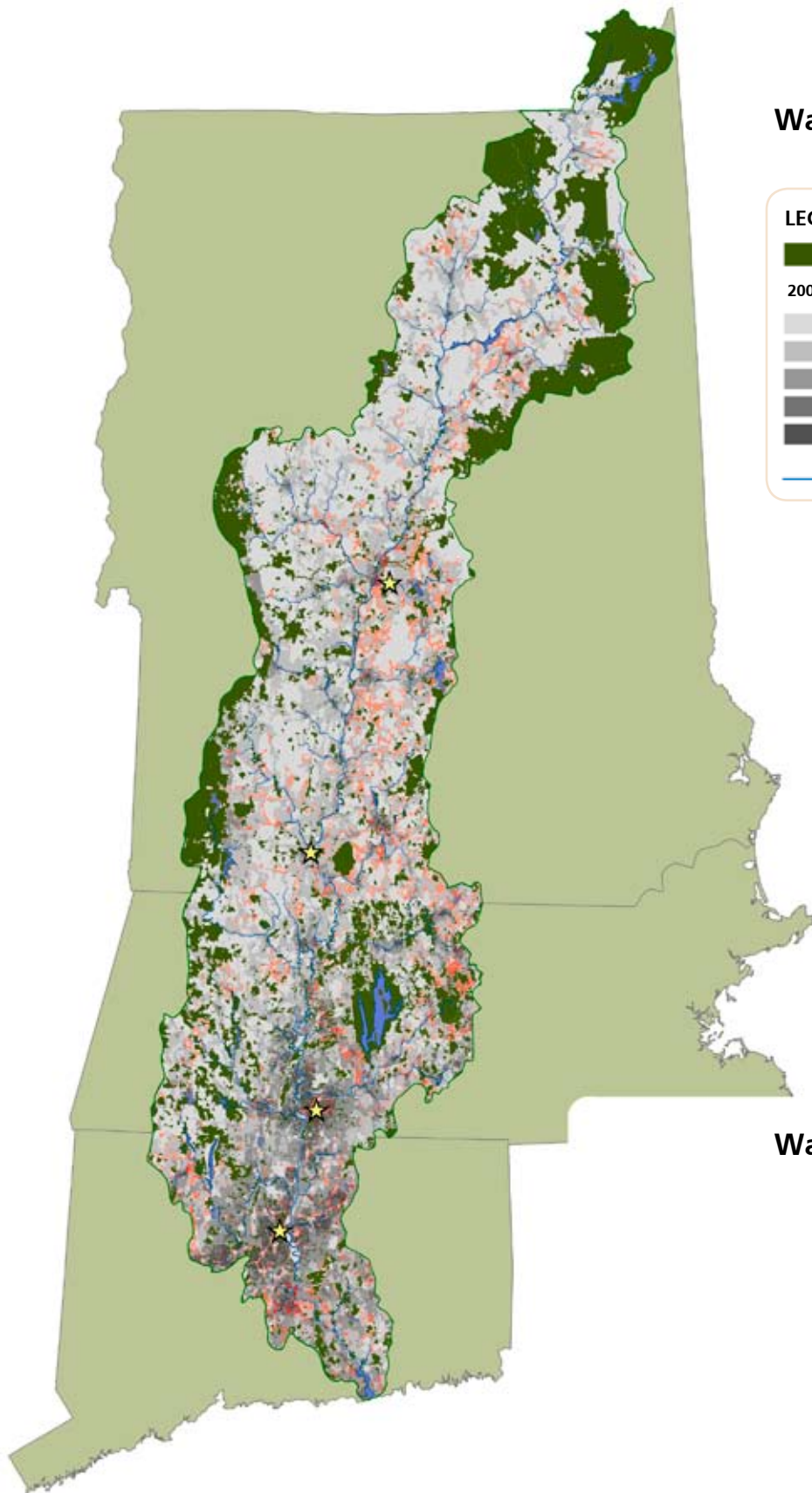
Change to...	Acres
Dense Urban	8,000
Urban	23,000
Suburban	92,000
Exurban	323,000
Total	446,000

Watershed-wide, the most prominent trend is toward exurbanization, exemplified by the development of housing on 10-acre lots²² that enable owners to enjoy their own mini-farms, while altering an area's character through the

Increasingly, new roads and cul-de-sacs are being built in agricultural lands, permanently altering these habitats and paving over some of the most productive soils in North America. A growing human population and skyrocketing demand for prime real estate will continue to place enormous pressure on agricultural lands.







Map 5 (this page)
**Watershed Housing Density,
 2000-2020**

LEGEND

- Conserved lands
- 2000-2020 changes in housing density**
- Rural
- Exurban
- Suburban
- Urban
- Dense urban
- Change to exurban
- Change to suburban
- Change to urban
- Change to dense urban
- Rivers
- Waterbodies
- State's largest river city

Map 4 (facing page)
**Watershed Housing Density,
 1960-2020**

LEGEND

- Rural
- Exurban
- Suburban
- Urban
- Dense Urban
- State's largest river city
- Rivers
- Waterbodies



The Society for the Protection of New Hampshire Forests is one of many groups trying to conserve land through cooperative agreements with landowners. Ethan Nedeau

networks of roads and services that must serve them. In the watershed, 323,000 acres of land classified as rural in 2000 are projected to become exurban by 2020. While this does not mean that every bit of this land will be developed, it does mean that these places will feel more populated and risk losing some of their rural charm.

This spreading pattern is largely a function of social institutions, including a shift to the automobile culture, state zoning and land use regulations, and local decision-making. Cities, though they are already designed and built for people to live in, fall prey to blight and economic strain. People leave for the open space and vistas of the suburbs, simultaneously paving over the open space and erecting buildings amid those vistas to bring required services to new neighborhoods. Together, these trends erode the region's traditional pattern of denser developments surrounded by rural areas that provide important natural economic assets and ecological value. Thus, making cities desirable places to live is an important part of an effort to

keep rural landscapes intact. As it turns out, it is also fiscally sound public policy. According to Robert Burchell, co-author of a 10-year study on the costs of sprawl, sprawling communities need longer public roads, increase the cost of new water and sewer hookups by 20 percent to 40 percent, impose higher costs on police and fire departments and schools, and more. These costs are passed on to businesses and residents through higher taxes and fees and sometimes through reductions in public services. In most cases, sprawling developments do not generate enough property taxes to cover these added costs.²³

If you are not convinced of the value of cities, imagine for a moment an even distribution of today's housing units across the entire Connecticut River watershed, except those areas already protected. Without adding a single person or home, the region would be carved into approximately one million five-acre lots! While a boon to the lawn industry as long as water could last, such a housing distribution would rob the region of essentially every virtue it possesses, resulting in congested roads, polluted air and water, and a characterless landscape.

SEEKING SOLUTIONS: A PLACE FOR LAND CONSERVATION

The US Council on Environmental Quality's Sustainable Development Indicator Group defines conservation as "the protection of land from damage, development, or destruction."²⁴ Land conservation is a set of tools that achieves this protection through permanent, legally enforceable, non-regulatory means. Most commonly, land is acquired by public entities or land trusts that serve the public interest, or easements over privately owned land are acquired by the same entities for the same public purposes. These transactions take place in the marketplace, with willing sellers or donors who are motivated to give up the land or some rights to it. This motivation may be based on the buyer's offer price, tax benefits of a conservation donation, altruism, or some combination of the three.

Land conservation can be deeply personal for those who care about the protected land, and it is often the most potent way to ensure permanent protection. No one argues that it should be the only tool to manage sprawl, but most experts agree that protecting land is a critical component of a comprehensive smart growth strategy. First, protecting land enhances quality of life—economists speak of recreational services, rural amenities, and so on. Second, it can guide growth to more appropriate (less sensitive or cherished) places, often with less controversy than

is occasioned by regulatory approaches. Third, it provides a secure “green infrastructure.”

Green infrastructure includes all the things that land conservation can help protect. We often take these things for granted until they are threatened or gone: working forests and farms, recreation areas, special habitats, and networks of wetlands, lakes, ponds, rivers and streams. To varying degrees, the components of green infrastructure produce ecological goods (water, soil and clean air) and ecological services (water purification, nutrient recycling, climate regulation, pollination, etc.) in addition to their more visible uses for food and fiber, recreation, wildlife and livelihoods. They also frequently provide a set of cultural amenities: scenic views, rural character, historic links, and many others. These are called nonmarket goods and services; they are often not produced in quantities that maximize the public good simply because we lack effective markets for them, they are a challenge to place value on, and they are overlooked in our fickle public budgets. Nonetheless, their economic value is widely recognized, and calculating the future benefits often makes land conservation look like a bargain.²⁵

Like the lingo or not, the logic is irrefutable. In a global economy that is unkind to the New England farmers and foresters who own most of the landscape, we cannot take for granted the public benefits that these land uses have long provided. We also cannot expect landowners with limited land-based income to respond solely to tax incentives designed to encourage agricultural and forestry uses, especially when they are receiving tempting offers from developers. In the Connecticut River watershed, two-thirds of the landscape is neither developed nor protected. For the most part, this unprotected and undeveloped land is enhancing our lives, but with little or no guarantee that it will do so in the future. Protecting the lands that provide the greatest public benefits (and the lands whose loss will generate future public costs) is smart public policy, and an important legacy to pass on to future generations. It is also an effort that is most effective if it is integrated with planning, zoning, taxation, economic development, and other tools that may seek similar results.

Some of the highest intensity development in the Connecticut River watershed occurs near Hartford, Connecticut. Cities serve a valuable role by concentrating people and reducing sprawl into surrounding rural lands. Riverfront Recapture, Inc. has worked for 25 years to reconnect Hartford to the Connecticut River.





Rocky shoreline of the Quabbin Reservoir in central Massachusetts . Patrick Zephyr



WHAT IS AT STAKE: CONNECTICUT RIVER RESOURCES

This section examines several natural resource issues in the Connecticut River watershed, showing which lands do, or could, serve important functions, as well as which of these areas are most affected by the housing density changes we have just described. Studies typically divide the region into at least three distinct areas. The Northern Forest section is remote and forested, the glacial lakebed trends from rural to urban as the River flows south but features prime farmland throughout, and the estuary portion is surprisingly quiet and filled with distinctive ocean influences. We chose to minimize this type of segmentation to focus on the resources themselves with a watershed-wide perspective, although we sometimes report results by state.

In 1992, the last year for which consistent region-wide satellite data are available, the watershed was 77.1 percent forested, 8.5 percent farmed, 5.4 percent developed, 4.9 percent wetland, and 3.9 percent water or “other.” These figures closely match other data sources.²⁶ The following pages discuss four resources: farmland, large roadless blocks of forested land, wildlife habitat, and drinking water supply lands. One theme that cuts through this resource-by-resource analysis, and that our history section illustrates, is that of the land’s potential as compared to its current use. A given piece of land often has both current and potential benefits in multiple resource categories and may be worthy of conservation for more than one purpose.

FARMLAND

Glacial Lake Hitchcock covered the area from Rocky Hill, CT (just south of Hartford) to Bath, NH (and up tributaries as far north as St. Johnsbury, VT). When it finally drained, it left a relatively flat valley with deep lacustrine soils; add to this the alluvial deposits laid down over subsequent millennia and you have farm soils that are among the best in the country, some say the world. It is no surprise that agriculture is a large part of the watershed’s story. Dairy products, fruits, and vegetables from the area’s farms boost local economies as they grace tables in homes, restaurants, and grocery stores near and far.



Farm machinery sits idle after an afternoon of haying in Hadley, Massachusetts. Clem Clay

What We Have

Between 8.5 percent and 12 percent of the watershed's land is actively farmed, and between one quarter and one third of farming takes place on prime farmland as defined by federal standards. The watershed's approximately 221,000 acres of prime soils that are currently farmed are of particular importance to the region's identity and to its ability to provide vegetables and grains that only thrive on productive soils.²⁷ Much of the currently farmed, and most productive, prime soil lies in fertile river valleys in Massachusetts and Connecticut, where the Connecticut River mainstem is home to towns known for centuries as the breadbasket of New England. Vermont and New Hampshire contain smaller portions of the soil in their river valleys, but Connecticut River valley soils are still among the best in either state.

Map 6 shows the locations of land that is classified as "prime" by the USDA Natural Resources Conservation Service,²⁸ as well as other soils that are categorized as currently farmed by analysis of satellite images.²⁹ The table on page 26 shows the amount of farmland (and non-farmed land that is prime for farming) for each state. While data are not fully available or perfectly consistent between states, this map both reinforces the agricultural primacy of the Connecticut River valley and demonstrates that good soil and active farms are widespread, even in areas that are largely forested.

According to the Census of Agriculture, farmers making \$1,000 in annual agricultural income own 10.9 percent of the region. Of the over 800,000 farm acres covered by the Census region, half are woodland, 28.5 percent are actively cropped, and the rest is in non-harvest rotation, pastured, fallow, or used for farm structures and other purposes. Of the cropped land, 69 percent produces forage for livestock (mostly cows). The following table shows the acreage occupied by other major crops. Note that far more corn is grown for forage than for grain, accounting for its ubiquity on the region's landscape.

Crop	Acres	Percent
Forage	157,826	69
Vegetables	13,971	6
Christmas Trees	5,841	3
Corn for Grain	2,708	1
Tobacco	2,904	1
Potatoes	3,193	1
Orchards	4,073	2
Nursery, sod & seed	6,761	3
Other	31,456	14
Total	228,733	100

The Census of Agriculture shows that the region was home to 6,207 farms in 2002 with an average size of 130

acres. Of these, 2,030 generated at least \$10,000 in income in 2002. The top revenue generators for the region's farmers in 2002, in rank order, were: nursery products, dairy, tobacco, vegetables, "other crops and hay," and fruits and nuts. Maple syrup dominates the "other" category in value, and the watershed can claim more than one quarter of the approximately one million gallons produced by New England in 2002, including the majority of the Massachusetts and New Hampshire portions. Together, these products generated \$355 million of the region's \$422 million in farm income in 2002.³¹ In all, these farms had a \$103 million payroll and employed 15,309 workers; 4,784 worked over 150 days on 875 farms large enough to hire full-time non-family workers.

These data emphasize the unique characteristics of farming in New England and the Connecticut River watershed. The valley floor farms with prime soils and the ability to compete with other regions in cash crop production are an extremely precious resource, but the forested farms and dairy operations in the rest of the watershed (with associated pasture and forage crops) are responsible for far more of the land in farming. Both are critical to regional identity. Both contribute to the "rural amenities" that are vital to the region's economy and identity, and also frequently provide wildlife habitat and other benefits. Despite their contributions, the region's farmers find it difficult to earn a living due to the fickle cycles of federal dairy policy, competition from foreign producers, and other challenges. But many are making the best of circumstances, converting to organic production in search of premium prices, capturing specialty niche markets, building value-added processing facilities, or benefiting from buy-local campaigns such as the successful "Local Hero" campaign sponsored by Community Involved in Sustaining Agriculture in Massachusetts.

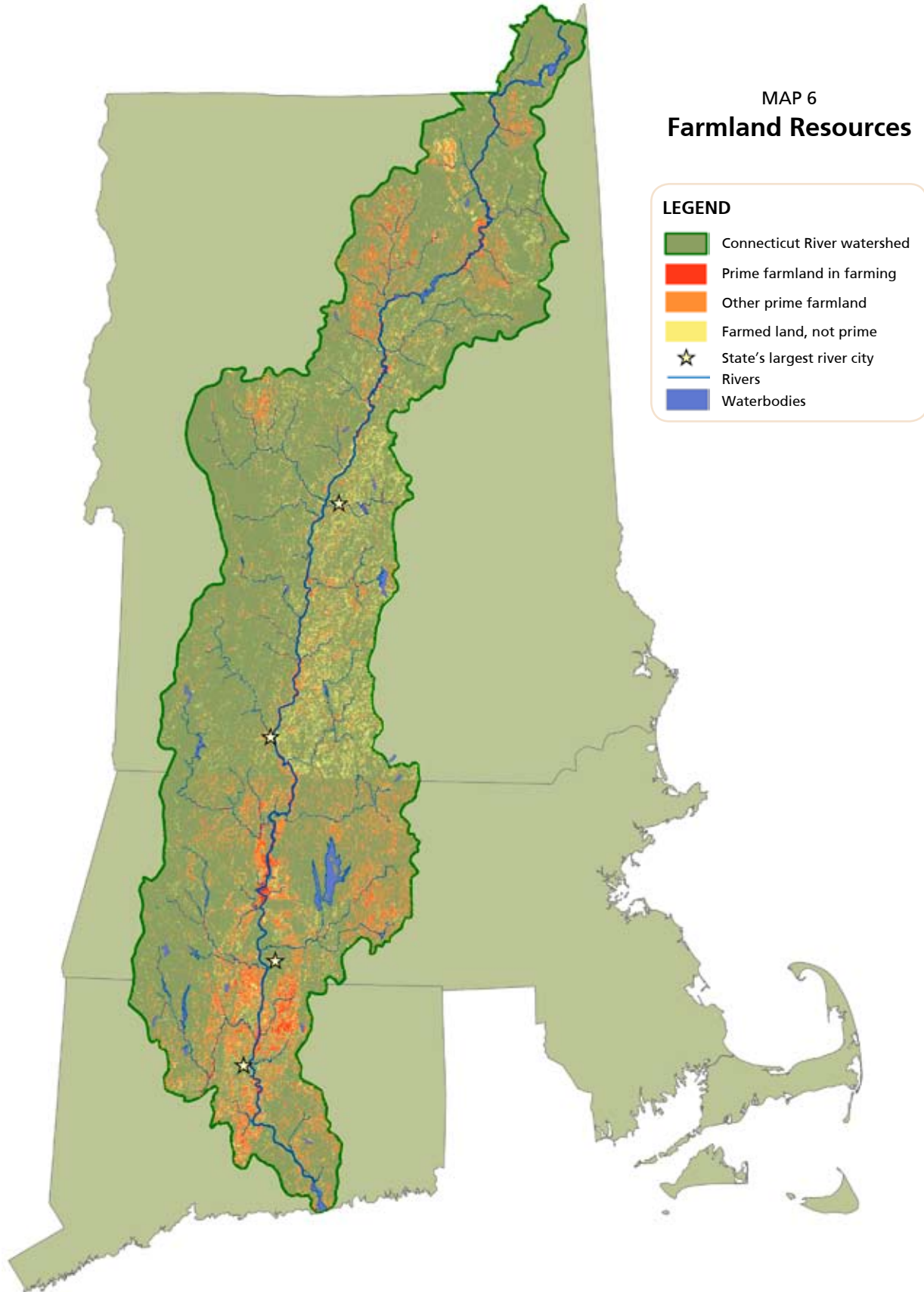
What We Are Losing

Efforts to sustain farmers are not able to stem the tide of farmland loss: between 1982 and 1997 the watershed lost 19 percent of its farmland.³² During those years, the amount of developed land increased by 31 percent.³³ The American Farmland Trust placed portions of the Con-

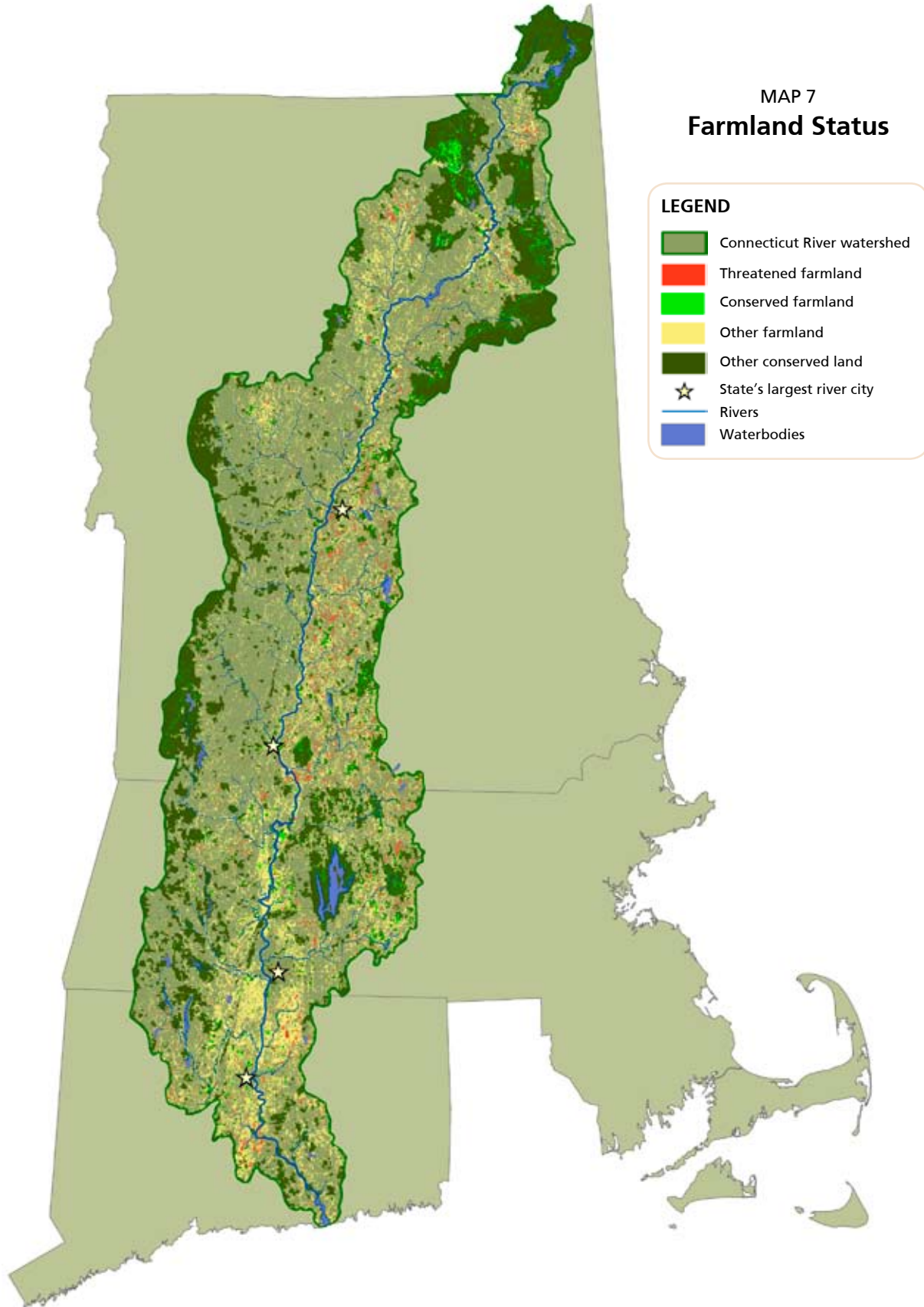
Farmers take advantage of the rich soil at the northern end of glacial Lake Hitchcock's footprint in Haverhill, New Hampshire and Newbury, Vermont. Riparian buffers protect farm soil from erosion and create wildlife habitat, but current farm policies provide inadequate incentives for farmers to widen these strips.



MAP 6
Farmland Resources



MAP 7
Farmland Status



necticut River Valley among the top 20 most threatened important agricultural areas in the US.³⁴ An additional 75 percent (65,000 acres) of the watershed's farmland was lost between 1997 and 2002—fully 45 percent of net farmland loss in New England.³⁵ The region lost 819 farmers in five years (11.9 percent). Farmers are aging (average age in 2002 ranged from 53.9 in Vermont to 55.4 in Connecticut) and the value of their land is rising far faster than the income it can generate from agriculture. Even as farm income declined slightly from 1997 to 2002, the value of the land and buildings owned by the watershed's farmers shot up by nearly one third (32.5 percent), topping \$3 billion. Between a third and a half of this total value resides in the 604 farms worth over \$1 million each.³⁶ The average real estate value per acre in the watershed is \$3,839, with a wide range from \$1,417 per acre in Essex County, Vermont, to \$13,139 per acre in Hartford County, Connecticut.³⁷

Rising farm real estate values are only partially correlated with farm income potential; competing demands for so-called “higher and better” uses drive the price of farmland sky-high in many locations. The story of housing and commercial development sprouting on former farmland is all too familiar to the region's inhabitants—farmland is al-

ready cleared, often drains well enough for septic systems, and frequently boasts lovely views and proximity to valued amenities. Once land is developed for housing, even on large roadfront lots with open acreage beyond the home-stand, the potential for future production in the immediate area is at risk. Neighbors grow intolerant of the sounds and smells of farming, larger farmers cannot lease and access parceled lands easily, and farm supply businesses lose their customer base and disappear.³⁸ As family farms become exurbs and suburbs, communities lose pieces of their heritage and character, as well as sources of food, income, views, and the environmental benefits of open space.

Map 7 shows all prime and farmed land, highlighting the areas already conserved and those most vulnerable to housing development pressure. The table below shows the acreage of each of these land classes by status (protected, threatened, or neither). Though development pressure is most concentrated in New Hampshire, it is present throughout, and often exists in the middle of farm country. Approximately 129,000 acres of active farmland in the watershed are permanently protected from development through state and federal easement programs, including 24,000 acres identified as prime soils. Over 74,000

Farmland Category By State	Threatened	Protected	Neither	Total
<i>Connecticut</i>				
Farmed land that is not prime	8,357	6,284	84,196	98,837
Farmed land that is prime	5,933	3,272	57,299	66,503
Prime land that is not farmed	7,670	6,912	80,949	95,531
<i>Total</i>	21,960	16,467	222,444	260,872
<i>Massachusetts</i>				
Farmed land that is not prime	7,448	13,919	93,500	114,867
Farmed land that is prime	3,845	8,955	52,881	65,681
Prime land that is not farmed	9,143	27,938	123,271	160,352
<i>Total</i>	20,436	50,812	269,651	340,899
<i>New Hampshire</i>				
Farmed land that is not prime	35,729	53,597	188,341	277,667
Farmed land that is prime	4,636	3,217	27,048	34,901
Prime land that is not farmed	8,340	11,253	61,136	80,729
<i>Total</i>	48,704	68,068	276,526	393,298
<i>Vermont</i>				
Farmed land that is not prime	6,032	31,985	129,800	167,817
Farmed land that is prime	2,370	8,238	43,174	53,782
Prime land that is not farmed	3,788	12,222	79,711	95,721
<i>Total</i>	12,190	52,446	252,685	317,320
Grand Total	103,290	187,792	1,021,306	1,312,389



Family-owned farmstands are part of the spirit of the Connecticut River valley and help connect people to the land and their local communities. Ethan Nedeau

acres of farmland (including 17,000 acres of prime soils) are identified as under high threat. An additional 180,000 acres of prime farmland and 496,000 acres of non-prime farmland are located in places where the rural/exurban boundary may not be crossed by 2020, but where individual farms may be threatened by development.

On one hand, a small proportion of currently farmed land is protected—only 11 percent of prime soils and 16 percent of farms on other soils. On the other hand, considering the watershed's vast size, what remains to be protected would not be overwhelming if adequate funding were available to compensate farmers for their development rights. Just under 200,000 acres of prime soils that are currently farmed remain to be protected, which is less than three percent of the watershed's area but capable of sustaining food production in the region. All of these soils should be a priority for protection, and the owners of the relatively small number of large farms on prime soils should be given real conservation options before retirement and death force families to sell land for development.

Malls and big box stores are an increasingly common sight in small communities close to larger population centers. Development along Route 9 in Hadley, Massachusetts, affects nearby farmland, grassland bird habitat, and the Fort River, the state's longest free-flowing tributary to the Connecticut River.



Protecting the remaining farmland on non-prime soils would do a great deal to maintain the agricultural landscapes of New England. More prioritization will be necessary to determine which of these farms are most capable of maintaining a viable operation over time, which produce additional public benefits worthy of compensation, and which are most threatened. An extraordinary group of land trusts, including the Vermont Land Trust, Upper Valley Land Trust (Vermont and New Hampshire), the Franklin Land Trust and Valley Land Fund (Massachusetts), and Connecticut Farmland Trust are making daily progress working with farmers on the ground, while American Farmland Trust, the Working Lands Alliance, and others pursue the necessary policy and funding tools.

Protecting the land for the use of future generations of farmers and other benefits to society is important, but it is not the same as protecting the economic viability of the region's farms. A one-time infusion of cash assists with business re-investment, enables inter-generational transfer of equity, and makes land more affordable to future farmers, but cannot provide protection from foreign markets or reform the food system along local lines. Without the land we are rapidly losing, however, future policy innovations and market shifts will have little potential to take advantage of the breadbasket New England can call its own. With public commitment and farmers willing to sell development rights at a fair-market price, most of the prime soils and much of the farm landscape we take for granted today could be protected, ensuring forever the region's ability to produce significant portions of its own food and maintain its agrarian values. With the watershed's farms valued at \$3 billion, and a substantial portion of this value in houses, farm buildings, and crops, it is conceivable that an ambitious protection effort could achieve its goals in 10 to 20 years.

FORESTS

As important as agriculture is to the region, the equal weight of the forests cannot be denied. A quick replay of the watershed's landscape history makes evident that the transition from forest to farm and back to forest is the most notable of all the changes that new Americans wrought on the land. Even facts from the preceding section on farmland—the prominence of maple in the agricultural economy, the high proportion of prime agricultural soils that are not in farming, and the fact that half of the land on farms is woodland—are reminders that farm and forest are less easily separated here than anywhere else in the



Hikers in Vermont's Northeast Kingdom. Jerry and Marcy Monkman

nation. Nonetheless, the Northern Forest and many highland regions are dominated by expanses of forest that are among the most productive and threatened in the nation.

What We Have

In this section, we emphasize the economically productive potential of the region's forests. Forests are prized for benefits beyond timber, including habitat and water quality benefits, and even carbon storage to mitigate climate change. Environmental advocates increasingly value the protection of a vast network of sustainably harvested woodlands under private ownership. A viable forest economy slows fragmentation, buffers protected habitat reserves, and provides jobs that sustain rural communities.

Even though the watershed is centrally located in the region, is crisscrossed by highways, and was predominantly cleared in the 19th century, it is surprisingly rich in forests.



Of the Connecticut River watershed's 7.2 million acres, 5.6 million (79 percent) are forested. This proportion is higher than in New England as a whole (71 percent), and much more than the four watershed states as a group (64 percent). Of course, there are fewer forests in the watershed's southern portions (56 percent in Connecticut and 74 percent in Massachusetts) than in Vermont and New Hampshire (85 and 86 percent respectively). Just over one million acres (18 percent) of the watershed's forests are publicly owned, with slightly less than one third of

The Connecticut River Watershed has an enormous array of habitats, including the western slopes of some of New Hampshire's White Mountains that feed the headwaters of the Wild Ammonoosuc River.





Spruce forest along the Long Trail in Vermont. Patrick Zephyr

that amount in National Forest. The remaining 4.6 million forested acres (82 percent) are privately owned, some protected from development by easements, but most still vulnerable to development. The watershed is a prime example of the few areas in the country that are more than 75 percent forested and have more than 75 percent private ownership of forests.³⁹ The US Forest Service has noted the unique contributions of such areas to the public good, and the nation's vulnerability to losing them.⁴⁰

Northern New England, more than any other region in the nation, is known for its high proportion of productive timberland. Maine, New Hampshire, and Vermont are among the four US states with more than three quarters of their forest classified as "timberland" (unreserved land capable of producing 1.38 cubic meters per hectare of industrial wood annually).⁴¹ These forests provide jobs in the watershed. Looking at the four-state region as a whole (watershed-level data are not available), the forestry sector generates nearly 4,000 jobs, while "lumber and wood products (including logging)" provide work for nearly 20,000 more, and the "paper and allied products" industry employs more than 33,000. The total payroll for these 57,000 jobs exceeds \$1.8 billion. In each sector, either New Hampshire or Massachusetts provides the most jobs or the largest payroll. However, the standing volume of both hardwood and softwood is estimated to be largest in Vermont. In total, the Connecticut River

watershed comprises 17 percent of New England's forest, but 30 percent of its softwood volume and 34 percent of its hardwood volume.

In many respects, the watershed's forests are representative of New England's forest diversity. The overall balance of forest communities in the watershed is similar to that in the six states, though with a significantly higher proportion of sugar and upland red maple. The table below shows key forest types by the percentage of total forest that they represent in the upper and lower portions of the watershed. The data come alive for anyone who has walked these woods: from the maple and birch forests of Meshomasic State Forest in southern Connecticut to the spruce, fir, and hardwoods near Connecticut Lakes in Pittsburg, New Hampshire, on the Canadian border.

Forest Type	Upper Valley	Lower Valley
White - Red - Jack Pine	11.5%	14.9%
Spruce - Fir	12.9%	1.4%
Oak - Pine	0.7%	2.8%
Oak - Hickory	3.4%	23.4%
Elm - Ash - Cottonwood	0.5%	3.1%
Maple - Beech - Birch	62.8%	51.2%
Aspen - Birch	8.2%	2.7%

Map 8 shows large roadless blocks of forest in the watershed, with block size distinguished by color. While

there are clearly other important factors, large blocks are a key determinant of the viability of sustainable forestry, and are important to conservationists for their multiple benefits. Experts state that, while some smaller operations are successful, one thousand acres is a minimum area of forest to consider as valuable for a large-scale assessment of forestry potential.⁴² In all, 1.7 million acres (24 percent of the watershed) are found in blocks of forest of at least 1,000 acres. The vast majority of these blocks are in Vermont and New Hampshire.⁴³

What We Are Losing

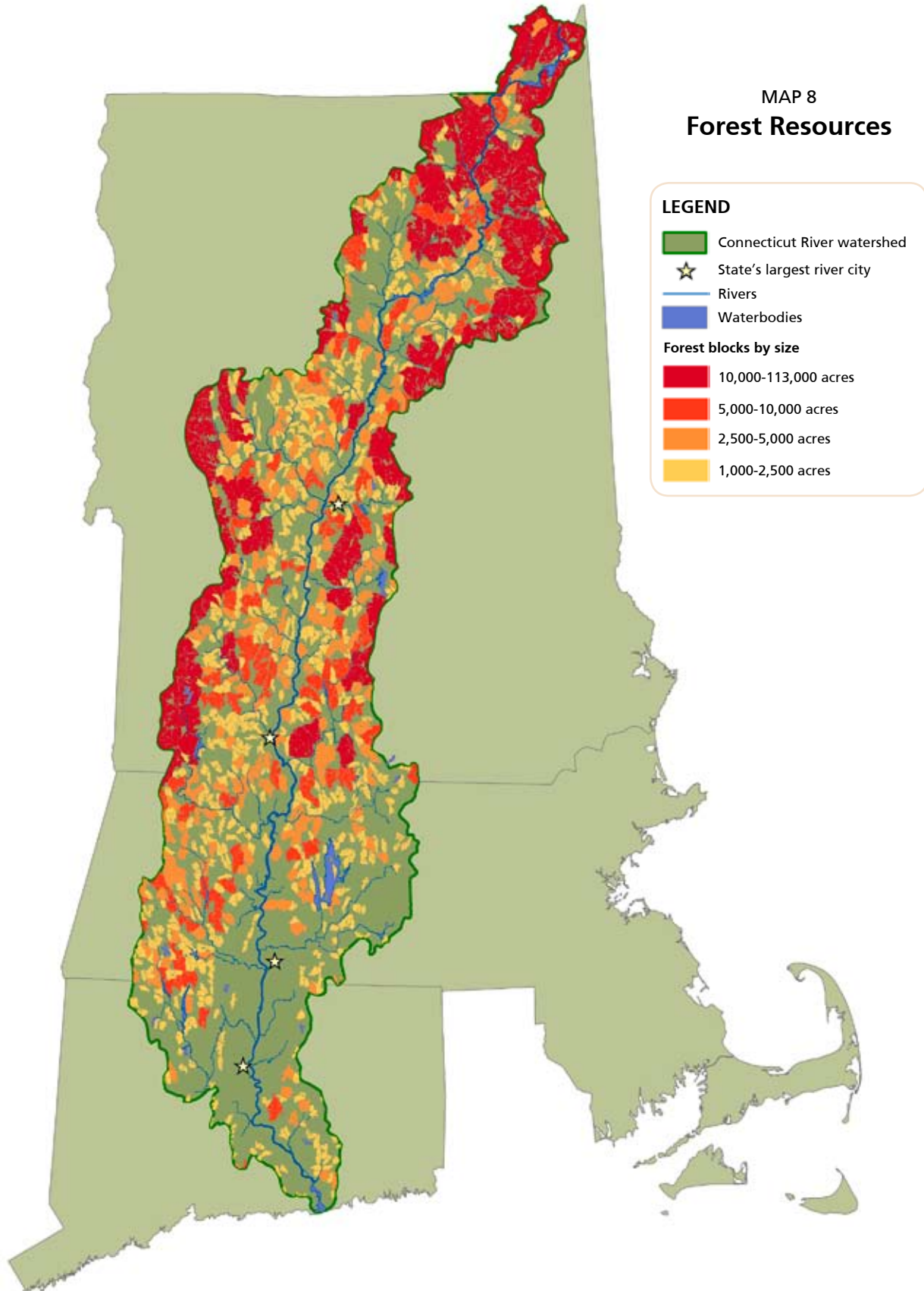
Forest ownership is much more lucrative than it used to be—as long as you are not in the timber business! In many cases, the economics of private forestland ownership encourage short-term, high value return from timber harvesting, followed by parceling and resale, while ownership for the purpose of long-term sustainable timber management is becoming increasingly challenging. As tracts are parceled, their timberland value decreases while their non-timber value, particularly for development, increases. The Northern Forest portion of the watershed has experienced a tumultuous shift in ownership patterns in recent years, with a trend away from vertically integrated ownership by the pulp industry and toward more owners with smaller holdings and a wider range of financial interests and management objectives. Between 1998 and 2003, nearly one-third of the total landmass of the watershed's northern forest tracts in Vermont and New Hampshire went up for sale.⁴⁴

The conservation community has succeeded in protecting many key parcels during the sale process. As with farmland, protection of working forests from development is typically accomplished not by public acquisition, but by placing easements (often paid for with public and private funds) on privately owned land. As the real estate market has pushed up prices for land and state and federal funding has fallen, these transactions have become increasingly difficult to fund. The US Forest Service 2005 "Forests on the Edge" study identified portions of the Connecticut River valley in Vermont and New Hampshire as among the 20

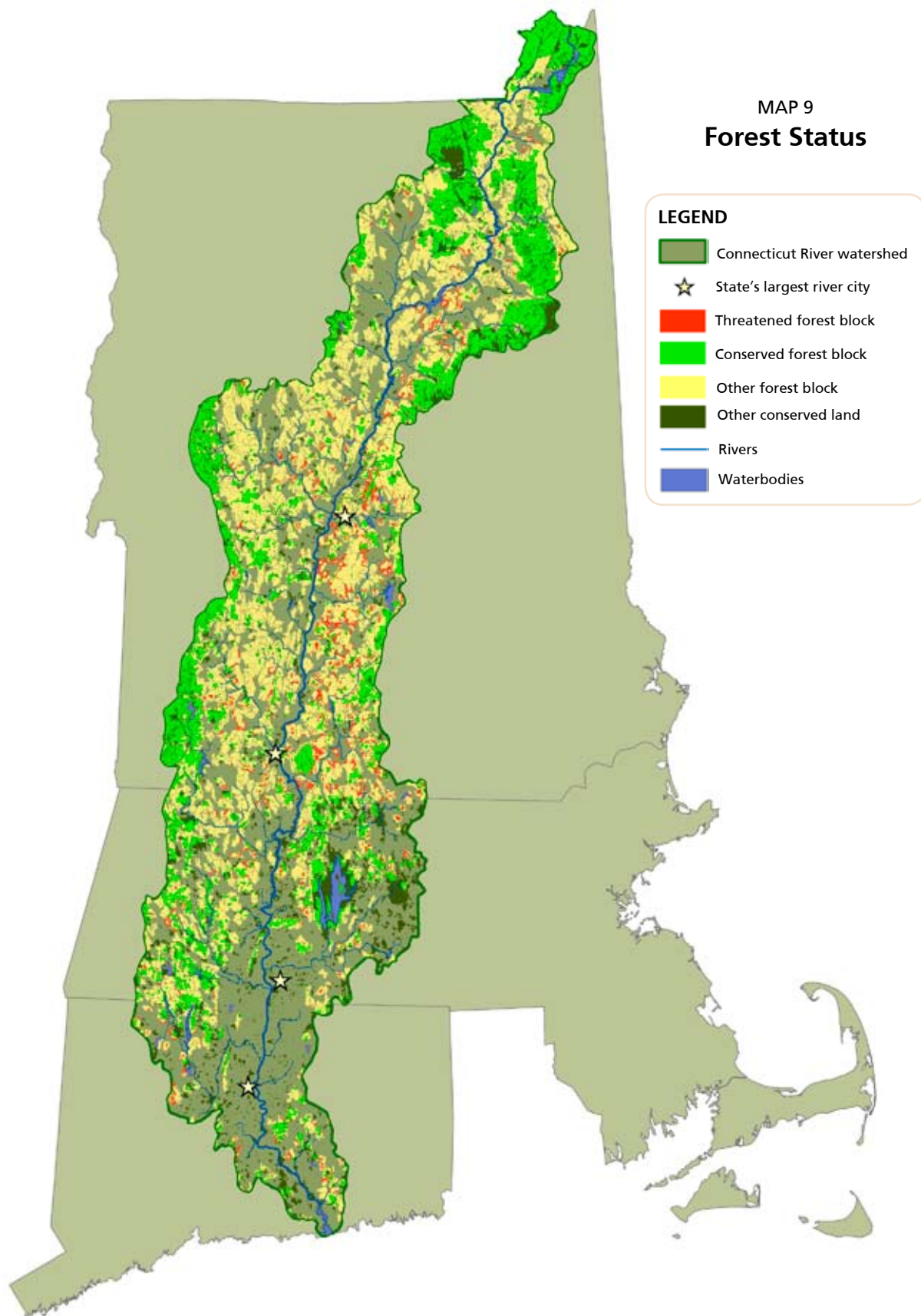
The northern forests of the Connecticut River watershed provide some of the most commercially valuable timberlands in the Northeast. In a landmark 2002 deal, TPL negotiated the protection of 171,000 acres of land in the Connecticut Lakes region. The most sensitive 25,000 acres were set aside as a habitat reserve, while the rest will sustain the forest and tourism industries in the region without the threat of parcelization or large-scale clear-cutting.



MAP 8
Forest Resources



MAP 9
Forest Status



most threatened watersheds in the US that have a high proportion of privately owned forest. This study employed a housing density threat analysis similar to the one we have used for this report.

Map 9 identifies the conserved and threatened lands in the watershed that are part of forest blocks of at least 1,000 acres. The table below summarizes, by state, the protected, threatened, and other lands in these blocks.

State	Threatened	Protected	Neither	Total
CT	7,430	27,928	53,273	88,632
MA	12,459	74,497	161,654	248,610
NH	67,116	162,222	383,409	612,747
VT	20,097	255,428	488,639	764,164
Total	107,103	520,075	1,086,975	1,714,153

While substantial progress has been made in protecting 30 percent of the watershed’s large roadless forested blocks, the job is far from done, with over 1.2 million acres of forest blocks unprotected. Following a common trend, the highest elevations have seen the highest level of land protection, though in many mountainous areas on the watershed’s edge important conservation gaps remain. Focusing additional attention and resources on forest blocks closer to the Connecticut River mainstem will help avert the loss of economically important forests in places where parceling and housing development are rapidly reducing block size. In addition, refining our ability to identify the forests with the greatest long-term productive potential will help to prioritize protection efforts designed to ensure the sustainable future of forestry in the region.

HABITAT

Aside from two million-plus people, what lives in this watershed? How do we place a value on their presence? The Connecticut River connects the entire region with Long Island Sound, providing 70 percent of its freshwater and critical linkage for a wide variety of migratory aquatic species. For some, nesting bald eagles or the annual flights of migratory birds north and south through the River’s flyway are the highlight; for others it is the sight of a 1,200-pound bull moose; still others thrill at the unique vegetation of floodplain forests and bogs, or seek out the unusual species inhabiting traprock ridges knifing from the valley floor. The list could go on and on: we get more out of wildlife than we can ever name or quantify, each of us responding uniquely to the mysteries nature reveals. People



The Connecticut River supports Massachusetts’ and Connecticut’s only populations of the yellow lampmussel, an endangered freshwater mussel. Ethan Nedeau

derive intrinsic value from both protection of endangered species and from ensuring the continued viability of common ones. This section examines the habitat features of the Connecticut River watershed through three lenses, recognizing that ultimately, every species depends on the health of land and water.

What We Have

The watershed provides habitat to approximately 59 mammal species, 250 birds, 22 reptiles, 23 amphibians, 142 fish, 1,500 invertebrates, and 3,000 plants. Of these, three birds, one fish, two invertebrates, and four plants are federally listed as threatened or endangered, and the US Fish and Wildlife Service is the primary agency charged with their protection.⁴⁵ The Silvio O. Conte National Fish and Wildlife Refuge is a unique tool in the Service’s toolbox; its boundary is the entire watershed, and in addition to selective land acquisition in priority focus areas, the Refuge can work with private landowners, partner with nonprofit groups, and engage in outreach and education to achieve watershed-wide results.

Each watershed state lists species that are rare or endangered within the state’s borders, though not nationwide, that the state prioritizes for protection. There is no standard among states for including species on these lists, making multi-state analysis challenging. In addition, each species is unique, so determining the necessary habitat would ideally be a completely customized effort for each species.

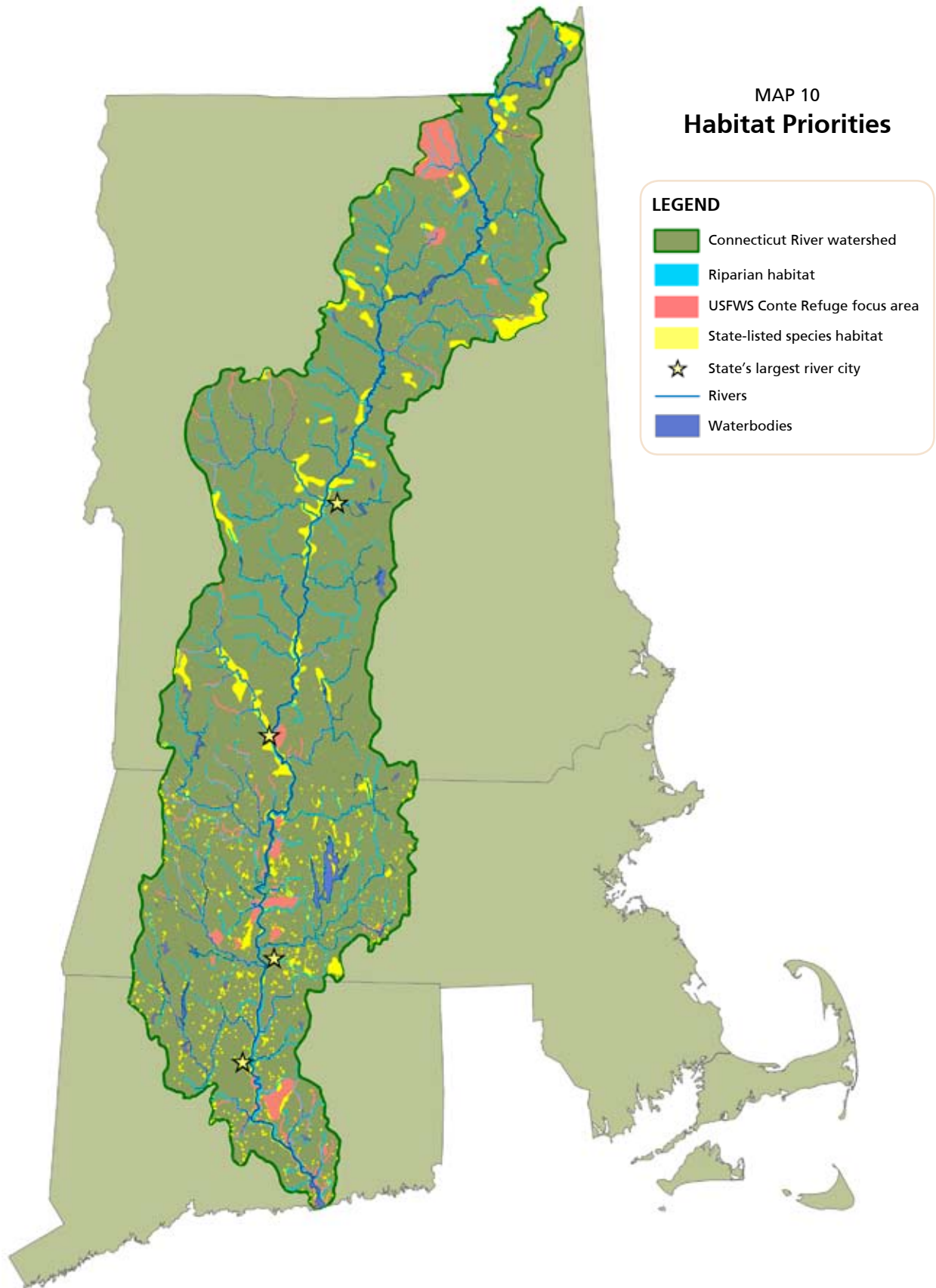
Map 10 displays habitat priorities at the federal and state levels, and enhances those with a riparian buffer zone around the watershed's rivers. The federal priorities are those listed as part of the land protection strategy outlined in the 1996 Conte Refuge action plan; they include many sites of known importance for federally listed species, but are not based on a current watershed-wide analysis of the locations and needs of these species. State priorities are based on the work of state wildlife programs using a least common denominator approach; we made the results more uniform where possible, so that each state's priority sites are the smallest areas of land that, in total, include the general locations of as many known habitats as possible. The state and federal priority sites included many riparian zones, but we added a separate layer to include all of them on larger streams and rivers because they are so important to many terrestrial species for food, protection, and movement, and valuable to aquatic species for erosion and temperature control. Given the complexity of the task, these maps provide only a rough guide to the habitat values that others have identified in the watershed. Many organizations and agencies continue to revise data, standardize interpretations, and develop new methods for predicting and prioritizing rare species habitat conservation.

Naturalists recognize that "keeping common species common" is an important conservation goal that sometimes suggests different priorities for land conservation than protection of rare species habitat. Unfortunately, such an analysis has not been completed for Vermont and New Hampshire. In addition, except for riparian zones, we have not included habitat types that are not state or federal priorities. Another approach to understanding the importance of wildlife to people is through a variety of econometric methods that measure expenditures, activity, willingness to pay, and other parameters. These studies are rarely done for small geographic areas, but a national survey conducted by the US Fish and Wildlife Service in 2001 indicates that wildlife-related expenditures in the four watershed states totaled \$2.6 billion. The following table gives a breakdown of these expenditures by state and activity. These numbers provide compelling evidence of the importance of wildlife habitat to economic activity.

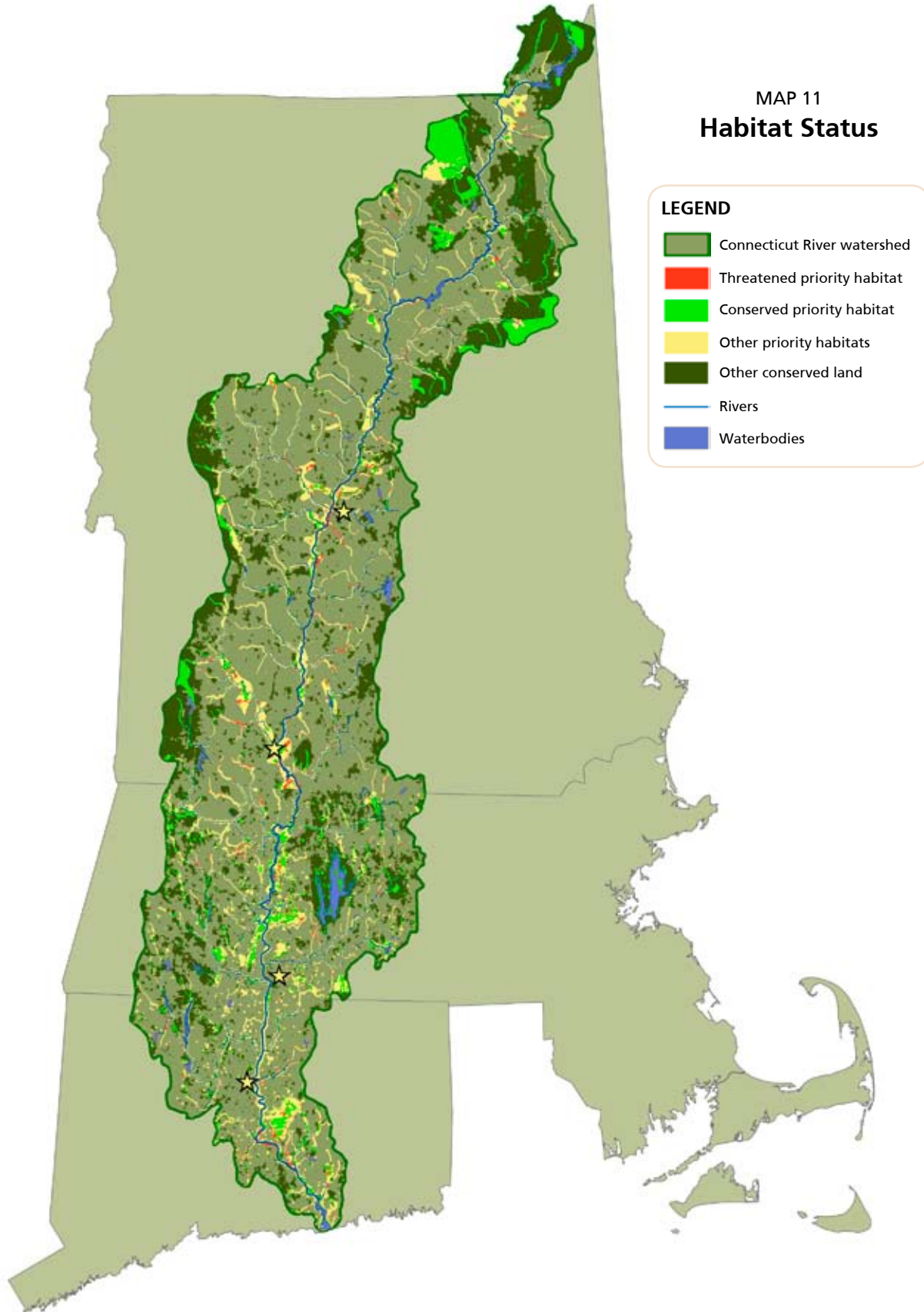
The Mill River in Hatfield, Massachusetts has received a high level of ecological research, conservation, and restoration by local groups and state and federal agencies. The river is home to a viable population of the federally endangered dwarf wedgemussel and is a focus of Atlantic salmon recovery efforts.



MAP 10
Habitat Priorities



MAP 11
Habitat Status



State	Fishing & Hunting*	Wildlife Watching*	Total Expenditures*
CT	\$276	\$226	\$502
MA	\$603	\$493	\$1,096
NH	\$276	\$343	\$619
VT	\$182	\$204	\$386
Total	\$1,337	\$1,266	\$2,603

*values in millions of dollars

What We Are Losing

Whether endangered or common, many species are adversely affected by the spread of housing across the landscape. There are exceptions: bears, coyotes, raccoons, beavers, and others are thriving in the human landscape (perhaps to the detriment of the species). Exurbanization and suburbanization of the landscape will undoubtedly reduce habitat for most native species.

Map 11 depicts the priority habitat shown earlier as protected, threatened, or neither. The table below summarizes the results of that analysis by state; nearly 1.3 million acres falls into one or more habitat priority categories.

State	Threatened	Protected	Neither	Total
CT	16,022	36,740	145,253	198,015
MA	13,961	105,489	243,574	363,025
NH	24,372	93,801	181,949	300,122
VT	15,746	144,114	273,200	433,060
Total	70,101	380,144	843,976	1,294,222

Important habitat areas are roughly evenly distributed among the states according to their land area in the watershed, but the greatest threats lie in New Hampshire.

These data show that, within the limitations of the analysis, we have done about as well in protecting identified habitat priorities in the watershed (29 percent protection) as we have with large forest blocks (30 percent protected), but that we have by no means completed the job. Acres do not tell the whole story, of course. In some cases, protecting a small area can make an important contribution, as the Conte Refuge's recent protection of 29 acres of federally endangered Puritan Tiger Beetle habitat in Cromwell, Connecticut, demonstrates. In other cases, large and connected areas must be assembled over time to achieve meaningful success.

WATER

Water is essential for homes, farms, businesses, and aquatic and all other life. Its path through the watershed depends on climate, geology, soils, and human intervention. Its flows have shaped the landscape, defined habitat types, and loomed large in human experience, from pre-European salmon and shad runs to the Great Floods of 1927 and 1936. The sacrifice of four Massachusetts towns to supply Boston's water and several Vermont and New Hampshire towns for the series of hydroelectric dams at Fifteen-Mile Falls stand out as water resource choices with enduring implications. Increasingly, New Englanders will be faced with challenging public choices about Connecticut River basin water in the interrelated dimensions of quality, quantity, location, timing, and access. This section focuses on those issues that are most relevant to land conservation: river water quality, flood storage, and drinking water. Due to lack of current and reliable data, only the latter is included in the maps.

River Water Quality

It is a simple-sounding goal that almost anyone would support—ensuring that all reaches of the River and its tributaries are fishable and swimmable, and that the River's input to Long Island Sound does not harm the quality of water there. By and large, the River is safe for swimming except where bacterial counts are driven up by sewage and street drainage overflows in its urban corridor. But the goals referring to fish and the Sound are complex: they beg questions about which species we should be able to fish for, how those fish can bypass dams even if the water is clean, how much water can be withdrawn, which pollutants are the highest priority, and so on. The solutions are just as challenging, and include treating urban combined sewer overflows, small dam removal and large dam reoperation, reductions in airborne mercury from outside the region, and many other actions. The Connecticut River Watershed Council, The Nature Conservancy, the Connecticut River Joint Commissions, and numerous state and federal agencies work hard pursuing these important reforms.

For this report's purposes, the key concerns are how much improvement in water quality can be gained through land conservation and where the highest-priority lands are—those whose protection would do the most to improve or secure the quality of water flowing through the watershed and to the Sound. Public agencies and university researchers have developed several computer models of the watershed, but no integrated approach guiding land

conservation choices region-wide has yet become feasible. The best model in use for analyzing the relationship of land characteristics, hydrological flow, and land use is the US Geological Survey's New England SPARROW model, which focuses exclusively on nitrogen and phosphorous pollution as part of the effort to develop nutrient loading standards for Long Island Sound. Its results suggest that forest conservation is a top priority for water quality.⁴⁶ Agriculture—often a culprit in other regions where large-scale animal operations are more common—is a relatively minor contributor to nitrogen loading in the Sound. Contributions to pollutant loads from all land uses depend on the management practices in use. Land conservation typically guarantees future implementation of some level of pollution-reducing management practices, but additional improvements depend on government or market incentives and private landowner choices.

The experiences of densely developed and intensively farmed watersheds such as the Chesapeake Bay region tell a cautionary tale about water quality in New England. EPA and other studies have shown that a high proportion of forest cover in a small watershed vastly improves water quality, with 90 percent forest often cited as an important threshold. Conversely, more than 10 percent impervious surface typically degrades water quality. In some areas of the watershed, housing development far exceeds these thresholds. Where increasing housing density is not offset by adequate water treatment infrastructure, and where intensive animal agriculture is not offset by adequate nutrient storage and management, the river will suffer. Fortunately, large and intensive animal operations are not typical of our region's farms.

Although there is currently no map to highlight land conservation priorities for Connecticut River water quality, and much depends on local soil, slopes, and management practices, we know that in general, farmland is better than developed land and not as good as forest. Wetlands serve a particularly important role in water filtration, and are fortunately less vulnerable to development in our region than is drier ground. Riparian zones play a special role in water quality, particularly in reducing erosion and sediment loads. Previous sections of this report have included

Flood control dams, like this one on the Farmington River in Connecticut, were built after the devastating hurricane of 1938 to protect towns and infrastructure from floods.





The Westfield River in Massachusetts. Jerry and Marcy Monkman

riparian zones and forest blocks as important habitat and working lands priorities, so we have elected not to produce a separate map for this report, although we note the need for developing the information that could lead to a refined map of this type in the future. What is clear is that everywhere in the watershed, land protection contributes to our long-term ability to maintain and improve the quality of the water traveling through the system and to the Sound.

Flood Storage

The Connecticut River's floods are legendary. The US Army Corps of Engineers (USACE) maintains 16 dams to control flow in the system for the protection of human life and property, significantly reducing the likelihood of the damage experienced in earlier major flood years, most notably 1936. However, these dams operate at an ecological cost, and are unlikely to provide protection against all future storms. By protecting land in strategic areas that are capable of absorbing large amounts of floodwater by virtue of their expanses of flat land near the River, it is possible to provide important flood management capacity while also protecting farmland, habitat, and the River's need to wander. Of course, some areas that once provided this "natural valley flood storage" are now too developed to make large-scale land conservation for future flood storage practical; many of these are protected by levees. In other areas, however, this approach may be practical. With new

hydrologic models and a complete assessment of the costs and benefits, natural valley flood storage may emerge as an important land conservation target.⁴⁷

Drinking Water

Drinking water is a critical resource and a priority for all Americans. According to polls commissioned by TPL and The Nature Conservancy, 84 percent of Americans believe it is "very important" to buy land to protect drinking water quality, and 56 percent are willing to pay \$50 or more in addition to current taxes to support land conservation for water quality and other purposes.⁴⁸ The case for land protection in sensitive areas around public water supplies has been made for decades, with many states dedicating funding to this purpose. The Connecticut River mainstem supplies no drinking water, but numerous tributary dams create reservoirs that supply water to millions of people. In addition, groundwater (much of it stored in aquifers with a geologic history parallel to glacial Lake Hitchcock's) provides drinking water to many municipal water suppliers.

Map 12 shows the locations of designated drinking water supply areas in the watershed, except in Vermont, where data are not available. We have distinguished between lands owned by water companies and other lands because lands owned by private companies are often taken for granted as protected, but many lack full legal assurances against future development. Overall, more than half a mil-

lion acres of water supply land are identified in the three states where data are available, including: 203,000 acres of water supply land in New Hampshire, 241,000 acres in Massachusetts, and 78,000 acres in Connecticut. Map 13 shows the combined water supply area from the previous map and identifies threatened and conserved lands. The following table summarizes the same data by state.

State	Threatened	Protected	Neither	Total
CT	5,594	14,722	57,525	77,841
MA	8,720	103,893	128,010	240,623
NH	20,801	47,330	134,771	202,902
VT	N/A	N/A	N/A	N/A
Total	35,115	165,945	320,306	521,366

Despite our expressed willingness to protect land important to drinking water quality, and great success in doing so in some places, the Connecticut River watershed's known water supply areas are only 32 percent protected, marginally better than forest blocks and wildlife habitat. Through statewide bonds, federal loan sources, user surcharges, and other means, there is great potential to develop strong land and easement acquisition programs to protect drinking water quality. States should support communities by channeling state and federal funds to municipalities eager to protect these lands, and by ensuring that water supply protection programs are compatible with programs that help protect farm, forest, and recreational lands. These investments can lead to direct savings in filtration and other costs while generating many habitat and recreational benefits.

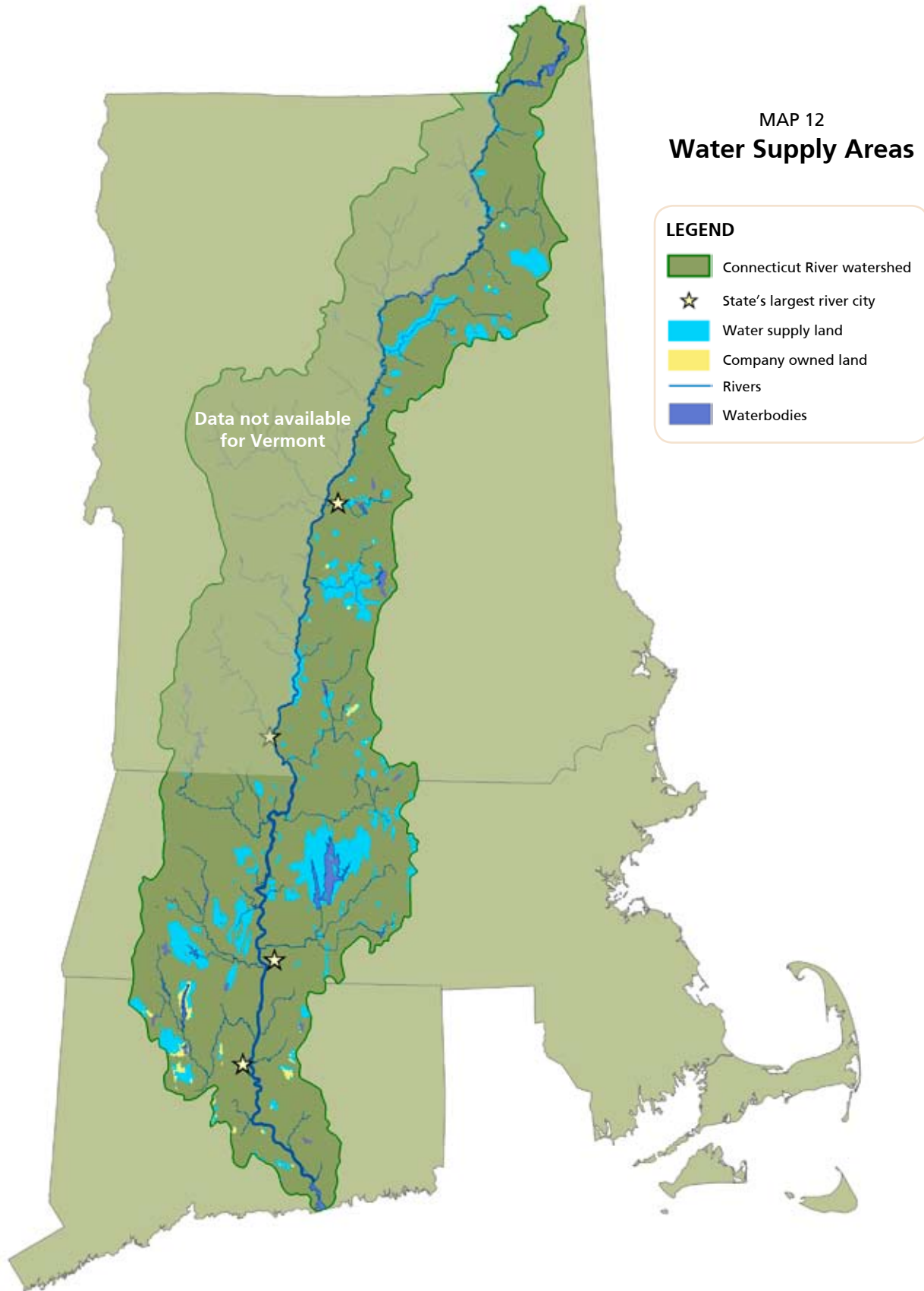
OVERLAPPING RESOURCES ASSESSMENT

Maps in the preceding section represent a partial but valuable effort to quantify and visualize the land resources of the Connecticut River watershed. More can and should be done to incorporate additional aspects of habitat value, forest economics, and farmland value, as well as to add new information to the analysis. In addition, the importance of static resources on the map are enhanced by connectivity: a viable link between two patches of conserved habitat

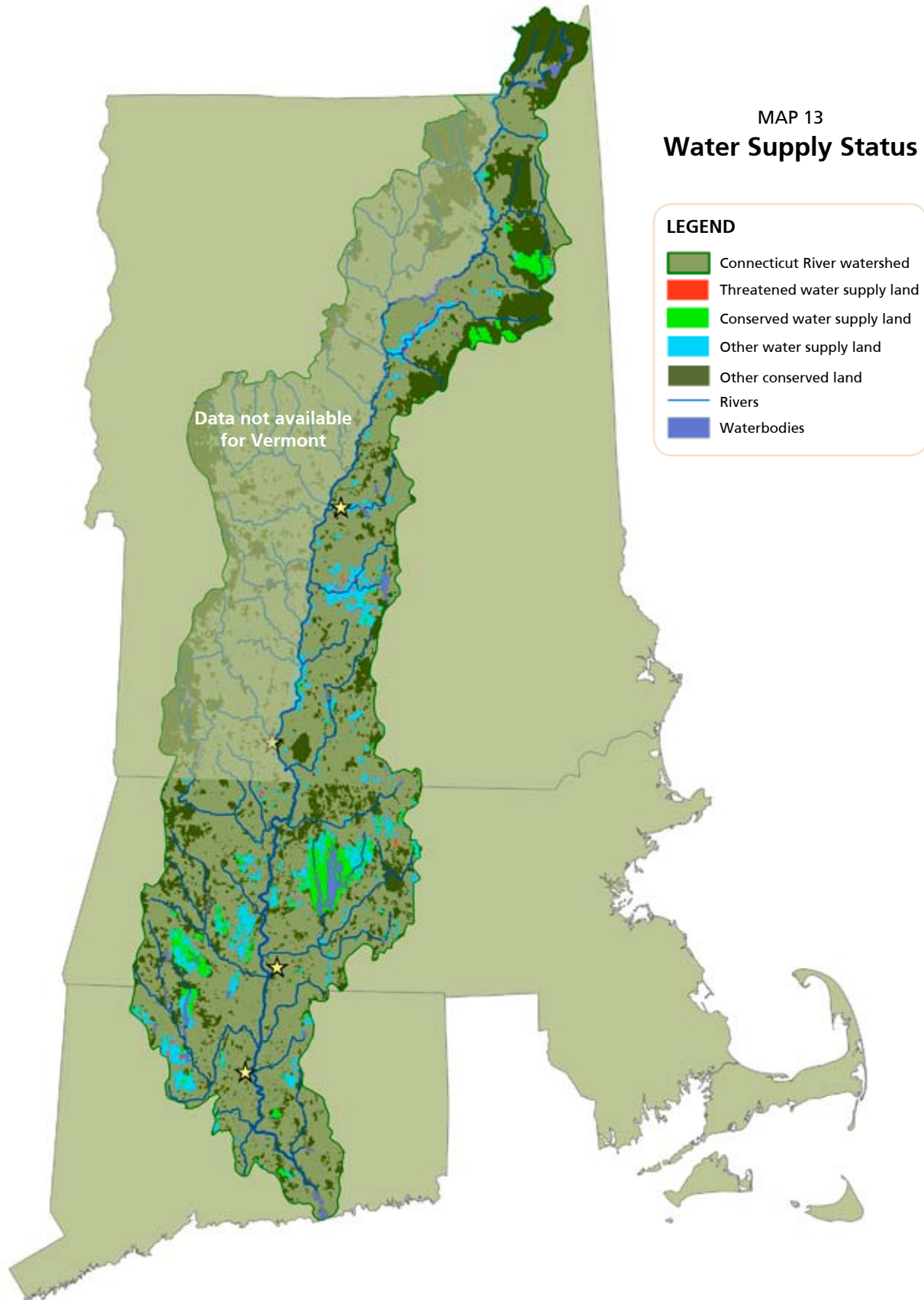
The Quabbin Reservoir, formed by damming the Swift River, is one of the largest man-made public water supplies in the United States and is one of the largest unfiltered water supplies in the world. Its surrounding landscape is one of the largest assemblages of protected land in Massachusetts.



MAP 12
Water Supply Areas



MAP 13
Water Supply Status



increases the value of each; farmland near conserved and thriving farms is more valuable because it is likely to be supported by a network of farm suppliers and markets; likewise for working forests. Effective mapping of this information is done best at the scale of smaller regions, ideally with access to parcel boundary information.

By presenting resources separately, we can examine them with respect to threats, opportunities for conservation, and specific funding programs. Another approach is to look for places where multiple resource values coincide. Map 14 shows the results of an elementary analysis of the resources presented in earlier sections. Each pixel in the map system (100 meters square, just under 2.5 acres) received one “point” for each time it showed up in the data: rare species (state or federal), riparian habitat, large forest block, currently farmed land, or prime farmland. Water supply was omitted because no data were available for Vermont. Redder hues indicate areas with greater overlap of farm, forest, and habitat values. This map can be a starting point for discussions about how to improve the data and refine the analysis to reflect the best of our knowledge and agreement about conservation priorities. This overview is designed for the regional scale—TPL strongly believes that local priorities and knowledge deserve recognition.

Map 15 depicts the 1.2 million acres that received at least a score of two in this analysis, showing which are conserved and which are threatened according to our housing density projection. The following table provides acreages by status and state for lands with overlapping resources.

State	Threatened	Protected	Neither	Total
CT	14,483	25,217	124,343	164,042
MA	13,178	75,430	188,520	277,128
NH	39,600	111,862	236,173	387,636
VT	12,496	125,193	229,477	367,166
Total	79,756	337,702	778,513	1,195,971

Past conservation efforts have achieved great successes. Of the 1.65 million acres of conserved land in the watershed, 20 percent include at least two of the conservation values included in the analysis. Yet, 864,000 acres of unprotected places contain overlapping resource values. Of these, 80,000 acres are projected to cross a housing density threshold by 2020. These places represent opportunities for a single conservation transaction to achieve multiple public benefits.

Of these lands, 28 percent are already protected and nearly seven percent of these are likely to be threatened

by development in the future. Often, no single state or federal program can pay the full cost of conservation, and program rules can impede land trusts seeking to apply funding from various sources to projects with obvious and compelling value. A simple example might be a project that protects riverfront farmland, ensures that houses are not built in an area that can provide natural flood storage, provides a riparian buffer to protect against erosion and keep waters cool, and provides wetland habitat for migratory birds. Many farms provide such benefits, but matching funding from various public programs to the needs of the landowner so that the benefits will be conserved can be a monumental task. TPL believes it is critical to unite as a region to identify and address priorities of regional importance while supporting efforts to address local threats using local resources and priorities.

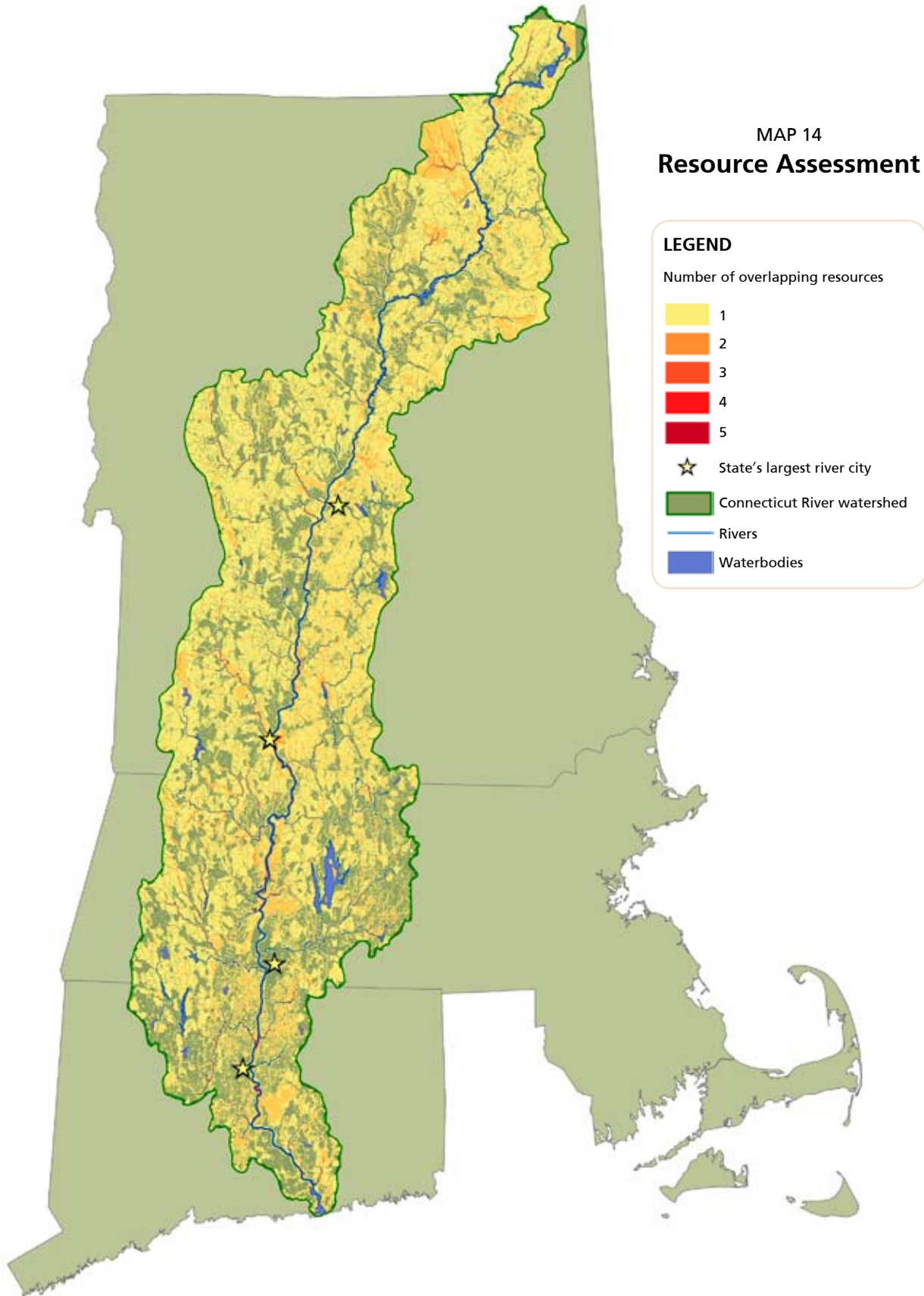
OTHER RESOURCES

Farmland, forest blocks, rare species habitat, and drinking water supply areas are extraordinarily important aspects of the Connecticut River watershed’s land base, but they only begin to tell the story. Historical, scenic, and recreational virtues of the land are difficult to catalog and map because of the subjectivity of ranking their importance, but they are essential to the story of this place, and they are the reasons we live and visit here. The value of the land and landscape is measured not simply by its raw productivity, but also by its role in attracting employers, workers, and tourists through the nebulous notion of quality of life. We may have trouble defining and measuring it, but we know it when we see it, and especially when we see it disappearing.

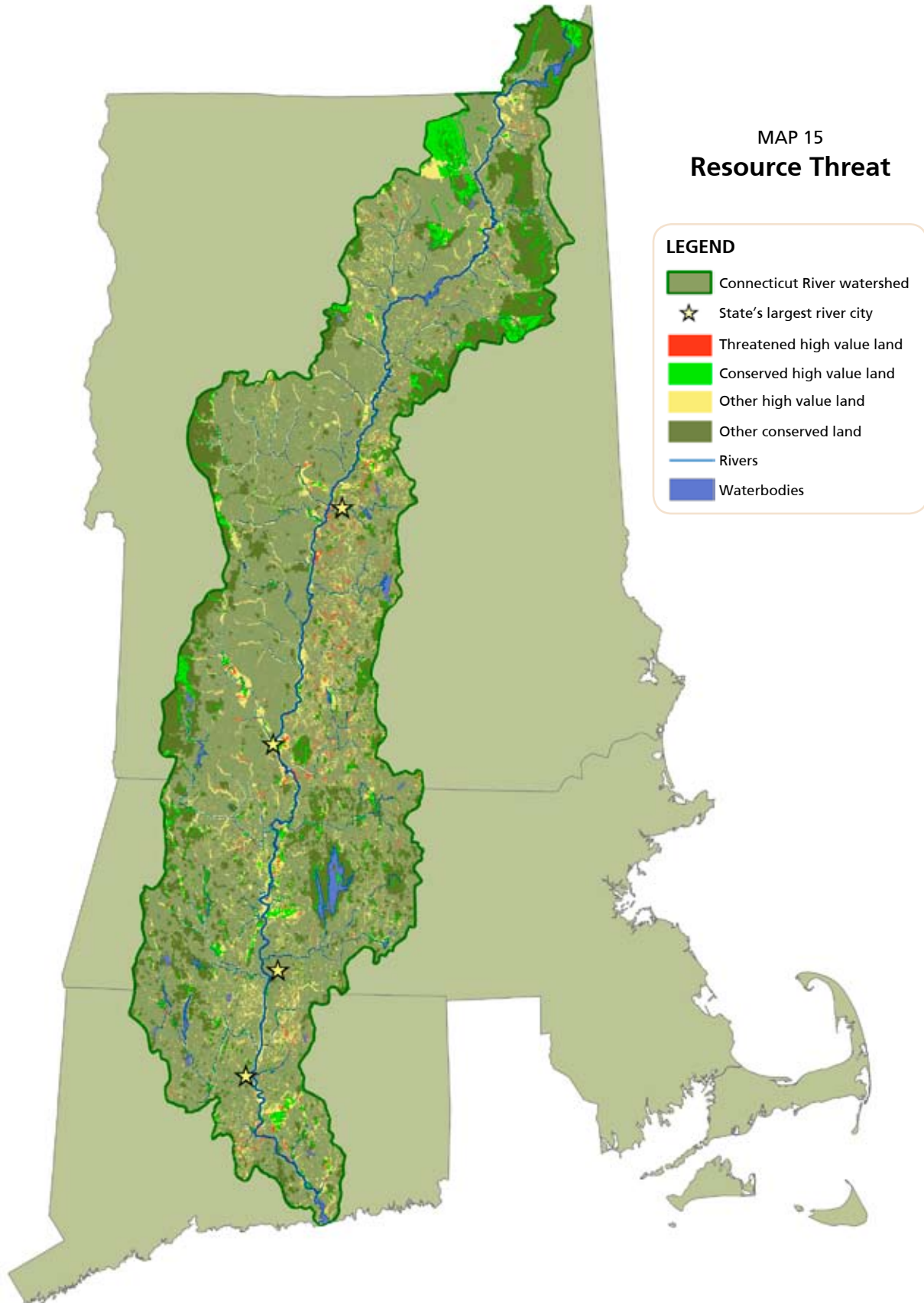
Tourism

Tourism is good business in New England. Vermont is widely recognized for branding its charming landscape, chalking up successes like inclusion in National Geographic Traveler Magazine’s World’s 50 Greatest Destinations list. New Hampshire, western Massachusetts, and the estuary portion of the River are all highly dependent on the images of their landscape that lure visitors. As a percent of state gross economic product in 2003, tourism expenditures contributed 6.7 percent in Vermont, 5.8 percent in New Hampshire, 3.8 percent in Massachusetts, and 4.0 percent in Connecticut.⁴⁹ Official estimates put the entire four-state region’s annual tourism-related business at \$22.3 billion in consumer expenditures, an amount that most analysts increase with “multiplier effect” factors that can nearly double the overall economic impact of tourist

MAP 14
Resource Assessment



MAP 15
Resource Threat



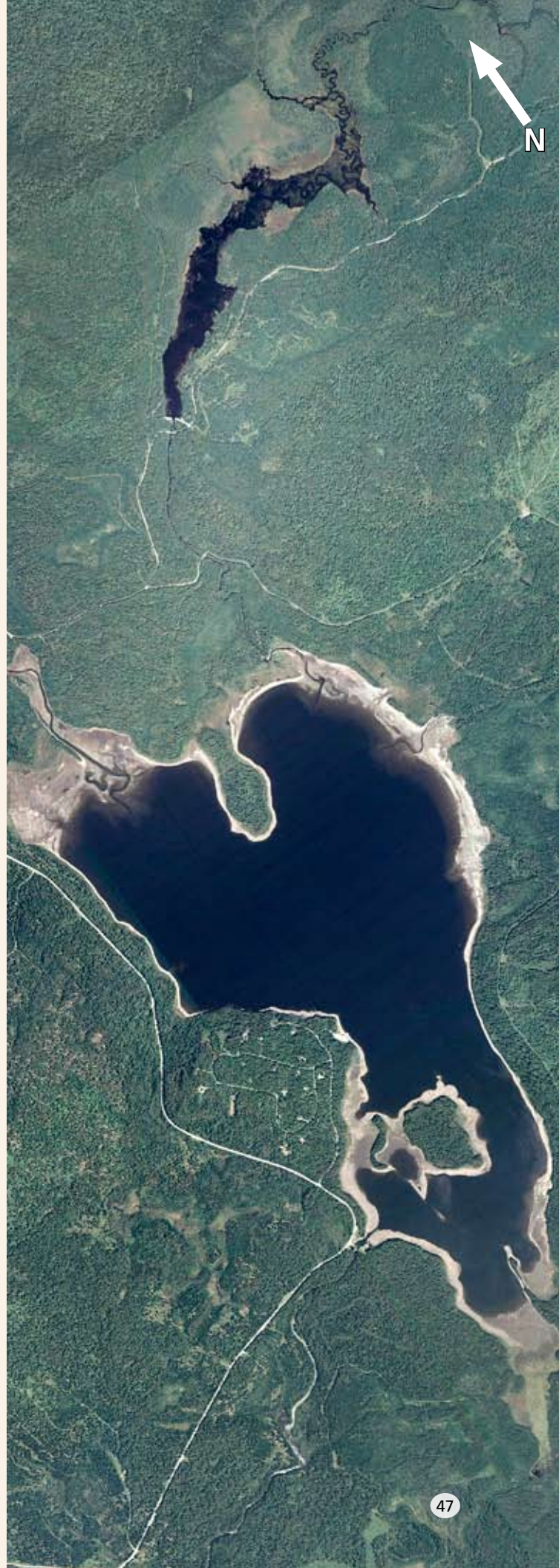
spending. By our conservative estimate, the tourism business in the Connecticut River watershed accounts for at least \$2.7 billion in spending, generates tax revenues in excess of \$380 million, and provides at least 26,000 jobs with a payroll of more than \$563 million, plus income for many self-employed business owners.⁵⁰

Scenic byways are an example how to use the region's natural and cultural amenities to attract visitors without spoiling its fragile resources. These byways create a natural constituency for conservation because visitors—and local businesses that cater to them—see the importance of maintaining the landscape's appeal. In Vermont and New Hampshire, the Connecticut River Scenic Byway received national designation in 2005. With 500 miles of road on both sides of the River, 10 communities hosting waypoints with visitor services, and countless scenic views and attractions, this effort (led by the Connecticut River Scenic Byway Council and the Connecticut River Joint Commissions) provides a unique opportunity for River towns and businesses to benefit from regional promotion. In Massachusetts, the Connecticut River Scenic Farm Byway is a state-designated route passing through some of the Valley's most fertile and beautiful farmland. Federal highway funding has helped to protect a number of farms within view of the route from development in recent years. Promotion of the route by regional planning commissions and a county roads website is helping to bring visitors to the farm stands and other businesses along the way.

Recreation

There are many ways to enjoy the watershed. In Connecticut, sail from River's estuary to the Sound, stroll along Valley Railroad State Park Trail to Haddam Meadow, picnic on Hartford's Riverfront Plaza, or fish for shad in May in Windsor. In Massachusetts, hike the Mount Tom and Mount Holyoke Ranges, bike the Manhan or Norwottuck rail trail, kayak the whitewaters of the Deerfield River, or go rock climbing at Northfield Mountain. In Vermont or New Hampshire, a short trip from your doorstep might put you in a canoe on the Connecticut or on the Appalachian Trail, or you can fish the Northeast Kingdom's trout streams, or backpack the 162-mile Coos Trail from the

The woods and waters of the Connecticut Lakes region in northern New Hampshire is a paradise for outdoor enthusiasts. This photo shows Second Connecticut Lake and the Norton Pool Preserve to its north.





Paddling Mud Pond in view of Nurse Mountain in Granby, Vermont. Jerry and Marcy Monkman

White Mountains to the River's headwaters.

Mapping these activities is a challenge for several reasons.⁵¹ There is no ideal way to distinguish between popular local opportunities and those that are of regional significance. It is also important to think beyond the formal recreation opportunities that exist today to those that are informal and could be lost, or opportunities that are worthy of new effort. While details of the location and formal status of recreational greenways are open to debate, TPL believes that the identity of the River and watershed will be enhanced by efforts to develop answers to questions like: How can I walk from Source to Sound? How can I bike from Old Saybrook, Connecticut, to Pittsburg, New Hampshire? If I want to canoe the entire River, where can I put in, camp, and portage? Where and when can I see the birds that migrate on the Connecticut River flyway? Most of us will never cover these long distances, but knowing we could tickles the imagination and inspires more modest local trips that help us feel connected to something larger. Key components of the answers to these questions are found within existing long-distance and multi-state initiatives that run primarily north to south:

- The Metacomet-Monadnock Trail from Connecticut to New Hampshire, with further connections to Lake Sunapee and the Connecticut River, which was recommended by the National Park Service in 2006 for designation as a National Scenic Trail

- The Coos Trail, the longest (162-mile) trail built in New England in 70 years, and the Monadnock-Mount Sunapee Greenway, both in New Hampshire
- The Connecticut River Water Trail in Vermont and New Hampshire and the water trail associated with Connecticut River Greenway State Park in Massachusetts
- The Connecticut River Birding Trail in Vermont and New Hampshire
- The Long Trail (hiking) and Catamount Trail (X-C skiing) in Vermont
- The Farmington Canal Greenway in Connecticut, with rail-trail connections to Northampton, Massachusetts

In addition, east-west connections extend beyond the watershed to the rest of New England and beyond:

- The East Coast Greenway from Florida to Maine
- The Mass Central Rail Trail from the Berkshires to Boston
- The Appalachian Trail in the Green and White Mountains (Vermont and New Hampshire)
- Vermont's Cross Vermont and Lamoille Valley Trails, each with potential counterparts in New Hampshire

Few recreational resources are complete or secure, but they represent a tremendous set of opportunities. Land conservation can help protect these resources, and can be most effective if the watershed states embrace a clear vision for the region in their individual statewide recreation plans.

The vision should include a variety of connected opportunities to experience the watershed's rivers and mountains, plans and funding needs for trail development and land protection, and community input and access points so that these regional resources have maximum local value.

Historic sites and landscapes

Historic sites are so numerous in the watershed that it is difficult to travel more than a few miles without coming near one that is listed with or officially eligible for National Register designation. Each has unique value, and a cluster of historic buildings generates hometown pride and impresses visitors. Historic significance helps determine the importance of buildings, and of land, for conservation. Protecting historic landscapes that preserve the stories of the Connecticut River watershed is a special challenge. One success story is the work of the Kestrel Trust to protect parcels in Hadley's Great Meadow, designated as one of the most threatened historic landscapes in the state by Preservation Massachusetts. Dozens of lots of rich soil were laid out for plowing by oxen in 1661 and have been farmed in small holdings ever since.

Special places

Some places are simply special. Intangible qualities that are difficult to name and measure emanate from these places. Whether because of a scenic view, the proximity of a quiet place to bustling surroundings, or other reasons, it is worthwhile to identify these places. Because this information must come from people, TPL intends to use public forums on land conservation to invite organizations, towns, and citizens to help put these places on the map and include them in a future vision for land conservation.

These four categories (tourism, recreation, historic, and special places) are not mutually exclusive. Frequently, we perceive the greatest "quality of life" in a place where these virtues overlap. The ubiquity of such places in the Connecticut River watershed and the opportunities they provide are of incalculable value to those who are born and raised here, those who choose to live here, students who form lifelong bonds while attending the region's legendary and numerous colleges, and those who visit from afar.

The Connecticut River empties into Long Island Sound in Old Saybrook, Connecticut. The tidewaters, salt marshes, and estuarine habitats near the mouth represent a globally important wetlands complex.





MAKING THE COMMITMENT

The Connecticut River watershed's resources are largely intact, mostly healthy, and clearly threatened. Land conservation can help protect this green infrastructure, but failing to find a meaningful collaborative approach may mean failing the River and losing a piece of what makes it a New England icon. The leadership of the Connecticut River Joint Commissions in Vermont and New Hampshire provides a good example of the challenging but necessary integration of public and private entities and of local, regional, state, and federal perspectives. TPL believes that groups and citizens committed to the Connecticut River and its land base need to develop and promote a shared four-state agenda that includes land protection and other goals. If we do not, we will fall behind the efforts of other multi-state regions, miss funding opportunities, and achieve less than our collective potential.

What Must Be Done?

Here are some recommendations for actions that can help protect New England's great river and heartland.

Federal Agencies and Elected Officials. Seek increased federal funding for the watershed through the Farm and Ranchlands Protection Program, the Forest Legacy Program, the Land and Water Conservation Fund, and other existing sources. Create new funds in federal legislation that can meet the special needs of our region. Seek opportunities to work across agency lines and with states to achieve multiple conservation benefits.

State Agencies and Elected Officials. Increase state funding for protection of working lands, water resource lands, habitat, and cultural resources. Provide state-level incentives for local conservation financing, but do not ignore the duty to protect resources of statewide importance in communities that lack capacity to protect them. Partner with federal agencies and communities on important land conservation projects. Coordinate with other Connecticut River states.

The Farmington River as seen from the Metacomet Trail in Tariffville, Connecticut. Jerry and Marcy Monkman

Regional Planning Agencies, Councils of Governments, and Conservation Districts. Partner with land trusts to deliver conservation services to towns. Help to build bridges within the watershed between municipalities, states, federal representatives, nonprofits, and other planning agencies.

Municipalities. Assess the value of unprotected land to quality of life and make plans that identify priorities for protection. Raise funds locally to achieve priorities and attract matching funds from other sources. Collaborate with land trusts and neighboring towns.

Land Trusts and Watershed Associations. Partner with landowners, towns, regional planners, and agencies to deliver public value in every conservation transaction. Participate in watershed-wide planning and strategy efforts.

Businesses and Other Employers. Contribute to efforts to preserve what makes the region a great place to live and work. Help communicate the importance of the landscape and river to your success.

Educators. Use the Connecticut River and its watershed as a teaching tool and help students connect to groups working to protect it.

Private Foundations. Increase funding for strategic investments that will build momentum for increased public funding. Provide incentives for collaboration among grantees and increase collaboration among philanthropists interested in the Connecticut River and New England. Fund new initiatives, but do not let fatigue prevent ongoing worthy investment.

Individuals. Volunteer and donate; many of the groups and agencies mentioned above are doing a great deal to achieve river-wide goals despite limited authority and funding, and need public support and recognition. Help your town do more to define and pursue its conservation priorities and ask how regionally important resources fit into local plans and actions. Encourage state and federal agency staff to invest in the watershed through land conservation funding, river-related programs, and participation in cooperative endeavors across agency, state, and town lines. Participate in grassroots efforts to attract public funding. Encourage those you send to Washington, DC, to work closely with the entire Connecticut River delegation to advance common goals. Don't forget to thank those who do so.

Conclusion

The Connecticut River watershed is the heart of New England, a place residents are proud to hail from and visitors are glad to know. Whether walking out the back door and up a nearby mountain, bringing the family to a local apple orchard, taking an ambitious expedition by bike, foot, or canoe, or simply enjoying the view out the window, the Connecticut River and the land that feeds it evoke a sense of place filled with passion, loyalty, and commitment. That sense of place depends on the region remaining beautiful, ecologically healthy, and full of old and new traditions. Conserving land in the Connecticut River watershed will preserve an important part of New England's identity; letting open space be swallowed up by generic development will erode that identity. In economic terms, one of the watershed's greatest competitive advantages is a green infrastructure that can provide land-based income for many and a healthy, attractive environment for all. The region will always boast a talented and industrious workforce, but will never have the nation's cheapest labor or cost of living. It makes sense to play to our strengths, including protecting the landscapes that make this a special place where people want to live and visit.

The Trust for Public Land conserves land for people to enjoy; our mission is fundamentally related to quality of life for individuals and communities. Since 1972, TPL has enhanced people's lives through investments in green infrastructure. We are committed to working through our New England region and our offices in all four Connecticut River states—and with others—to help protect the lands that make the Connecticut River the greatest of New England's treasures.

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- The Connecticut River Watershed Council highlights the following challenges: a variety of water quality threats (combined sewer overflows, point-source pollution, and nonpoint-source pollution), habitat loss and fragmentation, air pollution, hydroelectric dams, and invasive species.
- The Connecticut River Joint Commissions of Vermont and New Hampshire identifies a host of water quality issues, including lack of monitoring, toxins in fish tissue, nonpoint-source pollution, loss of riparian buffers and bank erosion, urban runoff, and shoreline and floodplain development.
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 27. There are three ways to assess the region's farmland on a large scale. One is to look at lands now in farming, most easily done with interpretations of satellite imagery. A second is to look at the soil's productive potential using detailed on-the-ground soil surveys converted to digital maps. A third approach is to tabulate county-level results from the USDA's Census of Agriculture, a mandatory reporting requirement for all farmers with over one thousand dollars in annual sales that includes information on land use and economic data. We have used all three sources to compose a picture of the region's farmland and agricultural sector.
 28. We only used the NRCS definition of "prime," excluding those that are designated important by each state or that require irrigation or drainage, and resolving any discrepancies in definitions as fully as possible. We also created a proxy prime soils dataset for areas where digital soils data are unavailable (Franklin County in MA; Essex and Caledonia Counties in VT; Coos County in NH). The proxy was created by a computer model derived from statistical correlations between land form, geologic, and land use data provided by The Nature Conservancy and known prime farmlands in areas where data was available. While useful for a regional analysis, these results are not reliable at the local level, may overestimate prime soils, and should be replaced with actual data as they become available.
 29. Because the most recent region-wide satellite dataset dates to 1992, we elected to use the best available data in each state for this land use analysis. In addition, the accuracy of the land use interpretations of land cover data from satellite images is in the 76 percent range. Thus, there is reason to believe that the determination of "farmland" by these methods in New England is helpful but imperfect, and that our results will reflect differences between states in the methods used.
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50. Detailed tourism data for the watershed are unavailable separate from state data. The effect of Boston as a magnet for tourism is confounding. The Valley's three counties generated between 4.01 percent and 6.35 percent of Massachusetts travel dollars in 2002 in five tallied categories, so our calculations used 4.0 percent of 2003 data for the state. County-level data were unavailable for VT, NH, and MA, so we used the conservative estimate of 20 percent of the statewide total, even though the watershed makes up more than 30 percent of land area in each state. These results are estimates that TPL believes are conservative but they should not be cited as authoritative figures.
51. TPL has worked with a team of graduate students and their professor, Robert Ryan, from the Department of Landscape Architecture and Regional Planning at the University of Massachusetts, Amherst, in its recent effort to revise a 1999 New England Greenway Vision Plan with a focus on the Connecticut River watershed. As part of this effort, the team identified existing and potential trails for hiking, biking, and boating. The draft map is available from TPL upon request.

FIGURE AND MAP DATA SOURCES

FIGURES

Note: All tables not listed here display data derived from the geographic information systems analysis that also produced the accompanying maps. See Map Data Sources for more information on the data and analysis employed.

Crop Acreages (p. 26)

“2002 Census of Agriculture,” (Washington, DC: USDA National Agricultural Statistics Service, June 2004). See endnotes for further discussion.

Forest Type (p. 34)

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Expenditures Related to Fishing, Hunting and Wildlife Watching (p. 42-1)

U.S. Department of Interior, Fish and Wildlife Service and U.S. Department of Commerce, U.S. Census Bureau. 2002. 2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, Washington, DC.

MAPS

Note: Sources are only introduced once; when used in subsequent maps they are not listed repeatedly. Also, common sources (including watersheds, water bodies, and political divisions) are not listed. All maps are in Albers Conical Equal Area projection using the North American Datum of 1983 (NAD_1983_Albers). More detailed information on data and methodologies is available at www.tpl.org/criver.

Map 1: Connecticut River Watershed

Standard map data sources; city populations from US Census Bureau (2000 Census), with Lebanon and Hanover combined due to their proximity.

Map 2: Built Infrastructure

Data from The National Map and ESRI standard datasets, widely available free of charge. Airports and dams selected based on size. Aqueducts from Connecticut Department of Environmental Protection (1:24,000 hydrography, 1994 data processed 2005) and MassGIS (1:25,000 hydrography, February 2005). Urban areas are “densely settled areas” made up of urbanized areas with total population greater than 50,000 and urban clusters with total population between 2,500 and 49,999. Both areas “generally consist of a geographic core of block groups or blocks that have a population density of at least 1,000 people per square mile, and adjacent block groups and blocks with at least 500 people per square mile.” (www.census.gov/geo/www/tiger/glossary.html)

Map 3: Conserved Lands

This dataset is a collection of conserved lands compiled by TPL in January, 2005. Sources vary by state in quality and currentness. Attributes and definitions also vary; TPL’s analysis attempted

to bring a measure of uniformity and exclude lands not legally protected from development.

Vermont: Public and Private Conservation Lands (2005) from UVM Spatial Analysis Lab;

Connecticut: DEP properties (2004), Federal Property (1997), and Municipal Property (1997) from CT Dept. of Environmental Protection;

Massachusetts: Open Space (2005) from MassGIS;

New Hampshire: Conservation/Public Lands (2004); NH GRANIT. TPL also provided data for the Connecticut Lakes project, covering 171,000 acres in NH, largely located within the watershed.

Maps 4 and 5: Watershed Housing Density and Change

Data: US Census Bureau and the above-mentioned conserved-lands dataset.

Analysis: Theobald, D.M. 2005. Spatially Explicit Regional Growth Model (SERGoM) v2. Unpublished report, Natural Resource Ecology Lab, Colorado State University.

Map 5 shows areas where density crosses a threshold between 2000 and 2020, from rural to exurban, exurban to suburban, and so on. These areas are used in maps 7, 9, 11, and 13 to represent the threat associated with current trends in landscape change.

Map 6: Farmland Resources

Farmed land data from best available source in each state in 2004/5: *Connecticut:* Land Cover (2002) from University of Connecticut CLEAR

Massachusetts: Massachusetts Land Cover (1997) from NOAA Coastal Services Center/Coastal Change Analysis Program (C-CAP)

New Hampshire: NH land cover assessment (2001) from NH-GRANIT

Vermont: Vermont Landcover/Landuse (1992 NLCD variant) Vermont Center for Geographic Information Mount Holyoke College

Prime soils data from: USDA, Natural Resources Conservation Service, SSURGO datasets for most counties available at <http://soildatamart.nrcs.usda.gov>. For Central Hampshire and Hampden Counties, pre-release data received from the Massachusetts State NRCS office, 2006. In counties with no available SSURGO data, a predictive model (see endnote discussion) relied upon “Systems30” data generously contributed by The Nature Conservancy. (The Nature Conservancy Conservation Science Support, US Geological Survey, US Environmental Protection Agency, and Geological Surveys of ME, NH, VT, NY, MA, CT, RI, PA, NJ, DE, 2003, systems30. Copyright © 2003 The Nature Conservancy. All rights reserved.)

Map 7: Farmland Status

Combines all prime and farmed lands (Map 6) and segments them according to coincidence with the 2000-2020 density change model results (Map 5).

Map 8: Forest Resources

Data: ESRI Streetmap data, landcover data as described for Map 6, USGS Digital Elevation Model.

Map 9: Forest Status

Combines all forest blocks over 1,000 acres (Map 8) and segments them according to coincidence with the 2000-2020 density change model results (Map 5).

Map 10: Habitat Priorities

Data: Federal priorities based on USFWS Conte National Wildlife Refuge Special Focus Areas from the 1995 Refuge Action Plan (now under revision as part of comprehensive conservation planning).

Vermont: Biodiversity Hotspots (2000) from UVM Spatial Analysis Lab; point occurrences (2003) from Vermont Center for Geographic Information.

New Hampshire: point occurrences (2003) from NH Natural Heritage Inventory.

Massachusetts: Priority Habitats of Rare Species (2003) and point occurrences (2003) from Natural Heritage and Endangered Species Program.

Connecticut: Natural Diversity Database (2003) from Connecticut Department of Environmental Protection.

Analysis: Vermont, Massachusetts, and Connecticut each use distinct techniques for generalizing the locations of known rare species habitats; TPL combined these three datasets without revision.

New Hampshire has no equivalent polygons but released point occurrence data; we approximated the Vermont hotspot approach, drawing polygons that capture 75 percent of all point occurrences in a much smaller proportion of land area. In addition, all points in VT, NH, and MA that were not in the resulting polygons were added with 200-meter buffers, with the exception of vernal pools, which are only well documented in MA. For riparian habitat, we buffered the Connecticut River mainstem 400 meters on each side, primary tributaries 200 meters on each side, and minor tributaries 100 meters on each side.

Map 11: Habitat Status

Combines all identified habitat areas (Map 10) and segments them according to coincidence with the 2000-2020 density change model results (Map 5).

Map 12: Water Supply Areas

Data: New Hampshire Dept. of Environmental Services (Drinking Water Source Water Protection Areas, received 2003); MassGIS

(Zone II and interim wellhead protection areas and Zone C surface water supply protection areas, received 2003); Connecticut Dept. of Environmental Protection (active reservoirs and final wellhead protection areas, received 2003). Information is not available from the state of Vermont because of national security concerns.

Analysis: Company owned lands within NH and CT derived from water system attributes. Company owned water supply land in Massachusetts open space datasets is listed as “permanently protected” and is therefore counted as conserved. The question of developability of company owned water supply lands is controversial and varies by state law and culture, as well as by individual case. To the extent possible, TPL aimed to distinguish lands that are protected through public ownership or legal protections from those that are not.

Map 13: Water Supply Status

Combines all water supply areas (Map 12) and segments them according to coincidence with the 2000-2020 density change model results (Map 5), classifying them as threatened, conserved, or neither.

Map 14: Resource Assessment

All data are from previously described sources. Water supply lands were excluded because Vermont data were not available. Areas of overlap between critical resources were calculated on a 100-meter square algebraic analysis that assigned one “point” for each of the following characteristics attributed to each square in the raster grid: prime farm soil, currently farmed, within forest block of at least 1,000 acres, within a riparian buffer, within a state rare species habitat area, within a federal (Conte Refuge) habitat focus area. TPL intentionally avoided applying weights to particular resources, but there is inherent bias in such an analysis based on the data available and chosen for inclusion.

Map 15: Resource Status

In this map, all grid squares with a score of two or higher in Map 14 are displayed as “high-value land” because they provide multiple conservation benefits. This map segments those high-value areas according to coincidence with the 2000-2020 density change model results (Map 5), classifying them as threatened, conserved, or neither.

APPENDICES AVAILABLE VIA INTERNET

The following appendices, along with the full version of this report, can be downloaded at:

www.tpl.org/ctriver

I. Connecticut River Federal and International Designations

II. Data and Methodologies Used

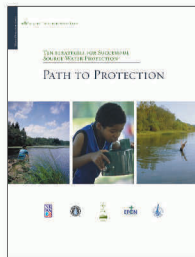
III. State and Federal Land Conservation Funding in Connecticut River States

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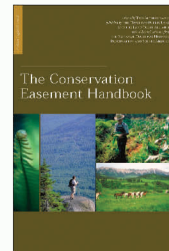
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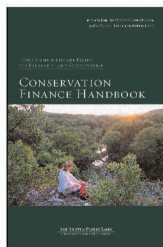
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