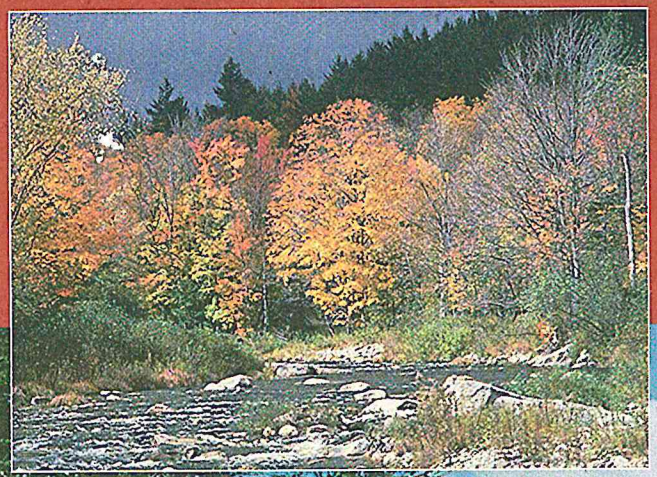
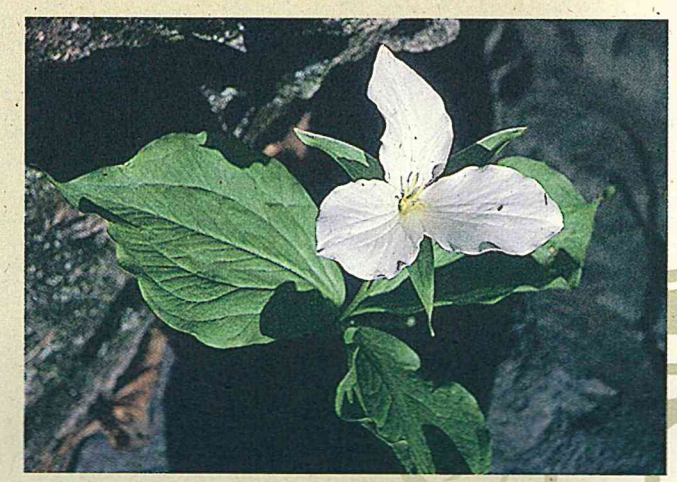


THE VERMONT AGENCY OF NATURAL RESOURCES

Environment 1996

An Assessment of the Quality



looking forward

WE BELIEVE THAT, FOR THE BENEFIT of this and future generations, the integrity, diversity and vitality of Vermont's natural systems must be sustained and enhanced."—*from the Agency Mission Statement*

What type of future are we creating for Vermont? Is it a future we will shape or is it a future we feel is beyond our ability to influence? Do we have a shared vision of what we as Vermonters want?

Above: Trillium, a species native to Vermont.

With Environment 1995, we at the Agency of Natural Resources shared a retrospective that put 25 years of environmental progress into some perspective. With Environment 1996, we look into the future. This report will provide not only an up-to-date assessment of the quality of our environment, but will also describe important environmental trends and what we at the Agency are doing to help Vermonters create our collective future. This document underscores the Agency's commitment to environmental protection, environmental education, accountability for results, and public/private collaboration to protect our natural resources.

Despite monumental accomplishments, Vermont continues to face both specific risks and broad, encompassing challenges that threaten the integrity of our environment. As the population of Vermont, the nation, and the world continues to increase, more and more demands are placed on already scarce resources (*Figure 1*).

In charting a course for the challenges that lie ahead, the Agency's three departments have begun to practice natural resource management techniques that embrace the pivotal concepts of biodiversity, ecosystem management, and sustainability, as well as striving to forge a stronger link between the environment and the economy. Some of these terms may be strange and new for many, but they underpin the very mission of our Agency. They are concepts which respect the web of life and direct us to act when human actions tear at that web.

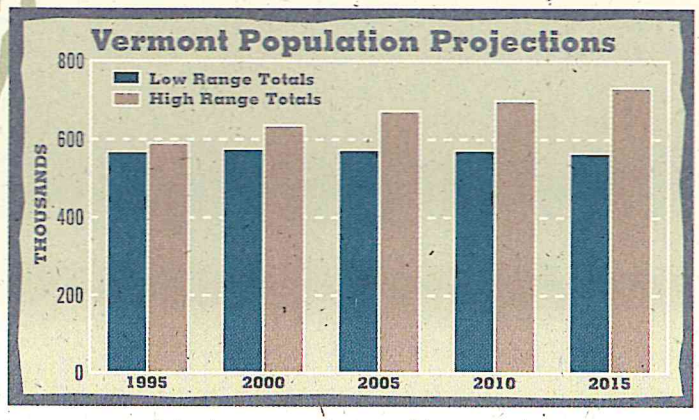


FIGURE 1: *Demands on our natural resources tend to increase as the population increases. Source: Vermont Health Care Authority, 1993.*

Although the terms are relatively new, their ideals are reflected in many laws and policies enacted by the Vermont Legislature and the Agency. That the Fish and Wildlife Department limits the number of moose hunting licenses and allows their use in only four management districts is an example of managing a wildlife resource sustainably. Working with a timber company to minimize the environmental consequences of logging, the Department of Forests, Parks and Recreation allows for both a profitable timber harvest and protection of a deer wintering habitat — an example of ecosystem management in partnership with the private sector. Battling the spread of Eurasian milfoil and zebra mussels, the Department of Environmental Conservation reflects its concern for Vermont's biodiversity.

As our understanding of these concepts matures and becomes more sophisticated, we will become even more effective stewards of this complex web of life.

BIODIVERSITY: THE FULL SPECTRUM OF NATURE. In an effort to promote greater awareness of the need to protect and enhance biological diversity, or biodiversity, the Agency

is exploring ways to generate a broader discussion of the issue and to integrate biodiversity concerns into Agency policies and practices.

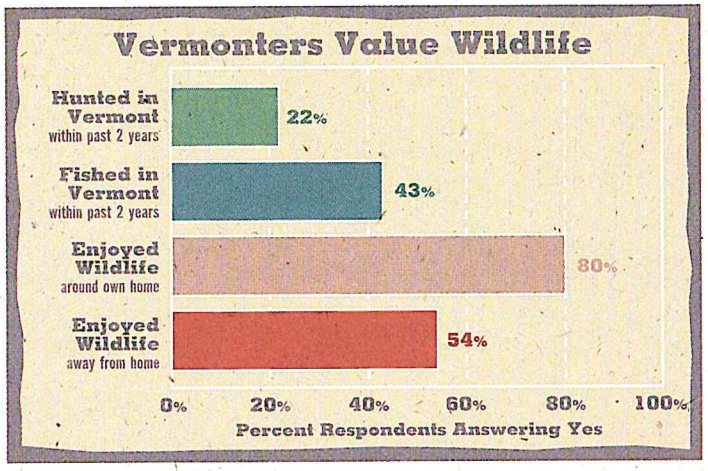


FIGURE 2: *Vermonters take a special interest in wildlife. Source: Vermont Department of Fish and Wildlife, 1995.*

Biodiversity is garnering increased attention within the scientific community as it becomes clear that both species and habitat diversity are decreasing at a rapid rate. On the global stage, the loss of tropical rainforests is widely known and intensively studied. The diversity of native plants, animals, and habitats in Vermont also has diminished. The sandplain forest of the Winooski River Valley was once a significant and vibrant ecosystem covering about 15,000 acres; development in the Burlington region has reduced the sandplain forest to less than 600 acres. In Lake Champlain, our native freshwater mussels are threatened by the exploding zebra mussel population and a loss of habitat.

Although the concept of protecting biological diversity already underlies much of the Agency's work, it has not, until very recently, found a voice in policy. The Agency remains committed to managing state lands for many different uses, such as wildlife habitat, silviculture, hiking, and snowmobiling. Such policies may even enhance biological diversity. To test this, the Agency is developing a set of criteria to assess the biodiversity of any given area or habitat. The Agency will then use this information to strengthen and modify existing management practices.

The Agency defines biodiversity as the variety of plants and animals, their genetic variability, their interrelationships and ecological processes, and the communities and landscapes in which they exist.

ECOSYSTEM MANAGEMENT: SEEING THE FORESTS AND THE TREES. One of the many ways the Agency and large private land owners are working to protect and enhance biodiversity is by managing lands as whole ecosystems. Ecosystem management focuses attention to all the plants, the animals, the physical environment, and how they all work together when making decisions regarding the use and protection of a particular area. Although many of the principles and practices of ecosystem management are still being developed, future forest and wildlife management strategies are certain to be influenced by this thinking and by the importance of protecting biodiversity.

This isn't to say development and environment are conflicting terms. Problems arise, however, when the linkage between the two is managed unsustainably. Economic development cannot be sustained if it continually undermines the healthy functioning of Vermont's ecosystems or exhausts its natural resources. Balancing economic growth and environmental protection should not be framed as an either-or proposition.

SUSTAINABILITY: FOR NOW AND FOREVER. Development with an emphasis on sustainability is development undertaken with forethought and sensitivity toward the needs of future generations. As an example, we cannot guarantee that the wildlife we enjoy today will exist 50 years from now for our grandchildren to enjoy; we can, however, guide development to ensure that wildlife habitat is protected and, in some cases, preserved for all time. In this way we will have at least saved a place for wildlife.

Sustainable natural resource management is not a single policy or plan incorporated into any one department or function. It is a framework for decision-making to be used throughout the Agency. Developing actual indicators of sustainability and benchmarks toward achievement of goals (see page 14 for an example) will assist us in determining whether our actions are sustainable or not.

Much of the state's economy and our quality of life are based upon the condition of Vermont's natural resources. Tourism, agriculture, and manufacturing, too, profit from clean air, clean water, and an aesthetically pleasing landscape. A 1995 survey of 1,000 Vermonters found that an overwhelming majority of us take a special interest in wildlife (*Figure 2*).

We look to our natural resources for recreation and, directly or indirectly, for our livelihoods, meaning the quality of life we desire here in Vermont depends on a healthy environment and a vigorous economy, qualities which future generations will, no doubt, also desire.

We at the Agency of Natural Resources believe our growing understanding of bio-diversity, ecosystem management, and sustainability will improve our ability to manage Vermont's natural resources in such a way as to perpetuate their high quality and to ensure their availability into the future.

Environment 1996

An Assessment of the Quality of Vermont's Environment

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vermont's ecosystems

VERMONT IS HOME TO A VARIETY OF environments where plants and animals live, known as habitats. The distribution of plants and animals is determined by their unique traits and what resources they need for survival. Some species can adapt to many different habitats, while others are specialized and limited to only one. Each habitat may have a maximum number of different species we would expect to find living there.

Above: Southern view of Dewey Mountain.

Much of Vermont consists of habitats that are widespread and have many different species that can co-exist there given the characteristics of the site. There are certain habitats, however, which are uncommon or limited in size. Some of these sensitive or rare habitats are owned and managed by the Agency, others are privately owned. Protection of these uncommon habitats offers a better chance of sustaining the organisms that are dependent on them for their survival.

There are many interactions among organisms living together in habitat communities and between organisms and the environment surrounding them. These interactions are often difficult to fully understand, but they shape the composition, health, and survival of communities. When changes are made to any part of the ecosystem — the organisms and physical environment in which they live, considered as a whole — this alters other components. Some changes are short-term, others are permanent. Resource management must incorporate information about the whole ecosystem to determine the sustainability of our natural heritage.

An examination of two different ecosystems — one forested, one aquatic — provides a glimpse of how detailed ecosystem information helps us manage our natural resources.

FOREST ECOSYSTEM. Mount Mansfield is covered with trees which form a canopy over streams, smaller vegetation, animals, and organisms living in the soil. Air surrounds all the organisms with its physical properties (weather conditions), and its chemical properties (*Figure 1*). The rock beneath also contributes to the system through factors such as water drainage and soil characteristics. The most visual trait of this site is its elevational grandeur, rising from 1,000 feet to nearly 4,400 feet.

Mount Mansfield Atmospheric Conditions

Elevation	Annual Precipitation (inches)	January Minimum Temp. (Fahrenheit)	July Maximum Temp. (Fahrenheit)	Wet Sulfate Deposition (kg/ha-yr)	Ozone Exposure (SUM06, ppm-hours)
1500 ft	45.8	2.3	76.3	25.3	11.6
2000 ft	50.5	-0.1	74.4	27.9	13.2
2500 ft	55.3	-2.4	72.6	30.6	14.9
3000 ft	60.0	-4.8	70.7	33.2	16.6
3500 ft	64.8	-7.2	68.9	35.8	18.3
4000 ft	69.6	-9.6	67.1	38.5	20.0

FIGURE 1: *Weather and air quality at different elevations on Mount Mansfield. In general, as elevation increases, temperatures are lower, precipitation is higher, and pollution is greater.*

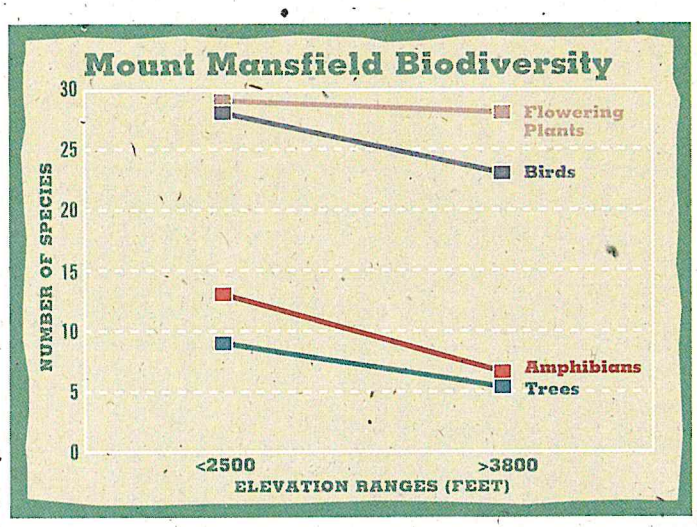

FIGURE 2: *Bird survey by Christopher Rimmer, Vermont. Institute of Natural Science, amphibian survey by Stephen Trombulak and James Andrews, Middlebury College, flowering plant and tree surveys by William Howland.*

From many studies conducted on Mount Mansfield under the Vermont Monitoring Cooperative, a program jointly administered through the Agency, the University of Vermont, and the Green Mountain National Forest, information is combined to determine what organisms are part of the ecosystem and how they are interrelated. This effort requires a spirit of cooperation between researchers and resource managers unique to Vermont.

In the forests of Vermont's tallest mountain we have found that the number of plant and animal species is lower at the highest elevations (*Figure 2*). The environment at and near the summit is harsh. Cold winter temperatures, short growing seasons, steep slopes with rocky soil, and poorer air quality all contribute to a stressful high-elevation environment that supports fewer living organisms than in the milder lower-elevation habitats. In fact, the summit area is one of the few sensitive subalpine communities of the state, home to 12 plants on the state's list of threatened and endangered species and 22 other plant and animal species considered rare or sensitive.

As we pass from lowlands to mountaintop, there is a shift in the types of plants and animals found and how they look. There are more lichens and mosses at high elevations. These plants lie low to the ground and are insulated by deep snows in the winter. Trees become shorter and often bent, their response to more extreme weather. Some species disappear and are replaced by others found only at higher elevations. Birds of lower-elevation forests, such as the hermit thrush, red-eyed vireo, and black-throated green warbler, give way to their high-elevation counterparts, such as the white-throated sparrow, the blackpoll warbler, and the Bicknell's thrush.

Altering the forest canopy, increased recreation demands, and development can all change the characteristics of the forest environment and the variety of organisms within it. Effects in small, localized areas are of great concern when considering the cumulative impact in forests across the state.

With a wealth of natural resources in our state, the key to sustainability is to recognize what we have and how best to manage it. Recognizing the limitations of our natural resources to withstand additional stress is the role of Vermont's resource managers. Forests such as those on Mount Mansfield can fulfill many desired uses, including recreation, aesthetics, watershed protection, wildlife habitat, and timber production. But we must use each area according to its capacity to withstand various stresses and still remain a viable and healthy ecosystem. The Agency is implementing an ecosystem management demonstration project on Mount Mansfield that will help us understand the link between managing our forests and the effects this has on the organisms living in the forest, their diversity, health, sustainability, and other values and uses of the forest.

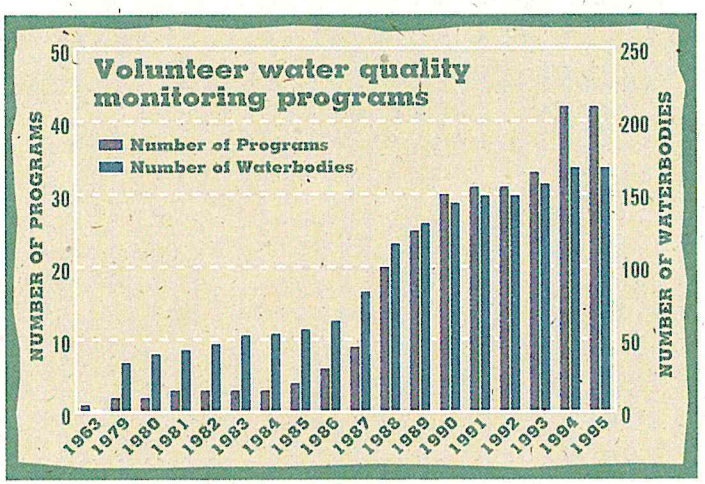

FIGURE 3: *Vermonters have come forward in dramatic numbers to protect and enhance surface waters. Source: Vermont Department of Environmental Conservation.*

Because ecosystems are influenced by both local activities (such as timber harvesting) and human activities on a state, regional, and global scale (such as air pollution and climate changes), ecosystem management needs to incorporate information on all of these factors when developing resource management plans that will ensure the sustainability of our forest resources.

AQUATIC ECOSYSTEM. A watershed is an area of land and water from which all water drains to a common location. Large watersheds such as the Lake Champlain and Connecticut River drainage basins are made up of smaller watersheds, which are in turn made up of still smaller watersheds. A watershed supports an ecosystem consisting of air, land, water, and living things woven together in a myriad of complex interrelationships. Watersheds may not be significant in defining terrestrial ecosystem boundaries. However, virtually all activities conducted within a watershed, whether it be building an industrial park, managing a woodlot, or fertilizing a field or lawn, have the potential to affect the quality of surface waters within that watershed. Watersheds are highly significant in defining the boundaries of aquatic ecosystems, and as such become the primary units for managing the health and integrity of those aquatic ecosystems.

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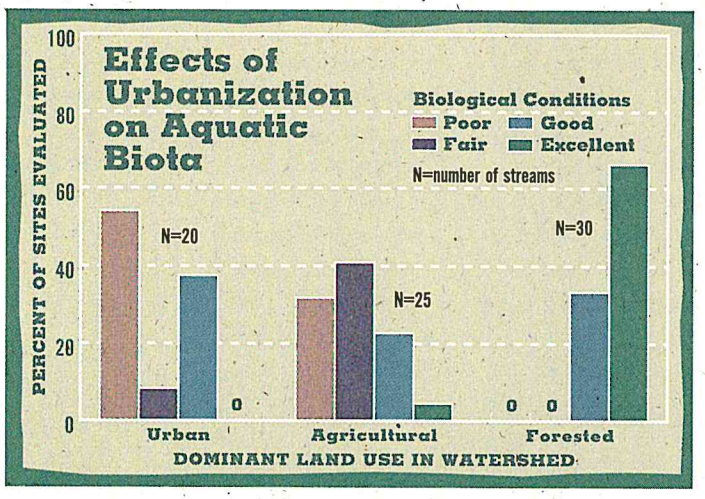


FIGURE 4: *More than 50 percent of monitored streams in urban areas exhibit poor biological condition, while more than 60 percent of the streams in forested areas are in excellent condition. Source: Vermont Department of Environmental Conservation.*

Water pollution control traditionally has been a top-down process in which federal and state governments have exerted their authority to regulate specific point-source discharges. The result has been rapid and dramatic water pollution abatement. The more difficult task of protecting and further enhancing aquatic ecosystems is dependent upon bottom-up, or grassroots, activism. Government may play an important role in providing resources and guidance, but many of the complex details and difficult collaborative decisions involved in watershed management are most appropriately handled at the local watershed level. Watershed residents have the deepest knowledge of local issues and a great interest in maintaining and sustaining the economic, social, and ecological integrity of their immediate environment.

Public participation in aquatic ecosystem monitoring and management has increased dramatically in the past 10 years (*Figure 3*). When looking at a watershed in its entirety, forming partnerships has helped identify appropriate management practices to reduce runoff from nonpoint sources (pollution not coming out of pipes) and assist in directing available resources toward implementing those practices. For example, the Agency of Natural Resources has joined with a diverse group of federal and regional agencies, town governments, interest groups, and individuals in greater Chittenden County in an effort to develop watershed management plans for small urban watersheds draining areas of relatively heavy urban and residential development. Historically, urban streams such as South Burlington's Potash Brook have been viewed as convenient waste disposal systems rather than as functioning ecosystems, meaning many of these waterways are in poor biological condition (*Figure 4*).

Potash Brook is a small watershed that drains directly into Lake Champlain near the north end of Shelburne Bay. Agriculture was a dominant activity in the watershed for centuries, as evidenced by the presence of native American farming utensils found along the stream banks. The largest portion of the watershed lies within South Burlington city limits and has been extensively developed. Included in the watershed are some of Chittenden County's busiest highways, largest farms, most extensive shopping malls, and densest residential and commercial neighborhoods. There are more than 90 points where stormwater is discharged into the stream.

The Agency has evaluated and mapped the aquatic habitat characteristics of the entire Potash Brook drainage system (*Figure 5*). While some areas of the stream are heavily degraded, there are still some areas where the aquatic ecosystem appears quite healthy. Areas of the stream with good habitat characteristics support more than 55 species of aquatic invertebrates, such as mayflies, caddisflies, and dragonflies, and up to 11 species of fish in a well-balanced distribution. In other words, these areas support a diverse and healthy aquatic ecosystem. Conversely, in those areas of degraded habitat, the number of species of aquatic macroinvertebrates often drops below 20, and fish species may number three or less. Not surprisingly, the healthy communities are found in areas of the watershed which are relatively undeveloped and protected, while the degraded communities are found in the most highly and recently developed areas of the watershed.

By far, the most significant influence in the degradation of the Potash Brook aquatic ecosystem has been stormwater runoff, with its high volume and velocity causing streambank erosion, and excessive loads of contaminants that destroy habitat. The most significant influences in protecting the Potash Brook aquatic ecosystem have been public ownership of conservation

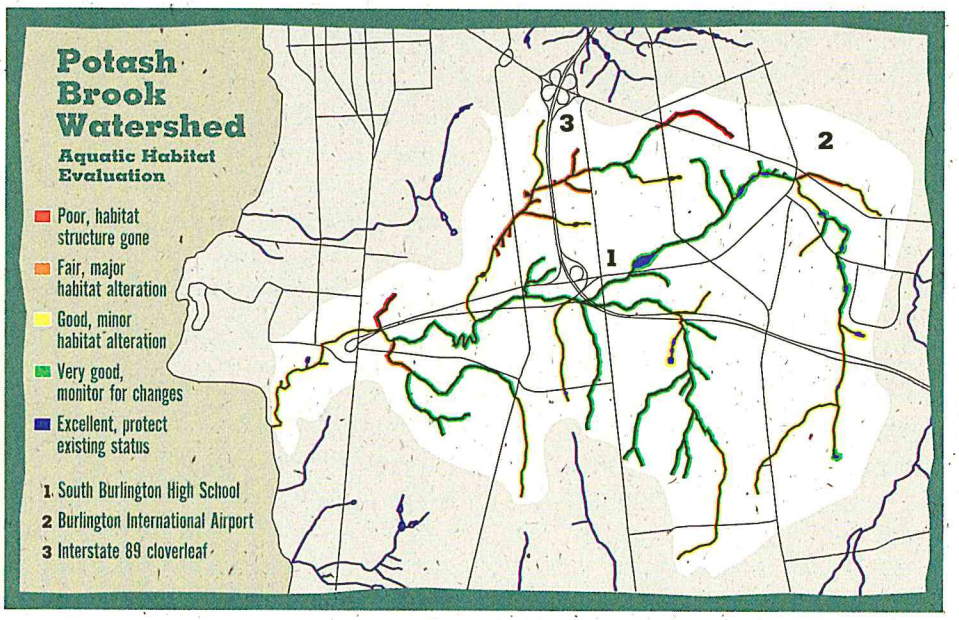


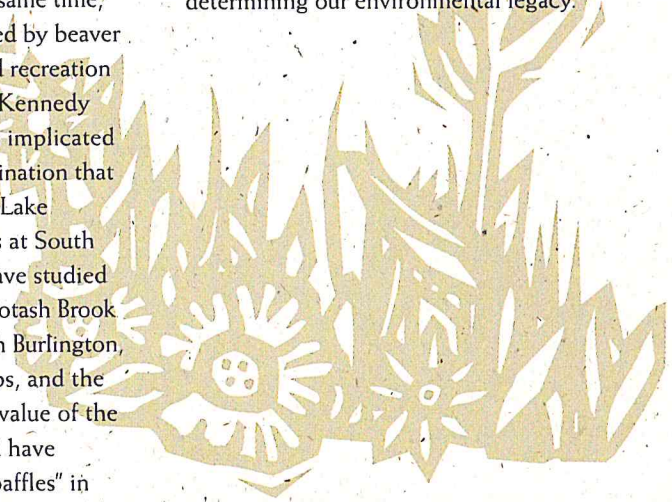
FIGURE 5: *Aquatic habitat condition in the Potash Brook watershed in Chittenden County. Source: Vermont Department of Environment Conservation.*

land, or natural areas, and the inaccessibility of some sections of the stream. In addition, the city of South Burlington, through its Natural Resources Committee, has established regulations which require water quality protection buffer zones for development along streams. Much of Potash Brook has vegetated stream banks, perhaps the single most important factor in protecting water quality.

The natural areas of Potash Brook provide opportunities for recreation, learning, and spiritual enjoyment often lacking in an urban environment. Parks, recreation paths, and environmental study areas are among the uses enjoyed by residents.

These natural areas also provide a home for beavers, a significant component of the natural ecosystem and an example of the type of conflict which can pit ecosystem values against human use. Beavers create dams and wetlands that greatly expand the ecological diversity of the system; these wetlands also serve to treat and purify contaminated stormwater. At the same time, increased water levels produced by beaver dams have threatened to flood recreation paths and streets adjacent to Kennedy Drive, and beavers have been implicated as sources of bacterial contamination that has resulted in the closure of Lake Champlain beaches. Students at South Burlington's public schools have studied the effects of beavers on the Potash Brook ecosystem. The City of South Burlington, the Youth Conservation Corps, and the schools have recognized the value of the beavers to the ecosystem and have installed innovative "beaver baffles" in order to reduce the potential conflicts between the natural environment and human use.

There are numerous other examples of public watershed management initiatives in Vermont. Volunteer monitoring activities often are the seed from which grows an increasing awareness of the values represented by healthy, diverse and sustainable ecosystems and the means by which those values can be protected and enhanced. Most watershed protection initiatives have taken root with the desire of local citizens to become informed about water quality issues and their willingness to accept a role in environmental protection. They have brought together multiple interests — economic, recreational, spiritual, and environmental — into partnerships to help manage the watershed ecosystem in a manner that is equitable to all. Through these grassroots initiatives, an increasing number of us have become involved in the process of making ecologically-sensitive decisions that will have long-term significance in determining our environmental legacy.



ECONOMICS AND THE ENVIRONMENT

That the quality and stability of the state's economy and its environment are linked cannot be contested. Marketing products as "Made in Vermont" has proven to be a savvy strategy that increases sales.

Not only do we directly market the state's natural resources like trees and granite, but indirectly as when we appeal to a consumer's image of Vermont as a special place of green mountains, fertile meadows, and quaint villages. The land and its natural resources are key to a vibrant economy.

Vermont's unemployment rate in 1995 remained one of the lowest in the nation. Even full employment, however, does not guarantee adequate state tax receipts when too many Vermonters are working at low-wage jobs. Trends in the state's economy suggest that many higher-paying jobs have been lost and are being replaced by lower-wage jobs. This situation may be made even more pronounced over time as the state's economy becomes increasingly reliant upon recreation and tourism.

One of our tasks in state government is to help foster a new age of clean manufacturing, encouraging companies to prevent pollution rather than controlling it after it has been generated. The Agency's Environmental Assistance Division has helped hundreds of Vermont companies — from small service stations in every county to some of the state's largest private employers — develop ways to reduce their generation of hazardous waste, conserve resources, and safeguard employee health, always with the understanding that every business must maintain product quality and profitability.

In the best of all situations, what is best for the environment is also most affordable for the shopper. Ours, however, is not the best of situations. Because the pricing of products does not consistently incorporate the costs of pollution or of waste treatment or disposal, the marketplace does not send clear messages to consumers about the real costs of owning, operating, and eventually disposing of the products we buy.

For example, on first glance it is still cheaper to buy an energy-inefficient refrigerator than to buy one with superior insulation and an energy-efficient pump and compressor. At second glance, however, it becomes apparent that the refrigerator costing less to take off the salesroom floor will cost much more in the long-term because of increased energy costs and other expenses incurred over the lifetime of the appliance.

We at the Agency of Natural Resources have an important role in helping Vermonters understand the environmental consequences of their purchasing decisions.

Polls have repeatedly shown that Vermonters desire both a clean environment and a robust economy. As we approach the dawning of a new century, it is not clear whether Vermont will successfully merge the goals of environmental protection and economic prosperity. But the rewards will be many should we succeed.

air quality

ON A SCALE OF 1 TO 10, HOW CLEAN is Vermont's air? The 1994 "Development Report Card" by the Corporation for Enterprise Development ranked Vermont air quality the best in the nation. The "Vermont 1993 Environmental Quality Index" report from the Environmental Programs in Communities gave Vermont's air quality its worst rating. Congress is discussing dismantling the Environmental Protection Agency and repealing environmental laws like the Clean Air Act.

Above: A Plymouth hillside.

Have our federal and state air quality laws gone too far, or not far enough? How clean is Vermont's air?

WHICH POLLUTANTS? A major goal of the federal Clean Air Act is to attain and maintain air quality standards for six pollutants: particulate matter, sulfur dioxide, ozone, carbon monoxide, nitrogen dioxide, and lead. The federal law singled out these "criteria pollutants" because they are often present in large urban areas at levels resulting in adverse health effects. Nationally, 60 million Americans live in areas which exceed health standards for one or more of these pollutants. In Vermont, all areas of the state were cleaner than federal standards in 1994 (*Figure 1*). For most pollutants, except ozone, Vermont levels are at or below 50 percent of federal standards, and trends, except for ozone, have been improving since 1970. By these national criteria, Vermont's air quality is excellent.

Federal standards, however, provide a limited yardstick for measuring our air. Standards for particulate matter and ozone are considered inadequate to prevent health effects and are currently being revised by the U.S. EPA. Federal standards also neglect economic impacts, such as the effects of sulfate haze on visibility and tourism, or ecological impacts, such as the effects of acid rain and ozone on ecological health, diversity, and sustainability. They cover only six of the thousands of chemicals present in our air, many of which may be more harmful than the criteria pollutants.

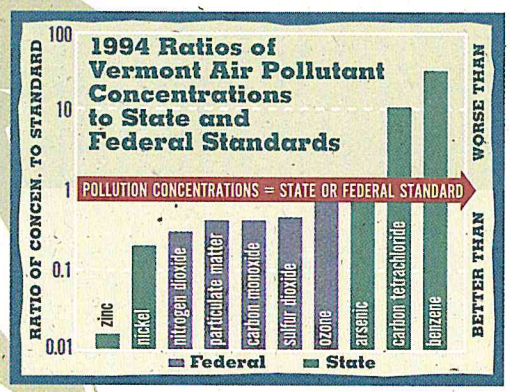


FIGURE 1: *Vermont air quality compared to standards. Source: Agency of Natural Resources.*

In 1988, the Agency of Natural Resources proposed state air quality standards for several hundred "hazardous air contaminants," including irritants, toxins, and cancer-causing pollutants not covered by the federal law. Recent measurements for some of these "air toxics" suggest that concentrations vary widely with respect to standards and from one site to another. Some pollutants, like nickel, are well below standards, even in our largest urban centers. Other compounds, such as benzene, are more than 10 times higher than standards at some sites (*Figure 1*). From an air toxics perspective, Vermont's air quality is quite good for some pollutants and poor for others.

WHICH LOCATIONS? The data in Figure 1 represent worst-case Vermont concentrations from urban centers like Burlington and Rutland. Levels of many pollutants drop off rapidly as one moves away from urban industrial, residential, and automotive sources. Figure 2 shows 1994 ratios of urban to rural air concentrations of selected Vermont pollutants. A high urban-to-rural ratio indicates a strong, local source influence. Levels of benzene, emitted primarily from motor vehicles, are five times worse in a high-traffic urban site (Burlington) than in a nearby rural site (Underhill). Zinc (incineration, combustion) and nickel (oil burning) are also several times higher in urban centers than in downwind rural locations.

Sulfate and ozone pollution, on the other hand, are typically no higher in our cities

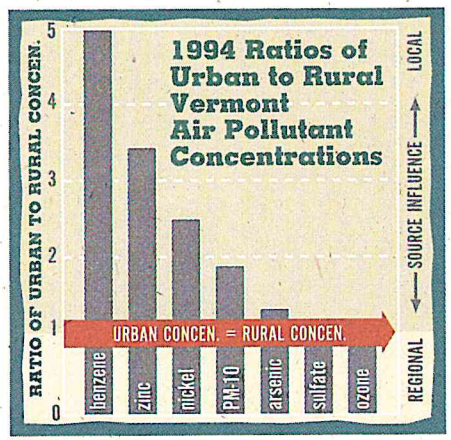


FIGURE 2: *Vermont pollutants come from local and distant sources.*

than in rural areas. Sulfate and ozone are not emitted directly from sources, but are formed in the atmosphere from reactions of "precursor" pollutants. This formation takes time, such that the maximum effects of Vermont sulfate and ozone precursors may occur tens to hundreds of miles downwind of sources. At the same time, Vermont concentrations of sulfate and ozone are strongly influenced by transport from sources hundreds of miles upwind of our borders.

SULFATE AND OZONE From a human health perspective, we are fortunate that sulfate and ozone are eventually cleansed from the air by chemical reactions and physical deposition processes. Sulfates dissolve in cloud droplets and are efficiently removed by wet deposition. Ozone is removed from the air by chemical reactions, and by physical interactions with the leaves of trees and agricultural crops. From an ecological perspective, these atmospheric cleansing processes for sulfate, ozone, and trace metals such as lead and mercury pose a serious concern for our forest and aquatic ecosystems. Wet sulfate deposition is a major component of acid rain, which has acidified a number of Vermont's lakes and streams (*Figure 3*) and may contribute to red spruce decline at higher elevations.

Ozone pollution causes visible damage to the leaves of ozone indicator plants such as blackberry and milkweed at locations throughout the state (*Figure 4*). Less obvious, but more important effects may occur as ozone can reduce photosynthesis, growth, and frost-hardiness in a variety of plant species. Some native Vermont trees, including white ash, white pine, black cherry, sugar maple, and birch, are considered ozone-sensitive. Combined effects of ozone and sulfate may weaken sensitive plants and animals, reducing their competitive vigor, and rendering them susceptible to damage from climatic, insect, and disease stresses. Over time, sensitive individuals or species may be eliminated, diminishing ecological diversity and sustainability.

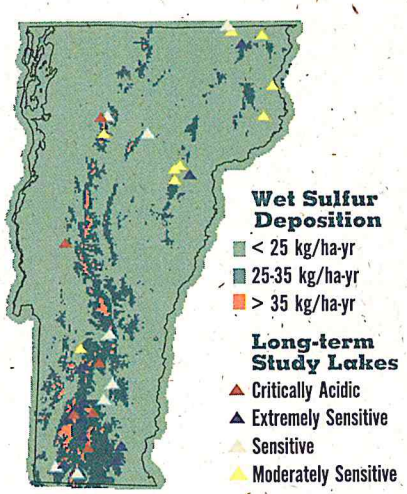


FIGURE 3: *Estimated wet sulfate deposition and acid-sensitive lakes in Vermont.*

THE "GREEN" MOUNTAINS
While no Vermont or federal standards exist for sulfate deposition, Canada and New York State have both proposed annual wet sulfate deposition standards of 20 kilograms per hectare (about 18 pounds per acre) to protect their surface waters from further acid rain damage. In Vermont, wet sulfate deposition rates are typically about 20 kg/ha at low-elevation sites in the state. As precipitation increases with elevation, wet sulfate deposition is estimated to exceed 40 kg/ha (36 pounds per acre) in parts of the southern Green Mountains (*Figure 3*).

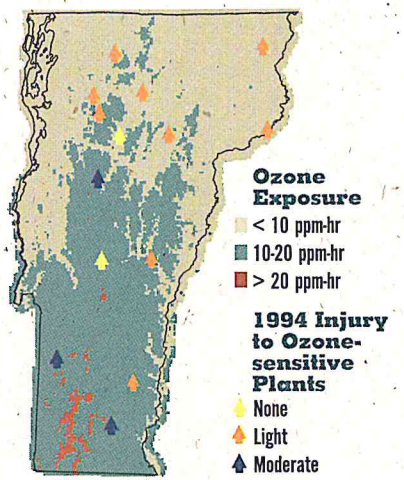


FIGURE 4: *Estimated summer SUM06 ozone and locations where ozone injury to sensitive plants was evaluated (1994).*

The current federal health standard for ozone is based on the highest one-hour concentration experienced each year. Forest health researchers are more concerned with long-term exposures to moderately high ozone levels during the growing season. EPA is considering a "biological effects" ozone index known as the SUM06, which sums all moderately high ozone values during the summer months. A seasonal SUM06 ozone value in the range of 16.5 to 26.4 parts per million-hours is currently being evaluated as a possible secondary standard to reduce effects on sensitive plants. Like sulfate deposition, SUM06 ozone values tend to increase with elevation. Recent estimates of statewide SUM06 ozone levels range from less than 10 ppm-hours at low elevations in northeastern Vermont to more than 20 ppm-hours at high elevations in the southern Green Mountains (*Figure 4*). High-elevation environments are characterized by thin soils, limited acid buffering capacity, and harsh climatic conditions. As we add additional stresses — ozone and acid deposition — the diversity and sustainability of these fragile mountain ecosystems is threatened.

CHALLENGES

In the next 10 years, national emissions control programs should reduce out-of-state contributions to Vermont's sulfate and ozone pollution. Whether these reductions will prevent further ecological damage is unclear. Federal regulations alone, however, will do little to reduce levels of toxic pollutants like benzene in Vermont's urban environments. Federally-mandated limits on emissions from new cars and trucks are offset by increasing traffic growth. Whether we will act collectively, effectively, and in time to reduce the impacts of air pollution from local and distant sources is a question which our children and grandchildren will answer.

On a scale of 1 to 10, how clean will their air be?

water supply and quality

VERMONT SUFFERED A DROUGHT in 1995, which underscored the value of freshwater. We Vermonters no longer took safe drinking water for granted, and many communities implemented conservation measures as the shortage worsened. Some municipalities took more drastic steps: Barre City and Newbury turned to emergency sources of water, while Fairfax and Peacham trucked in their supplies. Conditions reversed in northern Vermont with August's flash floods.

Above: Thurman Dix Reservoir, water supply for Barre.

As flood waters rose, waste along river corridors increased. Sewage, farm waste, pesticides, and industrial supplies were all potential contaminants. As a result, owners of springs and wells in many towns were cautioned to boil water. About 1,200 residents in Morrisville were warned not to consume the village water, and flood waters put a number of public water systems along the Lamoille River at risk.

WATER SUPPLY. Two fundamental factors define water availability: quantity and quality. Lack of rainfall in 1995 highlighted the importance of the former. Precipitation at one point was 8 inches below normal—this in a state that averages about 40 inches annually.

The world's freshwater volume is preciously small. Approximately 97 percent of all water is saltwater. The remaining 3 percent is freshwater; of this, only 30 percent is available for use, with most freshwater trapped in ice caps and glaciers. Freshwater is readily visible in the form of surface water, rivers and lakes, but this represents only 0.01 percent of the earth's total water. Groundwater is not so evident although approximately 0.6 percent of the world's water is found in the subsurface.

While nature greatly controls the supply of water, humans influence its use. An estimated 632 million gallons in freshwater withdrawals occur daily in Vermont. This serves electric generators, industrial and commercial needs, agriculture, and mining activities, along with what we use in our homes. Urban areas need large quantities of water and obtain it from surface sources such as lakes, ponds, and reservoirs (*Figure 1*). In rural areas, the smaller but more numerous public water systems depend on groundwater (*Figure 2*). Groundwater is also most apt to serve the single-family, self-supplied users. The average availability or yield of drilled wells is estimated at 3 gallons per minute.

Shortages of water can adversely affect human health and jeopardize our ability to dispose of waste. As water levels drop, turbidity may increase, resulting in increased bacteria. Moreover, the quality of water generally declines as it is used, which can affect the sustainability of the resource itself. In rural Vermont, domestic water eventually carries sanitary waste from homes, and water associated with agricultural activities may contain pesticides and animal

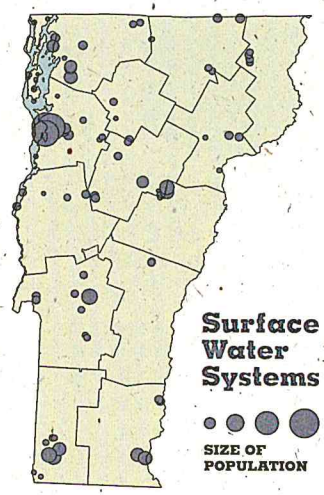


FIGURE 1: *Public community water systems served by surface waters.*

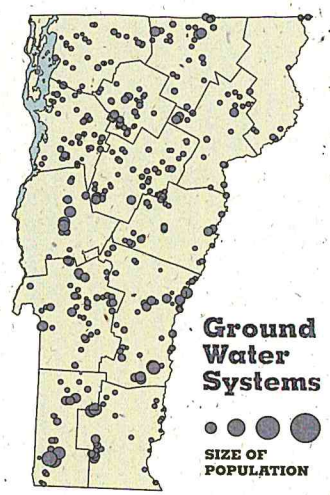


FIGURE 2: *Public community water systems served by groundwater.*

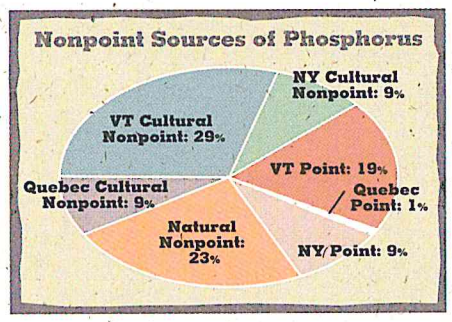


FIGURE 3: *Nonpoint sources are the largest phosphorus contributor to Lake Champlain. Source: Lake Champlain Diagnostic-Feasibility Study, 1994.*

waste. In urban settings, the combination of domestic, industrial, and commercial wastewater and stormwater can include an array of potential contaminants. Therefore, water conservation practices not only reduce the amount of water used, they also maintain its quality.

Although not in infinite supply, water in Vermont is abundant enough that with controls the resource can be managed. Conservation measures include repairing plumbing leaks, installing low-flow fixtures, washing full loads of dishes and clothes, watering gardens in the early evening or morning, and mulching plants to retain moisture. Such efforts have a crucial bearing on Vermont's economy. Water is necessary for industrial and commercial needs and agricultural activities, which provide development opportunities. Water is fundamental to the state's ability to grow, and, at the same time, growth impacts both the quantity and quality of this resource.

SURFACE WATERS. Vermont's surface waters provide a wide variety of habitats for fish, macroinvertebrates, plants, and other aquatic life. These same waters also provide a wide range of uses for humans: fishing, hunting, boating, swimming, and non-recreational uses such as drinking water, waste assimilation, industrial and agricultural uses, and power generation. For us, the stewards of this resource, water quality management requires the balancing of these human uses against the ability of surface waters to support and sustain biologically diverse communities of aquatic plants and animals.

Public surveys and legislation provide clear and consistent evidence that we Vermonters value clean lakes and rivers and believe that maintaining a high-quality environment is critical to maintaining our quality of life. We also have a deep concern for a healthy and growing economy. In other words, we want it all — a diversity of high-quality recreational opportunities, waters clean enough to support natural aquatic ecosystems, and a robust economy.

FIGURE 4: *Zebra mussels, seen here attached to native Lake Champlain mussel, pose serious threats to both aquatic ecosystems and water supply intakes. This native mussel will die due to the zebra mussels attached to it.*

While progress in cleaning up our waterways has been relatively rapid and successful to date, as with any waste removal process it's always more difficult to get at the final 20 percent. Many of the adverse water quality impacts which remain today are the result of many small nonpoint sources spread throughout the ecosystem which individually may be insignificant but cumulatively have tremendous effects (*Figure 3*). Effective solutions will require long-term, incremental changes in how we use water, often in partnerships, in order to achieve results (*See pages 5-7*). There is less immediate gratification in implementing small, individual nonpoint source control measures now than 25 years ago when everyone agreed that building a waste treatment facility was the right thing to do and the result was an immediate and dramatic improvement in water quality.

Threats to Vermont's aquatic biodiversity and sustainability do not come solely from waste. The proliferation of exotic species, a form of biological pollution, poses a significant threat to our surface waters. Lake users in Vermont are well aware of several exotic species which have invaded our surface waters: Eurasian watermilfoil and water chestnut can grow in such densities that swimming, boating, and, in some cases, fishing are precluded; sea lampreys affect sport-fishing; and zebra mussels can block water intake pipes and render swimming areas unusable due to their sharp, cutting edges.

Even more insidious is the effect these aggressive invaders can have on the biodiversity of the natural ecosystems that they invade. In many lakes, ponds, and wetlands, diverse stands of native plant species have been replaced by dense single-species stands of Eurasian watermilfoil, water chestnut, Japanese knotweed, or purple loose-strife, resulting not only in a reduction in plant diversity, but also a loss of habitat diversity that affects a wide range of plants and animals. The ability of native trout and salmon species to thrive in Lake Champlain is threatened by sea lamprey predation. And native mussels in Lake Champlain are likely to be severely impacted, if not totally wiped out, by colonizing zebra mussels (*Figure 4*).

For some exotic species, there are population control options, sometimes including the use of chemical pesticides, which are often controversial and usually expensive. As with other water use issues, the balancing of environmental, economic, and recreational concerns dominates the debate over how best to control invading populations of exotic species — all against the backdrop of wanting a healthy, biologically diverse resource future generations can enjoy.

CHALLENGES

The future of water quality management in Vermont will require a commitment by all of us to learn about problems affecting our water and to participate in their solutions. In making this commitment, we should understand that although there will be no instant gratification, cumulatively our individual actions will ensure the long-term sustainability of Vermont's diverse aquatic resources.

In terms of water supply, we can implement water conservation measures which will save us water and money, such as the installation of low-flow plumbing fixtures. We need to become familiar with the sources of our water and the nearby activities which could contaminate them. Septic systems are necessary and numerous, and failed septic systems should be repaired. Household hazardous waste should be disposed of properly. Underground fuel tanks, especially old and potentially leaking ones, need monitoring.

waste

TO REALIZE THAT WE CAN'T JUST THROW something away is a critical first step to understanding the complexity of managing solid, hazardous, and radioactive waste. Waste, once generated, can be changed in form, as when household trash is converted to toxic ash and hazardous air emissions in a backyard burn barrel. Waste changes but it never just goes away. Alternatively, through reuse and recycling waste can be converted into useful products. We in Vermont reuse and recycle 200,000 tons of waste each year.

Above: Proper waste management can avoid scenes like this.

While being a small state with a predominantly rural population tends to mask the severity of waste issues, problems inevitably arise and tensions mount when we try to determine just where to put our wastes. Today, Vermont has fewer landfills than a decade ago, we continue to export a majority of our hazardous wastes for treatment and disposal in other states, and our low-level radioactive waste may soon go to Texas.

Many public and private dollars are spent to dispose of the wastes we create. Shipping and storing our low-level radioactive waste in Texas, for example, is expected to easily exceed the $27.5 million it will cost to access the disposal facility. In addition, we spend an estimated $60 million for disposing of solid waste and $77.4 million on hazardous waste annually in Vermont.

Because Vermont is one of the least industrialized states in the nation, we produce less hazardous and low-level radioactive waste than most states. As regards solid waste, however, our per capita waste generation rates are not that dissimilar to those of other states: 3.4 pounds per capita daily in Vermont, compared to 3.5 pounds nationally.

Each year, manufacturing companies must report their transfers and releases of nearly 700 toxic hazardous chemicals. This information is reported through the EPA Toxics Release Inventory, or TRI. Although the TRI data represent only waste generation and reduction activities by the state's largest industrial facilities, they are an important indicator for measuring industry's commitment to pollution prevention.

The 1993 Toxics Release Inventory, issued just this past spring by EPA, ranks Vermont 51st, or third lowest among the states and territories, in terms of total toxic chemicals released. Most of the toxic releases in Vermont — or 99.7 percent — were as air releases and the majority of these were volatile organic compounds (VOCs) associated with solvent use in coatings and cleaning operations (*Figure 1*). Of the 44 Vermont facilities submitting TRI reports, approximately two-thirds have already developed and implemented many waste reduction strategies included in state-mandated pollution prevention plans.

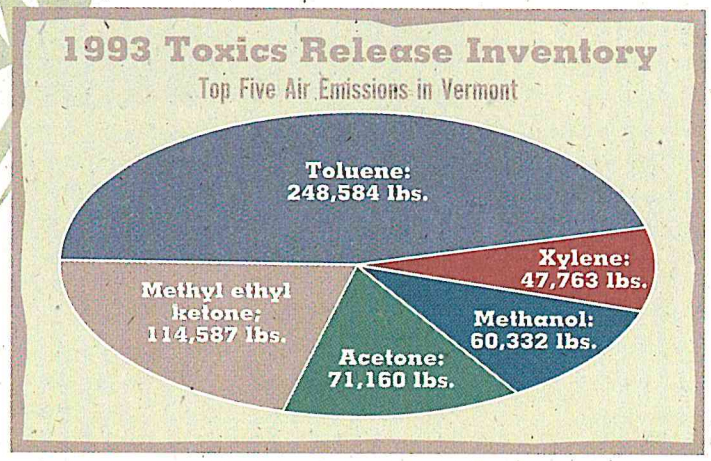


FIGURE 1: *Source: U.S. EPA.*

Between 1992 and 1994, there were 224 industrial facilities in Vermont required to prepare pollution prevention plans. These facilities used prevention strategies to reduce hazardous waste totals by 2,598,118 pounds. During that same period, seven large generators of hazardous waste prevented enough pollution to be reclas-sified as small generators, and 35 small generators reduced waste volumes enough to fall below threshold amounts and were exempted from future planning requirements (*Figure 2*).

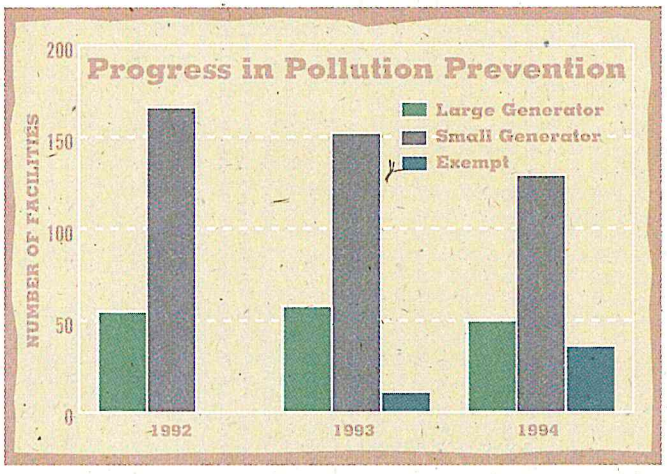


FIGURE 2: *Change in hazardous waste generator status. Source: Vermont Agency of Natural Resources.*

In 1995, the Agency established a contaminated sites cleanup program to enable redevelopment of previously contaminated properties. By cleaning up these properties and redeveloping them, communities are able to direct development into areas where they can capitalize on previous investments made in roads and utilities. The program reduces the liability of new property owners by involving the Agency in the review and oversight of work plans to clean up and monitor the properties.

SUSTAINABLE MANUFACTURING/ SUSTAINABLE CONSUMPTION.

Waste and inefficiency are demons common to both economic and environmental accounting systems. Waste, in particular, is indicative of inefficient systems for in nature there can be no waste — everything produced is used as food by some other living organism. There is a continuous cycling and recycling of the elements. If this weren't so, we'd likely be up to our eyeballs in waste, and our natural resource base would have been entirely depleted years ago.

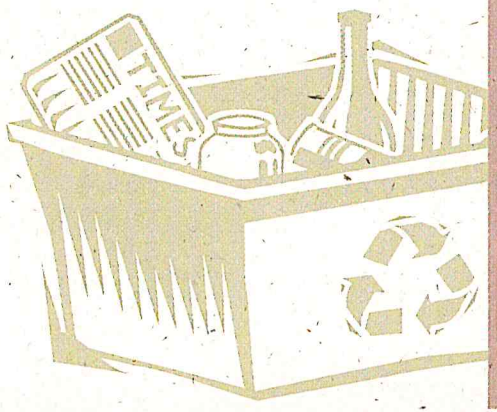
Some innovative Vermonters are designing sustainable systems that imitate the cycles and circles of nature. In a sustainable manufacturing system, industrial processes mimic nature by conserving energy and natural resources, minimizing waste, and reusing byproducts. A drycleaner in St. Johnsbury, for example, recently installed a machine that operates as a "closed loop" by capturing and condensing used cleaning chemicals and making them reusable. Similarly, the Vermont Department of Liquor Control sells waste corrugated packaging to a paper mill where it is recycled into the bags used in the Department's outlet stores.

One of the surest ways to reduce waste generation is to review the decisions we make as consumers. Money we spend to buy products, for example, pays for the packaging as well; we pay for packaging once at the cash register and again when we pay to dispose of it.

Buying reusable and durable goods with minimal packaging and recycled content helps to link sustainable manufacturing to sustainable consumption and is necessary if we are to continue making significant gains in waste reduction into the future.

POLLUTION PREVENTION PAYS.

Pollution prevention, or source reduction, offers itself as the management strategy of first choice because it avoids waste generation in the first place. Source reduction can be as simple as reaching for a reusable sponge instead of a disposable paper towel, or as complex as redesigning an industrial process in order to eliminate the use of a toxic, ozone-depleting chemical. Where it is not technologically or economically feasible to prevent pollution, however, we ought to reuse or recycle our wastes.



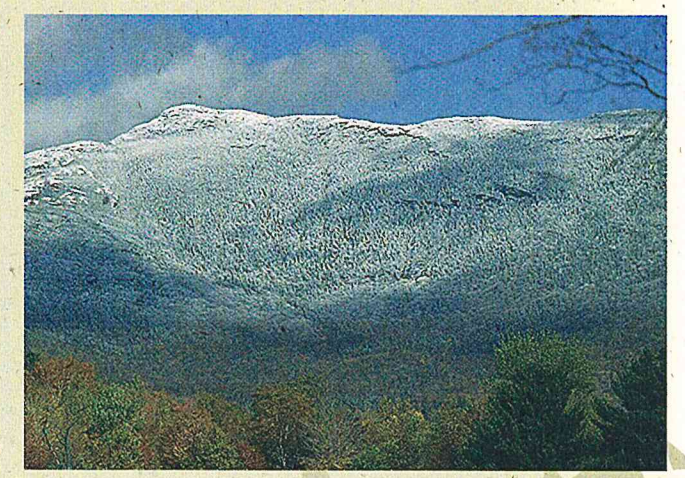
The reasons we prevent pollution are many. For a ridesharer living in Burlington, commuting in a full car to and from work in Waterbury not only reduces tail pipe emissions and ground-level ozone, but offers cost savings and companionship as well. For a company coating metal in Castleton, converting from a conventional spray painting system to an electrostatic powder coating system not only means reduced hazardous waste generation, but improved product quality, long-term cost savings, and improved indoor air quality as well.

In the town of Georgia, shredded scrap tires have been used in the base of a portion of a gravel roadway. This tire chip base has improved road surface conditions during mud season and has also saved the town money. The shredded tires, costing $1 per cubic yard, reduced the need for additional gravel which would have cost $3.85 per cubic yard.

CHALLENGES

The first challenge to realizing less waste in our lives is to envision a preferred future — one we would be proud to bequeath to future Vermonters. With this vision should come ample motivation to change many aspects of our lifestyles. We should seek opportunities to rideshare or use public transportation, to educate one another about ways to reduce, reuse, and recycle our wastes, and to eliminate toxic substances from our homes. In the end, we all will save money and improve the quality of our environment. (For more information about such opportunities, see the list of phone numbers on page 19.)

forests and forest lands



TREES HAVE VALUE. THEY HAVE value as single trees shading a house, a street, or a park bench. They have value as groups standing together as homes for wildlife, shading the ground, and being colorful in the fall. They have value when they cover large areas as landscapes, as complex ecosystems, and as air filters and temperature regulators. They help protect us from floods, enhance our lives, and provide a context for living in Vermont.

Above: Mount Mansfield, Vermont's highest peak. (photo © Stephen Ostrowski)

Inventory data prepared by the Agency and the U.S. Forest Service show Vermont has 18 billion trees. This does not include an uncounted number of trees standing alone or in small groups in fields, towns, and cities. Each of these trees has value, some for thousands of useful products we use everyday, some to look at, some to provide food and shelter for animals, and some simply for their inherent value. In Vermont and, in fact, across much of the Northeast, trees and forests have a profound influence on the environment.

HOW GREEN MUST OUR FORESTS BE? Vermont continues to wrestle with the issues of how many trees are enough, what kind of trees should grow in our forests (*Figure 1*), where they should be, and who gets to decide what uses they have. The recently revived Forest Resources Advisory Council, appointed by the Governor, has developed criteria for determining what makes Vermont's forests sustainable. The council will use nine benchmarks to measure sustainability. Using these criteria and public dialogue, council members seek answers to the question: How much is enough?

Our total forest resource is 62.7 million cords and continues to grow (*Figure 2*). While Vermont's annual harvest has increased at about 5 percent annually during the past 12 years, annual forest

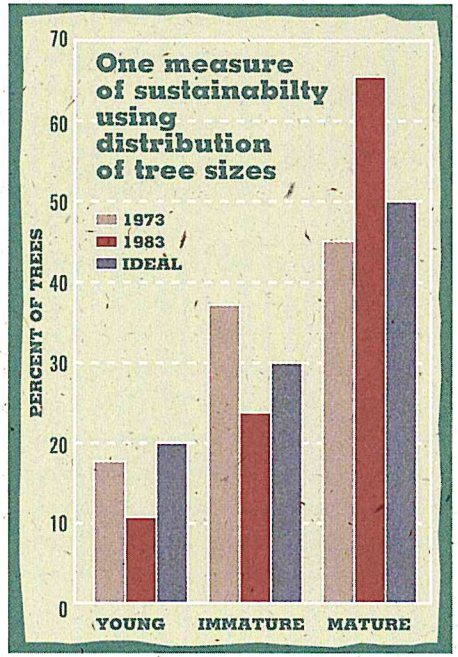


FIGURE 1: *During the past 20 years, there has been a shift toward more mature forests as represented by tree size. To sustain our forests, we must strive to increase the composition of younger trees in the state.*

9 BENCHMARKS TO MEASURE SUSTAINABILITY

1. *Maintain soil productivity.*
2. *Conserve water quality, wetlands, and riparian zones.*
3. *Maintain or create a healthy balance of forest age classes.*
4. *Perpetuate a supply of timber, pulpwood, and other forest products.*
5. *Improve the overall quality of the timber resource as a foundation for more value-added opportunities.*
6. *Improve scenic quality by limiting the adverse impacts of forest harvesting, particularly in high-elevation areas and vistas.*
7. *Conserve and enhance habitats that support a full range of native flora and fauna.*
8. *Protect unique or fragile areas.*
9. *Encourage opportunities for compatible recreation.*

Adapted by the Forest Resources Advisory Council

growth consistently outpaces this increasing harvest. The most recent comprehensive forest inventory was completed in 1983, meaning we cannot provide firm numbers on our state's forest resources. Based on the previous growth information, however, and because no major, widespread disturbance has occurred since the previous inventory, we can assume a similar relationship between growth and harvest between 1983 and the present. The next inventory results are due in the winter of 1997-1998.

Caring for all these trees is a critical job for every landowner. A healthy forest includes healthy trees and a diversity of species so the forest can be sustained despite environmental stresses. Monitoring changes in forest health allows forest managers to take actions to prevent or control potential threats to forest health. Early detection of stress problems as well as early prevention efforts help keep Vermont's forests green. The Department of Forests, Parks and Recreation annually examines and measures trees on more than 145 permanent study plots. Changes in forest insect populations and disease incidence are measured at more than 200 additional forest pest monitoring sites. The Department also conducts statewide surveys annually to detect damages to forests. Urban trees are not in such good shape, and many roadside and streetside trees show signs of neglect and decline. The Urban and Community Forestry Program is developing support from town tree wardens, foresters, and volunteers to reduce damage and loss, plant replacement trees, and maintain the health of existing trees.

Urban trees are often in poorer health than those in the forest or roadside trees because human pressures and poor site conditions are prevalent. Basic elements that promote tree health include sufficient water, optimum temperature and light, and a proper balance of nutrients. Too much or too little of any of these can cause stress. Because of inherent changes to the natural environment in urban areas, tree health is subjected to more stress than in rural situations. Also, past planting efforts that created continuous areas of a single tree species, such as American elm plantings, allow for devastating effects following insect and disease outbreaks. Maintaining tree health in urban and community forests relies on reducing stresses from both biotic (insect and diseases) and abiotic (human impacts, site conditions) stress agents.

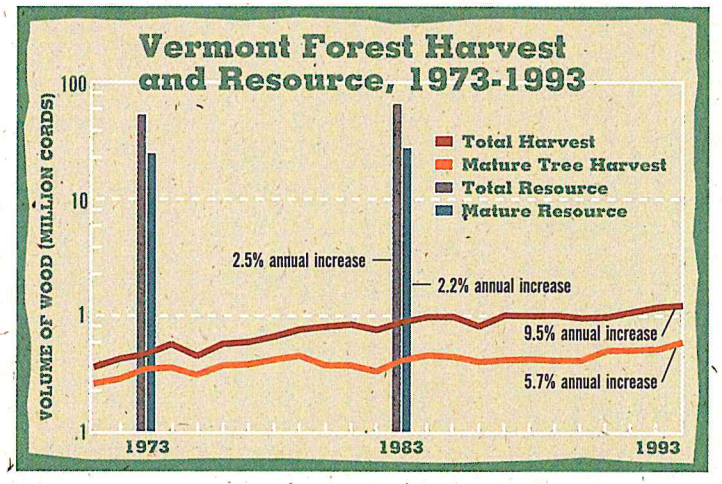


FIGURE 2: *While the rate of tree harvesting appears to be increasing at a faster rate annually than forest growth, the total amount of the resource still far exceeds harvesting. Note the logarithmic scale showing volume of wood.*

Vermont's most common tree species, the sugar maple, has generally been healthy for the past six years. However, some tree species suffer from diseases adversely affecting their growth and vitality. Butternut trees throughout the state are in jeopardy from butternut canker disease. American elm trees are scarce and still declining from Dutch elm disease. Beech bark disease continues to infect American beech. And flowering dogwood, an endangered tree species in Vermont, is afflicted with dogwood anthracnose. All four are life-threatening diseases caused by non-native pathogens. Other, less-defined health problems are affecting white ash, high-elevation red spruce trees, and birch.

Roadside sugar maples tend to be less healthy than forest-grown trees. In a recent assessment, 74 percent of roadside sugar maples were healthy, compared to 93 percent of sugar maples in forested areas. Trees growing on the sides of roads are exposed to more stresses than forested trees, with roots injured by ditch construction, salt application, plowing, and road maintenance.

Trees in rural and urban settings are affected by a variety of "stressors" that can adversely affect tree health, and therefore ecosystem health. In 1995, drought conditions were present statewide, causing scattered areas of tree mortality, with longer-term health problems expected. Most of the major insect defoliators have maintained low-population levels for the past few years, causing minimal damage to trees. Ozone damage to leaves of sensitive species, such as black cherry and white ash, was not as prevalent in 1995 as in 1994.

ARE WE GETTING GREEN FROM OUR FORESTS? Prices paid for standing trees have doubled in the past five years as demand for Vermont logs has increased by 37 percent. About one-third of Vermont's logs are sent out of state unprocessed. This represents lost economic opportunity for Vermonters, since most of the exported logs are used for commodity production. Softwood makes up 60 percent of log exports — principally spruce and fir — while hardwoods make up 70 percent of log imports into Vermont. This means while some revenue is lost from exported softwood resources, a greater gain is made by the imported hardwood, whose processing involves more jobs and higher valued products.

CHALLENGES

Occupying more than 80 percent of our landscape, trees are important to all Vermonters. We all must take responsibility to watch, care for, and wisely use this valuable resource. The crucial first steps are: 1) knowing how to monitor our forests for sustainability and maintaining a database on forest health, 2) providing education and incentives to help more private landowners understand their role as stewards of this resource, and 3) providing the wood products industry with a sustainable supply of raw material.

CONSIDER THAT VERMONT IS ESTIMATED TO HAVE 193 SPECIES OF BREEDING BIRDS, 58 SPECIES OF MAMMALS, 89 TYPES OF FISH, 41 SPECIES OF REPTILES AND AMPHIBIANS, AND MORE THAN 15,000 INSECTS SPECIES. ALSO CONSIDER THAT VERMONT HAS AN ESTIMATED 2,000 HIGHER PLANT SPECIES, IN EXCESS OF 5,000 FUNGI, AND UP TO 7,500 SPECIES OF ALGAE. THEN CONSIDER THAT THE VERMONT FISH AND WILDLIFE DEPARTMENT IS DEDICATED TO THE CONSERVATION OF FISH, WILDLIFE, AND PLANT SPECIES AND THEIR HABITATS.

Above: Bittern, a species native to Vermont.

fish, wildlife and habitat

More specifically, one Department goal is to "protect, enhance, conserve, and restore viable populations of native and naturalized, non-injurious fish, wildlife, and plants consistent with biological, social, and economic considerations."

Sheer numbers alone make this is a daunting task for the Department, but one enhanced in recent years by the addition of a zoologist, a community ecologist, and a botanist with the Nongame and Natural Heritage Program. A new focus on ecosystem program planning within the Department will further benefit the conservation of our living natural resources, as well.

To better understand the diversity of life around us here in Vermont, one of the Department's first priorities is to inventory and catalogue the occurrence of our state's species, as well as natural communities, to better understand their distribution and abundance (*Figure 1*). For birds and most fish species, we estimate that more than 90 percent of the state has been evaluated. For other vertebrates, our inventory estimate drops to less than 60 percent. For many insects and other invertebrates, the percentage of the state evaluated falls below 30 percent. Although 75 percent of the state has been screened for flowering plants, conifers, and ferns, less than 1 percent of the state has been inventoried for fungi and algae.[1]

With information gathered in these assessments, it will be possible to collate data, for a given point in time, so biologically diverse or rich areas can be identified. This will enable better decision-making in setting acquisition priorities, developing a land conservation strategy, and establishing management goals and objectives for state lands. With such data, the Department will be in position to provide even better information to town and regional planning commissions. The Department also may identify species that merit special management significance because they are threatened or endangered.

1. The evaluation percentages should not be interpreted absolutely. Instead, they provide a comparative portrayal of our level of knowledge by major species groupings.

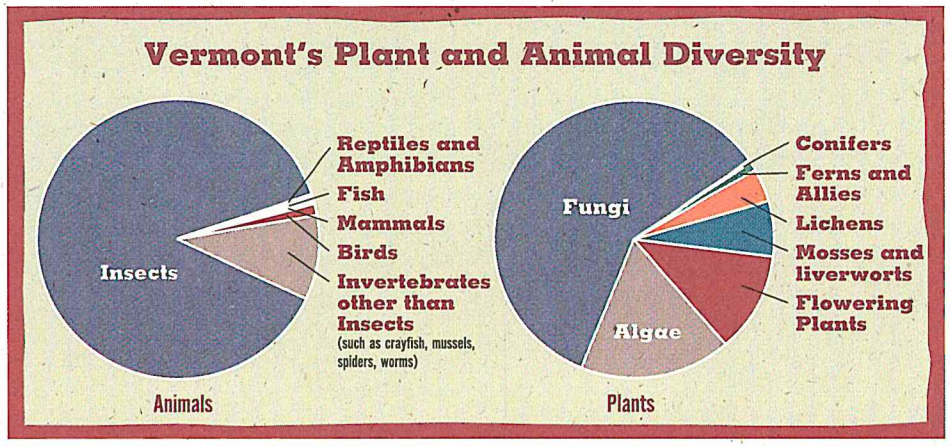


FIGURE 1: *Species native to Vermont.*

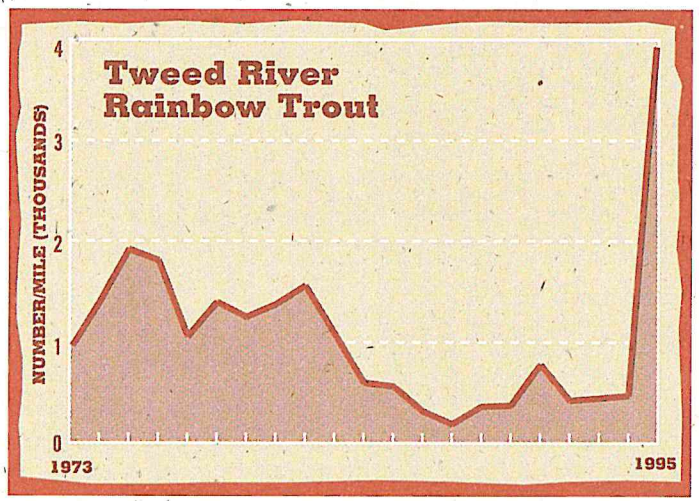


FIGURE 2: *Populations of rainbow trout in a section of the Tweed River during the past 20 years illustrate a general long-term decline, although there are short-term increases. The dramatic increase in 1995 was caused by an unusually large number of trout hatched in the springtime, and the Department of Fish and Wildlife will continue to watch this river.*

The science of biodiversity is still in its infancy and practical management applications remain for discussion. However, the Fish and Wildlife Department intends to incorporate biodiversity concepts in planning and management initiatives. We will continue to emphasize management for featured species, such as loons, deer, and lake trout, because of their existing high social value or low populations. We may, however, give additional consideration to how species-specific management initiatives will impact biodiversity considerations.

SUSTAINABILITY OF FISH AND WILDLIFE RESOURCES. The Fish and Wildlife Department is charged with maintaining the long-term sustainability of fish and wildlife resources and the plant communities that make up Vermont's many and varied habitats. Some of these resources are directly utilized by anglers and hunters while others may only be viewed or admired by the public at large. Fish and wildlife habitat protection, enhancement, and restoration — although often time-consuming and expensive work — are crucial activities in reaching and maintaining sustainable wildlife populations.

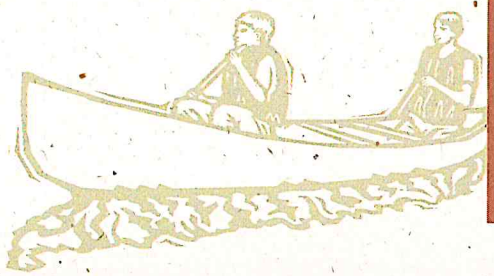
If fish and wildlife resources are to be sustained, allocation or use of these resources must be made in a manner that will meet the many different public demands for educational and recreational opportunities, including both "consumptive" (hunting, fishing, trapping) and "nonconsumptive" (viewing wildlife, outdoor education) uses. When problems arise due to user conflicts, the sustainability of fish and wildlife resources should be considered foremost. We must, for example, be cautious and take into account the impacts that can occur to other natural resources when we propose changing how we manage one species.

To accomplish this, there is an on-going need for the Fish and Wildlife Department to monitor the natural environment so we can take actions necessary at the appropriate times to sustain resources (*Figure 2*). Fishing and hunting regulations, visitor use and access restrictions on public lands, and permit processes, all with the intent of controlling human activity on natural habitats, are management tools which, if used properly, ensure that wildlife resources are sustained for the benefit of future generations.

WHAT IS WILDLIFE WORTH? When we set aside a wetland for migratory birds rather than drain it for a new development or when we protect a stand of high-country beech trees for black bears — is the effort truly worthwhile? It's difficult to put a dollar value on such decisions, but consider some of the following.

Vermonters, more than the residents in any of the other lower 47 states, say they enjoy wildlife. A 1991 national survey by the U.S. Fish & Wildlife Service found 82 percent of us pursuing some form of wildlife-associated recreation, such as hunting, fishing, bird watching, photographing wildlife, or feeding birds. The only state with a higher participation rate was Alaska.

UVM resource economist Dr. Alphonse Gilbert discovered in a 1990 survey that hunting generates an economic impact of $112 million each year in the state. He found in the same survey that fishing generates an economic impact of $120 million annually. Those expenditures include gas, camping, hotels and motels, and meals, as well as equipment and much more.



As for other wildlife-related activities, we know Vermonters spend more than $50 million annually enjoying wildlife when they buy bird seed, binoculars, film, and wildlife-related books and tapes.

Beyond the hard numbers, what's it worth to see a doe nursing her fawn at a field's edge? Or to hear spring peepers ushering in those first mild spring nights or the soulful call of the common loon while camping at lake's edge? Nobody can place a dollar value on these pleasures.

Protection of a wetland, a deer wintering area, or stream habitat that supports naturally reproducing trout is clearly worth- while in the long-run. We are reaping recreational and economic benefits now, and future generations of Vermonters will be able to do so, too.

CHALLENGES

A new national initiative, "Teaming With Wildlife," if approved by Congress, would generate a new revenue source not only for research and inventories of Vermont's biodiversity, but also for education and recreation. The revenue source would be a surcharge on the manufacture of selected outdoor recreation products such as binoculars, bird seed, and sleeping bags. For the average Vermonter who participates in wildlife recreation, the additional cost on equipment would be less than $5 per year. Yet, turtles, butterflies, and songbirds would benefit from an infusion of almost $2 million dollars into Vermont alone annually. The Agency of Natural Resources is supporting this initiative and can be contacted for more information.

program indicators

THE TOTAL AGENCY BUDGET FOR fiscal year 1996 is $43,618,700, of which $8,397,000 is from general state taxes (Figure 1). The Agency's allotment represents 1.2 percent of the total state General Fund, or close to $14.50 per Vermonter.

In fiscal year 1995, the Agency helped stimulate the economy through environmental stewardship by providing almost $24 million in federal and state grants, and more than $6 million in zero-interest loans to Vermont municipalities, small businesses, and organizations.

Above: Adamant Pond.

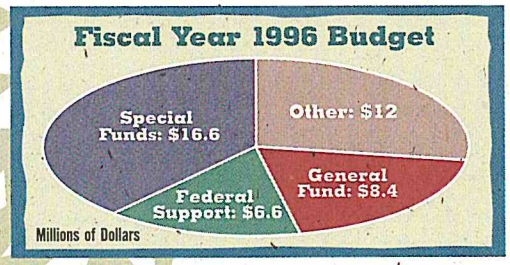


FIGURE 1: *The Agency's allotment represents 1.2 percent of the total state General Fund*

These funds were used to clean up and take care of Vermont's environment, with more than $23 million directed toward upgrading drinking water and wastewater treatment plants, extending distribution lines, and separating storm drain lines from sewer lines. These projects will result in cleaner surface waters and safer drinking water.

Eleven small petroleum retailers and four towns received loans totalling $425,000 to remove aging underground petroleum storage tanks and replace them with double-walled tanks. Businesses and individuals received $5.2 million to clean up releases from underground tanks. The Agency provided 27 towns almost $4 million to help close unlined landfills which might have contaminated groundwater. The Agency provided an additional $776,000 to site, design, and permit safer lined landfills and other solid waste facilities, and $865,000 to construct facilities and purchase equipment to manage unregulated hazardous waste, sludge, solid waste, and recyclables.

Various organizations received approximately $510,000 to study and clean up nonpoint source pollution coming from urban and agricultural sources. Vermonters used funds provided by the Agency to control nuisance plants in 11 lakes, improve public recreational facilities in seven towns, and develop and implement 28 community forestry programs.

INFORMATION ACTIVITIES. The Agency offers numerous programs and materials to help Vermonters make more informed choices about how their daily activities affect the environment.

In 1995, 934 young people learned about wildlife ecology at the Green Mountain Conservation Camps, run by the Fish and Wildlife Department, in Castleton and Woodbury. The Department trained 350 educators to use *Project Wild* and *Aquatic Wild* activity guides. Libraries throughout Vermont showed slides about backyard wildlife, bats, bluebirds, and endangered species provided by the Department's Nongame and Natural Heritage Program as part of the summer's "Go Wild, Read" initiative. The Department also filled 2,316 requests for curriculum packets and other educational materials.

The Department of Forests, Parks and Recreation provided training for 165 educators in the use of the *Project Learning Tree* activity guide. The Department's park naturalists offered daily activities in 10 state parks throughout the 1995 season, and provided free programs to 1,200 students and 230 adults in state parks during the fall 1995 school session.

The Water Quality Division of the Department of Environmental Conservation trained 80 educators in the use of *Project WET*, a new water education program for students in kindergarten through high school. The Lakes and Ponds Section offered more than 200 watershed protection workshops, presentations, and water quality monitoring training sessions to people interested in lake protection issues. The Department's Recycling and Resource Conservation Section responded to 1,127 information requests on the Recycling Hotline. The Section ran almost 850 radio

and TV announcements and print advertisements about reducing the use of household hazardous products, and gave more than 50 presentations, workshops, and media interviews about pollution prevention and resource conservation. The State Geologist's Office filled approximately 600 information requests about Vermont's geology.

PERMITS. The Agency's Department of Environmental Conservation administers 37 permit programs. In 1994, the Department processed 7,393 permits, with 94 percent of those meeting the performance standard for timely issuance, up from 90 percent the previous year. The Department began issuing the *Environmental Notice Bulletin* in 1995, which is a computerized system to track the status of pending projects requiring environmental permits. Citizens may access the Bulletin and many other Agency documents on The Agency's World Wide Web Home Page (http://www.state.vt.us/anr).

ENFORCEMENT. The Enforcement Division of the Department of Environmental Conservation has added three new attorneys since late 1994, strengthening its ability to enforce Vermont's environmental statutes. In the annual report period ending October 31, 1994, the Department received 1,619 complaints from Vermonters, including illegal backyard burning, wetland filling or draining, trash and hazardous waste dumping, and Act 250 violations. Of these, 1,101 complaints (68 percent) were closed (up from 61 percent the previous year), and 518 (32 percent) were pending at the end of the report period. Forty-eight percent of the closed complaints resulted in voluntary corrective actions; for 47 percent of the complaints, no violation was found; and an enforcement action was taken for 5 percent of the complaints.

FISH AND WILDLIFE. A majority of Vermonters (69 percent) rated the Department of Fish and Wildlife's performance as "excellent" or "good" in conserving and enhancing our state's fish and wildlife, according to a random survey of 1,000 people in 1995. The survey also discovered that 79 percent of the Vermont public supports a lottery game featuring a fish and wildlife theme to help fund Department work. The Department is searching for non-traditional funding to augment declining revenues from hunting and fishing license sales. Support for the Nongame Wildlife Fund — created to protect and preserve Vermont's rare, threatened, and endangered species — remains at about $120,000 annually, with most of that money coming from voluntary donations through tax returns.

STATE FORESTS AND PARKS. The Department of Forests, Parks and Recreation manages 47 developed state parks and forest recreation areas and 38 state forests. These areas are maintained for multiple uses, including forest management, wildlife habitat, and recreation. Annual surveys of park visitors reveal a high degree of satisfaction with the parks. Operation and maintenance of the state park system is funded entirely by park fees and receipts from ski area leases on state land. The park system has a significant impact on Vermont's economy; a 1993 study conducted by the University of Vermont estimated that park visitors spent nearly $60 million on goods and services related to their park visits annually.

A NOTE FROM THE SECRETARY

Two years ago, the Agency of Natural Resources began a comprehensive management planning process designed to be more responsive to all Vermonters and to allow us to plan for change. The benefits of this process are paying off as state government begins to downsize.

The Agency has set some strategic priorities for its three departments, which include:

- *improved customer service*
- *providing more information about the environment*
- *increased emphasis on sustainable use of Vermont's natural resources*
- *increased emphasis on maintaining healthy aquatic ecosystems*

As part of our planning process, the Agency conducted a telephone poll of 500 Vermonters in October, 1995. The results point to several areas where our performance is good, and several areas for improvement. The poll was based on a list of 25 "outcomes" that summarize our work at the Agency.

Those polled rated drinkable water, clean surface waters, and clean earth materials as most important to them. However, even the lowest-rated outcomes were judged important on a five-level scale ranging from "extremely important" to "not important at all."

The Agency received its highest performance rating for the outcomes related to drinkable water, minimal potential exposure to diseased and dangerous animals, and public safety support.

We at the Agency will use the poll results to revise our strategic priorities for the next two years. These priorities will help us decide where to do more and where to do less as the number of employees and available funds shrink. We will cut a total of 40 positions (7 percent of the workforce) in four steps by July, 1997. Federal funds, which accounted for 15 percent of our fiscal 1995 budget, will likely decline in the near future. Federal block grants to states may give us an opportunity to improve the way we do business. As with the Environmental Notice Bulletin, increased automation through the use of computers will help us become more efficient and deliver some services faster. The Agency is developing new ways to measure its effectiveness and provide accountability for its actions. Ideas and suggestions are always welcome. Please write me at the Agency of Natural Resources, Center Building, 103 S. Main Street, Waterbury, Vt., 05671-0301.

—Barbara Ripley, Secretary

RESOURCES

The following publications are available by contacting the Secretary's Office, Center Building, 103 South Main Street, Waterbury, Vt., 05671- 0301, by calling 802-241-3512, or by e-mailing a request to documents@anrimsgis.anr. state.vt.us.

A Field Guide to the Agency of Natural Resources. A complete description of ANR programs, and a listing of Agency personnel and phone numbers.

Bibliography of the Agency of Natural Resources. A list of available publications, videotapes and slide shows.

Vermont Educators' Guide 1995-96. A list of state, federal, and nationally recognized education programs and materials about natural resources and the environment.

Many Agency publications are available at the Agency of Natural Resources' Home Page on the World Wide Web: **http://www.state.vt.us/anr**

The numbers for the Agency's three departments are:

Fish & Wildlife	802-241-3700
Forests, Parks & Recreation	802-241-3670
Environmental Conservation	802-241-3808

The following toll-free numbers are also available:

The Lake Champlain Hotline	800-468-5227
Recycling Hotline	800-932-7100
Pine Street Barge Canal Hotline	800-585-7292
Pollution Prevention Hotline	800-974-9559
Hazardous Waste Emergency Hotline	800-641-5005
Radioactive Waste and Geology Information Line	800-649-3844

THE VERMONT AGENCY OF NATURAL RESOURCES

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