PART II: BACKGROUND

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Chapter One: Vermont's Surface Water Resources

Vermont has approximately 7,100[1] miles of rivers and streams, 230,790 acres of lakes, reservoirs and ponds and 300,000 acres of freshwater wetlands. The surface area of lakes, ponds and wetlands represent approximately 828 square miles of water or about 8.6% of the state's total 9,609 square miles. Vermont's border waters include the Connecticut River on the east (border with New Hampshire), Lake Memphremagog on the north (partial border with the Province of Quebec) and the Poultney River and Lake Champlain on the west (border with New York). There are seventeen major river basins in Vermont, which drain to one of four regional drainages: Lake Champlain, the Connecticut River, Lake Memphremagog, or the Hudson River.

Table II.1.1. Atlas.

State population	608,827 (2000 Census)
State population change (1990 - 2000)	8.2 % increase
State surface area	9,609 square miles
State population density	63.36 persons/sq mi
Number of water basins	17
Miles of perennial rivers & streams[2]	7,099
Border miles of shared rivers/streams (subset)[3]	262
Number of lakes, reservoirs & ponds (at least 20 acres)	287
Number of lakes, reservoirs & ponds (at least 5 acres but less than 20 acres)	317
Number of significant, lakes, reservoirs & ponds (less than 5 acres)	206
Acres of lakes, reservoirs & ponds[4]	230,789
Acres of freshwater wetlands[5]	300,000

[1] Source of figure is EPA's Total Waters Database. Past 305(b) reports have relied upon Don Webster's 1962 list of Vermont waters. However, a number of omissions have been discovered in this early listing. Many small streams had been overlooked and the lengths of some rivers and streams had been significantly underestimated.

[2] Includes the Connecticut River.

[3] Connecticut River - 238 miles; Poultney River - 24 miles.

[4] Figure includes the Vermont portion of Lake Champlain, some private waters and some waters less than 5 acres in size. This figure also accounts for two large CT River impoundments, Moore and Comerford Reservoirs, which are 1,255 and 777 acres in size, respectively. These were not previously tracked in Vermont's Lake Inventory Database.

[5] Figure does not include wetlands found on agricultural lands which are actively used for agricultural purposes.

There are no coastal waters, estuaries or tidal wetlands in Vermont. However, due to the size of Lake Champlain (approximately 120 miles long and 12 miles wide at its widest point), the lake is considered an inland sea by residents of Vermont, New York and Quebec. The Atlantic Ocean and Inland Waterway are accessible from the Lake via the New York Barge Canal to the south and the Richelieu and St. Lawrence Rivers to the north through Canada.

Total Waters/Mapping

Until Vermont completes its GIS mapping of waterbodies, the 305b Report will use EPA's 1995 estimate of total river and stream miles. Using Clean Water Act Section 604b Pass Through funding, the 12 Regional Planning Commissions (RPC) of Vermont have corrected/digitized many of Vermont's waterbodies on GIS maps by waterbody identification number. The Vermont Center of Geographic Information has received some funding to continue the correction/digitizing of waterbodies on a statewide basis. When the waterbodies have all been mapped, Vermont will then be able to determine the total mileage of its rivers and streams. More information about these efforts is available in Part III, Chapter 2.

Chapter Two: Water Pollution Control Program

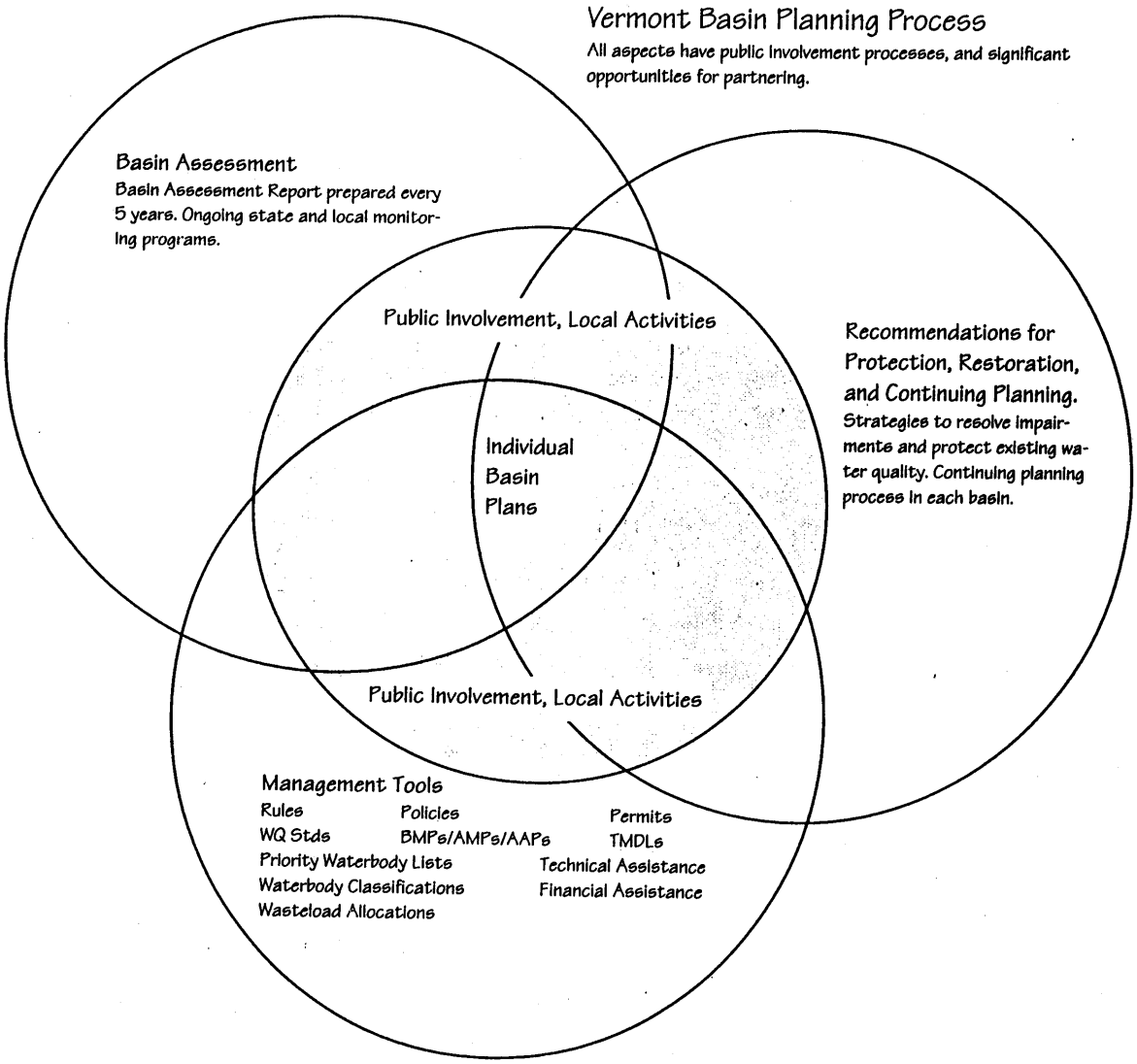
Watershed Approach

The General Assembly and the Vermont Water Resources Board have revised the deadline for the Agency of Natural Resources to complete new watershed plans to January 2006 (refer to Title 10 VSA Section 1253(d); Vermont Water Quality Standards - effective July 2000). With the assistance of a public and statewide "Framework Committee," VDEC is refining a "Guidelines for Watershed Planning." (See draft Guidelines and a description of the ongoing planning in the three planning basins in Appendix C).

The Department has begun to implement a new Watershed Initiative. Three Watershed Coordinators are conducting Watershed Planning in the White, Lamoille and Poultney/Mettowee River watersheds. One Coordinator is located in Rutland, a second will be working in Essex Junction and a third is based in Waterbury. The Coordinators provide individual assistance to lake, river and watershed groups, personally work with landowners to correct water quality problems, help form Watershed Councils/Teams and determine the watershed management needs of communities, among other responsibilities.

It is hoped that this approach, pieced together from the methods of other states and public ideas, will help the public to understand the Watershed Planning Process and how they can work with the Watershed Coordinators to motivate state and local interests, including towns, local commissions and watershed groups to improve water quality. A manageable number of watershed protection and restoration goals will be identified. Specific outputs of the approach will include, among others, seventeen watershed assessments with basin plans revised and adopted every five years and implementation of countless restoration actions related to the highest priority issues in each watershed.

The watershed planning process is an inclusive public process that takes into account current and past assessment, planning, and implementation activities at the state and local levels. Assessments are followed by the basin plans that will summarize current and past (within five years) water pollution or water quality management activities. This rotational planning process will also identify topics or areas of special importance in the basin, identify available management tools to address those topics, and make specific recommendations on how to address key topics, including recommendations for continuing community-based planning or implementation action. Each basin plan updates previous basin plans. Each basin is unique in its problems and opportunities. The following diagram illustrates the concept that Assessment, Planning and Implementation are constantly occurring at many different levels from the activities of landowners to municipal, state and federal levels and evolving with public participation. The Watershed Planning document looks at all of these activities including the condition of the waters in a given point in time and makes conclusions and recommendations for the future.



Although the myriad of assessment, planning and management activities within a basin are too numerous to capture in a single document, a basin plan can, with the help of an interested public, isolate specific high priority issues and elevate them for attention during and after the planning process.

Water Quality Standards

The Water Quality Standards are the foundation for the state's water pollution control and water quality protection efforts. The Standards provide the specific criteria and policies for the management and protection of Vermont's surface waters. The classification of waters as Class A, Class B or Class B with Waste Management Zone (WMZ) are the management goals to be attained, if not already attained. The classification also specifies the designated water uses for each class. The existing Water Quality Standards became effective July 2, 2000 and were used as

a basis for this report.

The Water Quality Standards call for the protection of existing uses and the maintenance of water quality necessary to protect those existing uses. Existing water uses are those uses which have actually occurred on or after November 28, 1975 in or on a waterbody whether or not the uses are included in the standard for classification of the particular waterbody. Determinations of what constitutes an existing water use on a particular waterbody shall be made on a case-by-case basis by the Secretary. The Water Quality Standards include detailed narrative criteria for the Water Quality Management Types (B1, B2 and B3) for Class B waters. These revised Standards also include greater detail concerning regulation of stream flows and inclusion of specific criteria for minimum conservation flows.

Surface Water Classification and Typing

Introduction to Classification and Typing

All surface waters in Vermont are presently classified as either Class A or Class B. Class B waters comprise approximately 95% of all waters in the State. They are managed to achieve and maintain a high level of quality that is compatible with designated uses. The July 2, 2000 Water Quality Standards recognize two categories of Class A waters. Waters designated as Class A(1) are Ecological Waters, which are managed to maintain waters in an essentially natural condition. Waters designated as Class A(2) are Public Water Supplies and allow slightly greater change from the reference condition for habitat, aquatic macro-invertebrates and fish assemblages than A(1). This is due to the fluctuations found in water supply reservoirs and streams. The new Standards contain a requirement that calls for all Class B waters to be eventually designated either Water Management Type 1, Type 2 or Type 3, depending upon the goals of the community for protection and management. The Type must recognizes the attainable of uses at the level of water quality protection associated with the Type and the level already afforded under the anti-degradation policy described in the Vermont Water Quality Standards.

Class A Re-classifications

The 1986 "Pristine Streams Act" created the opportunity for any waterbody supporting habitat that is ecologically significant and has water quality that meets at least Class B standards to be re-classified to Class A. A re-classification is a rule making procedure before the Water Resources Board where a public interest determination must be made pursuant to Vermont's Water Pollution Control Statute, Title 10 VSA Section1253. No streams have been reclassified to Class A since the 1998 305b Report.

Outstanding Resource Waters

An overlay of both Class A and Class B waters is the Outstanding Resource Water (ORW). ORWs are waters of the State designated by the Water Resources Board as having exceptional natural, recreational, cultural or scenic values. To gain an ORW designation, the petitioners must, in a contested case hearing before the Board, provide evidence and testimony that the waters in question have exceptional natural, cultural, scenic, or recreational values.

Reporting Note: The Vermont Natural Resources Council filed a petition with the Vermont Water Resources

Board during the 305b reporting period to re-classify the Nulhegan River and its tributaries to Class A and a second petition for designation as an Outstanding Resource Water. Both petitions were withdrawn due to the recognized need for more water quality and aquatic biota data. The Department conducted a water quality assessment for the Nulhegan River during 2000. The reader is referred to Appendix D for a summary of the Nulhegan River assessment.

Table II.2.1. Summary of Classified Uses & Values (Existing).

Classified Uses & Values	Total Size Classified for Use	
	Rivers (miles)	Lakes (acres)
Class A: ● water quality uniformly excellent ● enjoyment of water in its natural condition ● contact recreation when compatible ● public water supply with disinfection ● high quality waters with significant ecological value	164 approximately (does not include mileage for all waters above 2500' elevation)	1,736
Class B: ● water consistently exhibits good aesthetic value ● swimming & recreation ● public water supply with filtration & disinfection ● high quality habitat for aquatic biota, fish and wildlife ● irrigation and other agricultural uses	6,935	229,053
TOTALS	**7,099**	**230,789**

Point Source Control Program

Vermont administers a well-planned and comprehensive direct discharge water pollution control program, consisting of planning advances, construction grants and loans, permitting and compliance monitoring. With the construction of the state's last originally identified municipal waste water treatment facility (WWTF) and completion of the upgrades from primary to secondary, the program has continued to place emphasis on refurbishment of existing WWTFs, the completion of phosphorus reduction upgrades (refer to Table II.2.2), advanced waste treatment, correction of combined sewer overflows (CSO) (see Table II.2.3), control of toxics, pollution prevention activities and facility enlargements.

During the 2000 - 2001 reporting period, construction commenced on CSO corrections, sewer line rehabilitations and extensions, sewer system improvements, wastewater treatment plant upgrades, and phosphorus reductions. These various projects, located in three of the four major drainages within Vermont, are being funded by state, federal and local resources and total approximately $41 million (refer to Table II.2.4).

The three phosphorus reduction projects in the Vermont portion of the Lake Memphremagog drainage basin have been completed. Of the 31 facilities with planned phosphorus reduction projects in the Vermont portion of the Lake Champlain basin, 28 have been or are close to being completed.

Of the 32 planned CSO correction projects, 20 have been completed, 5 are underway and 7 are pending. It is interesting to note that after an initial assessment/survey, it was determined there was no need for CSO construction in Bennington, St. Albans City, Winooski and Woodstock.

Table II.2.2. Status of Phosphorus Removal/Reduction Projects.

Municipality	Construction Status	Comments
***** LAKE CHAMPLAIN DRAINAGE *****		
Barre City	completed	
Brandon	completed	work started in 2000
Burlington (north)	completed	
Burlington (main)	completed	
Burlington (east)	completed	
Cabot	completion by 10/01	work started in 2000
Castleton	completed	
Enosburg Falls (Phase 1 - chem)	completed	
Enosburg (Phase 2 - bio)	completion by 12/01	work started in 2001
Essex Junction	completed	
Fair Haven	completion by 12/01	work started in 2000
Hinesburg	completed	
Johnson	completed	
Middlebury	completion in 2001	
Milton	construction in 2002	may start later
Montpelier (Phase 1)	completed in 2000	
Montpelier (Phase 2)	completion in 2001	work started in 2000
Morrisville	completed	
Northfield	construction in 2002	may start later
Poultney	started in 2001	currently underway
Richmond	construction in 2002	may start later
Rutland City	completed	
South Burlington (Bartlett Bay)	completed	

Municipality	Construction Status	Comments
South Burlington (Airport Parkway)	completed	
Shelburne (Plant #1)	completed	
Shelburne (Plant #2)	completed	
St. Albans City & NW Corrections	completed	
Stowe	completed	
Swanton	completed	
Vergennes	completed	
West Rutland	completed in 2000	
Winooski	completed	
***** LAKE MEMPHREMAGOG DRAINAGE *****		
Barton Village	completed	
Newport City	completed	
Orleans	completed	

Table II.2.3. Construction Status - Combined Sewer Overflow (CSO) Projects.

Municipality	Construction Status	Comments
****** LAKE CHAMPLAIN DRAINAGE ******		
Brandon	completed	
Burlington	completed	
Enosburg Falls	completed	
Hardwick	completed	
Middlebury	completed	
Montpelier (Phase 1)	completed	
Montpelier (Phase 2)	started fall 1999	partially done; balance by 2003
Northfield	completed	
Poultney	underway	infiltration/inflow versus CSO
Richford	underway by Village	
Rutland City (Phase 1)	completed	
Rutland City (Phase 2A)	pending	monitoring Phase 1
Rutland City (Phase 2B)	pending	monitoring Phase 1
Swanton	completed	
Vergennes	completed	project effectiveness study underway in 2002
****** LAKE MEMPHREMAGOG DRAINAGE ******		
Barton	completed	project completed but overflow events still occur; evaluation study underway
Newport City	completed	
Orleans	completed	
****** CONNECTICUT RIVER DRAINAGE ******		
Bellows Falls	completed	
Hartford	completed	project completed but Order issued to abate remaining overflows
Ludlow	completed	done without state assistance
Lunenburg	completed	done without state assistance
Lyndon	completed	
Randolph	completed	project completed but overflow events still occur; evaluation study underway
Springfield (Phase 1)	started spring 2000	partially done; balance by 2003

Municipality	Construction Status	Comments
Springfield (Phase 2)	initiate 2003	completion by 2005
St. Johnsbury (Phase 1)	underway by town	work on-going since 1984; consists of storm water separation affecting 7 of 20 sewer overflow locations
St. Johnsbury (Phase 2)	initiate spring 2003	
St. Johnsbury (Phase 3A)	initiate spring 2002	
St. Johnsbury (Phase 3B)	initiate spring 2004	
St. Johnsbury (Phase 4)	initiate spring 2005	
Wilmington	completed	done without state assistance; done during WWTF upgrade
Windsor	completed	infiltration/inflow problems with no CSO

Table II.2.4. Municipal Pollution Control Project Starts.
(January 1, 2000 to December 31, 2001)

Community	Description	Est. Project Cost
****** LAKE CHAMPLAIN DRAINAGE ******		
Barre City	WWTF disinfection improvements to increase plant capacity from 3.4 MGD to 4.0 MGD	$ 800,000
Brandon	plant upgrade for phosphorus removal	553,000
Cabot	new WWTF & sewage collection system	4,559,000
Enosburg Falls Village	Phase 2 phosphorus removal improvements - biological removal of phosphorus	410,000
Fair Haven	plant upgrade for phosphorus removal - contract 1	528,000
	sewer rehab to correct I/I & overflow problems - contract 2	215,000
	sewer I/I corrections - pump station improvements - contract 3	350,000
Montpelier	Phase 2 CSO - contract 6	1,773,000
	Phase 2 CSO - contract 7	1,630,000
Poultney	WWTF upgrade for phosphorus removal & to eliminate plant bypass	3,886,000
Shelburne	sewer extension to Shelburne Heights	815,000
Shoreham	new WWTF & sewage collection system	2,458,000
Stowe	WWTF upgrade & enlargement, increase capacity from 0.25 MGD to 1.0 MGD	12,040,000
	sewer extension to Notchbrook Rd - contract 4	1,800,000
	sewer extension to Stowe Mtn Resort - contract 5	1,450,000
Vergennes	WWTF & pump station improvements to correct I/I & plant overflow problems	2,500,000
****** LAKE MEMPHREMAGOG DRAINAGE ******		
Derby Center Village	sewer extension to MHP - new pump station & force main	250,000
Newport City	upgrade Indianhead PS & install new force main	723,486
****** CONNECTICUT RIVER DRAINAGE ******		
Springfield	Phase 1 CSO - contract 1 - PS rehab	700,000
	Phase 1 CSO - contract 2 - sewer separation	1,196,000
	Phase 1 CSO - contract 3	2,048,000
Windsor	rehab of Weston Heights WWTF & sewers	850,000
TOTAL COST		**$41,534,986**

Chapter Three: Nonpoint Source (NPS) Control Program

Pollution from nonpoint sources continues to be the major source of water use impairment to Vermont surface and ground water resources. It is estimated that close to 90% of the miles and acres of the state's impaired surface waterbodies are the result of NPS.

As one of the first states in the nation to have an EPA-approved NPS Management Program (March 1989), Vermont has been able to effectively target areas, design work plans, compete for and capture funding and implement NPS projects directed at restoring and protecting water uses and values. In the twelve years of available Section 319 NPS implementation funding (1990-2001), Vermont has received about $11 million to implement a variety of activities.

In response to the release of the President's Clean Water Action Plan (February 1998), the State of Vermont and the EPA worked together to review the NPS Management Program document of 1988 as well as revise and implement enhanced State NPS management programs that incorporate the nine essential and key elements of a state program defined by US EPA. Those states which incorporate all nine key elements in their enhanced programs will receive financial incentives - such as being eligible to receive additional Section 319 funds - beginning in federal fiscal year 2000. The Enhanced Vermont NPS Management Program was approved by the regional office of US EPA (October 1999).

Specific details regarding NPS program and project activities are available from the Department. Readers of this 305b Report can refer to previous 305b reports for a listing of earlier 319-assisted project titles by funding year. Vermont will continue to pursue and apply Section 319 NPS funding in targeted areas that are likely to result in the successful implementation of Best Management Practices (BMP) and programs

Section 319 Special Projects
The following describes seven Section 319 Special Projects selected as examples of the types of projects taking place under this grant program.

1) Lake Champlain Basin Agricultural Watersheds Section 319 National Monitoring Program Project (1994 - 2001)
EPA supported this water quality monitoring and evaluation project located in the Missisquoi River watershed in Franklin County since 1994. Aside from visible degradation of the watershed, the receiving waters have suffered from increased bacteria and total phosphorus levels.

The seven year project, completed in June 2001, was designed to measure the water quality effectiveness of certain agricultural management practices, including: livestock exclusion fencing, protected livestock stream crossings, establishment of riparian buffers, and bio-engineering streambank erosion controls. Monitoring efforts of the project focused on water quality and aquatic biota changes in two small treatment watersheds compared to those in a control, untreated watershed.

The project successfully documented reductions in phosphorus, nitrogen, suspended solids and indicator bacteria in response to applied treatments. Treatments had a positive effect on stream biota (macroinvertebrates). Treatment effectiveness was reduced under unusual hydrologic events. In addition, the project was able to show the extent to which water quality impacts arising out of a single, acute problem can overwhelm the ability to detect response to land treatment.

2) The Vermont Better Backroads Program
This special project continued as a partnership between DEC and several outside organizations. A Small Grants Program was initiated during the summer of 1997 and continues to be administered by grant through the Northern Vermont Resource Conservation and Development Council.

The 1999 Vermont Legislature, through the House Transportation Committee, provided additional funding to the Small Grants Program which doubled the available funding for this effort. The Small Grants Program is currently emphasizing road inventory and capital budgeting projects as a means for towns to more effectively and systematically address road-related erosion. During the reporting period, 39 Better Backroads projects were funded (21 projects in 2000, 18 projects in 2001), at a combined cost of $136,000.

3) Demonstration of alternative manure management technology
The purpose of this special project is to demonstrate, on a farm within the Lake Champlain basin, the performance and adaptability of an electric reactor-type technology for treating dairy manure in northern New England conditions. Specifically, the project will evaluate how the technology may perform in a cold climate and its potential for "fitting into" current dairy manure management. The project involves a close and working partnership between the cooperating farm operator located in East Montpelier, the state and federal departments of Agriculture, the University of Vermont and the Winooski Natural Resources Conservation District.

4) Connecticut River sustainable riverbanks
One purpose of this special project affecting the upper reaches of the Connecticut River - a designated American Heritage River - and carried out by the Connecticut River Joint Commissions, was to establish riverbank stabilization priorities from previous riverbank erosion surveys and to demonstrate assistance with the stabilization of the highest priority sites. Of the 27 problem sites inventoried in the upper reaches bordering Vermont and New Hampshire, 3 sites were selected and given top priority for restoration. Two of the three priority sites are located on the Vermont shoreline.

The second project purpose, carried out by the Connecticut River Watershed Council, was to manage and coordinate the inventory of erosion problems, riparian habitat and different land uses along the lower portions of the Connecticut River in Massachusetts and Connecticut. This effort identified 173 problem sites (99 in Massachusetts and 74 in Connecticut).

5) Middlebury River water quality improvement
The purposes of this noteworthy project were to further define the source(s) contributing to unacceptably high bacteria levels in the lower reaches of the river and to generate local interest

in selecting and carrying out preferred improvement actions. A locally-based group of concerned citizens organized by the Otter Creek Natural Resources Conservation District spearheaded the project. Not only did the project result in greater environmental awareness of the problem and the development of an improvement plan, the project also resulted in the formation of the group now known as the Middlebury River Watershed Partnership.

6) Restorative & protective actions for a tributary to the West River
In response to a 1998 stream assessment survey, the Bonnyvale Environmental Education Center (BEEC) was awarded 319 funds to select, target and implement certain measures on priority streambanks and riparian areas in need of treatment. Following selection of three sites and the planned conservation measures, BEEC organized an outreach and education effort including recruitment of volunteers. The project provided an outdoor hands-on lab for students, volunteers and landowners. The project also demonstrated the power of partnerships by raising awareness of erosion and control methods.

7) Youth-based watershed restoration
The purpose of this project is two-fold: to address NPS problems and to provide meaningful short-term employment to high school and college-aged youth. Working in a supervised setting under the Vermont Youth Conservation Corps, participants are provided on-the-job training along with the opportunity to broaden their base of conservation consciousness. Corps members are assigned various in-stream, streambank and riparian restoration projects. Such youth-based efforts and activities, assisted by Section 319 funding, have been underway for several years. "Watershed crews" have been situated in Chittenden County, Franklin County, Caledonia County and Washington County. Recently, "roving crews" have been added to the program which provides further NPS pollution control capabilities.

Section 604b
Use of Clean Water Act Section 604b funds by the Department is directed at the inventory, evaluation, strategic planning and management of water resources within the state. Work under the 604b program during the reporting period has included the award of pass through grants to the 12 Regional Planning Commissions to determine the nature, extent and causes of point and NPS pollution problems and to develop plans to resolve those problems. Appendix E contains an updated inventory of pass through activities undertaken by each planning commission.

Section 104b3
The following project is an example of work being performed under this Partnership Program.

Urban Stormwater Management
This project involves the implementation of watershed management and watershed protection activities in a number of Chittenden County watersheds characterized as impaired by urban stormwater runoff. This project has supported the following activities: creation of a municipal-state-utility partnership to design and construct an extended detention wetland for a significant nonpoint source discharge to Shelburne Bay, mapping assistance to South Burlington to develop an accurate inventory of their storm sewer infrastructure, research/development of appropriate erosion control ordinances and stormwater maintenance guidelines for area towns,

education/outreach on riparian buffer zones for the Malletts Bay watershed, and coordination of regional discussions on stormwater management and watershed management.

Public information, technical assistance and both volunteer and contractual (Vermont Youth Conservation Corps) based watershed restoration activities have been carried out in targeted watersheds. Also, project activities have included: coordination of drinking water source protection activities with the Champlain Water District in the Shelburne Bay watershed (LaPlatte-Potash-Monroe-McCabes-Bartlett subwatersheds); participation in urban long term chemical and biological monitoring; investigation of water quality violations; research on urban stream channel morphology, and development of municipal stormwater guidance.

Other Federal Sources

Agriculture
Agricultural NPS control efforts in the state continued with financial and technical assistance being provided through several programs within the US Department of Agriculture (USDA). Federal FY1999 and FY2000 Environmental Quality Incentive Program funds (about $1 million per year) were directed as cost sharing assistance to approximately 120 farms annually for best management practices to protect waterbodies from agricultural-related runoff.

Lake Champlain Steering Committee & Lake Champlain Basin Program (LCBP)
The LCBP, in their October 1996 publication, *"Opportunities for Action,"* set out three priorities for action to improve the water quality of Lake Champlain. These priorities (reducing phosphorus pollution, toxic pollution prvention, managing non-native nusiance aquatic species) were discussed in detail in the 1998 305b Report. In October 2001, the Basin Program issued the updated draft of *"Opportunities for Action"* in order to address emerging issues, use new scientific and technical information and reflect important progress over a five-year period. The following paragraphs are provided as brief updates to those three priority areas. The reader is encouraged to contact the Basin Program (phone: 1-800-468-LCBP or via internet: www.lcbp.org) to obtain further details on the Program and progress.

- *1) Reducing Phosphorus Pollution.* In their 1999 publication (entitled *Progress '99*), the LCBP reports on significant progress made in the arena of phosphorus reduction. As for point sources of phosphorus, treatment plant upgrades are progressing on-schedule in Vermont (as reported earlier in Part II, Chapter Two) and are proceeding at an accelerated schedule in New York, thanks to the New York State Bond Act. Regarding nonpoint soures of phosphorus, LCBP reports significant progress, both by large agricultural projects and via local small-scale implementation grants.

  In June 2000, the LCBP issued a report entitled *Preliminary Evaluation of Progress Toward Lake Champlain Phosphorus Reduction Goals*. The authors of the report found that Vermont, New York and Quebec will have reduced the input of phosphorus to the lake by about 39 metric tons per year by 2001, a figure exceeding the five-year interim reduction goal. Attainment of phosphorus loading reduction targets would not, however, be accomplished in all lake segments within the 20-year timeline, especially with regards to

phosphorus reduction from nonpoint sources. Further, accelerating the timeframe to meet nonpoint source reduction targets in fewer than 20 years would require not only new control techniques but also higher annual funding commitments.

- *2) Preventing Pollution from Toxic Substances.* Burlington Harbor, Outer Malletts Bay and New York's Cumberland Bay remain sites of active toxics monitoring and research. In Burlington Harbor, the University of Vermont has received funding through the Pine Street Barge Canal settlement to conduct advanced research into the nature of the site's contamination. Tetra Tech, an EPA consultant, also did work in Burlington Harbor, assessing the biological impacts of the sediment contamination. Toxic substances of concern in this area include lead, mercury, silver, zinc and polycyclic aromatic hydrocarbons (PAH). Toxic substances of concern in Outer Malletts Bay are arsenic, nickel and manganese. The State of New York has completed a three-year $35 million remediation project to remove the PCB contaminated soil from the Wilcox Dock area of Cumberland Bay where toxic substances of concern include PCBs, PAHs, copper and zinc.

- *3) Managing Nuisance Nonnative Aquatic Plants and Animals*. A comprehensive management plan was approved by the Aquatic Nuisance Species Task Force in May 2000. Two years of USF&WS funding to implement the Plan have been received to date. There exists evidence that the impact of sea-lamprey on the salmonid fishery has lessened dramatically due to the Federally funded sea-lamprey control program. Recent commitments to funding water chestnut management by the Department, the LCBP and the Army Corps of Engineers, plus substantial volunteer assistance continue to slow the northward expansion of this species in Lake Champlain. In fact and during 2001, significant progress was made in pushing water chestnut back down Lake Champlain. The northern 30 miles of infestation are now controllable by handpulling alone.

State Sources

Many nonpoint source planning and management activities funded primarily from state sources were discussed in the 1996 305b Report, to which the reader is referred. The following are those state-funded activities which had notable changes during the reporting period.

Agriculture

The Vermont Legislature required the Commissioner of the Vermont Department of Agriculture, Food and Markets (DAF&M) to develop by rule, implement and enforce two types of agricultural land use practices - accepted agricultural practices (AAPs) and best management practices (BMPs) - in order to reduce pollutants entering waters of the state.

The AAP Rules, which became effective in June 1995, are statewide restrictions designed to reduce agricultural nonpoint pollutant discharges through implementation of improved farming techniques. The AAPs are basic practices that all farm operators are expected to follow without financial assistance as a part of normal operations.

The DAF&M has developed BMP rules. BMPs are voluntary and are more effective than AAPs and will be site specific practices prescribed to correct a problem on a specific farm. BMPs were

adopted and became effective as rules in January 1996. The Vermont General Assembly authorized in 1995 the creation of a state financial assistance program to help agricultural operators in support of their voluntary construction of on-farm improvements designed to abate nonpoint source agricultural waste discharges. Since the program's inception approximately $3.8 million in State General Funds have been committed to help in the installation of 947 BMPs on some 449 farms. Approximately 89% of these BMPs are located on farms in drainages to Lake Champlain or Lake Memphremagog. Approximately 60% of the BMPs installed statewide under this funding assistance program have been for "waste utilization" (i.e. manure /waste storage) and "barnyard treatment" (i.e. barnyard paving).

During the reporting period, permitting rules affecting Large Farm Operations were adopted. The LFO Rules, administered by the Vermont Department of Agriculture, Food and Markets, regulate farms that exceed a certain number of animal units. Existing farms, new farms or farms undergoing expansion will be affected by these requirements that are intended to minimize various environmental impacts. To date, there are 13 LFOs permitted within Vermont.

Storm Water

Hydrologically Sensitive Waters (HSW)

Due to rapid development of certain watersheds in Vermont, and concern over in-stream gravel mining, VDEC formed a Steering Committee to provide direction to the Department for controlling or mitigating these activities that encourage flooding and destruction of a stream's biological community. The Committee commissioned the study of hydrologically sensitive streams to be performed in three phases.

Phase I was completed in January 1998 and resulted in a literature search. The result of this search, entitled *Final Report for Watershed Hydrology Protection and Flood Mitigation: Phase I*, found that, based on studies from locations outside Vermont, human-induced land use changes cause various hydrologic (stream flow) and geomorphic (stream shape, size and alignment) adjustments, including the size and timing of flood peaks. Increased surface runoff from land changes can produce changes in the morphology of a stream with sediment release that have a potential to impact aquatic biota.

Phase II was completed in September 1999 and consisted of two parts. The first part, *Watershed Hydrology Protection and Flood Mitigation Project, Phase II - Technical Analysis, Stream Geomorphic Assessment*, quantifies the relationship between stream geomorphology (stream ecology, hydrology, and stream channel shape and size) and various watershed land use activities for Vermont. This part of the study provided a foundation for possible future guidance governing storm water management and other land use strategies for flood hazard mitigation and stream resource protection. The second part and entitled *"Impact Assessment of Instream Management Practices on Channel Morphology,"* described the impact on channel form associated with gravel extraction practices and instream works for flood hazard mitigation.

Phases III and IV have involved the development of management tools to address the connections outlined in the Phase II documents. The Steering Committee and its consultant (The Center for Watershed Protection) considered development of a set of draft activities which would

result in recommended changes to the Vermont Stormwater Management Procedures, procedures that were adopted by VDEC in 1997. These draft activities were developed after consideration of watershed approaches, thresholds, the Vermont Water Quality Standards and its classification system, and legislation promulgated by the 2000 Vermont General Assembly. The five major elements of this work were:

a. Identify vehicles to change watershed development patterns so as to reduce Vermont flood losses and maintain and improve stream stability.
b. Develop acceptable development practices for managing stormwater hydrology and quality.
c. Develop handbook(s) of acceptable development practices and vehicle to reduce flood losses.
d. Evaluate current Vermont Stormwater Procedures.
e. Recommend changes to the Vermont Stormwater Management Procedures based on the results of all of the above.

The draft *Vermont Stormwater Management Manual* was prepared for public comment in June and August 2001. A finalized version of the manual was presented to VDEC in January 2002. For the enhanced management of stormwater within Vermont, the manual promotes the five step/element integrated stormwater management concept:

1. better site design practices and techniques;
2. unified design criteria for stormwater control requirements;
3. downstream assessment;
4. stormwater credits for site design; and,
5. selection of structural stormwater controls.

In February 2001, the Department released a report entitled *Management of Storm Water Runoff in Program and Policy Options."* This report, prepared for the Vermont General Assembly pursuant to Act 114, outlines the principal ingredients of an enhanced program to manage storm water. The enhanced program would rely on a new set of storm water control measures and could include use of municipally-based storm water utilities and certification/privatization of particular aspects of the storm water permitting process. The Department released in June 2001 a draft document entitled *"The Vermont Storm Water Management Manual"* in order to take comment on the set of control measures and criteria for adoption.

<u>Storm Water Phase I and Phase II Rules</u>

Phase I of EPA's storm water program was promulgated in 1990 under the Clean Water Act. Phase I addressed storm water runoff from municipalities larger than 100,000 population (as Vermont has no municipalities of this size, the state was exempt from this category of permit requirements). Another category of the Phase I Rules requires the issuance of permits for construction projects larger than 5 acres, as well as certain state and industrial projects. The Department has been issuing Stormwater General Permits for construction projects involving more than 5 acres since 1991, and is in the process of drafting General Permit Rules for state and industrial projects.

EPA has promulgated Storm Water Phase II Rules, which became effective in December1999. Storm Water Phase II Rules are intended to further reduce adverse impacts to water quality and

aquatic habitat by instituting the use of controls on the unregulated sources of storm water discharges that have the greatest likelihood of causing continued environmental degradation. The new rules apply to "urbanized areas" as delineated by the Bureau of the Census, which have separate storm sewer systems (MS4s). The new rules also apply to small construction activities that disturb 1-5 acres. Any other storm water discharges could also be regulated if it is determined that storm water controls are necessary.

The new Storm Water Phase II Rules will likely apply to Burlington, South Burlington, Essex Junction and Winooski. Other towns in Chittenden County and Rutland County may possibly come under these new rules but this will not be determined until the 2000 Census has been completed and population data further analyzed.

A regulated municipality under Phase II will be required to apply to the Department for NPDES permit coverage, most likely under a general rule rather than an individual permit, and to implement storm water discharge management controls (best management practices). Among other things, a regulated municipality must include the following six minimum storm water control measures:

1. public education and outreach;
2. public participation/involvement;
3. illicit discharge detection and elimination ;
4. construction site runoff control;
5. post-construction runoff control; and,
6. pollution prevention/good housekeeping.

River Restoration & Protection

The Vermont Agency of Natural Resources is embarking on several new watershed initiatives in response to statutory mandates, identified public need and a growing constituency for watershed protection and restoration. The Agency has become equipped and more proficient with the tools necessary to formulate, implement and sustain these initiatives effectively.

Initiatives started in the 1970's, such as municipal wastewater treatment, were successful because they looked at a specific problem and solved the problem of wastewater assimilation at the watershed scale. Today, the problems involve the often competing demands for the use and enjoyment of waters, polluted runoff, exotic species and the pervasive problem of stream instability. To be effective, basin planning and other initiatives (such as stormwater management, TMDLs, riparian buffers, hazard mapping, public education) must go beyond the enumeration of symptoms and use the analysis of physical, chemical, biological, and social data to explain the root problems of Vermont's troubled waters.

Watershed assessments in Vermont's 305b reporting to Congress have described erosion/ sedimentation and phosphorus as the largest categories of pollution in the state. These two concerns are related, in that eroding stream bank soils may very well be one of the largest sources of sediment and phosphorus entering our watersheds. The root causes for eroding stream bank soils are the removal of riparian vegetation, hydrologic modifications, flood plain and channel encroachments and the channel management practices that have been conducted to

address the symptoms of these original causes. These activities have caused stream instability at the watershed scale, wherein bank erosion at one location triggers further stream bed and bank erosion in both upstream and downstream directions.

As a result of intensive staff training in recent years, the Agency has begun to implement the principles and applied methods of fluvial geomorphology in stream alteration permits, river restoration, public hazard identification, and river education programs. Initial success with explaining complex stream problems and restoring stream reaches using a geomorphic approach presents an important opportunity for resource managers and watershed constituents. Fluvial geomorphology - a science which seeks to explain the physics of flowing water and sediment in different land forms - is an essential tool and organizing principal for community-based watershed protection and restoration. The field data derived through physical assessments conducted on streams following a rigorous geomorphic-based methodology can be supportive of many other state water resource initiatives and programs.

The geomorphic river assessment which the Department is currently organizing, promoting and making available for river restoration and protection is outlined on the following page. The Department is aware of current geomorphic assessment programs in the following areas:

Basin 1: Walloomsac River, Batten Kill
Basin 2: Poultney River
Basin 3: Lewis Creek, Middlebury River
Basin 6: Tyler Branch
Basin 7: Lamoille River and certain tributaries
Basin 8: Mad River, upper Winooski main stem
Basin 9: White River and certain tributaries
Basin 13: Mill Brook

Vermont Geomorphic River Assessment Outline

1. Objectives

Stream Condition - departure analysis comparing the existing condition to the reference condition.
Adjustment Process or physical change currently underway due to natural causes or human activity.
Sensitivity of the channel condition to change due to natural causes and/or human activity.

2. Approach

Phase I - remote sensing, existing data and windshield surveys.
Phase II - qualitative and rapid assessment field surveys.
Phase III - field survey assessments (quantitative).

3. Parameters

Watershed inputs - flow and sediment discharge
Valley setting - geography and geology
Stream and flood plain geomorphology
Watershed and riparian corridor land use and land cover
Instream channel modifications and their effects.
Flow modifiers and their effects.
Flood plain modifications and their effects.
Erodibility of bed and bank material.
Stream and riparian habitat characteristics.

4. Products

Data base and map products containing stability assessments of river reaches and segments.
A watershed problem solving tool for river corridor protection, management, restoration and education.

Readers of this report who are interested in further details regarding fluvial geomorphology as a framework for watershed protection, management and restoration are referred to Appendix I.

TMDL (Total Maximum Daily Load) Program

A TMDL is the calculation of the maximum amount of a pollutant that a waterbody can receive and still meet the water quality standards. A TMDL serves as a plan that identifies the pollutant reductions a waterbody needs to meet Vermont's Water Quality Standards and develops a means to implement those reductions.

Under Section 303d of the Clean Water Act, all states are required to develop lists of impaired waters. These impaired waters are lakes, ponds, rivers and streams that do not meet the water quality standards developed by each individual state. In Vermont, these waters are described on the state's List of Impaired Waters. The Clean Water Act requires that TMDLs be developed for impaired waters on the list and the list provides a schedule as to when the TMDLs will be completed. (Refer to Part I and Part III, Chapter 2 for further discussion on 303d and listing of impaired waters).

TMDL determinations are unique to each individual waterbody but the general process by which they are developed can be summarized in the following manner:

Problem Identification – the pollutant for which the TMDL is developed must first be identified. Examples might include sediment that impacts habitat for aquatic organisms, nutrients that cause excessive algal growth, or bacteria that creates an unsafe environment for swimming.

Identification of Target Values – this establishes water quality goals for the TMDL. These may be given directly in the Water Quality Standards or may need to be interpreted.

Source Assessment – all significant sources of the pollutant in question must be identified in the watershed. This often requires additional water quality monitoring.

Linkage Between Targets and Sources – this process establishes how much pollutant loading can occur while still meeting the water quality standards. This step can vary in complexity from simple calculations to development of complex watershed models.

Allocations – once the maximum pollutant loading is established, the needed reductions must be divided among the various sources. This is done for both point sources and nonpoint sources.

Public Participation – stakeholder involvement is critical for the successful outcome of TMDLs. Draft TMDLs are also released for public comment prior to their completion.

EPA Approval – EPA approval is needed for all TMDLs as required by the Clean Water Act.

Followup Monitoring – additional monitoring may be needed to ensure the TMDL is effective in restoring the waters.

The table that appears on the following page is provided as a summary update of TMDL progress and an expression of near future TMDL direction.

Lake Champlain Phosphorus TMDL

In June 2001, the Department released a preliminary draft Lake Champlain Phosphorus TMDL for the Vermont portion of the Lake Champlain basin. The draft TMDL, which was discussed during a series of public meetings in August and September 2001, included five different point source wasteload allocation alternatives for consideration and refinement. Some of these alternatives would require wastewater treatment well beyond current phosphorus removal requirements. The treatment level required of municipal point sources affects the phosphorus loads from nonpoint sources such as farms and developed areas since the total allowable load to Lake Champlain is finite.

After further analysis and consideration of relevant issues, VDEC will revise the draft Lake Champlain Phosphorus TMDL by defining a preferred point source wasteload allocation and nonpoint source load allocation. This next revised draft Lake Champlain Phosphorus TMDL may be distributed for public review as early as April 2002.

Table II.2.5. TMDL Project Update.

Segment	Waterbody ID & Pollutant	Project Status	Projected TMDL Submittal
Winooski River (Cabot)	08-09 Pathogens	TMDL Complete	Approved by EPA (3/01)
Black River (Ludlow)	10-14 Phosphorus	TMDL Complete	Approved by EPA (5/01)
Trib #1, N. Branch Ball Mtn. Bk. (Stratton)	11-15 Sediment	TMDL Complete	Final Dec 2001
Styles Brook (Stratton)	11-15 Sediment	TMDL Complete	Final Dec 2001
Cedar Swamp (Shoreham)	03-10 Pathogens	Draft submitted to EPA. No formal comments received. Impairment eliminated since WWTF project is complete to correct problematic discharges.	Draft July 2000
Allen Brook (Williston)	08-02 Undefined NPS	Field data collection complete. Project progress report received 10/01. TMDL methodology and modeling being developed. Public outreach activities continuing. Extensive cooperation between the Town and contractor.	2002
Mettawee River (Pawlet)	02-05 Temperature	Data collection complete. Expect report by spring 2002. TMDL to be based on results of modeling.	2002
Lake Champlain	9 Segments Phosphorus	Draft TMDL prepared. Nine public briefing sessions complete. Final draft TMDL expected by 4/02.	2002
Acid Impaired Waterbodies	34 ponds 6 streams	Developing acid deposition loading estimates for the 34 lake watersheds. Monitoring NYSDEC approach. Anticipate utilizing USFS screening model to determine usefulness for TMDLs.	2003 (est)
Mercury Impaired Lakes	8 lakes 8 river segments	Have outlined needs to cover TMDL development for waters impaired due to mercury in fish tissue. Potential TMDL development to begin in late 2002 following REMAP project.	2003 (est)

Chapter Four: Cost/Benefit Assessment

Quantifying the costs of construction and operation of facilities (such as wastewater treatment facilities) or river improvement projects (such as the Trout River project) can be done rather routinely. Quantifying the environmental and human benefits in dollars as the result of an improved wastewater treatment plant or a stabilized river bank, however, is not an exact science, especially since the benefits of the projects may not be known for many years.

Point Sources/Combined Sewer Overflows

Vermont has constructed 93 municipal wastewater treatment facilities, 50 industrial pretreatment facilities and 53 industrial wastewater treatment facilities. The total expenditure for the public facilities has been approximately $553 million of state, federal, and local funds. This figure includes approximately $41 million of public wastewater treatment facility improvements made during the last two years. There has been no recent estimate of the total amount spent on capital construction of industrial wastewater treatment facilities. The amount of money spent on operation and maintenance of municipal and industrial WWTFs (approximately $69 million in 1994) has not been updated since the 1996 305(b) Report.

In general, improved water quality has meant less weed and algae growth, resulting in improved aesthetics and enhanced swimming, fishing and boating uses. Also, it was assumed that improved water quality meant less human sickness due to better removal of pathogens. As a result of these public and private expenditures, approximately 58 rivers and 3 lakes have benefitted from improved water quality and enhanced recreational, fishery and aesthetic uses.

During the period January 1, 2000 through December 31, 2001, $41.5 million of federal, state and local funds were spent on CSO corrections, WWTF improvements, construction of new WWTFs, sewer line extensions and rehabilitations, and phosphorus removal involving work at 15 communities. These expenditures have resulted in additional improvements to the water quality of 7 rivers and two lakes.

To give a more complete picture, one must also consider the costs and benefits of nonpoint source pollution control practices. A discussion of this effort follows.

Nonpoint Sources
Aside from several federal and state cost sharing programs to assist with pollution reduction from agricultural sources, there are two federal Clean Water Act programs to assist with planning and implementation of NPS pollution reduction. The first is the Section 604b Pass Through Program, awarded to regional planning commissions to assess, map, plan or report on areas of NPS pollution. The other federal program is the Section 319 program which awards grants (on a competitive basis) to water protection groups to be used to repair eroded banks and other areas which cause pollution. Updated costs of the Section 319 implementation program for twelve years, from 1990 through 2001 are approximately $11 million. Grant funds from the Section 604b Pass Through Program from 1989 through 2001 reached approximately $661,000.

Upper White River Stream Enhancement Project
The project involved work at six different sites from May to October, 1997 by the White River Partnership, and included streambank stabilization, buffer strip re-establishment and instream fish habitat activities. The result of the work was a total of 4,525 feet of shoreline being stabilized and/or enhanced for fisheries and riparian habitat. In 1999, the Partnership won national recognition for its work, and the Upper White River was named a National Showcase River for its successful and pioneering stream corridor restoration efforts.

Trout River Improvement Project
The Agency's newly adopted approach to river restoration and flood hazard mitigation is demonstrated for the first time on an approximately one mile reach of the Trout River in the Town of Montgomery. The town and river were devastated by flash floods in 1997. The new approach uses national emerging river restoration techniques to mitigate flood hazards and restore water quality, recreational values and aquatic and riparian habitat functions. Fundamental to the Trout River project was a high level of cooperation and coordination between the town, landowners and many state and federal agencies. During 1999, the river's dimensions, meander, slope and riparian vegetation were restored. Landowners agreed to maintain the riparian vegetation and to allow the river to naturally meander.

Urbanizing Watersheds
Chittenden County is Vermont's fastest growing county. As a result, some streams have not been protected from development, and much of their riparian buffer has been removed. Also, development of their watersheds has caused increased runoff with associated pollutants and streambank erosion. An attempt has been made to stabilize streambanks and restore streamside vegetation on certain streams, including Allen Brook with some good results.

Hydroelectric Facilities
Two Clean Water Act Section 401 water quality certifications were issued to hydroelectric facilities during the 1998-1999 reporting period. These were for the Vergennes Project and the Middlebury Lower project. The Vergennes Project has been issued a Federal Energy Regulatory Commission (FERC) license to operate, which will improve flows in approximately 10 miles of Otter Creek. The Middlebury Lower Project license is expected to be issued in 2000, and will improve flows in an additional approximately 2 miles of Otter Creek when the project begins operating under the new license.

During the reporting period, the Agency entered into an agreement with Central Vermont Public Service Corporation for the withdrawal of their appeal for a denial of their Lamoille River project which includes four dams. It was agreed that the utility would complete additional scientific studies before again seeking a water quality certificate. This 401 Water Quality Certificate, when issued, will improve 29 miles of the Lamoille River.

The Department is party to a settlement agreement between the FERC and State of New Hampshire regarding licensing of the Fifteen Mile falls project on the Connecticut River. The 401 Water Quality Certificate, if approved, will improve many miles of the Connecticut River, plus surface areas of the Moore-Comerford and McIndoes Falls impoundments. The certificate would include an agreement on the regulation on flows of the Upper Connecticut River Lakes, including Lake Francis.

Chapter Five: Special State Concerns & Recommendations

The following section describes primary water quality concerns of the State of Vermont. The discussion below, presented in unranked order, provides focus to areas of work which the Department believes deserve special targeting of resources either for protection or restoration of waters.

Onsite Domestic Waste Water Disposal

New on-site waste water rules have been discussed for many years and have not been achieved for a variety of reasons. There has been ongoing concern that the 10 acre exemption from subdivision permits is causing sprawl. There has been a parallel concern that the elimination of the exemption would render large parcels un-developable if the current onsite waste water control standards were to be applied.

There is now on the table a new initiative to 1) consolidate on-site waste water rules, 2) to provide the maximum flexibility feasible to help land owners do as they wish with their property within health and environmental protection objectives, 3) eliminate the 10 acre exemption, 4) allow towns with strong site planning and zoning to use the updated minimum site provisions when the rules go into effect, 5) give towns without planning, zoning or sewage ordinances time to decide whether they wish to implement land use controls contemplated by the new program and 6) after five years, the site condition standards would apply statewide, whether or not a town has chosen to adopt land use tools.

The Department is committed to reduce sprawl and other unintended consequences of the present law while assuring that the best and most modern wastewater treatment technology is applied to new systems.

Watershed Planning

Watersheds typically include a broad range of land uses. Some land uses are designed with their effect on water quality considered and minimized. Others have taken account of water quality consequences to a minimal or negligible degree. As a result of the myriad of land uses in our watersheds some streams, rivers, lakes and ponds achieve water quality standards, others do not. In general, the character of impaired waters is a reflection of the cumulative land runoff (and point sources). Recognizing this, and acknowledging that the conservation of high quality waters and the restoration of impaired waters will depend on the cooperation of many landowners, Vermont has initiated a highly public watershed planning program (Watershed Improvement Program).

Three Watershed Coordinators have been hired and a Framework Guidance document has been prepared. The Coordinators have assembled Watershed Councils/Teams to bring together representatives of the various stakeholders. Meetings are widely publicized. The goal is to produce plans that will begin to address some of the more pressing problems that are identified by the public and the state (under the law). The present level of effort is modest (three Coordinators - 17 basins requiring plans). Despite this, the public has been participating actively in forums, Council meetings and in site visits on the land along waters. In addition, Watershed

Coordinators have been working directly with land owners where there is an apparent cause and effect relationship between the condition of the waters and the use of the land. In this way, VDEC is setting examples of techniques that can be used to restore waters during the planning process. The intentions of the planning process are to create an atmosphere in which there will be agreement on the most pressing issues in the basins and that a process will be set in motion to continue resolving problems with a lower level of input from the Watershed Coordinator once the plan is completed.

Stormwater Management

Urban stormwater is receiving more and more attention, partly as a result of identifying waters on the 303d list as impaired and partly due to the slow pace with which this huge problem can be addressed. Because of the effect and importance of the approach on the nonpoint source program, a full description of Vermont's program is provided as Appendix F.

Gaging Stations

Stream flow gages provide important information to towns, the state, hydro-electric companies, recreationists and engineers. The information is used in the design of infrastructure such as waste water treatment facilities, bridges and dams for flood control. Many permitting processes use the information from stream gages to establish minimum flows for fish and wildlife below dams. Gages are also critical in the development of pollutant loading estimates. These and many other uses of gage information are in jeopardy as the state and federal governments attempt to balance their budgets by eliminating funding for the gaging network operated by the US Geological Survey. A dependable source of revenue to support the collection of this vital information is needed on a continuing basis. Without this network, the ability to make necessary management decisions will be significantly diminished.

Water Quality Monitoring Strategy

During the course of the reporting period, the Water Quality Division prepared a draft Surface Water Quality Monitoring Strategy. The Strategy is intended to comprise one element of Vermont's eventual Consolidated Listing and Assessment Methodology. The Strategy presents information on Vermont's current water quality monitoring programs and includes details on specific projects, and on quality assurance and data management issues. Also included are specific action items related to monitoring project review, enhancement, and modification all of which are intended to lead to comprehensive assessments of surface waters on a statewide basis. The Strategy is currently undergoing internal review and should be available by late summer 2002.

305b Assessment Methodology

During the reporting period, and following up regional efforts at developing consistency among States in methods for assessing use support, the Department has made significant improvements to the way in which it's assessment methodology is structured and presented. In some cases (e.g. rivers and streams), the actual methods have not changed drastically, but in other cases (largely lakes and ponds), methods have been changed significantly. In all cases, the presentation of these results has been improved and clarified. This assessment methodology is presented in Part III, Chapter 2.

Groundwater
Vermont's major needs are for a statewide groundwater quality and quantity monitoring network, geologic maps (i.e., fracture traces, bedrock and surficial geology, and aquifer maps), groundwater education and outreach for schools and planning commissions, and GIS locations of potential and actual sources of groundwater contamination. Many of these activities are being pursued; however, they have an extremely long timeframe for completion or are limited in scope.

Although the state has the necessary statutory and regulatory authority to complete these activities, it is hampered by the lack of adequate funding and in turn the personnel to carry out these tasks. A dedicated source of long-term funding for groundwater projects would allow Vermont to identify and prioritize groundwater projects with state, regional, and local entities.

To protect groundwater, additional monetary and personnel resources are needed to:

* Establish a monitoring and evaluation program of the ambient groundwater quality and quantity
* Assist municipalities and regional planning commissions with plans and programs to protect groundwater and drinking water
* Educate children and the general public on ways to protect and conserve groundwater resources
* Map groundwater and geologic characteristics to provide for protection and planning at the state, regional, and local level
* Improve existing GIS data layers and create new data layers on potential contaminants, geology, aquifers, soils and wells.
* Provide internet access to all of this information.

Preliminary estimates for completing this work are $250,000 per year.

Polluting Discharges from Large Farms
From a water quality perspective, there is concern regarding potential shifts in agricultural production from a large number of smaller farms to increasing numbers of larger farms. The water pollution potential from such large farming operations (LFOs) is equivalent to the waste generated by a small to medium sized city. It is recommended and essential that waste management and pollution prevention efforts are well coordinated. The new Large Farm Operation Rules, administered by the Vermont Department of Agriculture, Food and Markets, will help ensure animal wastes on these larger facilities are managed effectively.

Road Runoff to Waterbodies
Threats and some water quality problems as the result of runoff from local roads, as well as from state highways, are widespread. The problems arise from maintenance procedures that are not sensitive to water quality and allow sand and gravel to erode and wash into surface waters.

The Department has developed a small grant program entitled, "Vermont Better Backroads," to assist local road commissioners with better backroad maintenance and planning. The Department is being assisted by many partners, including: the Vermont Local Roads Program at St. Michael's College, Resource Conservation and Development Councils, the Environmental

Protection Agency (funding), Regional Planning Commissions, Vermont Lake Associations, Vermont Agency of Transportation and many others. The program offers small grants on a competitive basis for following up on local situations where there are no current water quality violations but where road practices threaten adjacent rivers, streams, lakes or wetlands. It is a good and effective program, but only a few towns are able to be helped each year due to limited resources. The 1999 Legislature, recognizing the value of the program, provided additional funding, effectively doubling the amount of the Section 319 federal funding. During the present reporting period, 39 projects were funded at a combined total cost of $136,000.

Lack of Strategic Statewide Vegetated Buffer Requirements

Undisturbed vegetation along stream, river and lake shorelines reduces pollutants from reaching surface water. Other than Act 250 development constraints and a few regulations adopted by a small number of municipalities, there are no strategic statewide requirements that riparian landowners maintain a minimum width of vegetation along bodies of water as there are in other states. As a result, many miles/acres of state waters are impaired by urban runoff, sediment, temperature changes, fertilizers, manure, and other pollutants which can be reduced or eliminated by properly-maintained vegetated buffers.

As the result of the recognized importance of riparian buffers to water quality in certain strategic locations, a Buffer Procedure Action Team was formed by Secretary John Kassel and met for the first time in October 1999. The Team was composed of staff from the Agency, whose task was to develop a revised Agency buffer policy and procedure, including general and site specific standards. The revised Buffer Procedure, once finalized, will be used by the Agency in the Act 250 process and as guidance to riparian landowners, including public and quasi-public agencies.

The Department has made some strides in the educational effort to inform the public and municipal planning commissions about the environmental benefits of riparian vegetation. The Department and Regional Planning Commissions have been working with municipalities to strengthen their municipal plans and zoning regulations to maintain streamside vegetation and have sponsored some workshops for town officials and the general public regarding strategies to encourage the maintenance of existing riparian vegetation, as well as promoting the planting of riparian areas lacking vegetative buffers. The Department, YCC, watershed groups and other volunteer groups have worked on many streamside planting projects around the state. However, there is still need for additional public education about the need to maintain riparian buffers for water quality protection and wildlife habitat. It is recommended that the Agency make more use of the print media, TV and radio to draw the public's attention to the benefits of maintaining riparian vegetation.

Atmospheric Deposition of Pollutants

Deposition of pollutants to the Vermont landscape from the atmosphere is principally responsible for the partial support of fish consumption and aquatic life uses on 15,356 inland lake acres and on all Vermont river and stream miles. Atmospheric deposition is the principal source of two major causes of use loss in Vermont: elevated mercury and low pH. The two causes are linked, since in many instances, lakes which are vulnerable to acidification are also those which transfer atmospherically deposited mercury to the aquatic food web in the toxic

methyl- form. There may be other lake types which are not at risk of acidification, but have the ability to transfer mercury into the trophic chain via alternate geochemical pathways. This is the subject of ongoing research in Vermont, and a major goal of this inquiry is to make refinements to the existing Vermont Department of Health fish consumption advisory.

Atmospheric deposition of mercury has resulted in the issuance of fish consumption advisories for any Vermont lake or river containing walleye, lake trout, smallmouth bass, and chain pickerel and for all fish except brown bullhead on the five Deerfield chain reservoirs, and two Connecticut River hydroelectric reservoirs within the Fifteen Mile Falls Project. The method by which the Department assesses fish consumption uses has been further refined during the reporting period, and is provided in detail in Part III, Chapter 2.

The impacts of mercury deposition are not, however, limited to loss of fish consumption uses. Recent research[6] has identified reproductive and behavioral impacts to wildlife that feed on fish which inhabit many northern New England lakes, including those in the Deerfield chain. Potential impacts to upper trophic level biota are presently being measured in several other Vermont lakes in conjunction with the on-going mercury studies (REMAP).

Loss of uses associated with atmospheric deposition also result from regional and long-range emissions of acid-inducing compounds. The atmospheric deposition of nitrous oxide (NO_x) and sulfate (SO_4) from Midwestern sources has resulted in acidification (low pH) of 34 lakes and six streams within Vermont. In Vermont, the potential for acidification is measured by direct measurement of pH, as well as corollary measures such as acid neutralizing capacity, NO_x , SO_4 and others. Deposition of SO_4 and in-lake SO_4 concentrations are presently decreasing.

Vermont continues to work at the local, regional and national scale, to research the environmental effects associated with atmospherically deposited pollutants, reduce Vermont's locally-generated emissions, and influence the development of Federal legislation aimed at reducing atmospherically-derived pollution. Specifically, the Department has recently completed a revised draft mercury emissions inventory, and is issuing grant awards under the REMAP project to map atmospheric mercury deposition to waters statewide, and to model mercury bioaccumulation in REMAP project lakes. Further, the Vermont Advisory Committee on Mercury Pollution continues to identify areas in Vermont where mercury use and emissions can be reduced. During the reporting period, the Committee also spent a significant portion of the year 2000 modifying legislation initially drafted by NEWMOA, for adoption by the General Assembly. Finally, VDEC staff continued to interact with the congressional delegation to address this issue from a national perspective.

Hydrologic Modifications in Lakes

In Vermont, water level manipulations are a source of use impact to lakes. There are 32 lakes and ponds (about 9,000 acres) in Vermont for which one or more uses are impaired due to water

[6]See http://www.vtwaterquality.org/hgreview.pdf.

level manipulations. Flow alteration affects aquatic life uses due to littoral habitat loss. In some instances, flow alteration can also affect aesthetic, swimming, and even boating uses, depending on the severity and/or timing of the drawdown.

The Department's Lake Bioassessment Program needs to obtain more precise and quantitative estimates of aquatic life use impairments in flow-altered lakes and reservoirs. There also exists the need to quantify the effect of water level fluctuation on the bio-accumulation of mercury in reservoirs.

The Department has designed a 'decision-making tree' to make the assessments uniform in lakes, ponds, and reservoirs in relation to hydrologic modifications. This is presented in Part III, Chapter 2.

Hydrologic Modifications in Rivers & Streams

As humans develop watersheds more intensely, remove stream gravel and alter the stream channel, increased flooding, impaired water quality, and impacts to aquatic resources are the unwanted results. Land use changes and instream management activities and their relationship to adverse impacts on rivers and streams are the focus of studies either completed or currently being undertaken by the Department. The recommendations of the studies have caused the Department to develop the *Stream Geomorphic Assessment Handbook* and are likely to result in changes to the *Stormwater Management Procedures*.

It is recommended that the Department encourage municipalities to incorporate the future revised management procedures in their plans and ordinances through workshops sponsored by regional planning commissions meeting with selectboards, conservation commissions and local planning commissions. In addition, additional resources are needed to assist with channel restoration of flood-damaged rivers and streams.

Exotic Aquatic Species as Pollutants

Vermont has a history of impacts related to non-native nuisance plants and animals in its lakes, and unfortunately, the number of non-native introductions to inland Vermont lakes continues to increase. In 1999, zebra mussels (*Dreissena polymorpha*) were found for the first time, either in adult or larval form, in three large and heavily-used inland lakes (Bomoseen, Dunmore, and Hortonia) near Lake Champlain. Fortunately, only Lake Bomoseen appears to have developed a viable adult population in the past two years. The existence of zebra mussels in Lake Bomoseen increases greatly the risk of infestation of other inland waterbodies, as this species is commonly spread by boating activities. A risk assessment performed by the Department in 1997 identified a large number of recreationally used lakes as being at significant risk of infestation by zebra mussels.

During this 305b reporting period, Eurasian watermilfoil was discovered in six new lakes (Crystal, Clyde, Derby, Great Hosmer, Ninevah, and Beaver in Proctor). Despite some targeted spread control initiatives, Eurasian watermilfoil continues to spread around Vermont at an alarming rate (refer to the figure on the following page). Significant increases to personnel and

financial resources will need to be directed toward spread prevention efforts if Vermont is to be successful in slowing the rate of spread of this nuisance species.

Water chestnut (*Trapa natans*) was discovered in the Lemon Fair River and at several new sites in wetlands and tributaries near Lake Champlain during this reporting period. Of major concern is the discovery in 2001 of a water chestnut infestation in the Pike River in Canada. This new infestation places Missisquoi Bay in Lake Champlain in extreme jeopardy of an infestation.

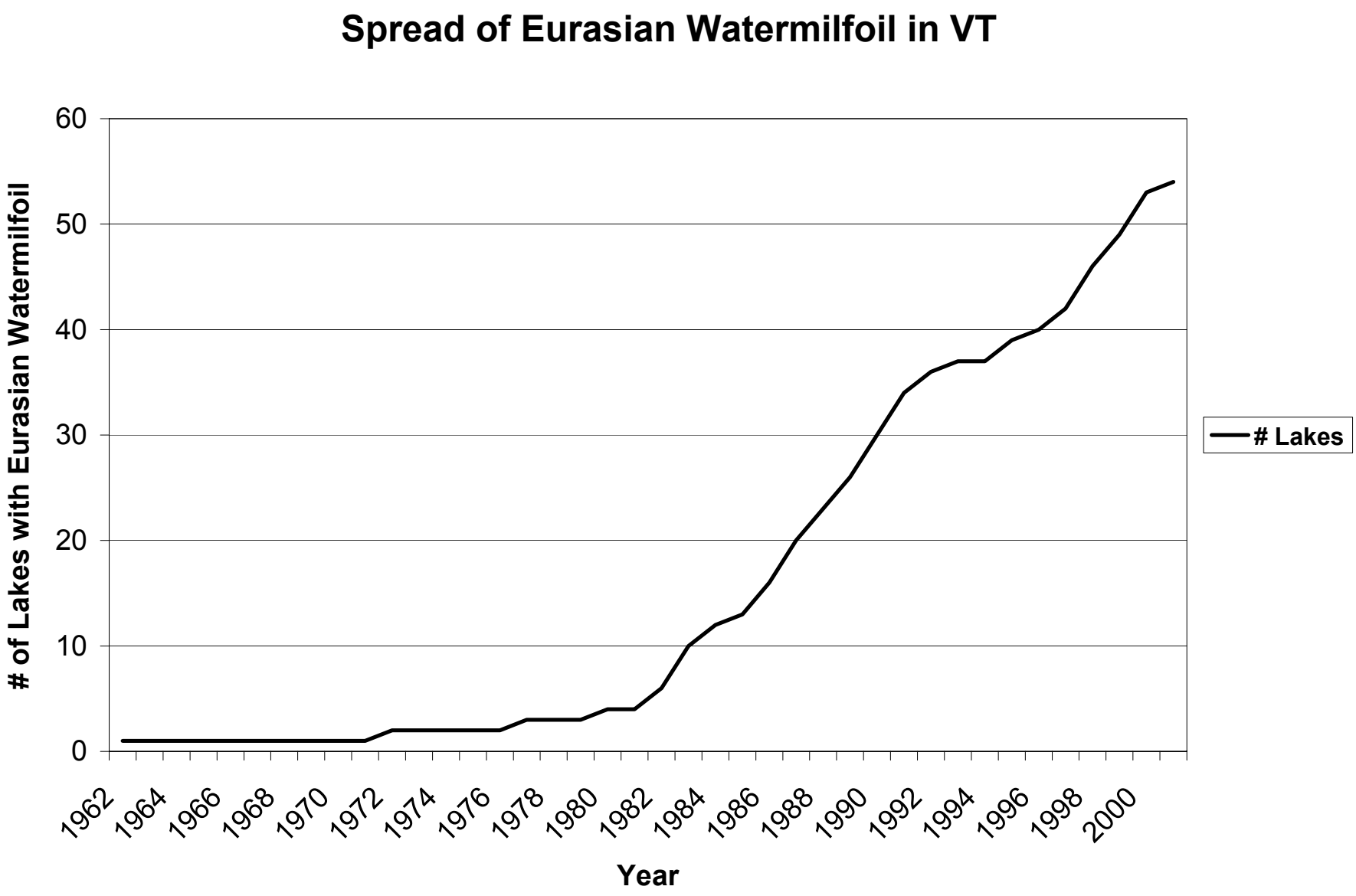
On a more positive note, sustained hand pulling efforts appear to have eliminated the water chestnut populations in Root Pond and Lake Bomoseen. The population in Lake Paran is nearly eradicated as well. It is essential that the Department receive continued funding for water chestnut control at or above existing levels to maintain the ground gained in the last two years in the battle against water chestnut in Lake Champlain (mentioned earlier in Chapter 3) and the inland lakes.

Lake Hortonia and Burr Pond were treated with a low concentration of the aquatic herbicide *Sonar*® in 2000 to selectively manage dense Eurasian watermilfoil populations there. A Eurasian watermilfoil population in Sunrise Lake was similarly treated in 2001. All of the treatments achieved 90-95% removal of the milfoil, and native plants began rebounding even in the year of treatment. Recreational uses that had been severely impaired for years in Lake Hortonia and Burr Pond have now been restored. Biological studies related to these treatments, involving target and non-target plants, macroinvertebrates, fisheries, reptiles, and amphibians, are ongoing. Given the success of these initial treatments, it is anticipated that numerous communities and/or local organizations will request permits and funding to conduct herbicide treatments on other lakes in Vermont in the next few years to restore recreational uses and native aquatic habitat that has been impaired by Eurasian watermilfoil infestations.

Heavy infestations of Eurasian watermilfoil and water chestnut have an impact on aesthetic, aquatic life, swimming, and boating uses in those areas where these plants grow densely. Zebra mussels in inland lakes at the present time only threaten swimming uses (due to the ease with which one gets cut by the extremely sharp shells). As infestations develop in inland lakes, they may affect aquatic life uses due to changes in the aquatic food web. The Department has quantified this effect in Lake Champlain, but not for inland lakes, as inland lake infestations, thankfully, have not yet developed sufficiently. The first report of a zebra mussel-clogged water intake pipe in Lake Bomoseen occurred in the fall of 2001.

Eutrophication of Vermont Lakes

The Department commits significant resources to the management of human-caused eutrophication affecting Vermont lakes. Vermont has relatively unproductive lakes as compared to other parts of the country. This is attested to by the fact that only two inland lakes appear on Vermont's Year 2000 303d list as impaired due to excessive eutrophic conditions (Shelburne Pond and Lake Carmi). The Department considers that proactive protective actions to reduce human impacts on lake health before impairments occur address the problem of eutrophication in a much more efficient manner than waiting until restoration is needed. Several such lake protection projects are described elsewhere in this document.


Spread of Eurasian Watermilfoil in VT
# of Lakes with Eurasian Watermilfoil
60
50
40
30
20
10
0
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
Year
Lakes

Eutrophication can simultaneously affect aesthetic, aquatic life, swimming, and in some instances even boating uses. The major causes related to eutrophication for inland Vermont lakes are nutrients, siltation, and organic enrichment. The major sources of these pollutants are construction, urban and suburban runoff, road maintenance and runoff, agriculture, silviculture, and other nonpoint sources. Since Vermont is only part way through the process of reassessing all of its lakes under the rotational watershed assessment process, the reader is urged to exercise caution in interpreting use impacts, causes, and sources related to eutrophication. In many instances to date, upon reassessment, use impacts related to eutrophication have been changed from partial support to fully supported but threatened based on a thorough review of available data in light of the new Water Quality Standards. This is likely to occur for a portion of the remaining Vermont lake acres which are to be assessed over the next two years as well.

Nutrient Criteria

During the reporting period, the Department has continued to participate in EPA's Regional Nutrient Criteria Technical Advisory Group. As of this writing, VDEC is developing a state-specific nutrient criteria implementation plan for lakes and rivers. The plan, once completed, will be consistent with the guidelines provided in the November 2001 memorandum issues to States from EPA's Office of Science and Technology.

Vermont's nutrient criteria implementation plan will focus on developing quantitative relationships between nutrient parameters and designated uses such as recreation, aesthetics, aquatic habitat, and public water supply. The Department will work to propose scientifically defensible nutrient criteria for adoption by the Vermont Water Resources Board within the three-year (2004) timeframe established by EPA.