Strafford Regional
Planning Commission

SRPC

The Oyster River Watershed Management Plan June 2001

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DRAFT

The Oyster River
Watershed Management Plan
June 2001

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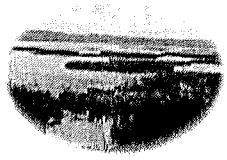
Bringing Our Estuaries New Life



New Hampshire Estuaries Project

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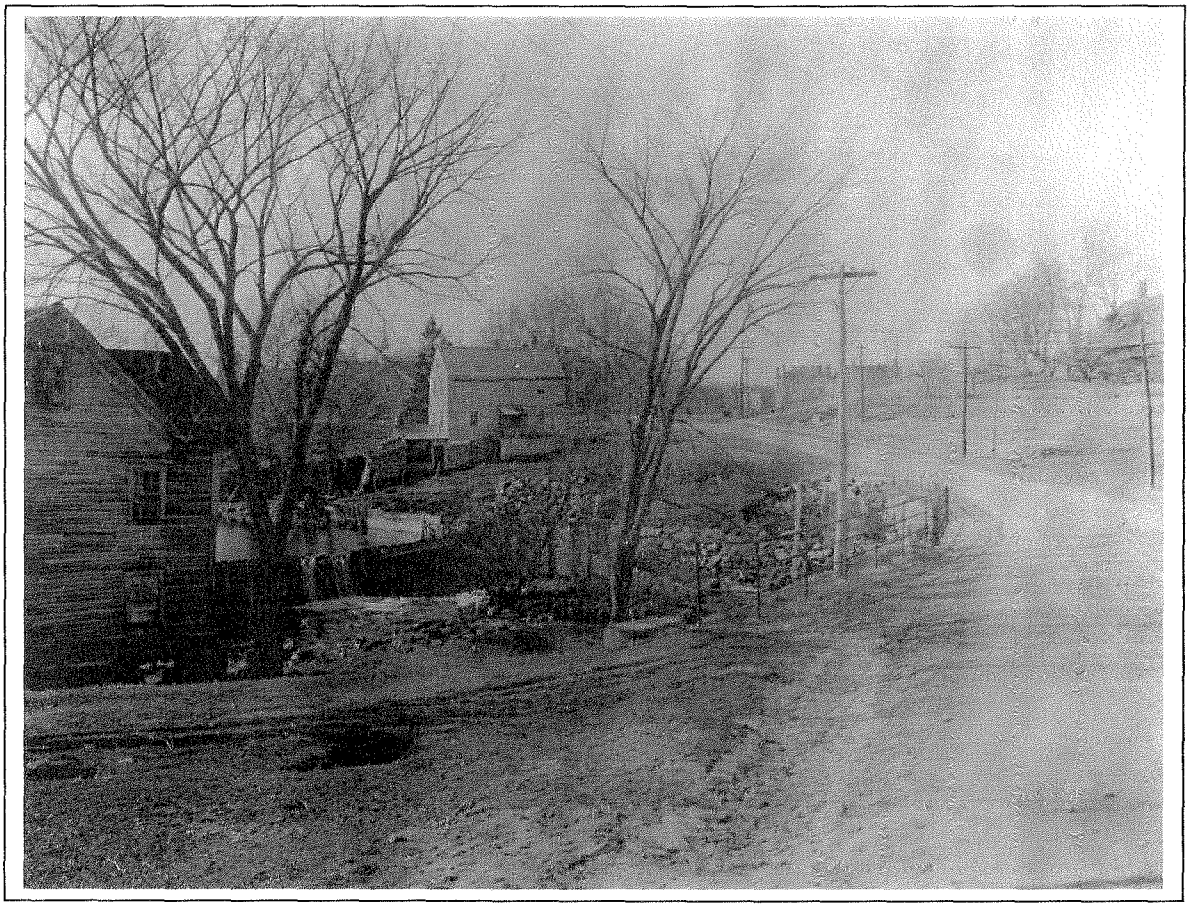


Historical downtown Durham

Photographs in this document courtesy of Andrea Bodo, Laurel Cox and Nancy Phillips

Table of Contents

List of Figures

List of Tables

An invitation

"Don't muddy the water around you. You may have to drink it soon."

"We have met the enemy, and they are us." Some wisdom from Pogo

We are all living together in this Oyster River watershed. What I do and what you do affects us both. I run a car and have a septic system like everyone else. I have faith that people want to be good neighbors and to do what is right and best for the good health of the neighborhood and the world around us.

Welcome to the Oyster River Watershed Association. I see this group as a way for neighbors within the watershed to get together, to begin to understand the needs and desires of one another in relationship to learning how to appreciate and maintain a healthy watershed. We can better understand the existing and potential problems through our explorations of the maps, river walks, water sampling and testing, learning more of the hydrology, pollution, land preservation techniques, and ecological interconnections. It is a universally agreed upon given that we are all concerned that our water supply be ample and of high quality.

Our dialogue with one another, with our surrounding communities, and with members of other watersheds must take place with openness and honesty. It must be inclusive of all elements that make up the community. We need to be able to do as much careful listening as talking.

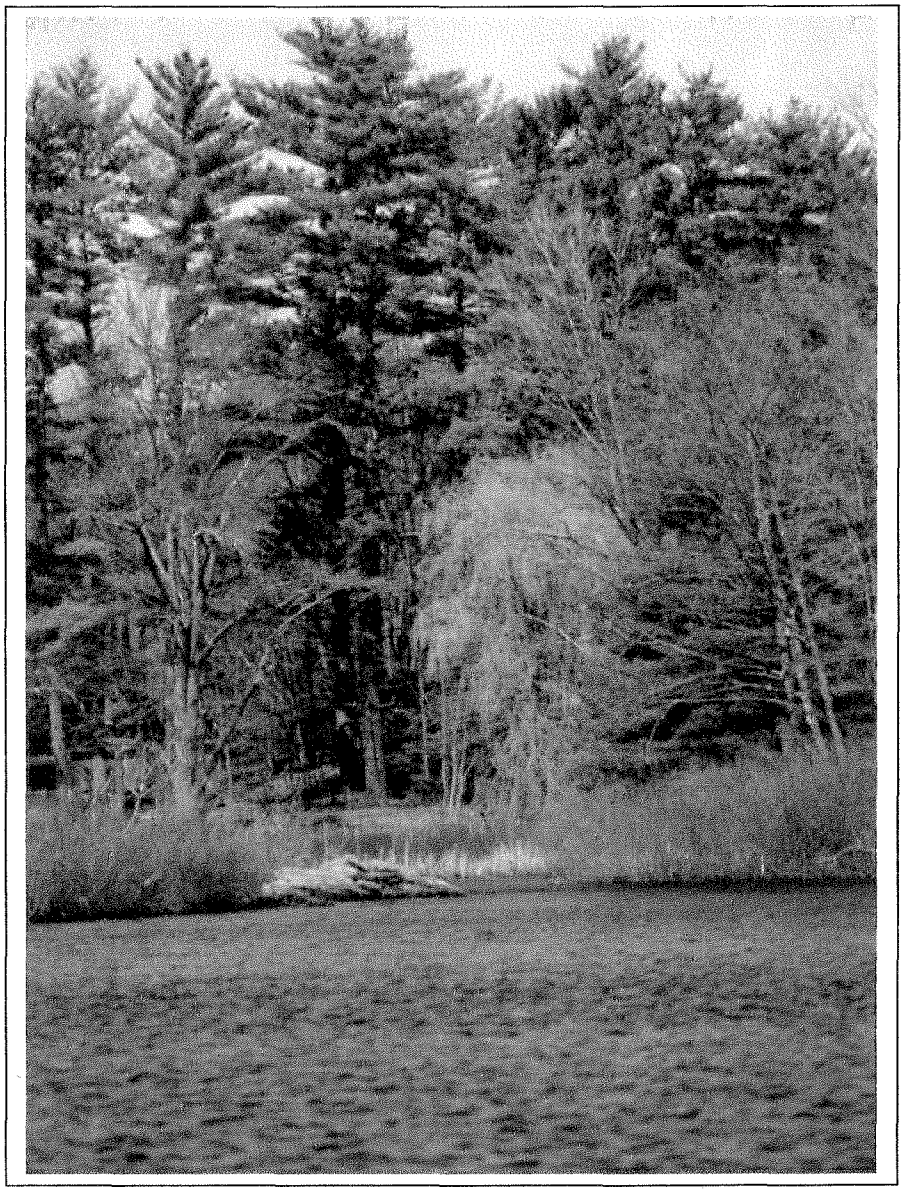
The process of the creation and implementation of the Oyster River Management Plan is integral to the plan itself. It must involve each of the elements of the communities that are dependent upon the health of the river. Every part of the community needs to be consulted and aware of the importance of the river and the ecosystem of the watershed, from gas stations, shopping centers, and fast food franchises to the farms, university, the water treatment plant, public schools, town sewage treatment plant, and the individual households of our citizens.

One of the most exciting aspects of the past year is the beginning of inter-town communication and cooperation. The towns of Madbury, Lee, Barrington, Durham, and Dover, and the University of New Hampshire have just begun to relate to one another on regional concerns, with the river as the vital link among them. .

As we begin our second season with optimism and energy, I continue to believe in the strength and power of this cooperative process of inclusion. We look forward to creating the future, as we work together to keep the river and its watershed healthy and clean.

Chuck Cox, 30 June 2001

I. Introduction



A view of Wheelwright Pond

I. Introduction

Development of the Oyster River Watershed Management Plan- Interactions Between the Oyster River Watershed Association and Individual Communities

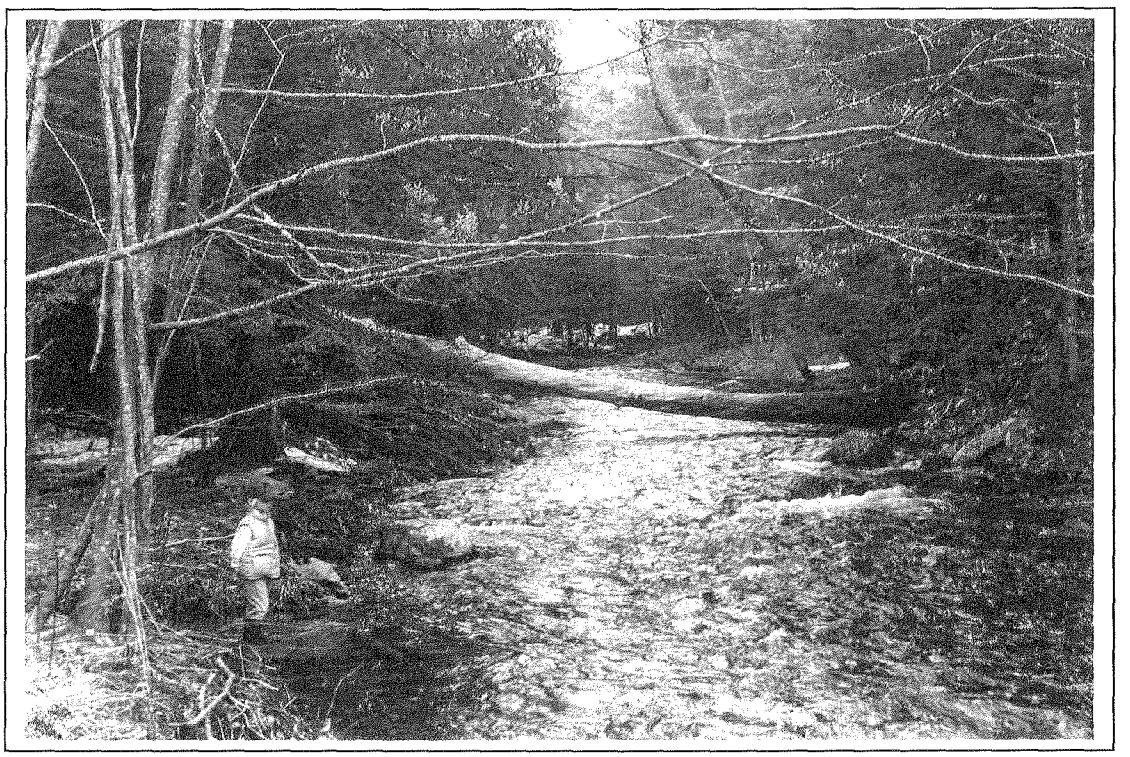
The purpose of the Oyster River Watershed Management Plan is to create a platform for conversations regarding the long-term protection and management of the natural resources within the Oyster River watershed. The platform rests upon the strong desire to use collective knowledge and wisdom to guide the decision making process as the Oyster River Watershed Association and the communities move into the future. In moving forward, it is recognized that change will occur, and a unique balance will be forged between the past, present and future cultural and social characteristics of this area. The point of balance, the point of convergence will always be found, as long as the conversations continue. The Management Plan creates a platform for conversations.

The move to develop a comprehensive watershed management plan for the Oyster River watershed began with the Oyster River Watershed Association reaching out through a series of focused interviews to gather an understanding of the communities and the citizens living within them. The interviews evoked discussions that went much deeper than simply deciding on management techniques. It brought forth thoughts about who we are as a society and how technology has influenced our behaviors. It evoked thoughts about where and how we place ourselves within the greater landscape and how to achieve a sustainable balance for the entire community. There was little doubt that technology has brought about a change in our patterns of living, such that services which were previously accessible within urban areas are now available to those living in the rural countryside. As such, preconceived notions of our living and working environment have changed. Development has spread, and the communities in the watershed are in the pathway of a suburban pattern of growth. With this growth pattern has come an increased demand for community services, infrastructure, and means of transportation. Amidst all of this, there is an increasing awareness of the need to sustainably manage the natural resources. The concept of conservation has taken hold in this watershed, such that individual and collective

community actions are considered paramount to maintaining the quality of life within this regional landscape. The interdependence of community development, transportation and natural resource management has become more apparent. The citizenry has become aware that to effectively plan for and manage this triad, regional approaches will be necessary. Within the Oyster River watershed, these changes in the way we live with the attendant changes in the surrounding landscape brought to the forefront many environmental issues.

The watershed management planning project was perceived as an opportunity that occurred at a time when it was needed the most. The concept of the management plan being used to protect valuable resources as compared to a management or restoration effort was foremost in most people's minds. There was consistency that participation and long-term commitment from the greater watershed community would need to be forged to fully implement the watershed plan. However, it was understood that embracing the concept of a greater watershed community may require that community independence and individuality be lost to some degree. Private property rights could inevitably be challenged and/or lessened. In order to manage lands to attain a desired quality of life and to safely stay within natural carrying capacities, the watershed plan accommodates for a degree of municipal oversight. However, this lessening of self-government has to be strongly balanced with efforts to pursue education and the development of unique community approaches to address common issues. The watershed management plan strives to attain an extremely delicate balance between individual and community efforts whereby community intentions and limitations are respected.

II. The Oyster River Watershed



A quiet moment at the Dishwater Mill site

II. The Oyster River Watershed

A. Features of the Oyster River Watershed

A watershed is an area of land that drains to any water resource, such as a wetland, river, lake or estuary. Watersheds can contain numerous tributaries and ponding areas. There are six communities whose municipal boundaries lie within the Oyster River watershed, which is contained within the larger New Hampshire Coastal Basin (Figure 1). The communities are Barrington, Dover, Durham, Madbury, Nottingham and Lee. The distribution of community area is shown in Table 1. It can be seen that Durham has the greatest percentage of its land area in the watershed (38%), followed by Lee (24%), Madbury (17%), Barrington (15%), Dover (5%) and Nottingham (2%).

Table 1. Distribution of Community Area Within the Oyster River Watershed

Community in watershed	Total acres	No.acres in watershed	Town percentage in the watershed
Barrington	31117	2876	15
Dover	18587	1074	5
Durham	15852	7517	38
Lee	12927	4758	24
Madbury	7799	3287	17
Nottingham	30997	316	2
Total watershed acres		19828	

The watershed is predominantly forested, with approximately 12,650 acres of forestlands. A variety of other types of land uses exist within the watershed (Table 2), the most prevalent of which are residential lands (2700 acres) and agricultural lands (2491 acres). The land use and zoning map (Figure 2) for the watershed shows the distribution of the land cover and land uses within this area. The relative amount of open space (agriculture, brush, forested, and surface waters) within the communities shows that most communities have a high percentage of open space ranging from 75% in Durham, 83% in Nottingham, 85% in Lee, 88% in Barrington and 89% in Lee. In Dover open space accounts for approximately 54% of the land area in the watershed.

Table 2. Distribution of Land Use and Zoning in the Oyster River Watershed

Community	Type of Land Use	Acres
Barrington	Residential	268.9
	Commercial-Retail	1.2
	Commercial-Services	1.2
	Industrial	3.5
	Mining-Sand/Gravel	30.8
	Transportation/Utilities	39.5
	Cemetery	1.1
	Agriculture	45.1
	Brush-Transitional	5.0
	Forested	2477.8
	Surface Water	2.0
	Total	2876.3

Community	Type of Land Use	Acres
Durham	Residential	1318.9
	Commercial-Retail	5.3
	Commercial-Services	10.0
	Government	7.2
	Institutional	1.9
	Educational	370.4
	Industrial	16.9
	Transportation/Utilities	131.2
	Water/Wastewater Facilities	9.3
	Solid Waste-Utilities	1.8
	Industrial/Commercial Complex	7.5
	Mixed	15.5
	Outdoor-Other	7.2
	Cemetery	6.6
	Agriculture	1183.9
	Brush-Transitional	88.7
	Forested	3874.8
	Surface Water	460.0
	Total	7517.1

Community	Type of Land Use	Acres
Nottingham	Residential	52.4
	Agriculture	22.1
	Forested	240.1
	Total	315.5

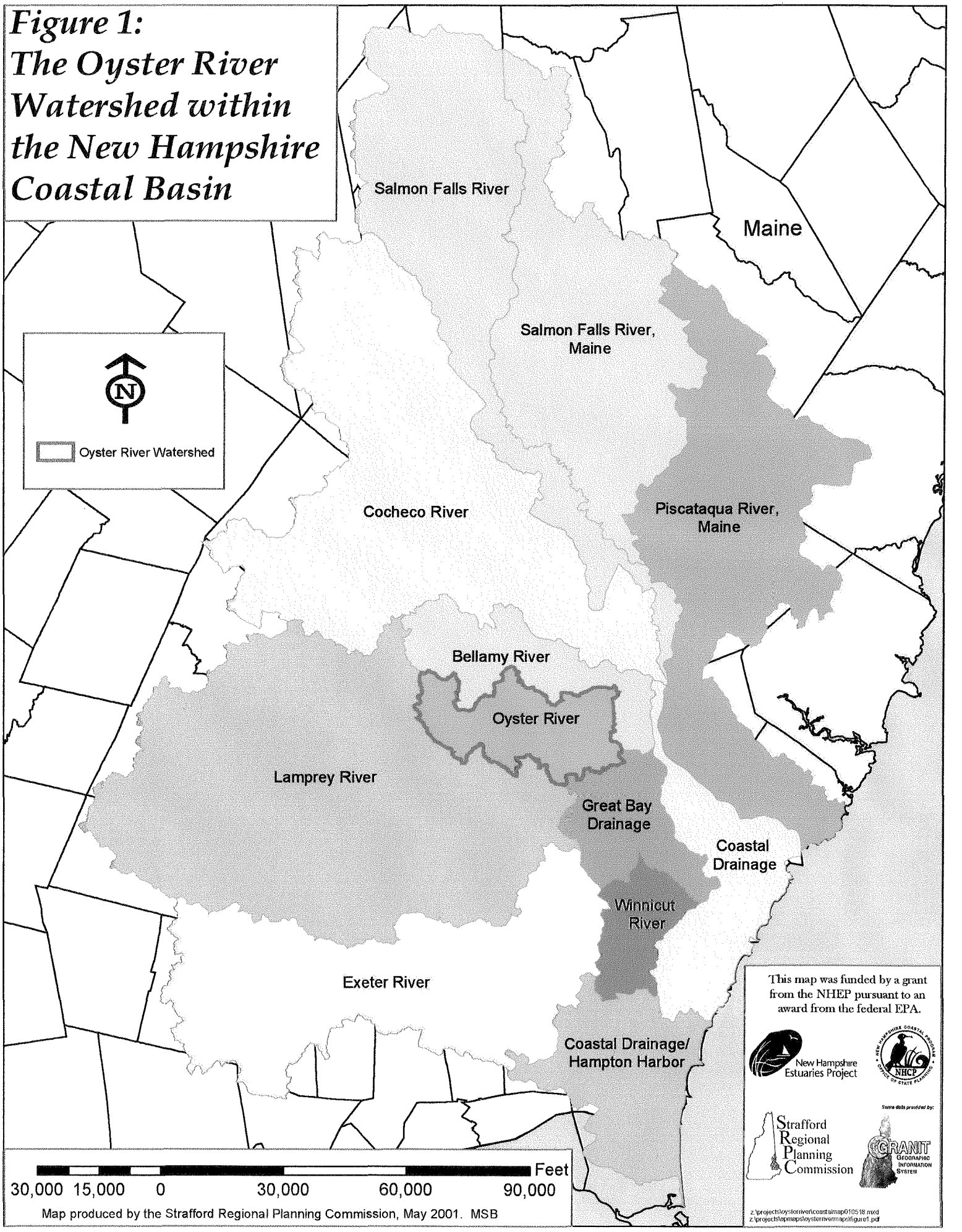
Estimates obtained from Strafford Regional Planning Commission GIS Services and New Hampshire GRANIT

Community	Type of Land Use	Acres
Madbury	Residential	228.8
	Government	0.8
	Institutional	1.4
	Educational	18.1
	Indoor-Cultural	0.0
	Industrial	11.1
	Mining-Sand/Gravel	0.0
	Transportation/Utilities	86.0
	Water/Wastewater Facilities	12.5
	Outdoor-Other	14.7
	Agriculture	561.7
	Brush-Transitional	3.3
	Forested	2336.1
	Surface Water	12.8
	Total	3287.2

Community	Type of Land Use	Acres
Lee	Residential	474.2
	Commercial-Retail	73.2
	Commercial-Services	16.9
	Government	1.3
	Institutional	1.2
	Educational	5.6
	Industrial	4.1
	Mining-Sand/Gravel	78.4
	Transportation/Utilities	36.8
	Solid Waste-Utilities	4.8
	Cemetery	4.9
	Agriculture	526.6
	Brush-Transitional	105.4
	Forested	3306.1
	Surface Water	118.4
	Total	4758.0

Community	Type of Land Use	Acres
Dover	Residential	357.2
	Commercial-Services	0.8
	Indoor-Cultural	5.2
	Mining-Sand/Gravel	104.8
	Transportation/Utilities	16.9
	Water/Wastewater Facilities	8.8
	Agriculture	151.8
	Brush-Transitional	5.0
	Forested	420.6
	Surface Water	3.2
	Total	1074.1

Figure 1: The Oyster River Watershed within the New Hampshire Coastal Basin



The Oyster River watershed is approximately 31 square miles or 19,828 acres in size. It is one of the smallest watersheds located within the New Hampshire Coastal Basin. The drainage from the Oyster River and its watershed empties into Great Bay, an estuarine system, which then empties into the Gulf of Maine. The Oyster River and all its tributaries in the towns of Barrington, Durham, Lee and Madbury are designated as Class A streams and are used as a water supply for the University of New Hampshire and the Town of Durham. The watershed has 64.87 miles of shoreline of rivers and streams. The rivers and streams located within the Oyster River watershed can all be classified as either first, second, third or fourth order streams. (See Table 3).

Table 3. Distribution of Shoreline by Stream Order in the Oyster River Watershed

Order	Length (feet)
First	8417
Second	10019
Third	28498
Fourth	57657

Estimates obtained from Strafford Regional Planning Commission GIS Services and New Hampshire GRANIT

The Oyster River watershed is blessed with a variety of natural resources, which have provided for some unique characteristics of the communities. For example, the watershed contains areas of highly productive stratified drift aquifers (those areas with transmissivity greater than 2000),

Table 4. Distribution of Groundwater Resources in the Oyster River Watershed

	Community						
Aquifer transmissivity	Barrington	Dover	Durham	Lee	Madbury	Nottingham	Totals
0-500	30	607	6094	3487	1599	11	11828
500-1000	324	101	22	293	75		815
1000-2000		47	37	33	64		181
2000-3000		**37**	**24**	**20**	**46**		128
3000+		**82**	**15**	**6**	**36**		140

Note: Area reported in acres.

Estimates obtained from Strafford Regional Planning Commission GIS Services and New Hampshire GRANIT

which supply the communities with a portion of their drinking water. The City of Dover contains the largest acreage of these water-bearing areas within the watershed, followed closely by Madbury (See Table 4). It should be no surprise that wellfields for public water supply wells are clustered in the area of Dover and Madbury. The location of the aquifers within the watershed are shown in Figure 3. Within the landscape of this watershed are also located the floodplains and wetlands, which represent the dynamic stream profiles and the areas of surface water and

Table 5. Distribution of Wetlands and Flood Zones in the Oyster River Watershed

Community	Wetland Type				100 year Floodzone
	Palustrine	Lacustrine	Estuarine	Unknown Type	
Barrington	320	0	0	6	0
Durham	367	22	438	0	972
Dover	44	0	0	2	19
Lee	455	101	0	14	500
Madbury	220	0	0	1	93
Nottingham	12	0	0	0	0
Watershed Total:	1419	122	438	24	1584

Area reported in acres

Estimates obtained from Strafford Regional Planning Commission GIS Services and New Hampshire GRANIT

groundwater interactions. The Town of Durham contains the greatest percentage of land area that is designated as 100-year floodplain by the Federal Emergency Management Agency. (See Table 5). This abundance of floodplain speaks to the location of Durham within the landscape, as it is the most downstream community along the Oyster River prior to the discharge over the Wiswall dam into the tidal portion of Great Bay. Adjacent to much of the floodplain areas are the wetland systems. It is recognized that there are three different types of wetlands throughout this watershed, although the palustrine (freshwater) wetland type dominates (See Table 5). There are estuarine (marine) wetland systems that are located exclusively in Durham. The location of the wetlands and floodplains is shown in Figure 4.

The area has a variety of soil types, ranging from marine sediments to rich farmland soils. There are 3550 acres of prime farmland soils and 690 acres of state important farmland soils. This represents approximately 20% of the entire watershed area, and has led to the agricultural community heritage in this area (See Table 6). The distribution of the farmland soils throughout the watershed is shown in Figure 5.

Table 6. Distribution of Farmland Soils in the Oyster River Watershed

Community	Farmland soil type		
	Local important	Prime	State important
Barrington	193	49	42
Dover	323	279	19
Durham	2010	1821	292
Lee	1177	732	138
Madbury	1199	670	200
Nottingham	No data available		
Totals	4901	3551	690

Many of the areas within the watershed that are rich in natural resource value have been placed into conservation over the years. Presently, the Town of Durham has over 2,000 acres of conservation lands within its borders as shown in Table 7. Most of this land is currently owned by the university. Other parcels of conservation land are also located throughout the watershed. Both the Towns of Lee and Barrington have active conservation programs that contribute to the acreage currently being protected. The conservation lands in the watershed are shown in Figure 6. There are still many large parcels of unfragmented lands that exist in the watershed (Figure 7), which offer opportunities for future conservation efforts, depending upon the priorities for conservation. A map of the watershed was generated to show areas in the watershed where several different valuable natural resources occurred, either individually or simultaneously. This map is referred to as the co-occurrence map for the Oyster River watershed and is shown in Figure 8. The critical features (important natural resources) that are part of this map include the location of aquifers, wetlands and wetland soils, and farmland soils. It is hoped that additional co-occurrence maps for the watershed will be generated as priorities change over time.

Table 7. Distribution of Conservation Lands in the Oyster River Watershed

Barrington	250
Dover	23
Durham	2284
Lee	317
Madbury	192
Nottingham	4
Total	2873

Estimates obtained from Strafford Regional Planning Commission GIS Services and New Hampshire GRANIT

The area that includes the Oyster River watershed was the subject of a Regional Environmental Planning Project conducted in 1998 by the Strafford Regional Planning Commission with support from the New Hampshire Department of Environmental Services. The project highlights the cultural and natural resources within the planning area. The Oyster River watershed as depicted in Figure 9 supports a variety of these regionally important areas including agricultural resources, habitat, historic mill sites, public resources, water resources, scenic resources, recreational resources, historic resources and other natural resources (woodlands, slopes, caves, and kettle holes). A summary of these regional important resources is contained in Table 8.

Table 8. Location of Special Resources within the Oyster River Watershed.

Madbury

Type of Resource	Location	Description
Natural Resource	Forest Along Johnson Creek	Significant area of forest along the Creek from Salt Hole upstream. Habitat, recreation, forest and aesthetic values.
Public Resource	Route 108 Corridor	One of two major highway corridors in Town. Prevention of strip development and protecting the natural resources and scenic qualities.
Historic Resource	Mast Road	One of the old roads used to haul trees to be used for ship masts from the inland forests to the seacoast. Rural /aesthetic qualities in the corridor
Historic Resource	Province Road	An early road from the Seacoast inland. Rural and historic landscapes along this road. Significant to the rural atmosphere and quality of life.
Historic Resource	Site of the Major DeMerritt Homestead	Major DeMerritt was involved in the capture of Ft. William & Mary- gunpower taken from the British was stored at this site then used at Bunker Hill.

Lee

Type of Resource	Location	Description
Natural Resource	Peter's Oven	A small cave where legend has it that Peter hid from the Indians. Well known feature in town.
Natural Resource	Indian Oven	Another small cave, similar to Peter's Oven. Well known feature in town.
Natural Resource	Forest Land	Forest land, in general, is highly valued. Northern Lee is an area with significant forest resources. Site of first saw mill in Lee.
Public Resource	The Hill	Village center, with civic and commercial offerings, retains much of its rural character.
Water Resource	Aquifer Area at the Lee Traffic Circle	One of the more significant aquifer areas in town.
Water Resource	Aquifer Area along Turtle Pond Road	One of the more significant aquifer areas in town.

Table 8. Location of Special Resources within the Oyster River Watershed (cont'd).

Durham

Type of Resource	Location	Description
Natural Resource	Beech Hill	Highest point in town.
Historic Resource	Train Station	Historic building with adaptive re-use (the UNH Dairy Bar). Soon to an active rail station again, contributing to intermodal travel.
Historic Resource	The Outdoor Pool	Believed to be the only remaining WPA-built pool still in existence (and in use)
Public Resource	Downtown	Traditional focal point of community. Town has worked hard to prevent commercial sprawl which would detract from downtown vitality.
Historic Resource	Historic District	Extensive area of early homes and buildings between the Oyster Rive and the downtown.
Historic Resource	The Landing	The initial center of commerce in town, where boats on the Oyster Ri loaded and unloaded.
Scenic Resource	Johnson Creek/Bunker Creek Area	Area around two tidal tributaries to the Oyster River. Scenic. Tidal wetlands. Route 4 corridor very scenic, with views and close tree canopy.
Historic Resource	Brickyards	Natural resource related industry of historic importance to region.
Recreational Resource	Greenbelt Along Oyster River	Primary reason stated for this corridor is for trails along the river, and enhance public access to the river. Much of the land is owned by UN
Scenic Resource	Rt. 108 Corridor	Many large parcels of open space along Rt. 108 north and south of village. Important gateways into the community.

Estimates obtained from Strafford Regional Planning Commission GIS Services and New Hampshire GRANIT

B. Existing conditions within the Oyster River Watershed

The monitoring program was developed to provide for initial watershed-wide screening followed by more intensive site-specific determinations. The monitoring consisted of biological and wildlife screening and water quality monitoring. The purpose of the biological monitoring and wildlife screenings initiated by the Association was to conduct a qualitative screening assessment throughout the watershed to characterize natural resource quality. The qualitative assessment yielded information ranging from location of critical problem areas to identification of high quality resources. Biological monitoring is a valuable screening procedure as the results represent an integration of chemical and physical characteristics of the site.

The Association used qualitative monitoring to conduct an initial screening, followed by quantitative monitoring to conduct site-specific assessments.

The biological monitoring demonstrated that the streams in the watershed supported healthy populations of macroinvertebrates that are indicators of high quality waters. For the Oyster River watershed, designation as a high quality water indicates that not only is there good water quality, but that the physical characteristics of the streams are of good quality and that there is good structural stability within the system. The wildlife screenings indicated that the watershed supports a diverse population of wildlife that is typically found in near-shore or water-dependent habitats. Similar to the results of the biological monitoring, the wildlife screenings indicated that animal species associated with high quality waters were present at several sites (e.g. river otter). The results of the qualitative assessments were used by the Association in several ways to help refine their efforts. For example, the information was used by the watershed workgroup to discuss priorities and to develop critical questions, which directed the refinement of the watershed management plan. In addition the information was used to select individual monitoring sites as part of the water quality monitoring effort. Additional water

Monitoring results were linked to the critical questions and the decision making process

quality monitoring was initiated by the Association to address site-specific concerns in the watershed (e.g. potential contamination of the water supply by known sources of Methyl tertiary-Butyl Ether or MtBE), as well as to conduct a quantitative assessment of the watershed. The parameters selected for inclusion in the monitoring plan will provide insight and answers to the critical questions developed as part of the watershed management planning process. By using a combination of quantitative screening techniques and qualitative site-specific approaches, the Association was able to link their monitoring efforts with critical decision-making, priority setting and refinement of the watershed management plan.

Biological stream sampling

Biological stream sampling was conducted during the month of July, 2000 at several sites throughout the watershed. Healthy populations of stone flies, mayflies, helgrimites, caddis flies, craneflies and isopods were found at all sites. Dissolved oxygen levels were 8 to 9 mg/l. The water quality at the survey sites was determined to be of high quality. (See Figure 10).

Results of the biological monitoring indicated that the aquatic system was healthy and stable.

Wildlife screenings

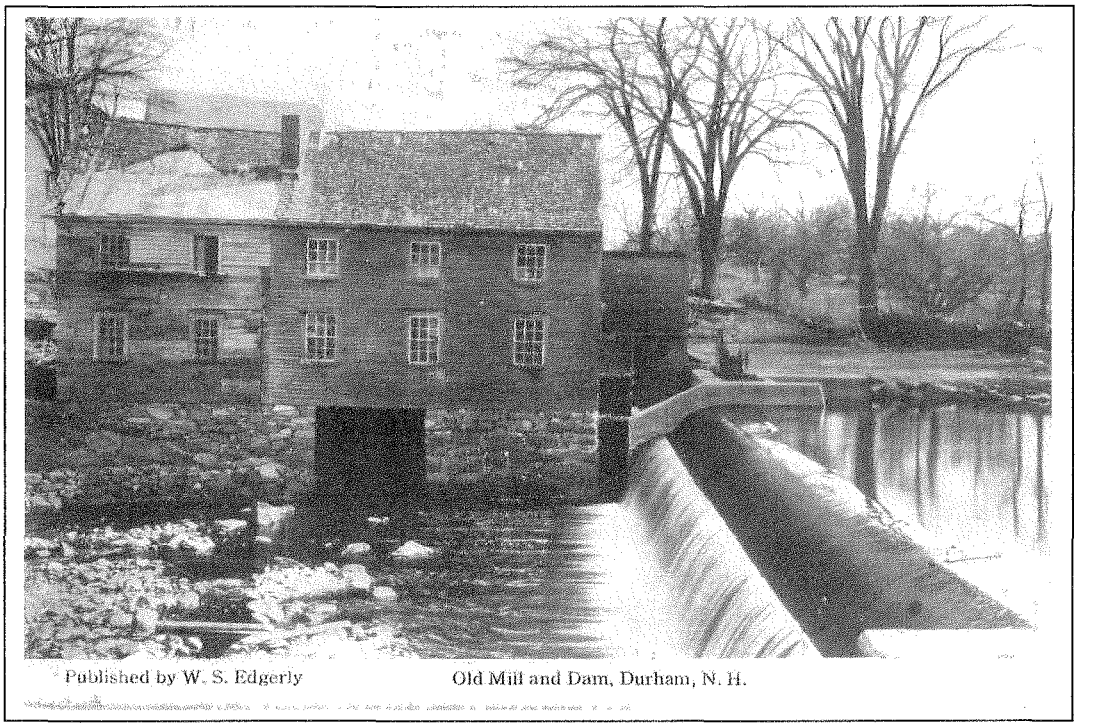
Wildlife screenings were conducted beginning in July 2000. The first screening was on July 22, 2000 and made note of the diversity of forest types (white pine and hemlock) in the survey area. Beaver activity was noted on the survey. The second wildlife screening was held on September 23, 2000. A beaver dam was found, as well as a red-bellied brown snake. The water clarity in the river was reduced as it passed through an area of clay soils. Spruce Hole (a large kettle hole with a sphagnum bog) was visited and contained black spruce and cotton grass. The third wildlife screening was conducted on January 27, 2001. This was a very rich wildlife area, with four beaver dams; six deer were sighted, and otter tracks and slides were noted. The fourth wildlife screening was conducted on February 4, 2001. On this walk, otter tracks, fox tracks and beaver

activity were noted. A beaver lodge was seen at Wheelwright Pond. No sign of deer was noted on this survey. (See Figure 10).

Water quality monitoring

An ambient water quality monitoring program has been ongoing in the Oyster River since 1990 as part of the New Hampshire Department of Environmental Services. Sampling was conducted during summer low flow periods in 1990, 1993 and 1998. Parameters analyzed included turbidity, pH, dissolved oxygen, nutrients, temperature, conductivity, bacteria, and heavy metals (aluminum, copper, lead and zinc). A grant to the University of New Hampshire was made by the New Hampshire Department of Environmental Services to conduct water quality sampling in selected areas of the water supply watershed beginning in June 2001. Of particular interest is sampling to determine if the MtBE contained in the aquifer at the Lee traffic circle is migrating into the surface waters of the water supply. Testing will include turbidity, pH, dissolved oxygen, nutrients, temperature, conductivity, bacteria, and volatile organic compounds (VOC's). The sampling will run year round, with bi-weekly sampling and event sampling. (See Figure 11).

III. The History of the Oyster River Watershed Association



The Old Mill and Dam

III. The History of the Oyster River Watershed Association

A. Creating an Adaptive Watershed Management Plan

The Oyster River Watershed Association had its genesis in local citizens concern over the loss of large tracts of agricultural lands in the watershed. The Association held its first meeting in early 2000 and was attended by twenty people. The group set to work gathering group consensus on what they perceived as important qualities and concerns and discussed actions that they could take. During the process of discussing common issues and perceptions, it was clear that the Association needed to develop a statement of its purpose, a statement that could provide them with cohesion and clarity, and a statement to serve as a gentle reminder of why they initially came together. The statement of purpose for the Oyster River Watershed Association follows:

To protect, promote and enhance the ecological integrity and environmental quality of the Oyster River Watershed through community participation and involvement.

This broad statement allowed the organization the ability to explore what it perceived as the valuable qualities that were within the watershed, qualities that gave rise to ecological integrity and environmental quality. Once identified, the apparent threats to these qualities were listed as well. Knowing qualities and threats provided the organization with a focal point for the ensuing discussion about what needed to be done, and more importantly what they could do. To implement any kind of strategy, it is nice to have an idea of what you would like to accomplish or change. The most important part of the strategy, however, is to know what can be done using the tools and resources available to you at the time. The watershed association thus created for itself a watershed management plan which, when implemented, would support its statement of purpose. The initial watershed management plan is contained in Table 9.

The Association utilized adaptive management to allow for changes in the focus and implementation of watershed related activities over time.

Table 9. The Oyster River Watershed Management Plan-February 2000

Qualities

Quality of the lakes, rivers and streams
- Water quality
- Natural history

Recreational access:
- Recreational trails for hiking, birding, skiing,equestrian, snowmobiling and fishing

Historic value:
- Mill pond
- Other historical features

Threats

Quality of the lakes, rivers and streams:
- University parking lot runoff
- Illegal dumping
- Development

Clean drinking water:
- Gravel pits
- MtBE gas additive

Rural character:
- Development and roadway networks

Recreational access:
- Lack of planning for access and parking

Open space and unfragmented lands:
- Development and roadway

Ample water supply:
- Lamprey/Oyster inter-basin transfer

Other:
- Management of holdings of school district and town holdings

Actions

Educational programs:
- Community education
- River clean-ups
- Oyster River awareness for school children

Land protection efforts:
- Easements
- Land preservation
- Protection in general

Research and data gathering:
- Inventory of riverfront owners
- Inventory of wetlands
- Inventory of all natural resources along the river

Linking with communities:
- Evoking feelings about special places

During the following eighteen months, this watershed management plan served as a focal point as the organization continued to grow and evolve. The plan became a framework for the organization during this time, which could be reinforced as well as being expanded. Through the implementation of identified activities, the plan was reinforced. Through the addition of new activities that related to the qualities and concerns, the plan was expanded. It was through the association's ability to allow for change and growth that the watershed management plan was a document that became alive through citizen action while reflecting evolving community needs. The watershed management plan, as it represents current activities, is contained in Table 10.

Table 10: The Oyster River Watershed Management Plan- June 2001

Qualities

Quality of the lakes, rivers and streams:
- Water quality
- Natural history

Clean drinking water:
- Quality of the surface and groundwater

Open space and unfragmented lands:
- Open space and its effect on quality and quantity of water
- Undeveloped lands
- Corridors

Recreational access and areas:
- Recreational trails for hiking, birding, skiing, equestrian, snowmobiling and fishing

Ample water supply:
- Quantity of surface and groundwater

Historic value:
- Mill pond
- Other historical

Threats

Quality of the lakes, rivers and streams:
- Lee traffic circle-runoff, hazardous materials, road salt
- Agricultural runoff
- University parking lot runoff
- Illegal dumping
- Development and roadway networks

Clean drinking water:
- Gravel pits
- MtBE gas

Recreational access:
- Access and parking

Other:
- Management of school and town holdings
- General lack of citizen awareness
- General homeowner impacts-lawn runoff, do-it-yourselfers
- Disincentives to stewardship because of tax laws

Rural character:
- Development and roadway networks
- Growth in general

Open space and unfragmented lands:
- Development and roadway networks

Ample water supply:
- Lamprey/Oyster interbasin transfer
- Excessive withdrawals of water
- Consumption within and export out of the watershed
- Sustainable water budget for the watershed

Table 10. The Oyster River Watershed Management Plan- June 2001

Actions

Land protection efforts:

- The Tamposi property in Barrington
- The Kimball Woods project in Lee
- The Schulz Land
- Current use fess and community capital investment funds

Linking with communities:

- Review of community preparedness in the watershed
- Emergency response teams-linking with Jackson Estuary Lab

Educational programs:

- Water quality training
- Biological monitoring training
- School program-Project Home/Project Wild
- Art show
- River signs
- ORWA Brochure
- Traveling display
- Coastal Watershed Forum

Resource planning:

- Development of the Oyster River Watershed Management Plan
- Risk analysis for existing and future conditions
- Development of environmental indicators for the Oyster River watershed

Encouraging local regulation:

- Extended wet detention pond treatment in College Brook
- Management of the Moore fields at UNH
- Management of gravel pits in the area

Establishing communication pathways:

- River Clean-up with UNH Office of Sustainability
- Community Development project with UNH

Organizational development:

- Non-profit status

Research and data gathering:

- Development of GIS databases
- Biological stream sampling
- Wildlife screenings
- Water quality monitoring
- Lee traffic circle CERCLA investigation

B. The watershed plan comes to life; A description of activities to date

Below is a list of activities that have been completed or are currently underway.

- Organizational development
- Educational programs
- Land protection efforts
- Research and data gathering
- Resource planning
- Linking with communities
- Encouraging local regulation

Organizational development

Non-profit status

The Association has been working to obtain non-profit status within the State of New Hampshire. The Articles of Agreement of A New Hampshire Nonprofit Corporation have been drafted by a working group and submitted to the Association for review. The organizational bylaws have been drafted by the working group. A final copy of the bylaws was signed by members of the Association in April 2001, and submitted to the state.

Educational programs

Water quality monitoring training

Training for water quality monitoring was held on May 24, 2001 with the help of the New Hampshire Department of Environmental Services Volunteer River Assessment Program. Funding for the monitoring has been provided in part through the New Hampshire Department of Environmental Services Source Water Assessment Program. Some of the volunteers (15) are new members of the watershed association and offered their time after they were contacted during the community assessment of qualities and concerns as part of the development of the Oyster River Watershed Management Plan.

Biological monitoring training

A workshop on biological stream screening techniques was held in July 2000 with the help of Rob Brown, a high school biology teacher from the Wheeler School in Providence, Rhode Island. The session was attended by ten people, where they learned about sampling procedures for aquatic macroinvertebrates in combination with water quality parameters (dissolved oxygen) to determine aquatic health.

Project Home/Project Wild

The New Hampshire Department of Fish and Game is working with students at the Oyster River Middle School to increase environmental awareness through the creation of wildlife habitat around the school. Two fifth grade classes are studying the watershed and doing some water testing with the salmon-raising project.

Art show

An art show that could serve as a community awareness and educational tool has been discussed. A desired location is the Mill Pond Center in conjunction with the Durham Art Association.

River signs

An effort has been made to design and install river signs on highly traveled roadways in the watershed. Some desired locations for river signs include state roadways (Routes 155, 125, 4, 155A, and 108). Currently the state is looking into the issue of "sign pollution" and has restricted the placement of signs along these roadways. It is hoped that this could become an Eagle Scout project.

ORWA Brochure

A brochure was developed for use as a handout at public gatherings. The brochure contains information about the Watershed Association, what it hopes to achieve, and how citizens can be involved in long-term protection. Contact names and a listing of other watershed efforts are provided.

Traveling display

The traveling display was created so that various members could bring information to local events and other locations within the watershed. Many pictures in the display were taken during the wildlife assessments. The traveling display has been used at Madbury Day (June 10, 2000, and June 9, 2001), Lee Country Days Celebration (June 17, 2000), Lee Fair (September 9, 2000), Durham Day (September 17, 2000), UNH Employee Benefit Fair (October 19, 2000), the DES Watershed Conference (November 18, 2000), the Coastal Watershed Forum (February 8, 2001), the annual meeting of the Strafford County District (April 5, 2001), the Strafford County Cooperative Extension Farmers Meeting, and Earth Day at the University of New Hampshire (April 22, 2000). The display was used at local libraries as a display in Lee (August-September),the Durham Public Library (October), and the Oyster River Middle School Library (January-February). The display was used for the public meetings held in Barrington (March 17, 2001) and Durham (March 19, 2001). Town meetings in Madbury and Lee provided opportunities for the display to be put up. The ORWA teamed up with the Office of Sustainability to have the display at the UNH Ben Thompson Work Day on April 26, 2001.

Coastal Watershed Forum

The Coastal Watershed Forum was attended on February 8, 2000. The Oyster River Watershed Project was one of the only protection efforts represented at this meeting, as compared to other watershed projects that were concerned with restoration.

Working with neighboring watershed associations

The Moose Mountain Watershed Association and the town of North Barnstead (Upper Suncook region) have been in contact with the Oyster River Watershed Association to find out more about forming an association and ways to get things moving. Both organizations will be invited to attend future meetings.

Land Protection Efforts

The Tamposi property

The first meeting for the Tamposi property was held on October 26, 2000. The land is approximately 1350 acres and one of the largest unfragmented forests in the area, and the site of three Atlantic White Cedar swamps which are endangered. The land forms the headwaters for the Oyster River and a tributary of the Bellamy River, both of which are public water supplies. The land is being considered for purchase under the States Water Supply Protection Program. All communities (Barrington, Dover, Durham, Lee, Madbury, and UNH) agreed to give $6,000 towards costs associated with acquisition. The state is providing $700,000 towards acquisition while the remainder is being taken as a charitable contribution from the property owner. Work continues on activities such as the land appraisal and boundary survey.

The Kimball Woods project

The Town of Lee worked with the Friends of Kimball Woods to purchase the land, which is 75 acres in size. It was placed on town warrant for the Lee Town meeting in March and passed with the approval to spend $225,000 as a fee simple purchase. Neighboring landowners (Joe Ford, 70 acres, Don Quigley, 40 acres, Fred Short, 10 acres, Tom Lee, 10 acres, and John McLean 4 acres) have volunteered to donate easements adjacent to Kimball Woods, which would allow for the preservation of over 200 acres of land in Lee.

The Schulz Land

Steven Schulz has given a 93-acre conservation easement to the Town of Lee. The Town of Lee accepted this easement in March.

Current use fees and community capital investment funds

The City of Dover approved in November of 1999 that all current use fees be set aside for conservation, including land and easement acquisition. The Town of Lee has been setting aside and using funds to buy easements and land for conservation. They have a committee that actively seeks out and evaluates potential acquisitions. The Town of Madbury is also active in looking for lands to purchase for conservation.

Research and data gathering

Development of Geographic Information Systems (GIS) spatial databases

A series of GIS maps have been developed from existing databases and available information for use by the Watershed Association with the help of the Strafford Regional Planning Commission through its GIS Services. Information that was important to have on the maps included hydrography, wetlands, land use, soil information, aquifer location and transmissivity, flood zones, community zoning and tax map parcels, topography, roadways, unfragmented lands, historical and natural heritage features, and co-occurrence of farmlands, wetlands and aquifers. To date, the maps which the Association has gathered or developed include (1) Conservation lands, (2) Land use and zoning, (3) Wetlands and floodplains, (4) Ground Water Resources and Hazards, (5) Farmland Soils, (6) Unfragmented lands, (7) Co-occurring Critical Features, (8) Municipal Sourcewater Protection Areas and (9) Municipal Source and Service Areas (See Figures 2-8, Figures 12-13). The maps have provided a focal point for many discussions within the Association and at public gatherings. As an assessment tool, the maps have been used to identify high priority areas for water quality, and biological and wildlife assessment sites throughout the watershed. As a planning tool, the maps have been used to support the development of a watershed risk assessment and environmental indicators. As an educational tool, the maps have been used to direct mailings to citizens within the watershed. The critical base maps that have been developed by the Association will be of use for future natural resource management purposes as well. For example, planning and management decisions which relate to erosion, water quality, hydrologic modifications, upland habitat, aquatic habitat, channel networks and community resources can all be supported through the use of these GIS maps.

Important GIS layers that were used by the Association included topography, hydrography, wetlands, soils, aquifers, flood zones, roadways, zoning and tax parcels and unfragmented lands.

Biological stream sampling

Biological stream sampling was conducted at several sites throughout the watershed. The biological stream sampling helped the Association determine the overall status of the watershed and to identify potential areas for restoration. Based upon the biological sampling, the watershed was determined to be in good condition, and that the emphasis should be on protecting the quality of the resources. (See Figure 10).

Wildlife screenings

Wildlife screenings were conducted beginning in July 2000. The wildlife screenings suggested that a diverse wildlife population existed in the watershed that was consistent with the forest type and location. Prominent wildlife signs that were observed or direct observations that were made indicated that the area was inhabited by beaver, river otter, deer, fox, herons and cormorants. (See Figure 10).

Water quality monitoring

The water quality sampling in selected areas of the water supply watershed will yield information on the long terms trends of the quality of the water. Testing is being conducted in the headwaters to the water treatment plant as well as other areas throughout the watershed. (See Figure 11).

Lee traffic circle CERCLA site investigation

The Association will be inviting a representative from the New Hampshire Department of Environmental Services (Susan Willoughby) to speak about the contamination problems associated with MtBE at the Lee traffic circle.

Resource planning

Development of the Oyster River Watershed Management Plan

The Watershed Association began the development of a watershed plan in August 2000 with funds from the New Hampshire Estuary Program. The effort focuses on finding common ground with communities, the University and different agencies including the Great Bay Estuaries

project. An emphasis has been placed on integrating the plan with municipal Master Planning Process. A large part of the project has been to develop organizational structure and set up communication pathways. Establishing community liaisons to bring forth the concerns of the watershed association will be important. Focused interviews along with surveys of riverfront property owners and ORWA members were used to identify priorities related to qualities, concerns and actions for the Watershed Association. A workgroup was formed to develop the framework for the management plan. Public meetings were held in Barrington and Durham (March 17th and 19th, 2001) to gather public input into the plan.

Risk analysis for existing and future conditions

The concept of using a risk assessment that identified existing and future sources of risk throughout the landscape has been discussed. It was apparent that as the communities changed over time through changes in land use, the type and degree of risk would change as well. More importantly than the changes in the risk itself would be the capabilities of the individual

The results of a risk assessment need to be tied directly into the community master planning process.

communities in addressing the risks. Any risk assessment will need to include a mechanism for change. The risk assessment can serve as a central core from which a watershed management plan can evolve and act as a catalyst for change within the communities and the Association. For these communities, this means that the results of the risk assessment need to be tied directly into their master planning process and land use regulations. It will be through this mechanism that the watershed management plan can become a living, working document.

Development of environmental indicators for the Oyster River Watershed

Whether to use a risk assessment to direct short and long term management of this watershed brought up a discussion of environmental indicators for the watershed. There was a clear desire on the part of the workgroup members to pursue the use of indicators that reflect the changes in

the quality and quantity of the drinking water over time. The indicators could be based upon the risk factors that would be used as part of the risk assessment. A series of preliminary risk factors were identified by the workgroup. The risk factors were used to help initiate a discussion of preliminary environmental indicators that could be used by the Association and the communities.

Linking with communities

Review of community preparedness

An interview with the Fire Chief in the Town of Lee has indicated that the Town itself is not as prepared as it would like to be to respond to an emergency situation, or to respond to catastrophic events. There was a suggestion that an effort be made to have discussions with neighboring communities regarding the possibility of creating a regional response team. It was felt that site-specific events were a concern, but the catastrophic events could be more of a concern over time. Catastrophic events would include response to fires and floods.

Establishing communication pathways

River Clean-up with the Office of Sustainability

A river clean-up was held in conjunction with the University of New Hampshire Office of Sustainability Programs and the New Hampshire Coastal Program in September 2000 as part of the International Coastal Clean-up Day.

Community Development project with UNH

Students from the University of New Hampshire developed a project to link the university community with the watershed. The project will include the construction of a permanent sign at the Water Treatment Plant, which will have space for current events and exhibits.

Encouraging local regulation

Extended wet detention pond treatment in College Brook

The University of New Hampshire has obtained approval for the construction of an extended wet detention pond to treat runoff prior to entry into College Brook. Funds for the construction of the project are directly from the University.

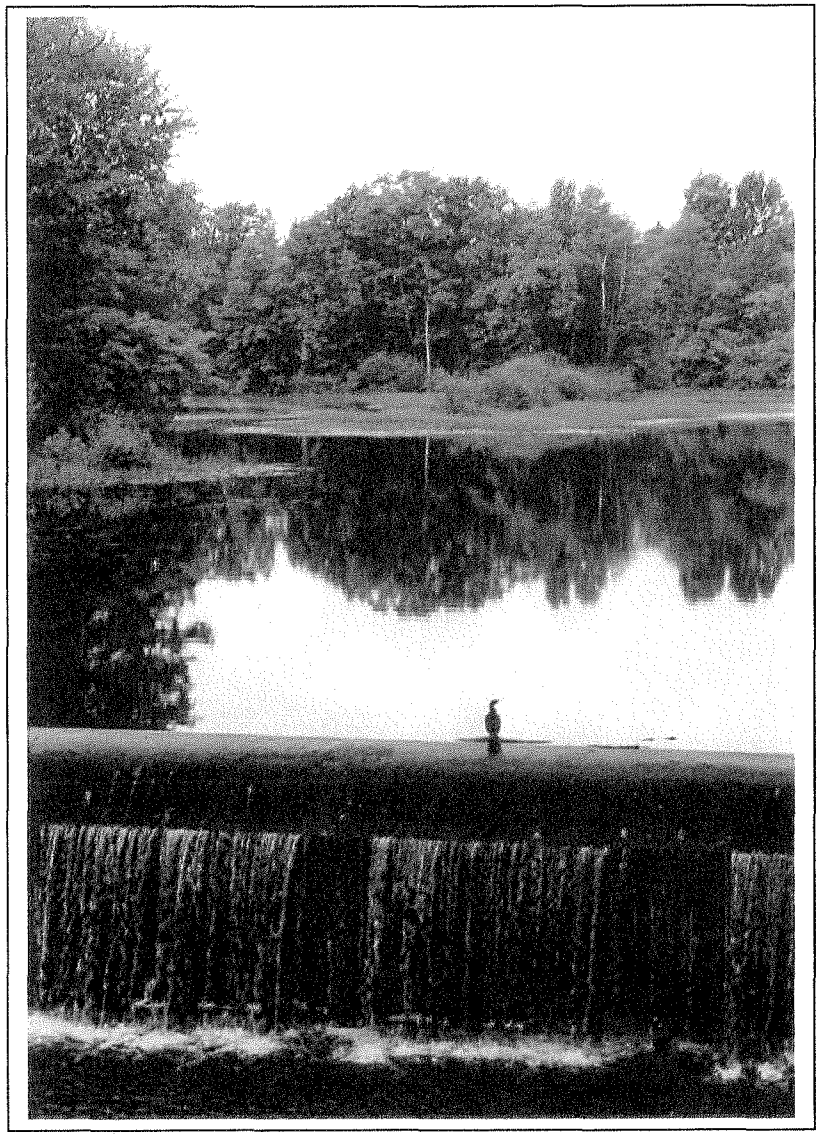
Management of the Moore fields at UNH

The University of New Hampshire is currently having discussions with a local business to develop the Moore Fields into a soccer complex that would include a stadium, bleachers, two Astroturf fields and nine grass playing fields. Drainage plans are being carefully designed to prevent nonpoint source pollution into the river.

Management of gravel pits in the area

Important gravel pits have been identified on Snell Road, Mill Road and Old Concord Road. The management of gravel pits is closely tied with community tax incentives for management of lands. This issue will be looked into through the Department of Revenue. In addition to the taxation issue is the long-term management of these areas. As part of the Source Water Protection Plan for the Water Treatment Plant, inspections of the area around the Durham well will be conducted. This area includes six (6) gravel pits. Regular inspections should help to prevent contamination of the aquifer.

IV. Growth of the Oyster River Watershed Management Plan: A Process for Change



A cormorant rests on the Wiswall Dam

IV. Growth of the Oyster River Watershed Management Plan: A Process for Change

The purpose of the community sessions was to clarify where commonalties and differences were within the watershed. For the Oyster River Watershed Association (ORWA), the community sessions presented a challenge along with a tremendous opportunity. The challenge was that the organization itself was little more than one year old. Although projects such as the display board had been underway to let local people know about the Association, it was difficult to determine how many people knew about their efforts and would be willing to become involved in this process. The Association wanted to ensure that they were developing a plan that would reflect community desires. In light of this challenge, the community sessions were viewed as an opportunity to engage a broader audience in the overall efforts while gaining insights into common desires and differences. The entire process was viewed as a time to grow as well as to refine, and perhaps a time to consider change as well as to further embrace fundamental beliefs. To move forward, the ORWA decided to use an approach that allowed them to evaluate and refine their own identity, while casting a broad net outward to more fully understand what a greater community identity might be. The approach utilized a core group working in tandem with public meetings. For both the core group and the public meetings, the desired outcome was to understand perceived qualities within the watershed, to identify their concerns, and to identify actions that could be taken, primarily by the Association. The watershed workgroup consisted of two representatives from each of the five communities, along with representatives from the Association and the University of New Hampshire. The workgroup met a total of three times prior to the public meetings. Two public meetings were held in the watershed, one in Barrington and one in Durham. Barrington and Durham were both considered critical communities to the efficacy of the management plan, but for different reasons. Barrington was in the process of spearheading an ambitious inter-community effort to purchase a large tract of land (the Tamposi property) in the headwaters of the Oyster River. The Bellamy River watershed is immediately adjacent to the Oyster River watershed. The inter-community dynamics that did effectuate the purchase of the Tamposi property would be the same dynamics necessary for a viable watershed management plan. Durham was selected because of the diverse community groups in the town. The community groups were all very active individually. It was perceived that it was important to

welcome and utilize this diversity to fully understand the broad perspectives of the entire watershed community.

A. Understanding Community Values and Concerns to Develop Future Action for the Watershed

The Watershed Workgroup

The watershed workgroup decided to use information gathered from a previous survey of Association members and riverfront property owners to open their discussion of qualities, concerns and actions. The results of the survey regarding uses showed that wildlife habitat was ranked the most important followed closely by the quality of the lakes, rivers and streams. Open space and unfragmented lands were ranked the third most important quality. When survey participants responded to the perception of diminishing quality or threat, the quality of lakes, rivers and streams was ranked first, followed by open space and unfragmented lands, and thirdly by a reduction in the quality of drinking water.

The workgroup wanted to explore more fully the concept of water and what it meant to the greater community in the watershed. It was clear from their discussion that the fundamental issue was the watershed itself as a water-bearing unit that provided the drinking water for the area. They felt that the plan should be about drinking water as a unifying theme, as the stated concern for the group and as the highest priority for the watershed management plan. With drinking water as the focus for this plan, it was quickly recognized that both the quality and quantity of this resource needed to be addressed. The importance of water for human consumption did not, however, negate the importance of other qualities in the watershed. It was felt that these other qualities, such as open space and unfragmented lands, could be viewed in relation and attendant to maintaining the quality of the drinking water.

The quality and quantity of the drinking water supply was considered by many to be at risk, but not in a state of crisis.

With these thoughts in mind, the workgroup began to question the status of the drinking water in the watershed. The watershed was considered by many to be at high risk in regards to quality and quantity, but not necessarily in a state of crisis. However, it was very clear that the window of opportunity to put long-term protection measures into place might have already passed. As such, aggressive, proactive management needed to be considered along with a diminution of future risk to the water supply.

The Public Meetings

The public meetings were conducted in a manner that facilitated open discussion and reporting while allowing for integration of everyone's opinion. A Master of Ceremonies who was from the Oyster River Watershed Association conducted the entire meeting. This person introduced the organization and was responsible for collecting and recording the information as the meeting proceeded. Working tables of 8-10 people were established, with a single facilitator at each table. Each facilitator was a member of the Watershed Association or a representative from a community on the workgroup. Each table was given a period of time to discuss an issue, beginning with Qualities, followed by Concerns and then by Actions. At the end of the time period, all of the tables reported back to the Master of Ceremonies, and a master list was compiled. An important dynamic for the public meetings were the small working tables and the use of community or watershed representatives as facilitators. The facilitators were not just familiar with the issues, they were living with the issues. There was no need for interpretation of the intent and desire of the community. There was no need to do any more searching for answers to community concerns, or to understand what needed to be done. It was all said as it was being lived.

"After going through this process, you will find there are priorities. When you come to know them, stay with them. Then, go out and do what you do best..."

A great recommendation from the public meetings came at the end of the meeting in Durham. An elderly gentleman raised his hand, and asked if he could speak to the group in general, to offer

some advice to the group as a whole. His advice was true and real, expressing the wisdom that comes with time, "After going through this process, you will find there are priorities. When you come to know them, stay with them. Then, go out and do what you do best as an organization. Keep this in mind and you will be successful." Knowing the organization, knowing the priorities and taking actions.

B. Summary of qualities, threats and concerns and recommended actions

The process of examining the perceptions held by the Association, the workgroup and the watershed community revealed that the commonalties were many and the differences few. In fact, many qualities, concerns and actions were repeated. These qualities, concerns and actions have been summarized for the entire community (Tables 11-13). Although these lists provide insight into the current status of the watershed, they do not begin to tell the real story of the dynamics within this watershed. The real story is how the watershed has shaped the communities and the people that live within it. The watershed and its communities are very diverse, all interacting with the watershed and its resources in different ways. Sometimes these interactions are very individual and offer unique community perspectives. It could be a special place within the landscape favored by community locals. It could be the unique community heritage that emerges from a diversity of land uses as historical industrial areas blend with outlying farmlands. Sometimes these interactions are encompassing and offer insights into the shared community desires. The enjoyment of broad landscapes and gently rolling hills. And so it is with the Oyster River watershed, a mixture of individual and community responses to the natural system that supports and surrounds them. What emerged from this process as priorities were those aspects of the watershed that offered interaction to the community as a whole.

Table 11. Important Qualities of the Oyster River and its Watershed

Quality of the lakes, rivers and streams:
- Water quality
- Natural history
- Tidal marshes
- Non-tidal marshes
- Soil quality
- Wetlands

Ample water supply:
- Quality of the surface and groundwater
- Aquifers

Clean drinking water:
- Quality of the surface and groundwater

Wildlife habitat:
- Biodiversity and wildlife
- Flora and fauna
- Wildlife habitat

Open space and unfragmented lands:
- Effect of open space on the quality and quantity of water in the system
- Corridors
- Unfragmented lands

Rural character:
- Solitude
- Rural character
- Variety of land uses creating a mosaic

Other:
- Area for education and research
- Watershed as unifying body for communities
- Inter-municipal communication
- Role in Great Bay ecosystem

Recreational access and areas:
- Recreational trails for hiking, biking, birding, skiing, equestrian and fishing
- Public access and the role of UNH

Historic value:
- Historical uses for brickyards, mills and dams
- Historical agricultural lands
- Other historical features

Fisheries:
- Fish stocks for fishing and food for wildlife
- Fish habitat
- Wildlife habitat

Scenic values:
- Scenic vistas

Table 12. Perceived threats to and Concerns in the Oyster River and its Watershed

Quality of the lakes, rivers and streams:

- University parking lot runoff
- Lee traffic circle-parking lot runoff, hazardous materials, road salt
- Illegal dumping
- Development and expansion of roadways
- Upstream impacts and downstream uses
- Agricultural runoff
- Effect of development and siltation to Beards Creek and Mill pond
- Enforcement of existing regulations
- Development or refinement of regulations to meet local desires
- Designation of prime wetlands
- Disposal of biosolids and solid waste
- Lack of floodplain

Open space and unfragmented lands:

- Growth in general-development and expansion

Fisheries:

- Restoration of shellfish to estuary

Ample water supply:

- Lamprey/Oyster inter-basin transfer
- Excessive withdrawals of water
- Consumption within and export out of the watershed
- Sustainable water budget for the watershed
- Effect of imperviousness on recharge
- Growth of UNH campus

Historic value:

- Preservation of dams, prime agricultural soils and agricultural lands
- Community heritage as agricultural use

Other:

- Management of public lands by the school district and towns
- General homeowners impact; lawn runoff, do-it-yourselfers, etc.
- General lack of citizen understanding of how to use the river and its resources sustainably
- Understanding what it means to "Keep it Clean"
- Disincentives in stewardship because of local taxing policies

Clean drinking water:

- Gravel pits
- Madbury Metals-migration into aquifer
- Lee traffic circle-MtBE
- Identification of aquifer boundary in Durham
- Aquifer contamination
- Private well identification

Recreational access and areas:

- Access and parking
- Meet local needs first

Rural character:

- Growth in general-development and expansion of roadways
- Traffic corridor development

Wildlife habitat:

- Loss of native species and threats of exotic invasives in both aquatic and terrestrial habitats

Table 13. Desired actions for the Oyster River Watershed Association

Educational program:
- Community education
- River clean-up
- Oyster River awareness for school children
- Create a physical model of the Oyster River and watershed
- Working with the UNH Office of Sustainability Programs

Linking with communities:
- Regional approach for watershed management needs
- Meeting the needs of the seacoast

Establishing communication pathways:
- Web site and information clearing house
- State supported recreational opportunities
- Fish and game access
- Communicate with other organizations

Land protection efforts:
- Easements and development rights
- Look at community taxing structure to encourage stewardship
- Protection in general
- Greenways
- Wildlife corridors
- Critical habitat protection
- Land preservation

Encouraging local regulation:
- Management of gravel pits in the area
- Consistent shoreland protection
- Consistent implementation of zoning regulations
- Biodiversity policy for the watershed
- Local enforcement
- Roadside vegetation control
- Alternative patterns for development
- Model legislation
- Improved zoning ordinances
- Private well log requirements
- Water conservation all the time
- Management of fresh water impoundments
- State and other agencies more involved

Resource planning:
- Watershed risk assessment
- Development of environmental indicators
- Develop management plan
- Prime wetlands designation
- Delineation of the aquifer

Environmental advocacy:
- Evoking feelings about special places

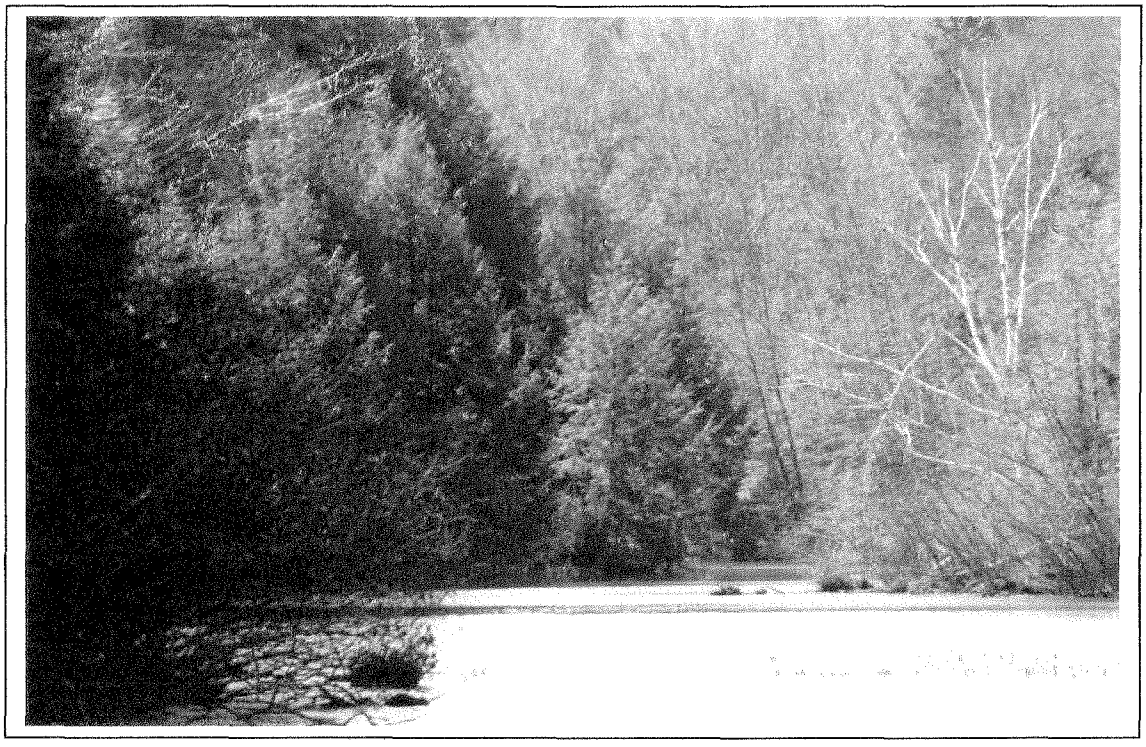
Research and data gathering:
- Inventory of riverfront owners
- Inventory of wetlands
- Inventory of all natural resources along the river
- Comprehensive monitoring program
- Identify point and nonpoint sources of pollution
- Identify river crossings
- Delineate aquifer boundary better

C. Linking with neighboring watershed efforts-A comparison with the Coastal Program, Great Bay, Exeter River, and the River

Each watershed will possess unique qualities that the community will want to protect or enhance. The watershed will also possess qualities that it may share, through landscape linkages, with neighboring watersheds. These shared qualities can sometimes serve as broad, overarching goals that are often recognized as part of large basin plans. In reviewing the plans for neighboring watersheds (the Exeter River and the Lamprey River) it was found that there were shared qualities that could be managed through complimentary efforts. The qualities for the Exeter River included the protection of water quality and quantity through an identification of point and nonpoint sources of pollution by establishing local land use controls, the protection of wildlife habitat through the protection of riparian zones, and a desire to educate the citizenry through the use of best management practices (BMP's) and land protection. In the Lamprey River, shared qualities included protection of water quality through the management of nonpoint sources of pollution, managing water quantity through water conservation efforts, and to sustain the river's integrity through land protection (shoreland, floodplain and wetland protection) and sensitive development.

The qualities and priority actions that were identified in the Oyster River watershed which are also recognized as part of the Great Bay Management Plan include the protection of shorelines through land protection and the preservation of community identity and rural character through open space management and protection. The Coastal Program efforts are focused on protecting water quality through nonpoint source management, land use management and education, and conservation easements.

V. Developing priorities for the Oyster River Watershed Association



The reservoir from the water treatment plant

V. Developing priorities for the Oyster River Watershed Association

Although the workgroup had previously discussed what the priorities for the management plan could be, it was important now to take the recommendations gathered from the community sessions and weave together a management plan that reflected community consensus while targeting priority issues. The workgroup looked to the topic that seemed to dominate most discussions at the community sessions; the quality and quantity of the drinking water. This priority appears to have evolved because of the inter-community and inter-basin transfer of water supplies, along with the use of private wells. The Town of Durham and its residents are host to the University of New Hampshire, a community within itself. The Oyster River provides the public water supply for the University and a portion of Durham. The demand for water to sustain the combined population is significant enough, especially during low flow conditions, to necessitate inter-basin transfers from the neighboring Lamprey watershed. The Town of Durham also has additional supply from a groundwater well that is located in the Town of Lee. Water bans have been used in the past in Durham during drought conditions. The City of Portsmouth, which lies outside of the watershed, partially provides for its residents through three groundwater wells located within the watershed in the Town of Madbury. A majority of the residents in the watershed who live in outlying rural areas such as Barrington, Madbury and Lee are on private wells.

The other priority which garnered as much attention and discussion as water supply was the impact of growth upon the watershed. The discussions that were held concerning growth identified issues that were much larger than the need for more roads and housing. Discussions revolved around the impact of growth upon the landscape as a whole, how growth would change the feel of the watershed; altering the rolling terrain, blocking scenic views, destroying woodlands, forever changing the expansiveness provided by open agricultural fields along the roadways, fragmenting the community heritage. The watershed and its landscape reflect generations of people who lived an agricultural life. This heritage, as expressed through the landscape, is threatened by growth.

These two priorities, water supply and growth, are closely linked to one another. It was perceived that many efforts to address one issue could also address another. The priorities, although initially perceived as being at odds with one another, could provide complementary solutions. With these thoughts in mind the workgroup developed a series of critical questions that would serve as the basis for future decision-making.

A. Developing critical questions

The workgroup developed a series of questions that addressed the priorities while allowing for the opportunity to contemplate methods to address these priorities. These were referred to as critical questions because they served as the framework for discussions and activities that supported the major objectives of the watershed management plan. The questions are found below.

Critical questions served as the framework that supported major objectives of the watershed management plan.

Open Space and Rural Character

- *Where are the most important community resources in regards to rural character and open space?*
- *What land protection opportunities are available to maintain rural character?*
- *What land protection opportunities are available to maintain open space?*

Quality of the Surface and Groundwater

- *What is the general surface and groundwater sensitivity in the watershed?*
- *Where are the areas of significant surface and groundwater interactions?*
- *What land protection opportunities are available to maintain the quality of the water supply?*
- *What management techniques are available to maintain the quality of the water supply?*

Quantity of the Surface and Groundwater

- *What is an estimate of the sustainable yield of the watershed?*
- *What are the existing and future factors that can affect the sustainable yield?*

- *What management techniques are available to maintain the quantity of the water supply?*
- *What management techniques, such as water conservation, are available to support wise use of available water supplies?*

B. Utilizing a Relative Risk Assessment as a Planning Tool

To answer several of the critical questions, a risk analysis was considered to identify and rank risk factors that contribute to the degradation of the quality and quantity of the water supply in the Oyster River watershed. These risk factors can be overlain onto areas that contribute to maintaining a clean and ample water supply. Within these areas, various watershed management practices can be implemented. A GIS map was developed to aid in the discussion of the existing and future risks to identified water supply resources in the watershed (Figure 12, described in detail below).

Critical GIS data layers for risk assessment would include hydrography, topography, aquifers, land use, sourcewater protection areas, infrastructure and population.

A review of completed risk assessments for the area included the New Hampshire Comparative Risk Assessment (May 1997) and the New Hampshire Estuaries Project: Identification of Critical Lands Threatened by Development.

The New Hampshire Comparative Risk Assessment identified specific risk categories for a number of concerns (ecological integrity, public health, and the economy) and allowed the development of weighting factors for each risk factor. Each concern was then summed up individually, and then all three concerns were combined to yield a comparative risk assessment for all risk factors.

New Hampshire Estuaries Project was conducted to evaluate relative risk from one specific risk factor, that being increased development. To identify critical areas, developable land (available lands - marginal lands) were identified and then overlain with critical natural resource characteristics (water quality buffers, wildlife habitat, locally important lands, drinking water resources, and unfragmented lands).

In looking at these two projects, it becomes apparent that areas the Estuaries Project generalized as threatened by future development were identified by the Comparative Risk Project as individual risk factors: The Estuaries Project did not try to rank any of the critical natural resource values.

- degradation of surface water habitat;
- loss of land habitat from development;
- physical alteration of aquatic and shoreland habitat;
- loss of aquatic habitat;
- degradation of forest habitat by fragmentation;
- petroleum in groundwater;
- hazardous wastes in groundwater;
- nitrates in groundwater;
- petroleum in surface water;
- soil damage from erosion;
- other metals in surface water;
- road salt impact on land use;
- road salt impact on groundwater;
- Polycyclic aromatic compounds (PAH's) in surface water.

The Oyster River risk assessment project could be somewhat of a hybrid between each of these approaches, in that water supply (quality and quantity) has already been identified as the priority issue, and a relative ranking could be conducted for existing and future risk factors. A GIS format would be useful, taking advantage of critical data layers already developed by the Association. These data layers would include hydrography, aquifers, topography, land use, infrastructure and population. The most important work, remaining to be done, is an agreement on the risk factors and the development of the ranking system (if desired). A table of risk factors was drafted for discussion purposes (See Table 14).

The limitation for conducting a risk assessment that would be useful for local communities was the lack of site-specific information. The data sets that are currently available from the state addresses regional issues but are not detailed enough to help local municipalities. Site-specific information is needed to conduct defensible planning and decision-making at this scale. Data needs include actual location of homes and estimates of residents by home-site in the watershed

along with reasonable estimates of consumers by type (residential, commercial, industrial) within the watershed to determine whether they are on private wells and septic systems, or a municipal system. Location data are necessary before detailed consumption maps and threatened growth areas can be identified.

Table 14. Existing and Future Risks to Water Supplies in the Oyster River Watershed

Objective	Existing Risk Factors		Future Risk Factors
	Urban Lands	**Agricultural Lands**	
Protection of water quality	Road runoff	Cropland	Increase and intensification of urban land use
	Gas stations	Pesticide storage	
	Industrial uses	UST's	
	Accidental spills	On-site septic systems	
	Private homes		
	Snow dumping		
	Automotive and repair shops		
	Junk and salvage operations		
	Car washes		
	Landfills, solid waste transfer stations		
	Golf courses		
	UST's		
	On site septic systems		
	Gravel operations		

Objective	Existing Risk Factors	Future Risk Factors
Protection of water quantity	Direct withdrawal from wells	Increased withdrawal from wells
	Excess surface water withdrawals	Conversion of lands into urban land uses

C. Development of a Water Budget for the Oyster River Watershed

The Oyster River Watershed Association is interested in assessing the availability of water within the watershed to support human consumptive use and at the same time sustain the existing aquatic ecology. A desire has been expressed to quantify water availability. All water within the Oyster River watershed is ultimately derived from precipitation. From long-term precipitation records the average annual input of water to this region is slightly over 40-inches per year. The Oyster River watershed covers approximately 20,000 acres or roughly 31 square miles. At 42-inches of precipitation per year, the total water input to the watershed is approximately 22.5 billion gallons per year.

In the Oyster River region, more than half of the precipitation is returned to the atmosphere through combined processes of evaporation and transpiration. The remaining water input to the watershed is locally estimated to be approximately 18 inches per year (or 9.7 billion gallons per year over the 31 square mile watershed). This amount would also represent the total discharge of the watershed to the Great Bay estuary. The United States Geological Survey (USGS) maintains a gauging station on the Oyster River immediately upstream of the Route 155A bridge in Durham. Average annual discharge measured at this station between 1994 and 1998 was 5.1 billion gallons. This number is roughly half of the estimated total discharge. However, since the gauging station is located in the middle of the watershed, these measurements do not reflect the discharge of the watershed areas downstream of the station. The USGS estimates that discharge from 12.1 square miles (40%) of the watershed is measured by the gauging station. Based on the recent gauging data, the rough approximation for total evapo-transpiration losses agrees fairly well. In local watersheds the total discharge is divided fairly evenly between direct runoff (overland flow) and water that infiltrates to become part of the groundwater flow system. The rate of infiltration of precipitation to groundwater is determined primarily by slope and soil permeability. This rate varies from over 20-inches per year in coarse sandy soils, to almost zero inches per year through heavy clay soils. Infiltration through loamy soils generally ranges from 6 to 12 inches per year in this region.

Groundwater is simply water which is present in the pore spaces of soils or unconsolidated surficial deposits, or water which is present within fractures in the bedrock. The quantity of precipitation that infiltrates to the groundwater system is significant to the ecology of the Oyster River watershed because it is the slow discharge of groundwater through springs and seeps that provides streamflow between precipitation events. Hydrologists call this discharge baseflow.

Manmade influences can disrupt the baseflow of a natural system. One of the most widely recognized factors is the effect of impervious surfaces. Increased paving, building roof surface area, and replacement of native forest vegetation with lawns causes precipitation to run off more rapidly, thereby decreasing the proportion of water recharged to the groundwater system. Studies have also shown that when the amount of impervious surface becomes greater than 10 to 20% of the land area, the surface water quality within nearby streams tends to be degraded.

Large groundwater withdrawals for municipal water supplies or irrigation systems can lower the local groundwater table below the nearby stream base level and actually induce infiltration from a stream or river to replace what is removed from the groundwater system. A recently completed study by hydrology students from UNH indicated that the Town of Durham water supply well in Lee draws a portion of its flow from induced infiltration from the Oyster River. The City of Dover takes advantage of enhanced production from the artificial aquifer recharge that occurs at sand and gravel washing operations adjacent to several of its municipal supply wells. The City of Dover also operates its own artificial aquifer recharge systems by pumping from the Isinglass and Bellamy Rivers when the privately-operated gravel washing operations shut down for the winter. For most of the year, such utilization of water resources by drawing from the interaction of groundwater and surface water sources is not a problem. However, during seasonally dry periods, municipal water service demands can place a significant strain on the health of riparian ecosystems.

Water resource planners are very sensitive to meeting the demand for municipal water during extended periods of drought. The long-term median daily flow rate of the Oyster River at the USGS gauging station during July, August and September averages 1.7 million gallons per day. During the early 1990's the average daily demand on the Durham/UNH water system was slightly over one million gallons per day, greater than half of the total Oyster River flow. This illustrates the challenge that the Durham water system faces in terms of meeting demand during dry periods. Through extensive water conservation programs, Durham has reduced its average daily water use to less than 800,000 gallons per day. However, the anticipated increase in the demand of the Durham water system must somehow be accommodated.

Figure 12 depicts the three municipal sourcewater protection areas present within the Oyster River watershed. The Town of Durham and UNH water system source areas are shown in pink, Portsmouth is shown in tan, and Dover is shown in green. On this figure, wellhead protection areas have been delineated by the municipalities and are based primarily on the NHDES Phase I delineation methodology. Surface water supply protection areas are depicted as those areas recognized as "conservation lands" surrounding the reservoirs, only some of which have formal use restrictions. It should be noted that all areas of the watershed upstream of the water system intakes contribute water to the municipal supply.

- Durham draws water from a wellfield located in Lee and from a reservoir on the Oyster River. Both source areas are located entirely within the Oyster River watershed. Annual production of the Durham drinking water system has averaged 346 million gallons from 1990 through 1999, or approximately 3.6 % of the total estimated discharge of the watershed.
- The City of Portsmouth draws water from a reservoir on the Bellamy River located in Dover and Madbury, a wellfield located off Freshet Road in Madbury, and also several wells located in Portsmouth and Greenland. Portsmouth's Freshet Road wellfield is located within the Oyster River watershed. The annual production of this wellfield in 1998 was 255 million gallons, or approximately 2.6% of the total estimated discharge of

the watershed. All of the water collected by Portsmouth's water systems in Madbury and Dover is exported from the source area watersheds.

- Dover draws water from multiple groundwater source areas, some of which cross into adjoining towns. Two of Dover's delineated groundwater source areas lie astride the boundary between the Oyster and Bellamy River watersheds. Estimating the amount of water that Dover draws from the Oyster River watershed is difficult because the position of the groundwater flow divide between the Bellamy and Oyster River drainages is poorly defined, the Portsmouth and Dover source areas overlap in this area, and Dover's artificial aquifer recharge system (noted above) is located very near the watershed's boundary. Between 1995 and 2000, Dover has obtained approximately 37% (an average of 315 million gallons annually) of its drinking water from aquifers located along this watershed boundary area.

Figure 13 depicts the source and service areas for the three municipal water systems that impact the Oyster and Bellamy River watershed regions. From an inspection of this figure, it becomes readily apparent that the NH seacoast's larger municipalities are dependent of the water resources of adjoining communities, primarily in the Oyster and Bellamy River watersheds. What is significant about the draw of the municipal water systems is that they have the potential to export large quantities of water out of a watershed, thereby potentially lowering stream flow at times of critical low flow. Figure 13 illustrates the need for ever-increasing inter-municipal cooperation in managing water resources on a regional and watershed basis.

The municipal water system source and service areas shown in Figure 13 represent only two components of three-part systems that can affect water resources planning within the Oyster River watershed region. A third factor is represented by the Dover and Durham municipal wastewater collection and treatment systems. Dover's drinking water system draws heavily from source areas in the Oyster and Bellamy watersheds. Dover's wastewater disposal system discharges to the tidal portion of the Cocheco River. Durham draws its drinking water from sources within the upper reaches the Oyster River watershed and discharges to the tidal portion

of the river. Such large-scale transfers of water from upper portions of watersheds to downstream areas, or outside the watershed, can negatively impact the riparian ecosystem, particularly during low flow periods.

It should be noted that a significant portion of the population within the Oyster River watershed relies on individual wells and on-site wastewater disposal systems (or septic systems). From a watershed-water budget perspective, such systems do not significantly alter the availability of water unless that which is drawn from wells or surface water impoundments is used for large-scale irrigation projects. Water that is drawn for homeowner use generally comes from bedrock (artesian) wells and is disposed on-site through septic systems into the shallow groundwater zone. Homes with municipally-provided water and on-site septic systems may actually enhance baseflow within the watershed, if the municipal source lies outside the watershed. The design estimate for household water use is generally based on the number of bedrooms in a home. The NHDES uses a design flow of 150 gallons per day per bedroom for residential dwellings.

There is concern that the detailed information necessary to complete a water budget for the watershed is not readily available. We have some information, such as square miles of the watershed, rainfall, and consumption rates, but the demographic information is not precise enough to address hydrologic dynamics and the resulting questions. There are specific data needed to be able to discuss this issue more completely. For example, occasionally the Town of Durham and the University of New Hampshire pump water from the Lamprey River to augment the municipal water supply. Exact figures on the number of residents that live within the watershed using private wells are unknown. In addition, complete information on the volumes of water being discharged, either as wastewater from the treatment plant or through on-site septic systems, by watershed residents is unavailable.

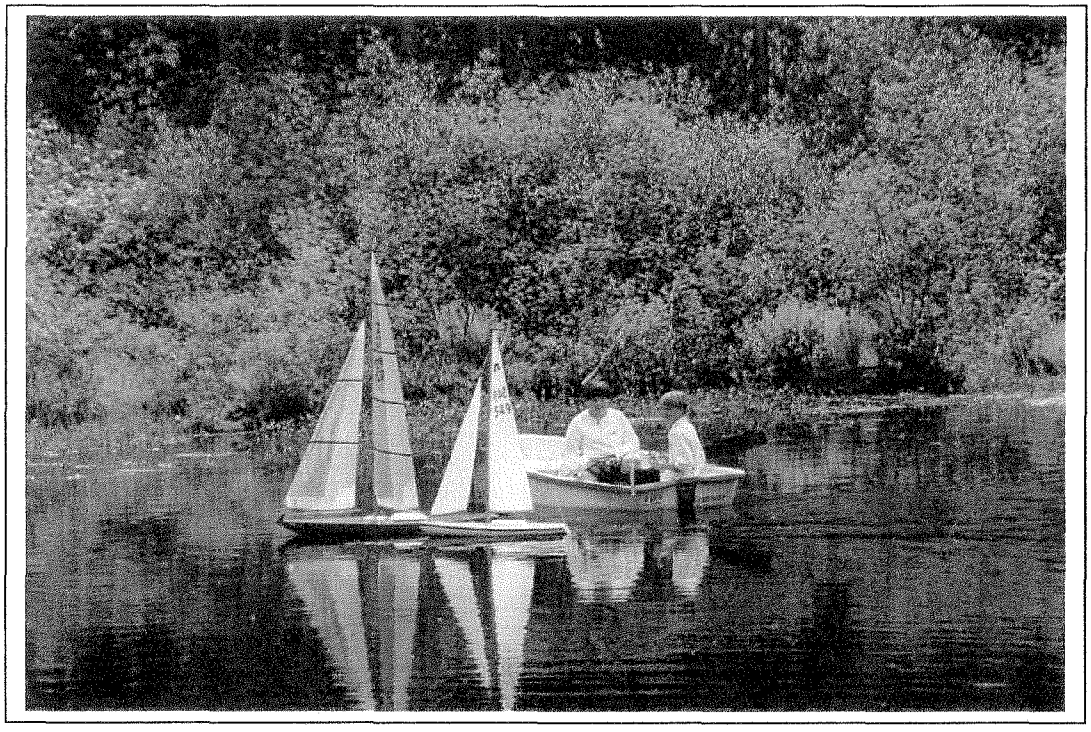
D. Linking a Relative Risk Assessment with Environmental Indicators

The workgroup determined that the use of environmental indicators to describe the changes in relative risk to the watershed over time would be useful. The preliminary risk assessment identified priority risk factors as those that would have the most significant impact on the quality and quantity of the water supply in the watershed. The environmental indicators developed for this management plan would be based upon water consumption. In the Oyster River watershed, a profile of water users revealed that some residents are on private wells, some are served by municipal water systems, and some water is exported out of the watershed to serve neighboring communities. Specifically, the Town of Durham receives some of its water from the Lee well site, the University of New Hampshire withdraws from the Oyster River to service a percentage of Durham residents and the university population, and Portsmouth withdraws from the Freshet Road wellfield in Madbury, and Dover draws an undetermined amount of water from the same aquifer utilized by Portsmouth. The representation of the water consumption, as shown in Figure 13, offers a striking overview of the issues related to consumption and inter-basin transport for the Oyster River watershed.

Using data obtained from readily available sources, a preliminary effort was made to describe the withdrawal scenarios for each community relative to one another. The preliminary estimates indicate a large increase, in the past five years, in the number of private wells drilled in Barrington and Lee. This indicator of water consumption demonstrated that the greatest rate of residential growth is occurring in the rural headwaters of the watershed. From a water-quality perspective, this type of consumption (through private wells) suggests that the water that is withdrawn from the site is probably being recharged on-site through private septic systems. This may indicate that environmental concerns attributed to development (increased roadways, other impervious area, homeowner actions) may become more important over time in these headwater areas. The rate of consumption of water through public water supplies has steadily increased during the past 10 years. The amounts withdrawn by Durham and Portsmouth have varied through the past 10 years but the net volumes from 1995 onward have been comparable.

The limitations for developing environmental indicators that would be of use for long term planning at the community level were the lack of site-specific information. The data, which is currently available from the state addresses regional issues, but are not detailed enough to allow coordinated municipal planning on a watershed basis. Site-specific information is needed to conduct defensible planning and decision-making at this scale. Data needs include actual number of consumers by type (residential, commercial, industrial) within the watershed and whether they are on private wells or the municipal system. Location data are necessary for each user before consumption volume estimates within the watershed can be generated and meaningful consumption indicators for use by the watershed communities developed.

VI. An Assessment of Tools and Techniques to Achieve Change



A summer day on the Mill Pond

VI. An Assessment of Tools and Techniques to Achieve Change

Change can bring about the desired action necessary to implement a watershed management plan. This change sometimes occurs on an individual level or it occurs on a collective community level. As individuals and communities, when change is seriously contemplated and subsequently acted upon, a series of factors will be considered, either consciously or unconsciously, relative to the change. These factors or decision criteria are significant to developing an intuitive sense of whether the change will ultimately be successful. For example, a common decision criteria would be the availability of tools necessary for change. Another criteria would be the cultural significance of the area. In watershed management, common decision criteria include community needs, socioeconomic factors, cultural significance, community support, technical capability, resource quality, available funding, time frame, watershed size, cost of inaction, and available information.

Common decision criteria include community needs, socioeconomic factors, cultural significance, community support, technical capability, resource quality, available funding, time frame, watershed size, cost of inaction, and available information.

As part of the process of developing the watershed management plan, a series of focused interviews were conducted with representatives from the Oyster River Watershed Association, the communities of Barrington, Dover, Durham, Lee and Madbury, and representatives from the University of New Hampshire. The participants represented a broad range of citizens, including landowners, members of planning boards, zoning boards, conservation commissions, Boards of Selectmen, Recreation Commissions, local citizenry, and university professors, managers and staff. The selection process for these participants relied heavily upon recommendations from their peer group. When there was convergence, that person was approached and asked to participate in the process. Using this approach, it was felt that the messages conveyed during the interview, although from an individual, would be as reflective of the greater community as possible. The responses from the individual participants have been gathered together to create

what are called Perceptions. Perceptions can be used to create a deeper understanding of how individuals and communities will make decisions and advance through the process of change. These perceptions are offered below to provide insight into this dynamic collective effort to protect the Oyster River watershed.

A. Perceptions

Barrington

What is the community's philosophical approach towards management of the natural resources in this area, and what is the greatest need?
The citizenry wants to slow growth and to stay ahead of urban sprawl to retain its rural character. In Barrington, efforts were made in the 1980's to implement protection measures, but the town was not ready for this town. Recently, prime wetlands designation has been adopted by the town as it moves towards long term resource management. Barrington is starting to use protection techniques such as conservation easements. Inaction of the community over time has put Barrington in a reactive mode while faced with important growth management issues. The town will probably end up doing more management than protection.

How closely do you perceive that organization you represent (board, citizens group, etc) ***reflects the intention of the greater community (e.g. plan viability vs. community intent).***
The land use boards are starting to move towards consensus on issues, but they still operate on individual levels to some degree. An example of the boards beginning to work together is the recent request from the Planning Board to the Board of Selectmen for help on legal/growth management issues. The Conservation Commission is presently moving forward aggressively to conserve natural resources in the town, however there is a general perception that they may be too aggressive. Appointments to the boards need to be a little stronger to be able to maintain the community character and to reflect overall community intent.

What are the public perceptions of the Oyster River and how this management plan fits in?
In Barrington growth may be unknowingly allowed and public will see benefit of the watershed approach perhaps a little too late. An educational effort needs to be conducted with the Planning Board and Board of Selectmen to show them how this effort will benefit Barrington before a serious commitment is made to the project.

What were the catalysts for the formation of or community interest in the watershed association?
There is a lot of support for regional management of the natural resources using a watershed management approach.

How would you describe the goals of the community in comparison to those of the ORWA?
In Barrington there are many large landowners that are very receptive the use of conservation easements and protection efforts. However, there are also people who want development. For

example the cluster development regulations are not well used and the recent update of the Master Plan did not include an update relative to Open Space. Because of this protection may not a high priority. As a result Barrington may remain more reactive than proactive as far as management of its resources.

What do you perceive as (a) beneficial outcome(s) from this watershed management planning effort through the watershed association?
It will be beneficial to establish an organization to manage the resources within the watershed, with mechanisms for regionalization and management of the services that the natural resources provide. In doing this the community should find a balance in doing environmental protection with a realistic view of growth.

How will your community or organization benefit from being involved in the project?
Success will be taking part in the process and looking inward to develop consensus on a management plan.

How significantly do you see private property rights affecting the outcome of this effort?
Private property rights used to be more important to the community. Historically there was not a great deal of community support for the Isinglass River project or the establishment of an aquifer protection district. However the community is beginning to realize the need for better planning and the concerns over property rights have diminished over time.

What specific mechanisms will be the most effective for watershed management in this area?
Planning

Dover

What is the community's philosophical approach towards management of the natural resources in this area, and what is the greatest need?
Dover's livelihood is based upon economic development and need for wellhead protection. Although the city is pro-growth, there is a citizen movement for more protection of the remaining resources. Currently the town is looking at creative land protection and shoreland protection approaches.

How closely do you perceive that organization you represent (board, citizens group, etc) reflects the intention of the greater community (e.g. plan viability vs. community intent).
Historically, the residents in Dover have handed over the decision making process to local governing bodies. There has been a recent change in that the residents see the need to take responsibility and become actively involved to ensure that the governing body does reflect community intent. This is best reflected by the relationship between the Conservation Commission and the greater community. There are many issues and lots of battles, but the community is beginning to ask for and get more with the help of the Conservation Commission. The entire process of alignment could take as much as 10-15 years to solidify.

What are the public perceptions of the Oyster River and how this management plan fits in?
Public does not really "see" the Oyster River because there is only a very small (Johnson Creek) tributary in Dover which discharges into the Oyster River. However, the public is more aware of issues related to wellhead protection. The management plan could be the beginning of raising awareness of inter-community issues related to water supply management.

What were the catalysts for the formation of or community interest in the watershed association?
It is perceived that the efforts of the association., leading by example, could be used to generate individual and community interest in becoming actively involved in town government. In addition, there are currently land acquisition projects going on in and around Dover which could be linked together nicely with help of the watershed association

How would you describe the goals of the community in comparison to those of the ORWA?
Land protection and shoreland protection are very important natural resource issues in the town of Dover. Water supply would be an additional issue that needs to be addressed. This seems to be aligned with the general protection ethic of the ORWA.

What do you perceive as (a) beneficial outcome(s) from this watershed management planning effort through the watershed association?
Linking parcels for comprehensive land protection across watershed and community boundaries, with the secondary objective of maintaining the quality of the water supply

How will your community or organization benefit from being involved in the project?
There are several opportunities. First, this project could provide small projects for citizens to "live" environmental management. The community needs to have small successes to encourage citizens to "take back" the process of making decisions within their landscape. Second, the management plan could be a vehicle to provide for outreach and education that would help to sustain current land protection efforts.

How significantly do you see private property rights affecting the outcome of this effort?
There is a strong desire not to invade private property rights. Dover seems to be in a quandary because of the desire to keep taxes low (limit new residential) while at the same time starting to be concerned about the placement of commercial/industrial in sensitive areas. Consensus on a community perspective of private property rights will not be apparent for some time.

What specific mechanisms will be the most effective for watershed management in this area?
Linking existing parcels through conservation easements

Durham

What is the communities' philosophical approach towards management of the natural resources in this area, and what is the greatest need?
Regional management of water supplies through land protection

How closely do you perceive that organization you represent (board, citizens group, etc) reflects the intention of the greater community (e.g. plan viability vs. community intent).
Durham has many different groups within the community. Presently town is in a state of flux as far as professional staff, as they have had a large overturn lately. To help focus the community and provide long term direction, the Master Plan document should prove to be beneficial.

What are the public perceptions of the Oyster River and how this management plan fits in?
The community is generally aware of the river because it is the water supply for the town. Also a significant amount of attention is paid to the Mill Pond area and its' specific management needs. The public needs to be more involved in the process of development of the management plan itself.

What were the catalysts for the formation of or community interest in the watershed association?
The community wants to encourage use of regional approaches to managing the natural resources. The Oyster River Watershed Association can help with this.

How would you describe the goals of the community in comparison to those of the ORWA?
The goals of both organizations are very similar. Together we can encourage regional planning and action, while looking at protection of open space for future water supply.

What do you perceive as (a) beneficial outcome(s) from this watershed management planning effort through the watershed association?
The watershed association can serve to gather community support to leverage the actions that need to be taken to protect water supply. They can be a place to identify common goals and the places where they overlap between the communities.

How will your community or organization benefit from being involved in the project?
Participation in this collective process will bring together all of the loose ends into one document. Plan can be a mechanism for going to Durham to request funds (part of capital improvement) to purchase source water lands.
How significantly do you see private property rights affecting the outcome of this effort?
Durham residents are willing to use the tools such as shoreland protection, wetlands protection, and aquifer protection overlay zone to the greatest extent possible. However, there will always be a fine line between what is desired for environmental protection and what the community will bear as far as "taking". In this case, community fathers and mothers need to be sensitive and have funds available to make outright purchases of land in high priority areas.

What specific mechanisms will be the most effective for watershed management in this area?
We must use appropriate management techniques, based upon community perception of the desired uses and the community needs.

Lee

What is the communities' philosophical approach towards management of the natural resources in this area, and what is the greatest need?
The Town of Lee has been using resource based zoning since the 1960's. Land protection and maintenance of open space through the use of management tools such as planning, zoning, and conservation easements have been useful in the past.

How closely do you perceive that organization you represent (board, citizens group, etc) reflects the intention of the greater community (e.g. plan viability vs. community intent).
The town boards in Lee are very closely aligned with community. First time in a while that desires of the Selectmen, Planning Board and Zoning Board are so closely aligned with the community sentiment and intentions. Currently the Boards are working towards moving ahead of what state and federal requirements are by making restrictions stronger.

What are the public perceptions of the Oyster River and how this management plan fits in?
It is not readily apparent how conscious the community of Lee is of the river itself, but it needs to be protected regardless. There is some degree of name recognition because of the Oyster River school district.

What were the catalysts for the formation of or community interest in the watershed association?
Recently there have been changes in the land use, which is viewed as being adverse. The Cox's started doing conservation easements and began to find out about others doing this as well. The community became interested when the Cox's started the group.

How would you describe the goals of the community in comparison to those of the ORWA?
The goals for Lee are somewhat different from those of the ORWA. The goals in Lee are not water quality/environmental based but based upon the desire to maintain the community and cultural heritage of farming. The citizens in Lee want to slow growth because of taxes while the newer more educated citizens want to have zoning and conservation. Together this equals natural resource protection in Lee which serves everyone's purpose but for different reasons.

What do you perceive as (a) beneficial outcome(s) from this watershed management planning effort through the watershed association?
A program for the town that has a goal of land protection along with long-term regional management of the water supply. There are many options still available in Lee for conducting land protection. The town just used capital funds to purchase a selected property in town. The selectmen are presently considering borrowing money to make more purchases. The Association is perceived as an organization that can develop consensus on these issues.

How will your community or organization benefit from being involved in the project?
There would be short term (land protection and protection of rural character) and long-term (water supply and water quality management) opportunities to Lee from this effort. The future development of Lee depends upon the Oyster River and aquifers for its future water supply. Because of this, there is a need for a regional approach to consider consumption and management.

How significantly do you see private property rights affecting the outcome of this effort?
The preservation of private property rights will be very significant. Initially, the community did not want zoning (too invasive), but then saw how it could be used to maintain the good and do away with the bad. Generally the population does not like government intervention but it also sees how it can be used to protect the river.

What specific mechanisms will be the most effective for watershed management in this area?
There will be a need to allow for flexibility in solutions within the landscape of the community. For example, Lee is already having problems with utilization of commercial lands in aquifer zone because of impervious restrictions. In the end, we will only use the authority of regulations when needed.

Madbury

What is the community's philosophical approach towards management of the natural resources in this area, and what is the greatest need?
The community of Madbury wants to protection of water resources, by having these resources serve as the prime basis for planning

How closely do you perceive that organization you represent (board, citizens group, etc) reflects the intention of the greater community (e.g. plan viability vs. community intent).
There seems to be a change in the interpretation of conservation between the "old" residents and the "new" residents. The effect of the gentrification of the area has lead to new perceptions of what conservation is. The two groups may have similar goals, but methods of getting there may not be the same. This has to be kept in mind as we move forward.

What are the public perceptions of the Oyster River and how this management plan fits in?
The public is not very aware of the Oyster River itself. There is a need for more outreach to the community at large. The Oyster River has been somewhat overshadowed by the Great Bay program. There is a need to bring awareness up into the freshwater portion.

What were the catalysts for the formation of or community interest in the watershed association?
There is a need to balance use between communities while maintaining quality of the area. An approach which embraces regional planning is needed to address the broader environmental management issues.

How would you describe the goals of the community in comparison to those of the ORWA?
Goals of community and ORWA are very similar. The focus will be to lessen the impacts of growth and to maintain the rural character.

What do you perceive as (a) beneficial outcome(s) from this watershed management planning effort through the watershed association?
Watershed association can be an organization that endorses protection, whatever the issue may be, anticipating problems rather than dealing with crisis. In this way the management plan can begin to address issues such as water supply management and carrying capacity regionally.

How will your community or organization benefit from being involved in the project?
The greatest benefit will be if we can base the Master Plan on a watershed concept utilizing regional cooperation to achieve the goals. For example, if Madbury becomes the keeper of the water, then consuming communities should somehow compensate Madbury for their protection efforts.

How significantly do you see private property rights affecting the outcome of this effort?
In Madbury, private property rights are an important issue. However, it is also recognized that municipal intervention is necessary to maintain the quality of life.

What specific mechanisms will be the most effective for watershed management in this area? Although there is a need for consistency, getting there will be difficult. Communities in the area are very individualistic. As such, this should be a flexible management program that can accommodate dynamic changes over time.

UNH

What is the community's philosophical approach towards management of the natural resources in this area, and what is the greatest need?
The university is attempting to manage the university system with concepts of environmental management. For example, we are using farmland and forestry management practices on the farms and woodlots. We are also beginning an aggressive water consumption campaign on campus (student education) along with the construction of a delivery system from Lamprey River directly into water treatment plant, rather than continually having water loss in old delivery system. Recently, there has been a shift to concerns with the water quality. Ten years ago the philosophy was just to treat the water as best as possible and to provide delivery to the students and Durham as a water quantity issue. There has been an increased effort to manage the quantity water better over time (water consumption and new delivery line from Lamprey). Now there is more attention being paid to water quality (as related to SOC's and IOC's) and prevention. In the future, we want to deal with turbidity (silt/clays and algae) violations after storm events. Many of the objectives that we have can be met through education.

How closely do you perceive that organization you represent (board, citizens group, etc) reflects the intention of the greater community (e.g. plan viability vs. community intent).
There is an to lead the university community towards a greater awareness of the resource and an understanding of the student populations' relationship with that resource.

What are the public perceptions of the Oyster River and how this management plan fits in?
The student population is starting to become more aware of the source of the water that it drinks and where its wastewater goes. The watershed management plan can help to express that in a different way. Hopefully, they will begin to see the water resource itself being more closely tied to the watershed and the importance of the watershed management plan over the long term.

What were the catalysts for the formation of or community interest in the watershed association?
There is a need to discuss what the shared values can be throughout the watershed. For example, it will be important to integrate the day to day issues at the water treatment plant and all facilities on the campus.

How would you describe the goals of the community in comparison to those of the ORWA?
Goals are shifting to good water management and appropriate land management for water quality protection, but not necessarily at land protection. The goals are very complimentary as a desire to establish watershed citizenship through education.

What do you perceive as (a) beneficial outcome(s) from this watershed management planning effort through the watershed association?
Mechanisms for communication between all the communities in the watershed will be established as a result of this project. This will be important meet the overall objective for

protecting and maintaining existing quality. Plan should lay out an aggressive policy for achieving this.

How will your community or organization benefit from being involved in the project?
For the university, there will be a number of benefits. Initially, there is an interest to initiate some collaborative efforts with the watershed association. For example, we need help doing long term base line monitoring of the river coming into the reservoir, and would like to get university/watershed association linked together to cover the whole year Secondly, it will be beneficial to have a clear understanding of the values for the watershed and what is prudent to maintain those qualities.

How significantly do you see private property rights affecting the outcome of this effort?
The university will continue to grow, but will also incorporate as many new technologies as possible that are required.

What specific mechanisms will be the most effective for watershed management in this area?
Implementation of specific management practices to accommodate the changes in land use. Right now the university is looking at maximization of the water delivery system and water consumption. Other mechanisms (storm water management) need to be discussed. However, a uniform prescription should not be imposed, but a shared set of values must be developed to begin with.

ORWA

What is the communities' philosophical approach towards management of the natural resources in this area, and what is the greatest need?
The approach should be based on protection, with management following. The river needs to be protected from overdevelopment and deterioration so we don't destroy what it is that people are coming here for, for example the rural character.

What are the public perceptions of the Oyster River and how this management plan fits in?
It will be important to start with the river and then work towards other natural resource management issues. In general there is not much awareness of the river, although discussion of the river does not appear to generate antagonism within the communities.

What were the catalysts for the formation of or community interest in the watershed association?
The formation of the organization came about because of the changes that were occurring in the community at large. Existing open space was being depleted, and there was a change in character of the community. It was apparent that economic development and growth was changing the face of the landscape. The growth in the area has necessitated an increased need for community services, including new schools. There has been growing contention between communities because of the school issues.

What do you perceive as (a) beneficial outcome(s) from this watershed management planning effort through the watershed association?
The Association can be a place to discuss community issues together acting, as a communication linkage between the towns and other organizations. There are many options that the organization has for addressing the immediate community needs, such as the need for land protection, especially in Lee, Durham and Madbury. It is the goal of the organization to take on an advisory role to remind people of the responsibility for the future through education.

How will your community or organization benefit from being involved in the project?
The Association needs to develop specific agenda and list of things to do to stay in business and gain notoriety within the area. This is a good time for looking inward into the organization. If we want to remain viable, we need more people to get involved. However, people only want to get involved in projects that are doable, definable and worthwhile to the cause. The management plan will be an important part of this process.

How significantly do you see private property rights affecting the outcome of this effort?
Private property rights will become significant issue. It is important for the municipal ordinances to reflect the private property owners' desire for conservation in concert with the concerns about private property. At times, the Association may need to look to other methods besides town ordinances to get things done. An example of this may be the need to use public/private partnerships.

What specific mechanisms will be the most effective for watershed management in this area?
We need to identify goals while allowing for a dynamic process while setting goals for the environment with recognition of community needs. These goals have to be balanced based upon the issues and individual community needs. There will have to be a place to accept individual town solutions as compared to consistency throughout the watershed.

B. A Review of Municipal Ordinances

Municipal ordinances are the most powerful tool that communities have to determine the direction of their future in regards to natural resource management. Ordinances can be developed to serve several purposes, ranging from protection of the resources to one that prescribes management. Ordinances are typically written in a manner that clearly outlines community intent and sets forth performance standards that meet that intent. An overview of the municipal ordinances that are already in place in the communities in the Oyster River watershed is contained in Table 15. It is clear that many protection and management tools are available to

Table 15. An Overview of Municipal Ordinances in the Oyster River Watershed

Town	Master Plan	Septic Controls	Erosion Control	Stormwater Control	Aquifer Protection	Wetland Protection
Barrington	1995	X	X	X		X
Dover	2000	X	X	X	X	X
Durham	2000	X	X	X	X	X
Lee	1995	X	X	X	X	X
Madbury	In progress	X	X	X	X	X

Town	Shoreland Protection	Open Space	Gravel Excavation	Floodplain Ordinance	Site Plan Review	Impact fees
Barrington	X	X	X	X	X	X
Dover	X	X	X	X	X	
Durham	X	X	X	X		
Lee	X	X	X	X		
Madbury	X	X	X			

these communities. A closer review of the ordinances provides insight into the intent of the individual community via the performance standards. A review of the performance standards is contained in Table 16. For example, there are shoreland protection ordinance in all communities. However, the performance standard for building setback from the shoreland may vary. Important considerations in watershed management are how these tools are currently used to address priorities and whether changes are necessary to meet the priorities. These decisions become very

difficult, because they often rely upon community desire as well as appropriate use of the ordinance based upon site-specific considerations. In the Oyster River watershed, there is consistency in the enactment of ordinances but diversity in the performance standards and application of the ordinances. This is not an unusual situation. This dynamic may present an obstacle to achieving the goals and priorities of the watershed management plan. If this is an obstacle, overcoming it may necessitate actions through the Association or the individual communities. It will be for the Association to determine, in concert with the communities, how to best proceed.

Table 16: Summary of Municipal Ordinances for Communities in the Oyster River Watershed

Community	Barrington	Dover	Durham	Lee	Madbury
Zoning requirements	Minimum lot size of 80,000 sq.feet, 60,000 free of Hydric A, upland not less than 35,000 sq. feet	Riverfront residential with lot size as 3 times minimum requirement; wetland acreage limited to 50% of minimum lot area: minimum frontage of 100 feet when on sewer, 150 feet when on septic.	Rural zone: 2.75 acre minimum lot size; < 20% lot coverage by buildings, < 25% poorly drained soils; no very poorly drained soils allowed, minimum shoreland frontage of 200 feet.	Residential; 2 acre minimum lot size, 64,000 square feet must be developable; 25% impervious lot coverage	Minimum lot sizes from 20,000 sq. ft (cluster) up to 180,000 sq ft (commercial/industrial).
Shoreland Protection	75 foot setback for structures and other disturbances (driveways). Zone within 100 feet of mean high water of the Isinglass River.	250 foot setback for structures; existing structures limited to 25% increase in size; no mobile homes closer than 100 feet to stream, lake or pond. Limit of cutting 50% basal area in 10 years, including shrubs.	125 foot setback for structures; 150 foot septic setback; restricts chemical use, tilling within 75'; limits vegetation cuts within in 150 feet of river and 75' feet of perennial streams. No clear cuts.	100 foot setback for roads, structures, and septic; limits vegetation cuts. No clear cuts.	300 feet from Bellamy Reservoir, 150 feet from Little Bay Estuary, 100 feet from mean high water of Bellamy and Oyster, 50 feet from all other brooks; No structures allowed within setback; natural vegetation to remain.
River Access	Not addressed at this time	Not addressed at this time	1 per lot; up to 10% lot frontage.	Not addressed at this time	Not addressed at this time

Table 16: Summary of Municipal Ordinances for Communities in the Oyster River Watershed (cont'd).

Community	Barrington	Dover	Durham	Lee	Madbury
Aquifer Protection	40% impervious cover restriction fro residential, 75% industrial.	20% impervious restrictions in secondary zone; Passive use allowed in primary zone; Contains restriciton of use in secondary zone (hazardous materials, road salts, petroleum products).	25% impervious cover restrictions; PB and Council review stormwater plans; All uses conditional; minimum road salt; hydrologic analysis required for projects with greater than 10 lots; Sewer hook-ups required.	10% impervious cover restriction; Low density residential; Certain prohibitions (road salt, underground storage tanks).	50% impervious cover restrictions;
Excavation	Not addressed at this time	Excavations have reclamation requirements to minimize erosion.	Requires conditional use permit in residential and office/research zones; Not permitted in rural zone	Requires site plan review; Allowed only in commercial zone	Revegetation plan require must meet slope standards
Cluster Development	Available for use at the Planning Boards discretion	Alternative lot layouts may be allowed to encourage open space,	Used on developments greater than 20 acres; 20% in open space, residential and nonresidential; Provides for greater density with formula for calculating net acreage: City Council approves.	Allowed for developments greater than 20 acres in size; 25% to open space, residential only; community water required; No increase in overall density allowed	Allowed at discretion of planning board: 10 acre minimum; 25% open spac requirement: Applications need to consider septic requirements, erosion and sediment control, and stormwater management.

Table 16. Summary of Municipal Ordinances for Communities in the Oyster River Watershed (cont'd).

Community	Barrington	Dover	Durham	Lee	Madbury
Floodplain regulations	No activity in the regulatory floodway which causes and increase in flood levels.	No activity in floodplain which causes an increase in flood levels.	Building inspector reviews applications; no activity in regulatory floodplain which causes an increase in flood levels; regulatory floodway mapped to Wiswall Dam; 100 -year floodplain mapped.	Development in regulatory floodway may not increase base flood discharge; flood hazard zone and floodplain are defined as undevelopable for lot size determination; 100-year floodplain mapped	Not addressed at this time
Wetlands Protection	Protects poorly and very poorly drained soils, streams and waterbodies. Wetlands setback of 50 feet for structures.	Protects poorly and very poorly drained soils, and poorly drained soil contiguous to surface waters in 100-yr flood zone; Wetland acreage not included in minimum lot size; Septic setback of 75 ft; 75 ft setback when changing surface configuation.	Protects poorly and very poorly drained soils, surface waters and rivers. 50-75 foot setback for structures; 75 foot septic setback; Planning board may grant conditional uses, but limited by buffer zone provisions	Protects poorly, very poorly drained soils, marshed, bogs, and swamps. No structures and no changes in natural surface configuration; Erosion controls for activities within 75 ft; 125 ft leachfield setback; No structures within 75 ft; Taxed as open space	Protects poorly and very poorly drained soils; 50 feet of natural vegetation required from edge into upland; Septic setback of 100 feet from wetland soils, public water bodies and permanent streams;

Table 16: Summary of Municipal Ordinances for Communities in the Oyster River Watershed (cont'd).

Community	Barrington	Dover	Durham	Lee	Madbury
Steep slope restrictions	Identified as critical area as slope lengths > 25 feet on slopes >15%; critical areas to be preserved as part of plan design	Not addressed at this time	Steep slope identified as criteria for conditional use decisions; Slopes > 25% considered in PUD open space and lot calculations.	Slopes > 15% defined as undevelopable for lot size conditions	Not addressed at this time

VII. The Oyster River Watershed Plan-June 2001 and Beyond

Birches along the Oyster River

VII. The Oyster River Watershed Plan-June 2001 and Beyond

The future plans for action within the Oyster River watershed are contained in Table 17 and Table 18. The specific actions were developed from a review of the previous management plans (Tables 9 and 10) and the recommendations from the community sessions (Table 13).The plans for action have been specifically developed to serve as guides for the Association itself, and for the communities. The actions may represent a unique project, or they may represent activities, which when woven together, create a collective project. Over time, the combination of small, unique and large, collective projects will merge to become the comprehensive watershed management plan. It is anticipated that as this plan moves forward, opportunities will be taken when available, and flexibility allowed in the manner in which goals and priorities are achieved. After all, the purpose of the Oyster River Watershed Management Plan is to create a platform for conversations regarding the long-term protection and management of the natural resources within the Oyster River watershed.

Table 17. Actions for the Oyster River Watershed Association

Research and data gathering:
- Complete inventory of riverfront property owners
- Continue water quality monitoring program
- Conduct cultural history inventory and identify priority lands for protection

Linking with communities:
- Develop regional approach for watershed management including inter-basin transfer and long term sustainability of water supply

Organizational development
- Secure sources of funding for projects

Educational programs
- Expand River clean-up into freshwater portion
- Develop water conservation program for homeowners
- Continue work with UNH Community Outreach program to develop projects
- Develop a recreational access and trailways map
- Initiate awareness program to encourage "a sense of place" and cultural heritage in the watershed

Land protection efforts:
- Support of the Tamposi Property Management Plan and Advisory Council

Establishing communication pathways:
- Ensure ready availability of data from state and federal agencies

Resource planning:
- Refine the environmental indicators
- Complete relative risk assessment
- Gather information
- necessary for development of a regional water budget

Encouraging local regulation:
- Encourage water conservation programs in industrial and commercial areas
- Utilize private well log requirements
- Encourage alternative patterns of development

Table 18. Actions for the Communities in the Oyster River Watershed

Lee:

- Contribute to the inter-town effort to manage the Tamposi property
- Review of land protection and wetlands restoration opportunities surrounding the Lee well site
- Continuation of land protection activities
- Identify protocols and potential improvements in emergency response in Lee
- Identify opportunities for sharing resources to maintain adequate emergency response
- Complete natural resource inventory of town owned lands and natural resource inventory for the entire town

Barrington:

- Contribute to the inter-town effort to manage the Tamposi property
- Implement new 50 foot setback requirements for wetlands conservation

University of New Hampshire:

- Continue discussions regarding utilization of the model rule for watershed management for surface water supplies
- Contribute to the inter-town effort to manage the Tamposi property
- Continue implementation of the water conservation program at the university

Dover:

- Implementation of consistent shoreland protection
- Contribute to the inter-town effort to manage the Tamposi property
- Continue groundwater reclassification project and communication with Town of Madbury

Durham:

- Contribute to the inter-town effort to manage the Tamposi property
- Continue implementation of the water conservation program for the town
- Review of land protection and wetlands restoration opportunities surrounding the Lee well site
- Continuation of land protection activities
- Develop and implement long term management plan for Mill pond
- Incorporate Oyster River Watershed Management Plan recommendations into the Town Master Plan

Madbury:

- Contribute to the inter-town effort to manage the Tamposi property
- Continue groundwater reclassification project and communication with Town of Dover

Appendix A

This appendix contains a variety of suggested actions that could be taken by the communities to effectively manage the natural resources in the Oyster River Watershed. These include "Specific Recommendations", "Environmental Planning Approaches" and "Environmental Characteristics Zoning".

Specific Recommendations

Subsurface Wastewater Treatment Systems

- Know the location of your septic tank and leaching area. Mark the tank covers with partially buried bricks
- Inspect the tank on an annual basis. If the sludge or surface scum combined are as thick as 1/3 the liquid depth of your tank, have the tank pumped out by a licensed pumper
- Do not flush bulky items such as disposable diapers or sanitary pads into the system
- Do not flush toxic materials such as paint thinner, pesticides, or chlorine into your system since they may kill the necessary bacteria in the tank
- Repair leaking fixtures promptly and use water reducing fixtures whenever possible
- Avoid putting food waste and grease into the system
- Keep deep-rooted tress and bushes away from the leach field
- Do not allow vehicles, livestock or heavy foot traffic over the leach field
- Avoid colored toilet paper, it does not break down in the tank as rapidly as white paper
- Many bathroom cleaning products, such as toilet bowl cleaner, contain chlorine. Use alternatives whenever possible
- Municipal officials should consider implementing a locally administered septic system education and inspection program. Consider adopting a local health ordinance for septic system regulation

Road Salting and Snow Dumping

- Facilities should be located on flat sites away from surface water and on impervious surfaces that are easily protected from overland runoff
- Sensitive areas, such as public water supplies, lakes and ponds, should be identified and made known to salt applicators
- Know when to plow and reapply salt. Give salt time to work. Time plowing operations to allow maximum melting by the salt before the snow is plowed off of roadways
- For lesser traveled roads, consider applying salt in a 4-8 foot strip along the centerline of the roadway
- Disposed snow should be stored near flowing surface waters, but at least 25 feet from the high water mark of the surface water. This way the sodium chloride is diluted with river water and impacts to groundwater, lakes and wetlands are avoided. Solid materials that are contained in the snow can be removed in the spring when the snow melts

- A silt fence or equivalent barrier should be securely placed between the snow storage and the high water mark
- The snow storage should be at least 75 feet away from any private water supplies, at least 200 feet from an y community water supply wells, and at least 400 feet away from any municipal wells

Control of Sand and Gravel Operations

- Investigate proposed pit areas as part of planning. RSA 674:2 describes a construction materials section for a municipal master plan
- Allow space for mild pit slopes (no greater than 2:1, diversions and adjacent owner protection
- Maintain an adequate depth of unexcavated material above the seasonal high water table, as a filter, for present and future conditions
- Assess the impact of the excavation on nearby drinking water wells especially if groundwater or surface water is to be withdrawn from the pit area
- Store petroleum products outside the pit area where possible
- Provide an above-ground containment area that can fully contain any spill if petroleum storage is essential in the pit
- Develop a spill prevention plan and provide employee training
- Maintain and wash equipment outside the sit area
- Control dust as necessary to prevent nuisance and public hazard
- Use retention basins to trap fine material, clean as necessary.
- Provide buffer strips of natural vegetation between the pit and surface water, wetlands, public roads, and property lines
- Use "anti-tracking" pads at gravel pit access roads.

Urban Runoff Management

The state best management practices manual, "Stormwater Management and Erosion and Sediment Control Handbook for Urban and Developing Areas in New Hampshire, is a comprehensive reference for structural and vegetative practices, including the following:

- Detention Basins
- Diversions
- Grassed Waterways or outlets
- Level Spreader
- Outlet Protection
- Parking Lot Storage Area
- Rock Riprap
- Sediment Basin
- Silt Fence
- Hay Bale Barrier
- Temporary Gravel Construction Entrance
- Vegetated Filter Strip
- Vegetated Swale

Management of Chemical and Petroleum Products

- Maintain an up-to-date material inventory and routinely cleanup operations on the site
- Conduct periodic visual inspections for leaks and conditions that would lead to a discharge, or for conditions that could lead to the direct contact of storm-water with raw materials, intermediate materials, waste materials or products
- Have a spill prevention and response plan that describes spill containment, diversion, isolation and cleanup practices and procedures for notifying appropriate authorities
- Store containers in areas that will contain leaks
- Manage service stations and auto repair areas to minimize release of hazardous materials and hazardous waste into the environment

Environmental Planning Approaches

Timing and phasing of development

- Communities can ensure that development takes place in an organized fashion. Phasing of developments ensures that large tracts of land remain intact until they are ready to be actively developed. In addition, restrictions on construction during certain times of the year (during rainy seasons) will reduce the potential for erosion problems.
- Intensity and use incentives
- Communities can direct types of development into areas within the landscape which are more suitable to different types of use. High intensity zones can be balanced with open space and community conservation areas, resulting in a mosaic of uses and intensities.
- Transfer of development rights
- Development rights for significant areas can be purchased from land owners to ensure that these areas remain intact.
- Planned unit developments
- Planned unit developments reduce the overall size of a development by using a variety of designs to achieve an overall density, thereby reducing the need for extensive roadways and infrastructure within the development. Planned unit developments can incorporate open space into the original site layout.

Cluster development

- Cluster development offers the developers of land
- Lot Size and Spatial Requirements
- Planning Boards should re-evaluate their lot size and subsurface wastewater treatment requirements. Lot sizing should be determined based upon soil type to ensure that development in the area is reflects site specific carrying capacity.
- Lot Coverage Standards (e.g. impervious area management)
- Efforts should be made by communities to minimize the impact of impervious surfaces on the surface water quality and the natural recharge of the aquifer. Methods which can be used to achieve this include:

- Post development rates and volumes of run-off should be equal to the pre-development rates and volumes for run-off up to the five-year return period. All water from the two-year storm should be infiltrated
- The use of angled parking and smaller spaces on one-way streets and parking lots
- Reduced parking ratios where possible
- Use vertical parking areas where possible
- Use permeable spill-over parking where appropriate
- Modify landscaping of parking lots to use permeable dividers and street-side buffer strips
- Use skinny streets to reduce roadway impacts
- Use grass swales instead of curbs and gutters
- Use one-sided sidewalks or paths
- Roof leaders and sump pumps should be recharged onsite rather than being conducted to the storm drain or sewage system
- Leave native vegetation intact between developments and streams. Encourage the planting of native plant species in landscaping design
- When rezoning, use lowest density residential development possible
- Develop clearing and grading construction guidelines that minimize site disturbance and vegetative loss
- Use mulched areas for part of the lawn
- Minimize lawn size and increase native landscaped areas

Environmental Characteristics Zoning

Wetlands Zoning

Municipalities should ensure that the wetland information they are requiring is the most current and accurate available. Minimum information required should be consistent with that required at the state and federal level. Planning boards should require that local approved projects be conditioned upon approval of state and federal wetland permits. Planning boards should consider having requirements for vegetative buffers to protect priority wetlands that would include the following:

- Require buffer limits on all plans. Establish clear vegetative targets and rules for different zones of the buffer
- Use level spreaders or other techniques to prevent channelized flow through the buffer
- Mark buffer boundaries with permanent signs or fences describing allowable uses
- Conduct periodic walkthroughs to inspect the condition of the buffer network

Floodplain Zoning

Planning boards should include setbacks and site specific data requirements in floodplain ordinances that are similar to those found in wetlands ordinances. Requirements for minimum or no increases in peak flood levels should be considered in floodplain zoning ordinances

Watershed Zoning

Municipalities should consider using the watershed zoning to protect the surface and groundwater supplies in the watershed. Performance standards should be implemented at the municipal level.

Aquifer Zoning

Municipalities should consider aquifer protection overlay zones where they will act to protect water quality and quantity. Aquifer zones can be used to further to protection afforded by a wellhead protection overlay zone.

Steep slopes Zoning

Steep slope restrictions should be considered in areas where erosion and sedimentation pose a serious threat to the surface water resource. In addition, steep slope restrictions can be used to protect areas which provide scenic values and specialized habitat.

Shoreland Zoning

Shoreland protection districts should be considered for all ephemeral streams in the towns. Special consideration should be given to the protection of fragile areas such as first and second order streams.

Suggested References

Best Management Practices for Irrigation in New Hampshire, Department of Agriculture, Markets and Food

Best Management Practices for Land Application of Biosolids, University of New Hampshire Cooperative Extension, 1997

Best Management Practices for Urban Stormwater Runoff, New Hampshire Department of Environmental Services, 1996

Best Management Practices to Control Nonpoint Source Pollution: A Guide for Citizens and Town Officials, New Hampshire Department of Environmental Services, November 1997

Buffers for Wetlands and Surface Waters, A Guidebook for New Hampshire Municipalities, Chase, Deming and Latawiec, November, 1995

Manual of Best Management Practices for Agriculture in New Hampshire, Department of Agriculture, Markets and Food, June, 1995

Corps of Engineers Wetlands Delineation Manual, 1987

Model Rule for the Protection of Water Supply Watersheds, New Hampshire Department of Environmental Services, April 2000

Strafford Region Natural Resources Inventory, Strafford Regional Planning Commission, December 1998

Regional Field Indicators for Identifying Hydric Soils in New England, New England Interstate Water Pollution Control Commission, May, 1995

Site Specific Soil Mapping Standards for New Hampshire and Vermont, Society of Soil Scientists of Northern New England, Publication No. 3, 1997

Stormwater Management and Erosion and Sediment Control Handbook for Urban and Developing Areas in New Hampshire, New Hampshire Department of Environmental Services, 1992

Water Resources Protection and Geographic Inventory Procedures, Office of State Planning, January, 1992

Water Budget Methodologies Part 1: Goals, Literature Search, Explanations and Reviews, New Hampshire Department of Environmental Services, September 1988