Tidal Rivers Land Protection Study

of the
Lamprey, Oyster, and Salmon Falls Rivers

Presented to the New Hampshire Office of State Planning
New Hampshire Coastal Program

by the Strafford County Conservation District
with the assistance of
The Strafford Rivers Conservancy, Inc. of Dover, N.H.

March 30, 1990

The New Hampshire Coastal Program provided a grant for the preparation of this report which was financed in part by the Coastal Zone Management Act of 1972, as amended, administered by the office of Ocean and Coastal Resource Management, National Oceanic and Atmospheric Administration.

Acknowledgements

The Strafford County Conservation District thanks the many individuals who contributed to this study.

Deborah Burrington, environmental consultant, was principal researcher for the project. The project was initiated because of her appreciation of the potential within the natural resource community to develop a plan to protect lands within the coastal zone.

Valuable field assistance was provided by wildlife biologist Kitty Eileen Miller, a board member of the Conservancy, and board member of the Strafford County Conservation District.

Extensive soils analysis was provided by G. Don Bailey, soil scientist and chairman of the Conservancy's Lands Committee.

Walter Franklin deserves special recognition for his donation to the Conservancy of an easement on his property in the study area on the Salmon Falls River in Dover and Rollinsford. The easement is given in memory of Mr. Franklin's wife, Mabel Franklin. The easement becomes the first easement held by the Conservancy.

While many other individuals contributed professional assistance to this project, the following people deserve special thanks for their work. Kevin McEneaney, of McEneaney Survey Associates and a technical advisor to the Conservancy, donated the survey of the Franklin property. Mary Ellen Boelhower, technical advisor to the Conservancy and land protection specialist for the Society for the Protection of New Hampshire Forests, completed probate research and wrote the conservation easement document. Michael Casino, Conservancy board member and a planner for RKG Assoc. of Durham, performed considerable field work during easement negotiations.

The maps included in this report were prepared using computer time provided by the Strafford Regional Planning Commission of Dover. Senior planner Robert Houseman donated considerable time in their preparation.

And finally, District Conservationist Michael Lynch of the U.S.D.A. Soil Conservation Service and technical advisor to the Conservancy, provided constant support and guidance as the study progressed.

Tidal Rivers Land Protection Study
Table of Contents

TIDAL RIVERS LAND PROTECTION STUDY
LAMPREY, OYSTER, AND SALMON FALLS RIVERS

INTRODUCTION

In keeping with the goals of the Strafford County Conservation District and the Strafford Rivers Conservancy, this study will locate and prioritize parcels of land for acquisition and protection in order to increase conservation, public access, open space, and recreation opportunities along the tidal rivers.

The New Hampshire Coastal Program focuses on three areas: the Atlantic Seacoast, the Portsmouth Harbor and the Piscataqua River, and the tidal rivers and estuaries. The focus of this study is on three estuarine rivers in the second tier of the Coastal Program. This area includes the wetlands and banks of these estuarine rivers, to the limit of tidal action and adjacent areas inland to the limits of the Wetlands Board jurisdiction--which extends to 100 feet above the highest observable tide.

New Hampshire has about 18 miles of coast line and about 27 square miles of estuaries, harbors, and bays. The Great Bay estuary derives its freshwater inflow from rivers that drain approximately 930 square miles. The study rivers drain about 449 square miles--the Lamprey drains 210, the Oyster 87, and the Salmon Falls 152 square miles.

The water quality of the three rivers is Class B, defined by the Water Supply and Pollution Control Division as acceptable for swimming and other recreation, fish habitat, but not recommended for drinking. However, large portions of the Lamprey, Oyster, and Salmon Falls Rivers are only partially supporting designated uses. All tidal areas are additionally designated as shellfish waters and must meet a more restrictive bacterial criterion of less than 70 coliform bacteria per 100 ml (vs. 240 for Class B fresh waters.) The tidal portions of nearly all of the inflowing rivers to the bays are violating shellfish criteria and not supporting designated uses.

Every estuary is the product of ocean water meeting and mixing with the fresh water of rivers and their tributaries. The estuary extends upriver until the salinity of the water drops below 0.5 percent (at .2 to .3 percent, freshwater vegetation dominates.) The tidal limit of the three rivers is delineated by upriver dams. The Lamprey River is tidal to the limit of the McCallen Dam in Newmarket at Route 108 for a stretch of approximately 2.0 miles. The tidal reaches of the Oyster River extend about 2.5 miles to the tidehead dam above Shipyard Landing in Durham at Route 108. The Salmon Falls River is tidal for a stretch of 3.7 miles to the dam below Route 4 in Rollinsford.

Tidal creeks make up an important area of the Coastal Program, and the environmental significance increases as recreational use and river traffic increases. The buffering capacity, nursery, and sanctuary quality are essential in the tidal marsh and creek and must be protected.

Description of Criteria

The policies and criteria for this project are interwoven to form the whole picture of open space study. The priority Coastal Program policies that are key to the scope of this tidal rivers study are: fish and wildlife habitat, coastal resource protection, recreation, water quality, research and educational opportunities, rural quality, rare and endangered species, historical/cultural significance, natural areas and floodplains.

The tidal rivers and tributaries are essential wildlife corridors and habitat for flora and fauna. The coastal resources cited of particular significance along the estuarine rivers are salt marsh, tidal wetlands, tidal creeks, rocky shores, oyster beds and clam flats. Recreation and public access must be balanced with protecting natural communities. Education and enlightened public policy are essential to protect these resources.

The rural quality so characteristic of the Great Bay estuary derives from the peripheral salt marsh, tidal creeks, islands, open fields, woodlands and agricultural uses. The open space and scenic vistas at the mouths of the estuarine rivers are key resources to be preserved.

In keeping with the educational component of the Coastal Program, the consultants have met with the public frequently during the course of the project. On June 7, the consultants toured the Lamprey River with a group of Oyster River High School Students. The consultants discussed the problems, issues, and assets of the tidal river with the students. A consultant presented the river study and discussed Coastal Program goals at a meeting of the state staff of the Soil Conservation Service. In addition, the individuals involved with the project have attended land use ordinance hearings and other public meetings to provide information developed during the project.

The identified parcels of priority are arranged by geographic area or area of particular concern, focusing on water and land resources. Prioritization is justified by scenic vistas, coastal-dependent species and habitat, abundance of coastal resources, potential for recreation, water resources, large size of holding or contiguity to protected area, rural quality, rare species/communities and public policy feasibility. The priorities also vary with intensity of use, threat of development and the need to conserve these critical resources.

The project began with a review of property information and tax maps. Data was also gathered by contact with local officials, commissions and important landowners. Goals for open space planning vary with each community, however protection of the riverine environment was a top priority in the three towns of Durham, Newmarket and Rollinsford. The progress on shoreline conservation zoning in each community is of particular interest in this study.

Data on species and natural communities are being compiled from reports and field observations. Information has been provided by the Natural Heritage Inventory under the Department of Resources and Economic Development (DRED) and the New Hampshire Audubon Society. The information is sensitive and will

be handled accordingly. More work remains to be done in this area to determine critical habitat.

Accurate mapping of the study areas are a high priority of the study. Sources for slides, maps, and photos have been the Strafford Regional Planning Commission, the U.S.D.A. Agricultural Stabilization and Conservation Service, the Soil Conservation Service, and the aerial photos taken in April, 1989 by the Sverdrup Corporation's environmental impact study for the east-west highway. The field researchers have developed an extensive slide inventory of coastal resources.

The water frontage (Wf) figures are approximations derived from tax map information, aerial photos, and landowner records.

Competition for finite coastal resources and waterfront property in the coastal zone of New Hampshire is intense. The three municipalities in the study area are reacting to development pressure and need to devote more time for the task of open space planning. It is the expectation of the Strafford Rivers Conservancy and the Strafford County Conservation District that progress in open space preservation can be made in the communities within the study area along the Lamprey, Oyster and the Salmon Falls Rivers with the help of this study.

Narrative Descriptions of the Rivers

LAMPREY RIVER

Mouth of the Lamprey

The tidal marsh in the study area is 5 acres, most of which is at the mouth of the river. The mouth of the river is defined by Moody and Shackford points. The mouth of the Lamprey has scenic vistas that are key to the rural quality and integrity of the Great Bay shoreline. Moody Point has protective covenants on the shoreline. There is rare species habitat in and along the Lubberland Creek marsh. Other coastal resources include a major oyster bed and rare plant site.

The opposite shore of the mouth is named Shackford Point--a tract of 89 acres of undeveloped shoreline extending upstream almost a mile. This property fronts extensive saltmarsh on Great Bay and around the point to forested cover inland and along the tidal Lamprey. The expanse of saltmarsh on the bay adjoins neighboring stretches which are contiguous to the Squamscott saltmarsh complex. The significance of this agricultural holding and abundance of coastal resources at this site rate primary importance in this study. The site contains rare plants and is used by threatened and endangered wildlife species. A potential access area to the tidal river is sited about .8 mile upriver near the storage area for the ice fishing shacks.

A vantage point across the river from the old brickyard marsh area (R2-48) could be held under easement to save what is left of the easterly shore. There is an abandoned cellarhole and three tiny lots that back onto the waterfront stretch. Those lots, if developed, must be handled in the most environmentally sensitive manner.

Recommended Land Use for Mouth of Lamprey

The agricultural tract of 89 acres (R3-36) on Shackford Point is the key to preserving the rural quality of Great Bay. The best use of the well-drained Chatfield-Hollis-Canton soils is woodlands. The Eldridge soils have medium potential for development but are not well suited to septic systems. The optimal use is farmland and the existing hayed meadow provides an agricultural vista. Eldridge soils are rated high for woodland and the forested cover provides habitat for wildlife species.

The potential for total development is low on this property--a portion of this land is in the floodzone. The potential for a town forest and protected farm is high. The very poorly drained soils of the marsh are in best use as tidal wetlands. The Hanrahan property west on the Squamscott marsh complex has been put on the market for about $1.5 million for 84 acres. Immediate action is required to plan to retain the adjacent open space. The Trust for New Hampshire Lands has approached the landowner to discuss land protection alternatives. A consultant for this project has also met with the Trust's land agent to discuss protection options. This property (the estate of Watson) rates very high in the list of priority policies of the N.H. Coastal Program.

UPPER NARROWS TO YOUNG'S COVE

Upper Narrows provides important public access at the town land and riverfront park. Trails extend inland along the historic Pindar Lane, along the shoreline of the Wastewater Treatment Facility and pump station, and beyond to the Fish and Game parcel. This adjoins the town plot of four acres in Young's Cove. The abundance of bird species in this area is a reflection of the underwater resources.

Newmarket once held about 50 acres on the river before the area was zoned industrial, put to use to treat sewage and generally cut up into lots. Land owned by the Essex Group Inc. needs to be sensitively developed and U3-49 is a tract of almost five acres that could add to a town recreational network, easily accessible by the residents. The existing park and landing is well used but it is only a pocket park of less than a half acre with limited parking for a launch site. The importance of Young's Cove and the town parcel (U3-50) increases with current competition for the waterfront on the Lamprey.

Recommended Land Use for Upper Narrows to Young's Cove

The need for clear goals in river corridor protection is evident here. The Town of Newmarket's goal of preserving the viewscape opposite the landing (U3-5) apparently lost priority in the planning state for the Wajda property/Heron Point (R2-86). On March 5, 1987 natural resource specialists were invited by the Cheney Corporation to review the site design for this project. The project as planned and allowed by town zoning clustered the living units in the eastern portion of the 47 acres. The resource specialists--including conservationists from the Soil Conservation Service, the Cooperative Extension Service, the Office of State Planning, and the New Hampshire Coastal Program--agreed that the plan as designed would preserve the existing expanse of forest land, minimize impact on the shoreline, and maintain the aesthetics of the forested view from the town landing.

A plan submitted in May, 1987 by the Cheney Corporation clustering 33 condominiums (with almost 28 acres of forested open space fronting the river) was not accepted by the planning board. The Medium Density Residential (MDR) zone was changed at town meeting to allow only single family units. This zoning change was partially a reaction to what town planners considered unsatisfactory cluster developments in progress in the MDR zone elsewhere in town.

In May, 1989 subdivision approval of about 30 single family units was granted; open space totals about 13 acres located at the rear and side of the property near the existing mobile home park. The water frontage is divided between 20 lots with setbacks of 100 feet from mean high water. Docks were constructed in late summer with walkways and 30 boat slips. Clearing in the forest is evident.

This is a brief account of the Heron Point project and is by no means intended to be an exhaustive analysis of the planning process. It is our opinion than an alternative design subdivision clustered on the Boxford soils (3-8 percent slopes) of the eastern portion would have protected the critical natural resources. This would keep the western bend of the Chatfield-Hollis-Canton soils in optimal use as forested open space and vegetated slopes to the river.

The view of forested frontage opposite the landing area and the sensitive areas, including rare plant sites, are not protected by the current plan. The walkways now invite foot traffic on the mudflats and marsh. Clearing in the uplands may increase erosion and the need for possible dredging at the town landing.

Siltation must be kept to an absolute minimum because this is a critical area for fish. The deep pools in the river provide important habitat during the spawning season for shad, herring, and salmon. It is important to keep the river free of silt which can smother fish eggs by burying them. Silt in the water also decreases the light which decreases the vegetation on which some fish eggs attach. More information about about the fish found in this area is included in Appendix B.

The town once owned 50 acres of open space abutting the river. This is a critical area for wildlife, especially since open space and forested cover are disappearing across the river (R2-86). Selling public land for development does not lower taxes. Future industrial development is best sited away from the tidal Lamprey River and away from finite coastal resources.

LOWER NARROWS

Lower Narrows is a rocky gorge-like pass that provides habitat for several rare plants and has the potential to be preserved as a scenic vista by restrictions on building on the open lots. This focal point on the western shoreline of the tidal Lamprey provides relief from the cliff-hanging dwellings and intensive development pattern along the river. The rights-of-way, building locations, ownership and deeded lots in this area are a tangled web that neither the tax assessor's office nor regional planning's vivid aerials (scale 1"=100') serve to unravel.

The activity of clearing and building without permits on the point should cease until a comprehensive plan of protection is adopted. This would enable a study of the feasibility of a continuous path from the town landing to Shackford Point. The conservation commission needs the tools and resource information to promote the value of conservation.

Recommended Land Use for Lower Narrows

Woodland suitability ratings are high for all soils in this area. The riparian banks slope up to 35 percent under the forested cover. The conservation commission needs to monitor the clearing evident along the river and prohibit setback violations. Any development should be sited well inland on the Boxford soils. The best use of the Chatfield-Hollis-Canton soils on the river banks is woodland, ideally with a 250-400-foot buffer from the river.

The town's conservation commission is accumulating an open space fund from its share of the land use change or transfer tax. This fund will be used to pay for a land use inventory and for land acquisition. The 1988 Master Plan of Newmarket recommends that the best use of the land with slopes greater than 25 percent is open space and wildlife habitat. The town could increase holdings in the Young's Cove and Lower Narrows area to supplement existing parcels and keep the view open on the point of the south bank.

OYSTER RIVER

JACKSON LANDING

The Jackson Landing area is one of the best boat ramp areas in the estuary. Coupled with Shipyard Landing below the dam, Jackson Landing provides key access to the tidal Oyster and the potential for expanded recreational area. The town of Durham holds a 5.5 acre parcel across Old Piscataqua Road, across from the rink, that could add to the recreational or buffer area of the waterfront holdings of 11-3 and 11-4.

From the public lands across the river there are scenic views of the Shankhassick Trust and adjoining Sawyer waterfront. Expansion of the protected area, including several rare plants, is of the highest priority in the landing area and environs. Education of the public to the sensitivity of this area can be blended with increased recreational opportunity.

Recommended Land Use for the Jackson Landing Area

Protection work must focus on the estimated 1524 acres of tidal marsh of the Oyster River, most of which is along the tidal creeks and landing area. To protect the coastal resources at Jackson Landing, the town should acquire the adjoining property (11-2) for habitat protection and passive recreational use. The variety of habitat--low and high marsh, disturbed lowland of tall, reedy invader plants, mature Eastern hardwood forest, upland of young poplar, birch, shrubs, tidal creeks and leveed banks along the river provide an excellent opportunity for environmental education.

Developing education programs about tidal wetlands would increase public awareness of the need to protect sensitive areas. The town's proposed downzoning to a Limited Business District with 10,000 square-foot lots (a more intensive use) will have a negative impact on the coastal protection area.

An issue raised by this study is restoration of the tidal flow under Rt. 108 in Durham. The tidal flow was cut off when the road was built, and the extensive wetlands are now freshwater wetlands.

The Shankhassick Trust and Sawyer property across the river can be best protected by keeping the zoning Residential Coastal (RC = 120,000-square-foot lots) instead of the proposed downzoning to triple the potential units. The Buxton soils are both prime farmland and farmland of statewide importance. Both Buxton and Hollis-Charlton soils are rated low for septic systems. The total development potential of this area ranges from moderate to low to very low near the river.

The increase in the tax base would not compensate for the cost of potential development and the loss of amenities such as open space and important scenic views. Public policy should encourage large tidal front properties to remain intact.

SMITH CREEK

Smith Creek to the mouth of the Oyster River into Little Bay and Durham Point on the opposite shore define the visual access to the tidal Oyster. The unspoiled scenic vistas and large agricultural holdings are important to Durham's heritage and worthy of preservation. These open fields and farms are cited as prime open space to be preserved in the drafted 1989 Durham Master Plan. The town voted this summer to spend $3.1 million to buy the Wagon Hill Farm in order to preserve important open space in Durham.

The adjoining Emery Farm waterfront and the Durham Point shoreline and cove become increasingly rocky and steep upriver, lending a diversity of habitat to the area. The rocky substrate and fringe saltmarsh plus the sanctuary of the tidal creeks and wetlands provide the foundation for unusual plant communities.

Signs of intensive usage by wildlife are evident throughout the area. Of particular importance are the islands near the mouth of the river and Smith Creek. Without the duck blind, the little island off the pitch pine point on the Tirrell property could be built up to be a suitable tern nesting area. Terns nest on Tern Island near Langley and Benning Islands.

Recommended Land Use for Smith Creek and Durham Point

SMITH CREEK

The Town of Durham should build on its acquisition of the Wagon Hill Farm by working toward other easements along the river. The adjoining Emery Farm should be an important element in this strategy.

The soils suitability rating is woodland for this area. The potential for total development is medium but low for septic systems on the less steep soils. The soils of 8 to 15 percent slope at the edge of the tidal marsh have statewide agricultural importance. The source of freshwater springs can be traced in these soils.

All active recreation and other development of the waterfront should maintain the integrity of the tidal marsh and sandy shore of the Wagon Hill Farm, and the adjoining meadows of the property. The town's new shoreland protection zone will help protect the forested frontage and vegetative buffer along the river and tidal creeks.

DURHAM POINT

The Langley Farm is cited by the 1989 Durham Master Plan as prime open space land--one of thirteen farms proposed by the conservation commission for protection. The soils potential index (SPI) rating of 75 percent, qualifying the 51 acres of permanent pasture for a reduced tax rate, was evaluated by the

Strafford County Conservation District. The result was a further tax incentive to maintain the property in its current agricultural use. Use of incentives and possible conservation easements will help protect this farm from development. The bluffs and slopes also provide a unique natural area worth protecting.

The adjoining Sandberg property does not qualify for a reduction in town taxes based on the soils potential index, due to the non-agricultural current use of the property. However, the SPI ratings would have qualified the property for a reduction in current use assessment if the field were used for permanent pasture. The best use of the the 3 to 5 percent sloped Hollis-Charlton soils is pasture. The accompanying sailing school is a coastal dependant use. The soils with slopes greater than 25 percent are best suited to ledge-hanging hemlocks which shade the tidal flats.

A recent tax increase in Durham put pressure on all large land holdings. The town might consider means to relieve tax burdens to keep the farms in agriculture. The alternative of public acquisition of all thirteen farms (Wagon Hill Farm alone cost $3.1 million) is too costly.

DEER POINT

The Deer Point area encompasses the most extensive saltmarsh on the river. The two largest holdings (38-1, 38-2) are in the same family and front the river's major oyster bed. On the shoreline there is evidence of an historical brickyard. The lowlying areas of artificially induced saltmarsh expands the area of marsh in the cove. The adjoining open space (13.5 acres including freshwater pond) on the marsh is held in common by the Deer Point Landowners Association as part of the 33 lot subdivision. The progress of development on the point has underlined the need for shoreline conservation, increased setbacks, erosion control, and undisturbed vegetative buffers.

Recommended Land Use for Deer Point

The goal must be to prevent degradation of the largest expanse of saltmarsh on the Oyster River. Building around the periphery has been subject to only 75-foot setbacks. The strong odor of sulfur dioxide in the Drew Creek marsh and the erosion due to clearing along the river (23-10) emphasizes the need for increased setbacks and vegetative buffers. Trampling and increased runnoff from cleared land may be the death of the salt marsh vegetation. The tidal areas must be safeguarded as more houses are built on Deer point. Environmental education may lessen the impact of development. The new 150 shoreland protection zone promotes tidal riverine protection and has been supported by this study in public hearings on zoning changes.

The large holdings on Drew Creek and farther upriver are important resource areas with the tree farm and upland meadow. The McNitts and Richmonds show active concern for the health of the Oyster River and adjoining tidal marsh. Any future development should be sited well inland due to the restrictions of tidal marsh and poorly drained soils curving in about 500 feet above the high tide line. The extremely rocky Hollis-Charlton soils with slopes of 8 to 25 percent are best suited to the forested boulder covered farm in current use now. The more gently sloping Hollis-Charlton and Buxton soils are well suited to pasture and the rural view open to neighbors.

HORSEHIDE BROOK

The Horsehide Brook area extends the undeveloped shoreline upriver of the McNitt tree farm. Over the years the Durham Conservation Commission has been working on acquiring a walking trail and wildlife corridor extending from the river through the interior of the Durham Point area to Adams Point. The interior Durham Point area is a rich wildlife area, as are the Lockhardt holdings.

Land Use Recommendations for Horsehide Brook

The Lockhardt Trust (formerly Jabre's Orchards) is the link to an extended wildlife corridor along the brook. The town's conservation commission holds at least 50 acres along the corridor, acquired over the years with donations and Bureau of Recreation funds and other public sources. This study recommends that the inactive orchard be rejuvenated to improve its usefulness to wildlife.

The Elmwood soil along the river and the tidal creek is prime farmland and the adjacent Buxton soil is of statewide importance agricultural significance. The best use of the Elmwood soil in this case is the existing meadow and woodland. The stony soil provides lots of wall-building rocks as seen in the 5 foot walls at the edge of the woods. Lot 36-2, though small in size, has been donated to the commission and provides an important starting point for a corridor protecting the wetlands.

JOHNSON CREEK

Johnson Creek is an unspoiled, priority wildlife habitat area. The Keefe property and the Butler Nature Sanctuary are reminders of what we need to protect from careless disregard of coastal resources and natural areas. Johnson Creek winds inland through a succession of lowmarsh, highmarsh, tidal and freshwater wetlands to the salthole at Gerrish Brook, below the historic path of the Dover-Durham turnpike. This comprises a notable reach inland and much diversity of resources.

Johnson Creek is largely undeveloped. However, two major subdivisions are approved: 1) the White property (map 11-27, 10 building lots downstream from the sewage treatment plant) and 2) Johnson Creek Development Limited, (map 11-16, 27 building lots above Route 4, with a common area of 22 acres open space along the creek). Construction has begun on Johnson Creek Development but all lots are unsold on the White property. The White property is located downwind of the sewage treatment plant.

The Vittands property near the mouth of the creek is not in current use, but the owner has taken particular care to secure adjoining lots and marsh from development by buying land at premium prices. The property provides a significant vegetative buffer on the east side of the creek holding the predominance of salt marsh. A conservation easement should be pursued for the critical marsh area and adjacent buffer. The major oyster bed of the river is located between the mouth of Johnson Creek and Bunker Creek.

Johnson Creek is also significant as a refuge for eelgrass, a plant that provides important habitat for fish and wildlife. Eelgrass has thrived in the creek historically, and preservation of the creek is essential for further study and survival of the plant. See Appendix A for a discussion of eelgrass in Johnson Creek.

Recommended Land Use for Johnson Creek

Salt marshes are very productive ecosystems, generating as much as five to ten tons of plant matter per acre each year. Because of the high productivity of this area, a large amount of nutrients is flushed from the marsh to nearby estuarine waters. Besides adding nutrients, the salt marsh acts as a filter for surface runoff, trapping in the mud many agricultural pollutants and heavy metals in the surface waters. Many bird and wildlife species are dependent on the marsh for nesting, feeding, and roosting habitat.

The area may rapidly change due to the Town of Durham's proposed upzoning (intensifying the use) to Residence B (RB) or Office and Research (OR), both of which would triple the density of the present zoning Residence Coastal (RC). We recommend that the zoning remain consistently RC throughout the tidal reaches.

The value of this coastal resource can not be figured on the town's tax rolls. Limited business development and further intensified residential development have no place here. The town master plan supports protection of the tidal reaches, therefore the zoning should support the intended protection. The town's proposal to upzone the area makes the potential cost of conserving the natural resources by public acquisition prohibitively expensive.

If the public wants to protect the fragile and limited tidal wetlands, zoning changes which increase the potential development value beyond what the public can reasonably pay is counter-productive. Conservation zoning is essential to protect the natural resources of this area. Wetlands mapping in order to designate prime wetlands is recommended here.

South of Route 4, Buxton silt loam (slope of 3-8%) dominates the upland portions of this area. A sewage line has been run to the property through the salt marsh. However, the findings of this report do not support the downzoning from RC to OR. If the zoning is changed, the lot size should remain 80,000 square feet within the OR instead the proposed 40,000 square feet. If planned well, an OR zone at Lot 11-27 may have less visual impact than the approved single family subdivision on open field.

The wooded vegetative buffer along the river and creek should be extended inland for shoreland protection. The creek bed flowing to the river and adjacent to the treatment facility has predominantly Suffield soils. Development activity should be setback at least 150, preferably 300 feet from the shorelines to allow for an adequate vegetative buffer recommended for wildlife.

North of Route 4, the diversity of habitat and tidal marsh increases with the inland flow of Johnson Creek. The holding agency of the 22 acres of open space in the Johnson Creek Development, Ltd. will be determined and an appropriate third party will hold executory interest. Conservation easements should be pursued all the way to the mouth of Gerrish Brook and beyond the beaver pond into Madbury.

BUNKER CREEK

Bunker Creek is a meandering tidal creek bordered by saltmarsh, a 100-acre tree farm, prime farmland, and the historic Bunker family graveyard. The town of Durham still holds its ancient thatch bed (map 11, lot 31-31), a rich high marsh near the mouth of Bunker Creek. Rare species have been mapped on nearly half the area of the tidal creek, occupying more of the site than the sensitive areas located on Johnson Creek. The scenic view upstream from Route 4 is enhanced by the rustic barn and pasture. This area is extensively used by herons and shorebirds.

Recommended Land Use for Bunker Creek

The deepest channel in the river is at the mouth of Bunker Creek. The depth is about 10 feet at the bridge at Rt. 4. The rustic barn, prime farmland and soils of statewide importance, graveyard, extensive tidal creek, and scenic view down the Oyster River at the rise of the hill rank the Palmer property (11-21) high in development potential. The adjoining Emery tree farm of almost 100 acres straddles Bunker Creek to the north.

The rocky outcroppings of the Hollis-Charlton soils near the bridge are part of the Riverview development. Tree clearing is restricted within 100 feet of the creek. Past clearing needs to be monitored by the conservation commission to control further cutting. The town also holds open space on lot 23-4 which is north of Rt. 4 at the mouth of the creek. On the opposite bank (west of the creek) the soils are of statewide agricultural significance. The soils potential for total development is very low for the very rocky and poorly drained soils up the creek, but medium for land use recommendations of this study. The current uses of property are optimal on Bunker Creek.

SALMON FALLS RIVER

Approximately 60 acres of tidal marsh is located on the New Hampshire side of the river, 15 acres from Cochecho Point to the Eliot Bridge and 44 acres above the bridge to the South Berwick dam.

The lower stretch of the river to the head of the tidewater was named Newichawannock by Native Americans (pronounced Ne-ge-won-nuck, which means my-wigwam-place). The Salmon Falls River extends above the Lower Mills dam with a southerly flow of 36.5 miles along the New Hampshire and Maine border. The river was so named for its abundant salmon before the dam and mills.

Preventing development along the banks of the Salmon Falls is stated as a high priority by the town of Rollinsford in its 1987 Master Plan. This scenic river corridor has the beginnings of protective easement and deed restrictions along the shore, with the potential to extend the length of the tidal river. The

Woodlands development has a 100' restriction on the shoreline. This is a minimal protective measure and should be expanded in depth to 250-300' where possible. This goal is consistent with the town's natural resource objective to encourage the use of conservation easement and deed restrictions to preserve open space, agricultural, sensitive natural areas, and areas of scenic beauty.

Recommended Land Use for Salmon Falls River

Franklin Marsh

A portion of the shoreline is now protected by conservation easement. The development rights to 47-acres of forested uplands with adjoining tidal marsh will be held in perpetuity by The Strafford Rivers Conservancy. The property owner, Walter Franklin, signed the easement document at the Conservancy's annual meeting November 27, 1989. The easement is dedicated to the memory of Mabel Franklin, Mr. Franklin's wife.

The list of Conservancy board members, technical advisors, and local business people who donated their professional services to this study and work on the easement are noted in the financial summary that is part of the permanent file at the offices of the N.H. Coastal Program and the Strafford County Conservation Office, and not otherwise part of this report. The land survey was donated by Kevin McEneaney.

Significant features of the easement include a 150-foot setback restriction on timber harvesting along the river to protect the scenic vista and more than 3,000 feet of shoreland. The erodible soils with slopes of up to 60 percent are protected from disturbance. The two treed points are intensively used perching, nesting, and feeding sites for many species including snowy egrets and eagles. The duck blind will be removed by the Conservancy.

The contiguous marsh and forested upland provide a richly diverse habitat in the easement area. The Conservancy will endeavor to extend the easement corridor up and down the river. A horse and foot trail along the right bank exists from the Eliot bridge to the northerly edge of the Franklin property. A complex of woods roads provides inland trails.

Final easement documentation is on file at the Dover, N.H. law office of Stephen J. Dibble, secretary of The Strafford Rivers Conservancy.

Madame's Cove

The findings of this study will be provided to the Nature Conservancy to assist establish protection boundaries for the rare plant communities of this intertidal and brackish flat. The landowner of the easement area both on the New Hampshire side and at Leigh's Mill Pond in Maine is on the board of The Strafford Rivers Conservancy. This individual holds more than 400 acres of upland agricultural fields already protected from development. The active farm and pastures add to the rural integrity so valued by Rollinsford in its future land use goals described in the town's master plan. The Strafford County Conservation District holds a conservation easement on riverfront land and meadow land.

WETLAND LOSS

There is no detailed inventory of wetland loss in this state. However, the Office of State Planning estimates in its draft "Wetland Priority Conservation Plan" that 7,500 acres of a total of 15,000 acres of tidal marsh has been lost. The majority of this loss is due to a change to freshwater wetland due to altered drainage patterns.

Wetland acreage was estimated at 95,440 acres in 1973. Using estimates provided by the state of a statewide loss of only 25 to 50 acres a year, there are approximately 95,000 acres of wetland remaining in New Hampshire since that date.

In the tidal study area wetlands by our estimates total:
Lamprey--5 ac
Oyster--1524 ac
Salmon Falls--44 ac

A specific analysis of wetland loss is not available but only a negligible loss is due to agricultural activity. The majority of acreage loss is due to residential and commercial development and road construction.

The state's wetland regulatory programs are extensive, requiring permitting and compliance with RSA 483:A and 149:8-A. Enforcement of Section 404 of the Clean Water Act is the responsibility of the EPA, FERC, and the Army Corps of Engineers. Hiring more inspectors under the NH Coastal Program is necessary to increase the effectiveness of the regulatory arm of the Wetlands Board.

Tidal wetlands total 8 percent of the wetlands in the state. State law encourages communities to adopt prime wetlands maps based on an inventory of wetlands. Each coastal community should begin wetlands mapping of the tidal areas in order to designate prime areas. The proposed state shoreland protection law, local ordinances, management practices to control storm water, agricultural waste, pesticide and herbicide runoff, and enforcement of existing law are necessary measures protecting water quality of these wetlands.

In order to protect its remaining wetlands, the state must carefully evaluate and adopt the new federal policy of no overall net loss of wetlands. This general policy is not a license for draining or filling existing wetlands standing in the way of economic development, even when a developer becomes obligated to replace the wetland by creating another. In tidal wetlands, there is no way to replace a wetland lost to construction activities. Therefore only careful mitigation should be permitted and closely monitored, and only when there is no alternative construction site.

SUMMARY OF FIELD RESEARCH

Highlights of data collection and field observations for each river are summarized in geographical units, river by river. Each geographical unit is defined by an outstanding feature, for instance a tidal creek. The bounds of each geographical unit are graphically defined on the maps accompanying this text. Additional field data is available in the office of the Strafford County Conservation District.

KEY

Tax Map # Property Owner Acreage (Ac) Water Frontage (Wf)
Description of Resources

Lamprey River 2 miles

Mouth of the Lamprey

R3-36 Estate of Watson 89 Ac 6000' Wf
Largest tract of open land. Scenic vistas in a naturalistic area. Deer cross river here. Expansive high saltmarsh on bay contiguous to Squamscott. Vegetative buffer with a stand of hemlocks and in June no cover apparent but these is abundant salt water cordgrass in September. There are also wide hedgerows and a treed, shrubbed, forbed area. Potential access point .8 mile upstream. Ice fishing with shack storage at site. Current use--hay pasture, wildflower meadow, and unbroken forested cover upstream. Birdlife: perching sites for endangered and threatened species on the mature trees; roosting sites for black-crowned night heron, green-back heron, kingfishers, sandpipers; hunting area for marsh hawk.

R2-48 Beauchesne 3 Ac 700' Wf
49,50,51 same each approx. 1 Ac
Vacant land with cellarhole. Well-used habitat for mammals and a variety of birdlife including songbirds and merlins. Area next to cove opposite upper R3-36 is called Doe's Neck.

R2-44A Beauchesne approx. .1 Ac
Rocky fill, pipe into cove.

R2-44 Raymond, Pernaa 1 Ac
Tidal inlet on cove with drainage pipe, fill. Property for sale. Lot size would require ZBA variance because zoning is 2-acre low density residential.

Upper Narrows to Young's Cove

R2-86 Wajda-Heron Point 47 Ac 3270' Wf
Viewscape across river from landing. 100-150' setback in shoreline conservation zone. Subdivision with 30 lots all 1/2-acre and less. 30 boat slips (4-to 7-foot deep channel) and 17 automobile parking spaces proposed. Back cove area has deep water fish spawning capability. Boat access with walking trail. Recommendation--close off trail to protect plants. State threatened species here--false water pimpernel. Sample was collected and donated to U.N.H. Hodgdon Herbarium. Birds: Plucking posts and lookouts for goshawks; mature pines serve as perching sites for great blue herons; in-river hunting sites for green-back herons; other in-river habitat for diving ducks.

U3-5,13 Town of Newmarket approx. .40 Ac 300' Wf
Landing and park providing public access. Moonlight Brook.

U3-50 Town of Newmarket 4 Ac 800' Wf
One of two places with undisturbed shoreline vegetation. Important night roosting for osprey. Important area for birds that need upland areas. Open space with boat access potential. In Young's Cove, spotted sandpipers. Hemlocks provide cover for mammals. At wastewater treatment plant (U3-47), water quality issues apparent. Riprap used for bank stabilization at facility. The tidal mud flats below riprap at Youngs Cove is a historic site for rare plants.

U3-5,13 Town of Newmarket approx. .40 Ac 300'Wf
Landing and park providing public access. Moonlight Brook.

U3-51 Fish and Game approx. .75 Ac 300" Wf
There is access for ice-fishing. There is a boat ramp.

Lower Narrows

There is evidence that the tidal inlet is silting in because of nearby housing constriction activity, disturbed soils, and loss of vegetative buffer. Early invasive plants are growing in disturbed soil. However, three species of Spartina grass grow at mouth of inlets. Early algal bloom nutrified from wastewater treatment facility as well as fertilizer runoff from riverfront lawns upstream. The depth of the channel is 4-to 6-feet.

U3-54 Beauchesne 2.5 Ac 530' Wf
Rocky face, gorge-like and a rare plant site. An unusual natural area and prominent point of open space.

U3-77 Felder 3 Ac 470' Wf
Wooded clearing, rocky and forested habitat for osprey, kingfishers. Clearing on banks, but behind surveyor's stakes. Soil is not badly disturbed, however, the shoreline is exposed within the shoreline conservation district.

U3-76 Jackson 1 Ac 160' Wf
Great Cove. Open lot showing development activity. Deck has been built on slope down to water. Erosion problem and limbing trees activity.

OYSTER RIVER DURHAM

Jackson Landing/ Beards Creek

Jackson Landing is currently being studied by the Nature Conservancy with N.H. Coastal Program funding. The landing area has wildlife, fish and shellfish. The fish provide good hunting for osprey, cormorants, herons. Ringbilled gulls and shorebirds use the area.)

11-4 Jackson Landing approx 1.5 Ac 800' Wf
UNH boat house on Town of Durham property. Increased sculling on river with attendant increase in parking in what was to be a passive recreation area.

11-3 Town of Durham 3.5 Ac 1100' Wf
Recreation area includes ice skating rink. Town proposes increasing active recreation here.

11-2 Jacques 5 Ac 900' Wf
Beards Creek is separated from the upland by high leveed banks. The banks has dens and burrows. A walking trail exists above the bank. Beards Creek area includes prime farmland soils and low, forested wetlands. There are extensive tidal wetlands with abundant ribbed mussel shells in intensive bird feeding area. Mature spruce, white pine (used as perching site) and oaks dominate the forested wetlands. The eastern slope has a young stand of poplar, birch, and understorey growth. The N.H. Natural Heritage Inventory lists this as a rare plant site for many species including the stout bulrush, and the exserted knotweed. Birds sighted include green-backed heron, great blue heron, mallard families. Natural buffer for Jackson Landing. Keep passive recreation uses.

11-9-4 Jackson 5 Ac 800' Wf
Saltmarsh with prime farmland. Cove adjoining town point.

11-35-1 Shankhassick Trust 44 Ac 1950' Wf
The owner of the property reports that its name is the Native American word for for the river--Shankhassick means "wild geese". This undeveloped property is opposite the mouth of Beards Creek and Jackson Landing. The open space is visually important, and is heavily used by wildlife. A rustic cabin at the site was built in 1923. Tidal marsh fringes the creek. There is an unusual dry creek bed at the property. The inland hickory trees indicated good soil to colonial settlers. Large old black oaks grow along the river. A large drainage area with ferns is below the path into the woods. Valuable view. River channel is 4' deep.

no tax map number Shipyard Landing Durham 3 Ac
N.H. Coastal Program has funded a project to rebuild tidal walls in the landing area. Provides access to boats moored in river. Erosion and siltation is a major problem. Channel at low tide is 6 inches deep. Lots of dead oysters in the narrow, disturbed channel. Area used for active recreational boating. Channel 6 inches to 2 feet deep.

11-34-1 Sawyer 59 Ac 1000' Wf
(includes 6-11-3) The treed point is a perching area for great blue herons, green-back herons, cormorants, kingfishers. It is a large tract, with pastures inland and saltmarsh surrounding the tidal inlet.

Smith Creek

12-8-2 Tirrell, Wagon Hill 99 Ac 6800' Wf
The Town of Durham voted 7/19/89 to appropriate $3.1 million dollars to buy this property. The town decided that the property was worth preserving for its open space and conservation values.

Scenic vista at mouth of Oyster River. Three tidal creeks with extensive marsh. Fresh spring in the extensive upland meadow. Offshore island is possible tern habitat. Pitch pine point offers mature perching area. Diverse frontage sandy beach, rocky shore. Passive recreation and public access. Chesley's Grove is a picnic area. Agricultural land has a Christmas tree plantation. There is an old field with fruit trees. Channel is 14 to 21 feet deep beyond mud flats on eastern shore.

11-22-4 Hill, Emery Farm 43 Ac 3500' Wf
Expansive meadow along creek. Rocky shore with steep shoreline. Seaweed stronghold in cove. Rural quality with productive farmland. Bird habitat for red-tailed hawk and herons. Freshwater spring at the head of a tidal creek in the middle of the property.

Durham Point

11-12 Langley 23 Ac 2100' Wf
11-13-1,4 Langley 64 Ac 1200' Wf
(includes 11-14) 30 Ac
Scenic vistas at the mouth of river. At Langley Island, reported bird perching sites; at Tern Island, nesting habitat. Birdlife: islands to shoreline provide loafing, hunting, and perching areas. Tidal inlet is a protected cove. Rocky bluffs fringe the saltmarsh. Distinct rural quality with agricultural preservation and a buffalo herd. 51 acres of permanent pasture. 25 foot channel north of Langley Island.

11-11 Sandberg 38 Ac 2200' Wf
Poynter Trust land. Rocky shore has dark gray slate substrate--Phyllite. Protected cove is an unusual natural area. Tidal clam flats. Orchards on unique farmland. Agricultural holding, including pastures. The sailing school is a coastal-dependent use. Channel is 4-6 feet deep beyond the mud flats.

Deer Point

11-38-1 Richmond 53 Ac 1700' Wf
11-38-2 McNitt 57 Ac 1600' Wf
Drew's Creek branches to a tidal wetlands. There is an extensive high saltmarsh and a protected cove with floodplain. A major oyster bed exists on the tidal flats where the river forms two channels. Rural quality is

preserved with pasture down to the river. The existing tree farm has 42 acres. Historic site with brickyard, burial site. This is the site of a rare species of algae, and habitat for osprey, egrets, ducks. The owner reports red-breasted mergansers, buffleheads, and goldeneyes. Channel is 4-6 feet deep.

23-1-34 Deer Point 147 Ac 2800' Wf
Open space at Drew's Creek is part of the Deer Point subdivision (11-23-33). The development has a 75-foot setback from the river. This open space is part of the largest tract of salt marsh on the river. There is a fresh water pond on the property, and there is community (not public) access to the river along a narrow path. Degradation of tidal area due to development at lot 23-10.

Horsehide Brook

11-37-4 Lockhardt 54 Ac 2300' Wf
11-37-1 Family Trust 38.5 Ac 1000' Wf
Tidal creeks with tidal wetlands. Bird habitat. Meadowlarks, kingfishers, herons follow the brook inland. Mowed open land through old orchard. Cemetery on site--Pickering and Burnham. A 5-foot high stone wall marks the edge of a well picked (rocks) pasture bordering the brook. Salt pannes--open depressions only flooded at extreme high tide. Pannes provide habitat for glasswort and algae. Salt meadow grass and beach heather and sea lavender grow in the area. Other flora include a bank of coltsfoot (indicating calcareous ledge) growing in the bank under the white pines and black oaks of the north-facing slope. UNH has done studies of algae at the rocky outcroppings. Channel is 4-6 feet deep.

11-36-2 Town of Durham 2.5 Ac 300' Wf
Public open space with a potential terminus for a trail corridor. Historic graveyard with flatstones c.1750. Tidal wetland. Easement held by Durham Conservation Commission.

Johnson Creek

11-15-2 Butler 20 Ac
Mud flats near rip rap. In mud flats, heron, otter, muskrat tracks. This nature sanctuary is an unusual natural area. The tidal high marsh is buffered by oak and pine trees. The town needs to define the easement status. This property abuts a 22-acre parcel of open space (11-16-28) that is part of the Johnson Creek, Ltd. development.

11-13 Keefe 123 Ac
Open space with adjacent prime farmland soils. Prime habitat for rare species. See discussion of importance of area as refuge for eelgrass in Appendix C. The land is a pristine natural area, untouched for 200 years. Extensive salt meadows at beginning of property. Eel grass grows among stones in rapids. Clear but shallow water. Three to 4 stream beds before mouth of Gerrish Brook. Gerrish Brook joins the tidal creek at the salthole. It is also the historic site of the Dover-Durham turnpike. Birdlife: habitat for waders; perching site for great blue herons and red-tailed hawk; sandpipers feeding at freshwater pond. Dead elm provides perching for osprey to use

while cleaning fish. Intensive use by wildlife: habitat for deer, otter, mink, muskrat, raccoon. A series of three otter runs. Old fields and red spruce provide habitat for deer.

11-29 Vittands 13 Ac
(+31-15,16 2.5, 1 Ac)

Fresh water cordgrass growing in area. Tidal creek has a vegetative buffer. Saltmarsh predominates on the east side.

11-27 White 24 Ac 1800' Wf

Important buffer of mature oaks along bank. Dens in trees and banks. Fawn tracks, otter and beaver activity. Aspen growing at site. Perching snags for birds and shaded flats on north bank.

Bunker Creek

Deep water channel at mouth. Easement of 100-foot setback to protect creek banks from development north to Rt 4.

11-31-31 Durham Thatch Bed 2.5 Ac

Low marsh, used historically by town for roof thatching, animal bedding, and banking for houses. Grass used is salt water cordgrass.

11-22-1 Emery Farm 98 Ac

Rocky ledges on east side, extensive low saltmarsh in tidal creek. Rural quality is preserved by the tree farm. Rare plant site.

11-21 Palmer 18 Ac

High marsh with remnants of old orchard. Classic meandering tidal creek. Rare plant site. Scenic view with trails, prime farmland, family graveyard and barn. Habitat for deer.

SALMON FALLS RIVER 2.8 miles miles above Eliot bridge

Franklin Marsh

4-4 Franklin 47 Ac 3000' Wf

A conservation easement on this property has been donated to the The Strafford Rivers Conservancy by the owner, Walter Franklin. Easement includes land in Rollinsford and in Dover (tax map N, lot 10). The 150 foot setback restriction on timber harvesting along the river protects the scenic vista and almost 3000' of shoreland. The two treed points are intensively used perching, nesting and feeding sites for birds. The contiguous marsh and forested upland lend a rich diversity of habitat to the easement area.

Extensive tidal wetlands connecting to Garvin Brook. Channel 6-8 feet deep at low tide. Extensive salt marsh. Bird activity with snowy egrets, cormorants, heron, shorebirds, waders, and ducks. Good perching on snags, fallen trees, good hunting site for birds. Well-marked walking and riding path up to Woodlands.

4-37-1 to 35 Woodlands 89 Ac 1400"Wf

Human activity impacts bird use of shore. Steep grassed banks but no serious erosion. However, path leading from Franklin property has been torn up by construction. There are 33 buildable lots of approximately 2 acres each with an average of 180 feet of frontage. A 4-acre strip including a buildable lot will be deeded to the town to prevent further development along the right-of-way off Sligo Road. 13 acres are built up as roadway. Drainage pipe outfall below drainage swales, freshwater inflow from culverts run directly into tidal marsh. Failed (blocked) drainage system. Maintenance is responsibility of homeowners association and town should require action. Evidence of stump dump--iron and manganese leachate. Monitoring is recommended.

Sligo Brook Marsh

4-37 Whalen 24.5 Ac 1400' Wf

Bank less steep than downriver. Tidal marsh fronts shore. Old floats on river at end of woods road. Good hunting and perching sites for birds--greater and lesser yellowlegs, least and semi palmated sandpipers and killdeer (all shorebirds), great blue heron, and osprey. Pasture with forested frontage. 400-to 600-foot buffer along river.

4-37-36 Hare 13 Ac 1100' Wf

Extensive salt marsh, rushes. The well at the site may be foul. House visible from river. Proliferation of cattails along river 200-foot forested buffer.

4-35,36 Aikman 29 Ac 2200' Wf

Much of Aikman property is protected by a conservation easement held by the Strafford County Conservation District. On remaining property, conservation of natural resources is practiced.

Extensive salt marsh, same land and river qualities as above. No agriculture use, however. Marsh is characterized by mixed vegetation and tall salt water

cordgrass reaching well out into the marsh which is broken by intermittent mud flats. This provides excellent feeding and cover for birds. Black ducks observed, otherwise same birds as in Madame's Cove.

Madame's Cove

4-34,33-30 Aikman 39 Ac 3200" Wf

Rocky outcroppings. Abrupt change to fresh and brackish water intertidal flats. Frequent use by osprey. Mixed vegetation. Turbidity near outlet of Leigh's Mill Pond. N.H. shore, across from Leigh's Mill Pond outlet, Nature Conservancy rare plant study site--six rare species listed in U.N.H. Herbarium records.

Tree species changing from downstream pine and hemlock to hardwoods. Osprey hunting site. Rocky outcrops in river. Some upstream animal waste where river channel narrows, but bank is stable. Rural quality and prime farmland protected by conservation easement along river. Rare species use of shore.

PROTECTION STRATEGIES AND PRIORITIZATION OF PARCELS

Growing public awareness of the long-term value of environmental conservation and the present lack of development pressure in the study region gives the communities surrounding the tidal rivers an opportunity to develop comprehensive land conservation plans that protect the estuarine environment.

It is too simplistic to say that the study rivers are each unique systems and that they need to be protected separately on a town-by-town basis, through zoning or through public acquisition of separate parcels. However, since communities are responsible for most land use decisions in this state (within the federal and state permitting structure) we have based many of our recommendations on the similarities of the rivers in the coastal zone in order to provide regional guidelines for the coastal communities to employ in their land use decisions.

In addition, we have developed a list of properties which if conserved through acquisition can maintain and even improve the quality of the riverine system for the public benefit.

Coastal communities are encouraged to develop and improve existing open space and recreation plans to encourage non-intrusive public use that does not degrade these rivers. Shoreland conservation zones can be developed in addition to existing river setback requirements. Rather than adding to a strict minimum setback, towns may want to consider a conservation zone based on values the community wants to preserve. If the town wants to conserve land for wildlife habitat purposes to the exclusion of development, a minimum setback of 300 feet (as recommended by the Audubon Society for wildlife corridors) might be appropriate. However, if the town wants to provide the opportunity for landowners to develop closer to the river, a conservation zone based on a development-limiting factor such as soil types could be adopted. The best approach to preserving the riverine system while accommodating landowner use of property may be a combination of the two. A setback requirement by itself may be easier to administer than an ordinance combining both methods, but it alone may not represent a community's conservation intent.

The step-by-step program of acquisition of parcels described in this report begins the identification of parcels located on the attached maps and described in detail in these pages. The specific strategy is different for each parcel, and the time frame for protective action is different as well. Generally, the sensitive parcels in the coastal zone are best protected by either town zoning or easement, and fee simple acquisition is not as likely as the others to bring results within the time frame of the program. The protection schedule is five years, with land use regulations being the most immediately attainable method of protection, followed by easements, followed by outright land acquisition which would generally take the entire time frame.

The conservation district is ready to assist the coastal communities improve their land use and natural resource protection strategies. For instance, specific details about stretches of the rivers that in our opinion need particular protection in order to preserve critical bird habitat are available

in the office. The district's technical resources include not only the staff of the Soil Conservation Service but the members of the board of directors of the district.

The district plans to present within each community a slide program of riverfront conservation that it has developed during this project. The basic presentation will be tailored for each coastal community by showing slides taken throughout the last nine months of the rivers and coastal properties.

Salmon Falls River

A project representative met with the Rollinsford Conservation Commission in February to review the preliminary report recommendations. Based on discussion with the commission and the inventory of land use patterns and natural resources, the study concludes that the town has been fortunate to have as little degradation of the coastal zone as there is. The town has been able to rely on the conservative agricultural use of the coastal zone as well as on private ownership that has not sought to develop the shoreland. The town is small, town government is accessible to all residents, and private ownership has generally conserved the shore. This is a case where conservative people have managed to develop ways of community interaction and land use that have not encroached upon their neighbors. However, such a town needs to secure its public policy in a community master plan before growth occurs which makes change unmanageable.

The land ownership pattern and the physical characteristics of the tidal portion of this river have meant a largely undisturbed riverine system. There are excellent recreational opportunities for people as well as opportunity for wildlife to thrive in undisturbed habitat. The town needs to continue to encourage these conditions.

Map reference numbers for this river are 1 through 4. A map of the Salmon Falls River is in the back of this report.

Property 1--Land owned by Marion Aikman, of Rollinsford totals about 400 acres in that town. The land within the coastal zone is either under easement protection now or is in agricultural use. A potential easement on land on the other side of the Salmon Falls River in Maine, some of which is owned by Mrs. Aikman, and all of which is undeveloped all the way down to the Eliot Bridge is part of the long-range protection plan of the adjacent Great Works Land Trust.

Timeframe for easement 1995
The schedule is flexible because there is no immediate threat.

Properties in section 4--Land owned by Whalen and Hare, totaling approximately 38 acres. Easement protection is advisable with a buffer along the river. The bank is less steep than property 3, and a conservation easement along the shore could be negotiated by the town after further on site evaluation of the exact appropriate width of the easement. This report recommends between 400-600 feet.

Timeframe for easement.....1992

Property number 3 Rollinsford is the site of The Strafford Rivers Conservancy's first conservation easement. The easement is along the tidal river, and represents a significant link in the chain of protection begun on the Aikman lands upriver, described in this report.

Under easement already.

Property number 2 Between the conserved properties (1 and 3) lies the one development on either side of the tidal Salmon Falls River--Woodlands, a development completed according to town regulation within the last two years.

Because the development is somewhat anomalous along this part of the river the successes and failures of construction activity punctuate the need to monitor future development. Development runnoff is changing the tidal marsh, and this can still be corrected. The conservation district is willing to advise the town about specific corrections. Further, clearing along the riverbank by private landowners seeking a river view should be monitored to protect the conservation values of the buffer between the development and the river as well as the Franklin property. The town may want to invite the residents of Woodlands to the in-town presentation of this study.

Timeframe for protection..... 1991

Oyster River

Conservation and land protection along this tidal river present a more complex situation than along the Salmon Falls. The community is larger, the property ownership pattern in the coastal zone is more diverse, and the town zoning is detailed and responsive to economic as well as environmental conservation needs.

The public policy boards in this town represent a broad range of community interests and values. As a result, the overlay of land use regulations is complex and needs subtle management within the community in order to protect the coast.

Upzoning--the concept of allowing a more intensively developed use of property than previously permitted in town regulation--is a technique which when it is applied to environmentally sensitive areas must be carefully applied. The coastal zone in the opinion of this study is no place for more intensive development. In itself more intensive use is not undesirable. However, what is required is serious commitment from the town to assure that what is developed in no way harmfully impacts the coast. Slippage that frequently occurs in development includes construction plans that are not always fully executed; planning board site plan requirements that are not always faithfully executed; planning board and conservation commission decisions that are not always based on the most precise environmental information available to those boards; after construction, maintenance and follow-through can not always be a high priority in the large scheme of managing the growth of a town. Upzoning requires a focused public commitment to preserving the integrity of the coastal zone.

Map reference numbers for this river are 1 through 10. A map of the Oyster River is included in this report.

Property number 1 Wagon Hill Farm protection strategy being determined presently.

Property number 2 Smith Creek Not only is it important to preserve Wagon Hill Farm (Property Map # 1), but preservation of the open space across the creek would help keep Smith Creek in its present healthy condition. An easement on this land buffering the creek (part of Emery Farm) is strongly recommended.

Timeframe for protection.....by easement, 1992

Property Area # 3,4 Bunker Creek The Palmer and Emery (map reference 3 and 4) properties are important elements in the protection of the area. Easements to protect low marsh areas and the scenic beauty of these properties are important. Whereas Johnson Creek is notable for its animal life, this creek is equally notable for the habitat it provides for endangered and threatened species of birds.

Timeframe for protection by easement, 1995

Property Area # 5 Johnson Creek The pristine tidal creek, expansive marsh, rick and diverse wildlife habitat, and open space make this area outstanding in the estuarine system. Not to be overlooked is the importance of the eelgrass growing in this creek. Eelgrass is critically necessary for some needs of fish and wildlife (see appendix material for discussion of eelgrass.)

Timeframe for protection by easement, 1995

Property number 6 Jackson Landing area. The 5-acre Jacques property can be an important addition to the public space in Durham. Its uses can be passive, and an important use can be environmental education because of the diverse wildlife habitat and rare plant species.

Timeframe for protection by fee simple acquisition, 1993

Property number 7 The Shankhassick Trust is important not only for its many conservation values but for the scenic views of it available to people using the town lands across the river at Jackson Landing.

Timetable for protection by easement, 1993

Property area # 8 Horsehide Brook This area offers good wildlife habitat. We recommend a wide buffer along the brook--both sides could be protected by conservation easement which is the most likely conservation strategy based on our findings.

Timeframe for protection by easement, 1995

Property reference #9 Drew's Creek area. As in the preceding properties, a similar situation exists with the Richmond and McNitt tree farm. The town must explore ways to encourage preservation of this land. Tax abatements are always a means at the town's disposal. In addition, the tidal marsh and open space at Drews Creek is important to protect. The conservation district's slide program of this tidal rivers land protection study will be available to the town to assist in public education of ways to protect the marsh. The marsh ecosystem is fragile and must be protected.

Timeframe for protection of Drew's Creek lands
by easement, 1993

Possible tax reduction to encourage open space use 1992
(Timeframe would be similar if this means were used in the Durham Point area.)

Properties # 10,11 at Durham Point The Langley (reference 11) and Sandberg (reference 10) properties are so outstanding in terms of maintaining open space and preserving the rural character and scenic beauty of this area that

the town should consider all the options available to it to encourage the landowners to maintain their present uses of the properties. The landowners themselves have been creative in their search for ways to maintain their present uses of the land--for instance, they have explored reduction in current use taxes based on the quality of soils on their properties for those areas actively used for agriculture. Considering how important these properties are to the general quality of life in Durham, and absolutely to the quality of the estuarine system, the properties need protection.

Timeframe for protection.....by easement along coast, 1992

Lamprey River

The town of Newmarket is developing a comprehensive conservation management plan with the guidance of the conservation commission. This plan will be a significant step forward in management of the town's natural resources including the resources of the coastal zone. Areas the town should seriously consider (and in fact has been made aware of by the researchers for this study) follow.

The map reference numbers are 1 through 5. A map of the Lamprey River is included in the back of this report.

Property map # 1 Mouth of the Lamprey Critical property is land owned by James Sawyer, nearly 90 acres of undeveloped land on Great Bay. Among the many values of this property is its usefulness to birdlife. (Note:During this study the researchers came upon a wounded young osprey that over a three-day period was able to recover, and presumably fly away. It found refuge in the hemlock stands and perches of increasing height as it recovered. If the osprey had fallen on any other stretch of the river it would very likely not have found a safe place from predators.)

Timetable for protection, easement corridor of 300-500 feet along riverbank 1993

Property Map Area 3,4 Lower Narrows The Great Cove area can be protected by a shoreland conservation zone with increased setbacks and carefully permitted uses. Setbacks in area 4, carefully permitted uses in area 3.

Timeframe for protection through zoning 1992

Property Map Area 2,5 Upper Narrows to Young's Cove Town-owned properties need to be protected because they are important sites for birdlife as well as public recreation. However, the town must make public use compatible with the needs of wildlife in addition to setting strict river setback requirements in these areas.

Timeframe for protection through easement 1992

APPENDIX A

LAND USE AND ZONING

The 1989 population estimates from the Strafford Regional Planning Commission are that Durham, with a population of 12,511 is growing at a rate of 1 1/2 percent a year; Newmarket, with a population of 6,848 is growing at 8 percent; Rollinsford, with a population of 2,847 is growing at 4 percent a year.

Current and proposed land use ordinances are reviewed in relation to the need to protect coastal resources.

DURHAM

Many recommendations for future land use are based on the priorities decided by town residents during a survey which helped form the town master plan. The community wants to protect (in descending priority order) wilderness areas and land along waterways; areas that are water sources; active farm land and scenic vistas.

The 1989 master plan summarizes existing land use, noting that of the total 16,450 acres in town, 1,450 acres are covered by water bodies. That leaves 15,000 acres of land of which 11,500 acres are not developed. About half of that land (6,400 acres) is unsuitable for development because it is floodplain, or has unsuitable soil, or has other environmental limits to development. Approximately 5,100 acres remain available for development.

One way the town has limited development has been with large lot zoning on the tidal frontage of the Oyster River. The town's Residential Coastal (RC) lot size of 120,000 square feet covers all coastal land as of October, 1988.

A zone of 20,000-foot lot minimum exists on the north side of the Oyster River east to Johnson Creek north of U.S. 4. South of the creek is a zone with a 40,000 square foot lot size. Beards Creek is encompassed by a proposed limited business district with a 10,000 foot minimum lot size. South of the Oyster River, downzoning of 40,000 square feet, which would triple the development potential for each lot is proposed up to the Shankhassick Trust land. With one third of the coastal land considered suitable for development, downzoning becomes a dangerous trend if the town intends to protect its coast.

The conservation commission proposes to protect thirteen farms, using wildlife corridors as one means of protection. Wildlife corridors are being studied by a town ad hoc committee on conservation lands, the Lamprey Watershed Association, and the UNH Natural Areas Committee.

The first of these farms, Wagon Hill Farm, has been purchased by the town for $3.1 million dollars. The town voted to acquire the land and buildings in order to preserve the scenic views, provide for future municipal purposes, and preserve open space. A restriction on future use of the property is that none of the property south of Rt. 4 shall be sold without a vote of the town in order to secure voter approval of land use along Smith Creek and the Oyster River.

The shoreland protection zone encompasses all the land within 150 feet of the high water level of Great and Little Bays, including tidal portions of tributaries, and the Oyster River up to the dam. However, since July the town council revised the setbacks to 100 feet along fresh water portions of the waterways.

NEWMARKET

Current zoning is low density residential with two-acre lots below the Lower Narrows on both banks of the Lamprey River. To the north, including Heron Point, the land is zoned medium density (one-acre lots) residential. The town center to the south is zoned for 1/2-acre lots in a high density zone.

The major change in land use in the coastal area has been from forests to residential. From 1952 to 1982 the forested class of land has dropped from 60 percent to 39 percent of town area. Developed land is now 38 percent of town, and the amount of development has jumped 4 to 5 times since 1952.

There are 8,640 acres in town, of which 930 are covered by water bodies. The remaining 7,710 acres are in the following uses: 25 percent residential, 17 percent commercial and public development (such as roadways), 16 percent agricultural land, and 39 percent forested land.

The Shoreline Conservation Zone includes all land within 100 feet of the shores of Great Bay, the Lamprey River, the Piscassic River, Follett's Brook and within 100 feet of areas identified as tidal marsh. This ordinance needs greater land use restrictions to protect the vegetative buffer along waterways.

ROLLINSFORD

As in most New Hampshire mill towns, the village center developed at the power source--the middle falls of the Salmon Falls River. The village center has remained relatively unchanged. There is classic large lot zoning (2-acre lots) south of Rt 4 along the tidal river. While the intent of the ordinance is to preserve rural character, a full build-out of the zone would result in a checkerboard of new houses with all sense of the rural character lost in two-acre landscaped yards.

Using an alternative design subdivision, large uninterrupted parcels could remain undeveloped while allowing the same overall density of development. The town cluster ordinance now requires open space of at least 25 percent after wetland, ledge, and slope restrictions are subtracted. Since the 1950s the greatest shift in land use has been from agricultural to residential.

The total area of the town is 4,585 acres of which 110 acres are water bodies. Agricultural land totals 1,330 acres, developed land (including residential and public use land) covers another 1,775 acres, and forests cover another 1,480 acres. There are only 5 acres of wetlands in town by the estimates of a University of New Hampshire land use study.

Setbacks of 100 feet are zoned along the tidal reach of river. North of the railroad tracks above Rt. 4 the shore is protected by a 250-foot restriction on development adjacent to zoned conservation land along the fresh water Salmon Falls River. There is a 50-foot setback from running streams. A shoreline protection ordinance further protecting waterways should be adopted.

The Strafford Rivers Conservancy easement on the Walter Franklin property in Rollinsford has conditions more restrictive than the town's zoning. The SRC required a 150-foot setback on clearing activities with cutting to be approved by a wildlife expert in order to preserve wildlife habitat in the forested upland. Within the riparian buffer, the intent is to leave standing all snag and den trees and all nest and roost trees for heron and raptors.

The development rights on the Franklin easement (47 acres) will be held in perpetuity by the Strafford Rivers Conservancy with executive interest held by the Strafford County Conservation District.

Appendix B

Soil Suitabilities for Selected Areas in the Lamprey, Oyster, and Salmon Falls Rivers Corridors

The soil suitabilities for selected land uses for the 11 areas listed below have been developed from the following sources: (1) the Soil Survey of Strafford County 1973; (2) Soil Potential Ratings (Strafford County) 1987; (3) the digitized soil map of the Newmarket area (from the Soil Survey of Rockingham County, in press). Where suitability ratings differed between sources (1) and (2), the ratings in source (2) were considered definitive.

LAMPREY RIVER

Upper Narrows

The dominant soils present in this highly urbanized area are identified as the Chatfield-Hollis-Canton conassociation on slopes of 8 tO 15 percent; these well-drained soils are rocky and vary greatly in their depth to bedrock, and because of this limitation their suitability ratings for homesites and septic systems are low. Boxford silt loam on slopes of 3 to 8 percent, a statewide important farmland soil, is found on the north bank of the river and on adjacent uplands. The suitability ratings for Boxford soils is high for homesites, and moderate for septic systems due to a seasonal high water table. The Scitico soils, located in depressions and along drainageways, are rated very low for homesites and septic systems because of a seasonal high water table. Eldridge soils on slopes of 3 to 8 percent, moderately well drained soils located in small areas on the upland, are rated high for homesites and moderate for septic systems due to slowly permeable subsoils. Urban areas, singly and in combination with Canton soils, are not rated. The suitability rating for woodland is high for the entire area, except for the area ranges from medium on the Boxford and Eldridge soils, to very low on the Scitico soils.

Lower Narrows

This area, adjacent to the Upper Narrows area, is less urbanized, and is dominated by the Chatfield-Hollis-Canton soils on slopes of 3 to 35 percent; most of the steeper slopes are along the river. These well-drained soils vary greatly in their depth to bedrock, and because of this and their steepness, their suitability ratings for homesites and septic systems is low to very low. Boxford silt loam on slopes of 3 to 8 percent is present on the uplands on both sides of the river; it has a high suitability rating for homesites, but is rated low for septic systems due to a seasonal high water table. Woodland suitability ratings is high for all soils in the area. In total, the potential for development of the area ranges from medium on the Boxford soils to low and very low on the remaining soils.

Mouth of the Lamprey--Shackford Point Area

The well-drained Chatfield-Hollis-Canton conassociation dominates the soil cover, especially in the western half. Slopes are steep on these soils, ranging from 8 to 35 percent. The suitability ratings for homesites and septic systems are low to very low on these soils, due to variable depth to bedrock.

Squamscott soils on slopes of 0 to 3 percent, with a high perennial water table, are adjacent to the tidal marsh on Shackford Point; the former soil is rated very low for homesites and septic systems, and the latter is unsuited for development. Between the variable-depth soils to the west and the poorly drained Squamscott soils noted above are Eldridge soils on 0 to 8 percent slopes. The Eldridge soils have a slowly permeable subsoil, and while this permits a high suitability rating for homesites, it results in a moderate rating for septic systems. A small area of Boxford silt loam on slopes of 3 to 8 percent is adjacent to the Eldridge soils, and this soil is rated high for homesites and low for septic systems sue to a seasonal high water table. Tidal marsh (Westbrook soils) contiguous to Shackford Point, is unsuited for development due to diurnal flooding. All of the soils except for the total development for this area is low to very low for the eastern and western sections, and low to medium for the central section.

OYSTER RIVER

Durham Point

Hollis-Charlton soil associations on slopes of 3 to 25 percent are dominant in this area. These well-drained soils vary greatly in their depths to bedrock, and some are very rocky. For these reasons these soils have suitability ratings of low to very low for homesites and septic systems. Buxton silt loam, a moderately well-drained soil on slopes of 3 to 8 percent is next in significance in the area, and it is a soil of statewide agricultural importance. Buxton soils have a high suitability rating for homesites, but because of a seasonal high water table they have a low rating for septic systems. Scantic silt loam with slopes ranging from 0 to 8 percent is found at the heads of the drainageways, merging with tidal marsh downstream. The Scantic soils suitability ratings for homesites and septic systems are both very low due to a perennial high water table, and tidal marsh is unsuited for all development due to diurnal flooding. The suitability rating for woodland is high for all soils except tidal marsh. The potential for total development for the area ranges from medium on the Buxton soils to very low on the poorly drained soils.

Deer Point (Drew Creek)

Tidal marsh is dominant in this area, centered on Drew Creek. Soils of this landform are unsuited for development. Adjacent to the marsh and the river are areas of Scantic silt loam with slopes of 3 to 8 percent; slow subsoil permeability and seasonal high water tables cause this soil to be rated very low for homesites and septic systems. At higher elevations are Hollis-Charlton soils with slopes of 8 to 25 percent, Hinckley loamy sand with slopes

of 8 to 15 percent, and Buxton silt loam with slopes of 3 to 8 percent. The Hollis-Charlton soils, which dominate the upland areas, have low to very low suitability ratings for homesites and medium to low ratings for septic systems due to variable depths to bedrock, rockiness, and steep slopes. Hinckley loamy sand with slopes of 8 to 15 percent is an excessively drained soil, and it is rated moderate for both homesites and septic systems. Buxton silt loam is rated high for homesites but because of the presence of a seasonal high water table is rated low for septic systems. Woodland suitability ratings for the area are high for all soils except those of tidal marsh. The potential for total development for the area is medium for the Buxton and Hinckley soils, and very low for the remaining soils.

Horsehide Brook

This area possesses a variety of soils with no one series dominant. Scantic silt loam is found in the upper sections of the drainageways, and these soils grade into the tidal marsh near the river. These soils are poorly drained, and are rated very low for homesites and septic systems sue to a high seasonal water table. Tidal marsh is unsuited for all development. The uplands are dominated by the well-drained Hollis-Charlton soil conassociations with slopes of 3 to 15 percent, and the moderately well-drained Buxton silt loam and Elmwood fine sandy loam, both with slopes of 3 to 8 percent. The Elmwood soil is a prime farmland soil, and the Buxton is of statewide importance. The Hollis-Charlton soils vary greatly in depth to bedrock, and most are very rocky with steep slopes; the these reasons their suitability ratings for homesites and septic systems are low to very low. The Buxton soils have a seasonal high water table, and while they are rated high for homesites, they are rated low for septic systems. The Elmwood soils possess low subsoil permeability, and they are rated high for homesites and moderate for septic systems. Small areas of Deerfield loamy sand with slopes of 3 to 8 percent are located on the upland, and these soils have the same ratings for homesites and septic systems as the Elmwood soils. One small area of Windsor loamy sand on slopes of 3 to 8 percent is located adjacent to tidal marsh, and this soil is rated very high for homesites and high for septic systems. However, this soil filters sewage effluent poorly, and its use for septic systems may pollute surface or ground water resources. Except for tidal marsh, all soils are rated high in woodland suitability. Excluding the small area of Windsor soils, which has a high potential for total development, the potential for the remainder of the area ranges from medium for the Buxton, Deerfield, and Elmwood soils to very low for the Scantic and Hollis-Charlton soils.

Jackson Landing

Tidal marsh dominates in the lower-lying sections of this area, and it is unsuited for development due to diurnal flooding. The upland features Hollis-Charlton soils conassociations, most of which are very rocky, on slopes of 8 to 25 percent, along with Buxton silt loam on slopes of 0 to 8 percent, and Charlton very stony sandy loam with slopes of 8 to 15 percent. The Hollis-Charlton soils possess variable depths to bedrock. Because of this characteristic, their rockiness, and their occurrence in steep slopes, they are rated low to very low for homesites and septic systems. The Buxton soils, which are soils of statewide agricultural importance, possess slowly permeable subsoils and seasonal high water tables; their suitability ratings are high

for homesites, and low for septic systems. Windsor loamy fine sand (clay subsoil variant) with slopes of 0 to 8 percent, a prime agriculture soil, is located adjacent to tidal marsh on Beard's Creek and on the north bank of the river; this soil is rated high for homesites, but low for septic systems, due to slowly permeable subsoils. A small area of Buxton silt loam with slopes of 0 to 3 percent, also recognized as prime agricultural soil, is present in the south half of the area. Buxton silt loam with slopes of 3 to 8 percent is of statewide agricultural importance. The Charlton soils, also of statewide agricultural importance, occur only on steep slopes, and for this reason they are rated moderate for homesites and septic systems. Woodland ratings for the area range from high for the Charlton and Buxton soils, and low to very low for the remaining soils.

Smith Creek

This area is characterized by moderately well-drained soils on rolling terraces with occasional steep knolls covered with well-drained rocky soils of variable depth. Buxton silt loam, the most common terrace soil is rated high for homesites, but due to a seasonal high water table it is rated low for septic systems. This soil is of statewide agricultural importance. Hollis-Charlton fine sandy loam with slopes of 3 to 8 percent occupy part of the terrace adjacent to the Durham-Madbury town line, and rocky to extremely rocky Hollis-Charlton and Hollis-Glouster soils are variable in depth to bedrock; because of this feature and their steep slopes, these soils have suitability ratings of low to very low for homesites and septic systems. Tidal marsh occupies the lower parts of drainageways adjacent to the river, and their diurnal flooding precludes development. Sufield silt loam on slopes of 8 to 15 percent, another soil of statewide agricultural importance, is adjacent to the tidal marsh; this soil possesses slowly permeable subsoils, and it is rated moderate for homesites and septic systems. The upper drainageways are occupied by Scantic silt loam with slopes of 0 to 3 percent, which is rated very low for both homesites and septic systems because of a seasonal high water table. A small gravel pit is present not far from the river, but it is believed to be inoperative. Except for the extremely rocky Hollis-Charlton soils and tidal marsh, the woodland rating for the area is high. The potential for total development is medium for the less steep Hollis-Charlton, Buxton, and Suffield soils, but it low to very low for the remainder.

Bunker Creek

This area is dominated by Hollis-Charlton soils on slopes of 3 to 15 percent. These soils are highly variable in depth to bedrock, and except for one locale on the eastern edge of the area, all are very rocky. The less rocky site is rated moderate for homesites, but the rocky Hollis-Charlton soils are rated low for homesites and these soils are rated low to very low for septic systems. The moderately well-drained Buxton silt loam with slopes of 0 to 8 percent is found in several locations on both sides of Bunker Creek. This soil is of statewide agricultural importance, and one section with slopes of 0 to 3 percent straddling Route 4 is recognized as a prime agricultural soil. While the Buxton soils have suitability ratings high for homesites, they are rated low for septic systems due to the presence of a seasonal high water table. Small areas of Suffield silt loam with slopes of 8 to 35 percent are present along the western edge of the area and adjacent to the river. Suffield soils on slopes of 8 to 15 percent are rated moderate for homesites

and septic systems, and on steeper slopes are rated very low for both uses. Suffield soils on slopes of 8 to 15 percent are soils of statewide agricultural importance. Scantic silt loam, present in the upper drainageways, possess very low ratings for both homesites and septic systems due to a seasonal high water table. The woodland potential is high for the entire area, except for the tidal marsh. The potential for total development is very low for the very rocky and poorly drained soils, and medium for the remainder.

Johnson Creek

Buxton silt loam with slopes of 3 to 8 percent dominates the upland portions of this area. This soil, one of statewide agricultural importance, possesses a seasonal high water table; because of this feature it is rated high for homesites and low for septic systems. Small areas of Hollis-Charlton soils with slopes of 3 to 15 percent are located on the uplands; these soils vary in depth to bedrock, and some sites are steep or very rocky. Suitability ratings for homesites on these less rocky Hollis-Charlton soils is moderate, and for the rocky soil is low. Ratings for septic systems for all these soils is low. A large area of Windsor loamy fine sand (clay subsoil variant) on slopes of 0 to 8 percent is present east of Johnson Creek. This Windsor soil is rated high for homesites and very low for septic systems sue to the slowly permeable subsoil. This soil filters sewage effluent poorly and its use for septic systems may pollute the creek. Tidal marsh which precludes all development due to diurnal flooding is dominant along the east bank of Johnson Creek, and is present in a small area along the river. Small areas of Scantic silt loam and one area of Swanton fine sandy loam, both with slopes of 0 to 8 percent, are present on the upland. Both of these soils are rated very low for homesites and septic systems due to seasonal high water tables. One small occurrence of Leicester-Ridgebury very fine sandy loam with slopes of 0 to 3 percent lies west of Johnson Creek; these soils are also rated very low for homesites and septic systems due to seasonal high water tables. Steeply sloping Suffield silt loam is located in a small area in the northeast corner and along the western limits of the area. Due to slow subsoil permeability, these soils are rated moderate for both homesites and septic systems. Suffield soils are also rated of statewide agricultural importance. The woodlands potential rating is moderate to high for all soils in the area except for Swanton soils (rated low) and tidal marsh. The potential for total development is medium for all soils except Swanton, Scantic, and Leicester-Ridgebury, which are rated low to very low.

SALMON FALLS RIVER

Eliot Bridge area

Windsor loamy sands are the dominant soils in this area. Soils with slopes of 0 to 8 percent are located on the terrace surface, and those with slopes of 0 to 8 percent are located on the terraced surface, and those with slopes of 15 to 60 percent are found on the adjacent steep banks above the tidal marsh and river banks. For homesites, the less-steep Windsor soil is rated high, and the steeper Windsor is rated very low because of the slopes. However, all the Windsor soils are poor filters for sewage effluent, and their use for septic systems may cause local pollution of the tidal marsh or the river. The tidal marsh is unsuited for development due to diurnal flooding. Woodland suitability for both Windsor soils is moderate. The potential development rating is very high for the less steep portions of the area, and very low for the steeper portions.

APPENDIX C

EELGRASS ON THE GREAT BAY

Eelgrass filters estuarine waters, stabilizes sediments, and provides habitat for marine organisms and wildlife. Its condition concerns researchers working to restore the health of tidal rivers and estuaries. A catastrophic decline in the 1930s, which was caused by a wasting disease, killed more than 90% of the North Atlantic eelgrass population. Eelgrass was able to survive in the less saline environment of the upper estuarine rivers and tidal creeks, eventually repopulating Great Bay estuary.

The wasting disease is currently causing losses of eelgrass and survival in the upper tidal reaches is not likely if water quality continues to decline. Poor water clarity and shading greatly increase the decline of eelgrass. Other negative impacts include nutrient loading, smothering by sedimentation, mechanical disruption, and the combined effects of pollution and disease.

Recent recommendations from the research at Jackson Estuarine Laboratory (Short et al, 1989) are listed in order of their value for rapid water quality improvement.

1) Improve wastewater treatment, including tertiary treatment to eliminate discharge of nutrients into estuarine watersheds.

2) Control surface run-off through improved erosion and sedimentation control and drainage practice.

3) Regulate boat traffic, with clearly marked channels, lowered speed and regulation to eliminate overboard discharge of waste.

4) Restore eelgrass beds by transplants to maintain habitat essential to sustaining resource populations.

5) Restrict fish and shellfish harvest by dragging which is mechanically damaging to eelgrass beds.

APPENDIX D

BACKGROUND NOTES ON GREAT BAY FISH

Estuary problems that effect Great Bay fish populations are the siltation and subsequent burial of eggs; siltation that reduces light that provides places for fish eggs to attach; and other matters that require further research. Some of those problems are the effect of silt on very young fish, and on the water temperature which effects the length of incubation. The fish that spawn in the tidal waters of the study area include the following.

Alewife or freshwater herring spawns in 55-60 degree F. water. Eggs .05 inches in diameter, stick to brush, stones, debris. Incubation is 6 days at 60 degrees. Young fish are 5 mm and grow to 15 mm in a month. As early as June 15 they move downstream in successive companies and continue throughout summer.

Summer herring or blueback, run later in the season than the alewife. Doesn't run as far up above tidewater as alewife. Spawns when water is 70-75 degrees and incubation is 50 hours at 72 degrees. Young are 30-50 mm, and soon find their way to the open sea. Spent fish return to sea shortly after spawning.

Coho salmon spawn in the fall peaking in October.

Atlantic tomcod spawn during the winter.

Shad spawn when the water is 50-55 degrees in late May and early June in sandy and pebbly shallows. Eggs are transparent, semi-buoyant and not sticky like other river herrings. Eggs hatch in 12 to 15 days at 52 degrees or 6 to 8 days at 63 degrees. Larval development more successful in brackish than in pure fresh water. Young fish are 9-10 mm at hatching, remain in rivers until fall. They do not run up ladders like alewives and aren't common in these tidal streams anymore.

White perch prefer brackish waters and river mouths. Spawn in spring in fresh or slightly brackish water. The eggs sink and stick together in masses or to any debris, or stones.

Winter flounder spawn in shallow regions during late winter and spring. The eggs are demersal and adhesive.

Smooth flounder are resident fish, and are found in inshore waters in softer substrate than winter flounder. They spawn in winter or early spring.

Rainbow smelt are inshore fish spawning in fresh water as early in spring as ice-out. Spawns into May, but most spawning is in April. Doesn't run far upstream. Eggs sink to bottom, stick in clusters to pebbles, debris, any water plant. Hatch in 8 to 27 days.

Atlantic silversides spawn in May and June in shore zone grasses.

Killifish spawn in summer in very shallow water. Eggs stick to the bottom.

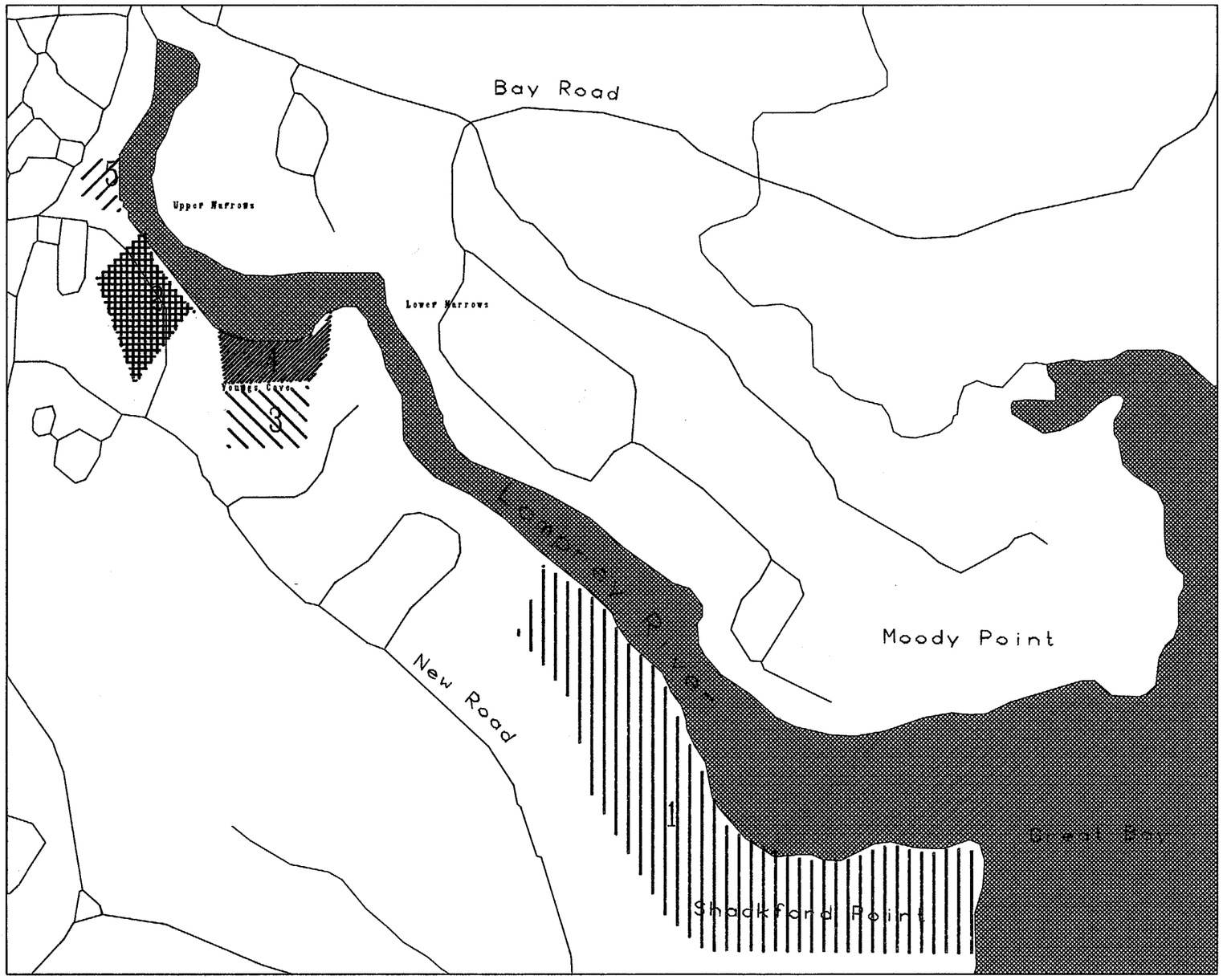
APPENDIX E

THE IMPORTANCE OF PRESERVING BIRD PERCH SITES

Perch sites are an important habitat feature along the rivers. Herons such as great blue herons, black-crowned night-herons, green-backed herons and snowy egrets; raptors such as ospreys, eagles and red-tailed hawks; belted kingfishers are some notable examples. These birds need landing places which can be approached and left easily, and support their weight. Various sites are used for resting, warming in the morning sun, avoiding inclement weather, consuming food, night roosting, and observation in relation to hunting, social behavior, and detecting danger. Rocky points with large dead and live white and pitch pine with horizontal branches are popular perching sites.

These same kind of trees found in coves also play an important but different role. For example, eagles steal fish from osprey so an unobtrusive perch can be useful. Coves also appear to allow these birds to feel somewhat buffered from human activity such as river traffic. Perches providing morning sun or shelter from wind, for example, are selected because of aspect in addition to structure. Night roosts and some day roosts are generally under a dense tree canopy in coniferous or deciduous trees. Kingfishers generally land on relatively low dead branches. Snowy egrets frequently choose downed or overhanging large trees along the river's edge.

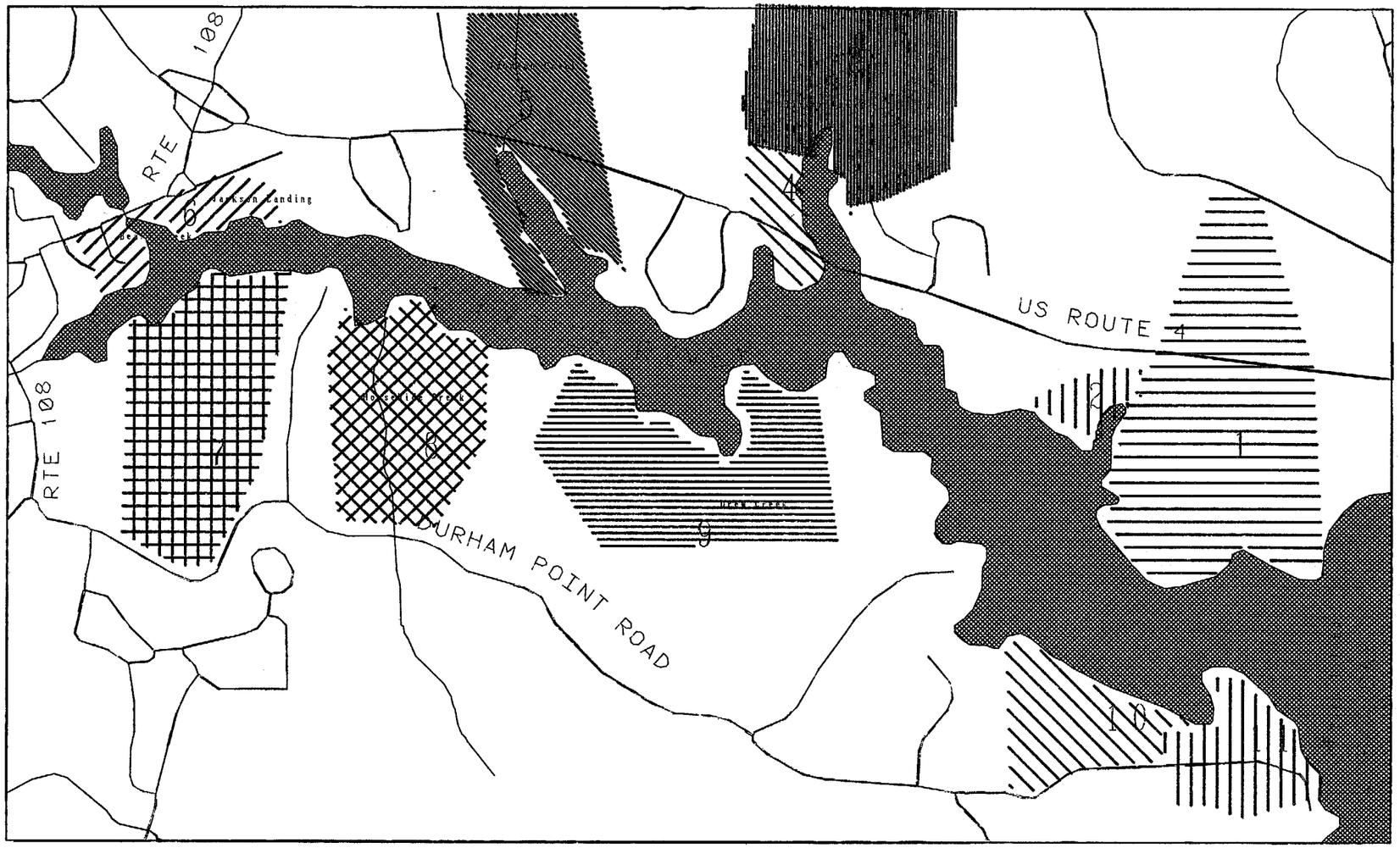
Obviously, a variety of sites and trees are needed including fallen trees. Shoreline conservation zone regulations generally do not take care of these needs. Presently the Salmon Falls River perch sites appear to be better secured than on the other two rivers. Two roosting sites found during this study particularly need to be protected. In addition, a variety of other types of sites need to be maintained.



Lamprey River

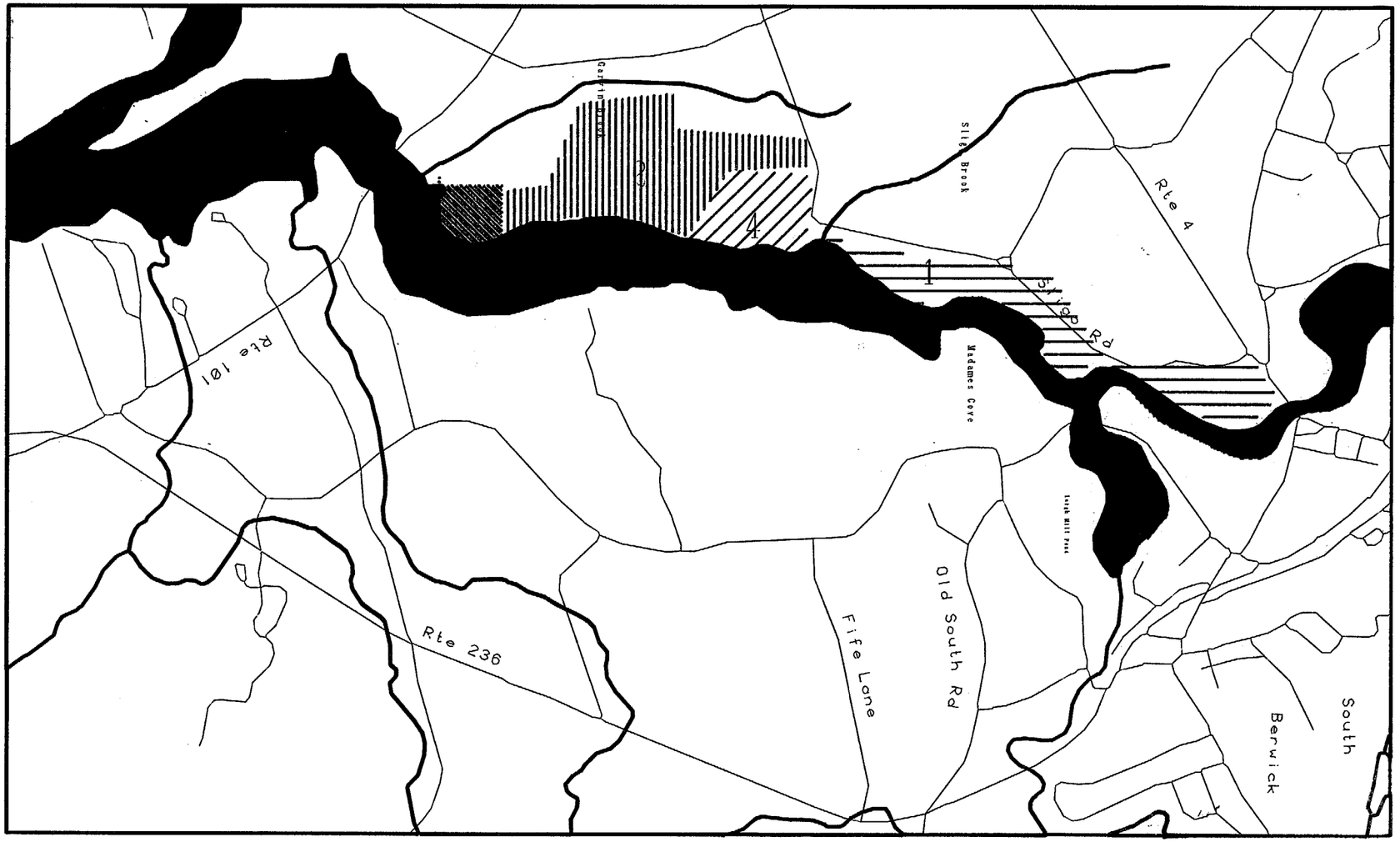
Tidal Rivers Land Protection Study of The Salmon Falls, Oyster and Lamprey Rivers

April 1990



Oyster River

Tidal Rivers Land Protection Study of The Salmon Falls, Oyster and Lamprey Rivers



N

Salmon Falls River

Tidal River land Protection Study Of The Salmon Falls Oyster and Lamprey Rivers